Town of Apple Valley

Priority Project

Water Quality Management Plan

For:

AP Investors Group Warehouse

SPR2022-005

APN: 0463-241-02 and 0463-241-03

Site Address: 18929 Central Road
Apple Valley, CA 92307

Prepared for:

AP Investors Group, LLC
Leon Benrimon GC/Owner Representative
(310) 980-7206
Leon@uncommondevelopers.com
9220 Winnetka Avenue
Los Angeles, CA 91311

Prepared by:

Merrell Johnson Companies
22221 U.S. Highway 18
Apple Valley, CA 92307
760-240-8000

Submittal Date: 8/23/2023
Revision No. and Date: 5/26/2023
Revision No. and Date: 2/17/2023 Preliminary Submittal
Final Approval Date: _____

Project Owner's Certification

This Town of Apple Valley Water Quality Management Plan (WQMP) has been prepared for:

AP Investors Group, LLC by Merrell Johnson Companies.

The WQMP is intended to comply with the requirements of the Town of Apple Valley and the Phase II Small MS4 General Permit for the Mojave River Watershed. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with the Phase II Small MS4 Permit and the intent of the Town of Apple Valley's compliance efforts. Once the undersigned transfers its interest in the property, its successors in interest and the Town of Apple Valley 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):	**CUP#**	Grading Permit Number(s):	**SPR2022-005**
Tract/Parcel Map Number(s):	**N/A**	Building Permit Number(s):	**SPR2022-005**
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			**0463-241-02 and 0463-241-03**

Owner's Signature			
Owner Name:	**AP Investors Group LLC**		
Title	**GC/Owner Representative**		
Company	**AP Investors Group, LLC**		
Address	**9220 Winnetka Avenue** **Los Angeles, CA 91311**		
Email	**Leon@uncommondevelopers.com**		
Telephone #	**(310) 980-7206**		
Signature		Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	**CUP#**	Grading Permit Number(s):	**SPR2022-005**
Tract/Parcel Map Number(s):	**N/A**	Building Permit Number(s):	**SPR2022-005**
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			**0463-241-02 and 0463-241-03**

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

Engineer:	**E. Cary Packer R.C.E**	**PE Stamp Below**
Title	Associate Engineer	
Company	Merrell Johnson Companies	
Address	22221 U.S. Highway 18	
Email	Cary.Packer@MerrellJohnson.com	
Telephone #	760-240-8000	
Signature		
Date		

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Section I - Introduction

This WQMP template has been prepared specifically for the Phase II Small MS4 General Permit in the Mojave River Watershed. This location is within the jurisdiction of the Lahontan Regional Water Quality Control Board (LRWQCB). This document should not be confused with the WQMP template for the Santa Ana Phase I area of San Bernardino County.

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

Section 1 Discretionary Permit(s)

Form 1-1 Project Information

Project Name	**AP Investors Group Warehouse**			
Project Owner Contact Name:	**AP Investors Group, LLC**			
Mailing Adress:	**9220 Winnetka Avenue** **Los Angeles, CA 91311**	Email Address: **Leon@uncommondevelopers.com**	Telephone:	**(310) 980-7206**
Permit/Application Numbers(s):	**CUP#**	Tract/Parcel Map Number(s):	**N/A**	
Additional Information / Comments:				

Description of Project:

Existing conditions:

The undeveloped site is located within the northeastern portion of Town of Apple Valley, within the Industrial Specific Plan Zone. See Appenix A.1.

Native creosote bushes (approximately 2-3 feet tall), desert grass and weeds are spordic with spaced growth. See Appendix E photos.

Johnson Road (north), Sycamore Lane (east) and Lafayette Street (south) roads are graded dirt roads. Central Road (west) is paved two lane with graded dirt shoulders on each side.

Site's topography indicates that surface sheets flows mostly uniformly from east to west.

Northwestern portion of the site has historical run-on that fans on the western property line (Central Road). Refer to Hydrology Study provided in Appendix G.

Existing conditions and areas are numbered below:

4. Site property perimeter CL to CL (sq.ft)	**3,271,838**	**75.11**	**acres**

The site will under go a lot line adjustment so the warehouse is on one APN.

7. Existing Paved Road (not disturbed) (sq.ft)	**25,093**	**0.58**	**acres**
Improvement Area (Sum of #4 - #7) (sq.ft)	**3,246,745**	**74.54**	**acres**

The site is divided as follows:

5. Exterior Road Improvements (sq.ft)	**187,051**	**4.29**	**acres**

Above area will include new pavement to Johnson Road (currently graded dirt) and LaFayette Street (currently dirt), and widening of Centeral Road (paved with soft dirt shoulders).
Historical run on will be diverted away from the site. The diversion areas are not included in the WQMP because they will not comingle with site. See Civil plans and Hydrology Study for details.

6. Portions Used to Divert Run-on (sq.ft)	**513,754**	**11.79**	**acres**
8. Facility Operations Area (On-site going to BMP)	**2,545,940**	**58.45**	**acres**
9. Disturbance Total (sq.ft.) (Sum of Items 5 + 6 + 8) (sq.ft)	**3,246,745**	**74.54**	**acres**

Areas decribed above are shown in "Site Map 1" in WQMP Exhibit.

….continue next page

…continued Description of Project:

…continued from Form 1-1

WQMP Project Area (sq.ft) (On-site going to BMP) **2,545,940** **58.45 acres**

Proposed Project will include:
New construction of a distrubution warehouse for the retail goods. Areas will include:

New Roof	**1,080,000**	**Sq. Ft.**	
New Impervious Paved Surfaces	**1,029,646**	**Sq. Ft.**	
New Curbed Landscape (Self-treating)	**53,174**	**Sq. Ft.**	
Bioretention Basin	**64,657**	**Sq. Ft.**	
Landscaped sloped area	**318,463**	**Sq. Ft.**	**and,**
TOTAL WQMP AREA (sq.ft):	**2,545,940**	**58.45**	**Acres**

The site will have one (1) Drainage Area (DA). An Infiltration Basin located on the western portion of the site which is divided with a central weir.
Prior to surface and underground infiltration, surface flows will be pretreated. Two (2) underground Pre-Treatment systems will be located adjacent to Basins.

Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.

At this time, the current Conditions of Approval are dated Janurary 27, 2023 and provided as Appendix L.

The site has was divided into three Drainage Management Areas (DMAs) for Forms 4.2-3 through 4.2-5 where flow rates were necessary to size Pre-treatment devices. They are as follows:

DMA - East **1,320,122 Sq. Ft.** **30.31 acres**

DMA East: includes eastern half of the roof, eastern loading area, northeast driveway to Johnson Road, a portion of the northern parking lot, southern driveways to Lafayette Street and the southern parking lot.

Storm drain inlets and underground pipes will direct flows to the southern Pre-Treatment System "MP-51E". After pre-treatment flows will enter "DMA-East Biorention Basin"

DMA - West **963,892 Sq. Ft.** **22.13 acres**

DMA West: includes western half of the roof, western loading area, the western driveway to Central Road, and the basins that is the final treatment for the Design Capture Volume (DCV).

Storm drain inlets and underground pipes will direct flows to the northern Pre-Treatment System "MP-51W". After pre-treatment flows will enter "DMA-West Biorention Basin". Overflow of larger storms will comingle to DMA-East Biorention Basin.

DMA - North **261,926 Sq. Ft.** **6.01 acres**

DMA North: includes the northern parking that will not provide worker parking and the northern channel. Heavy truck traffic is expected to be minimal in this drainage area.

Storm drain inlets and underground pipes will direct flows to the northern portion of the site to enter an 8 ft wide landscaped channel, approximately 930 feet in length. Channel will overflow to DMA West Bioretention Basin via under driveway culvert.

….continue next page

	Additional Design Concepts: **The Infiltration rate studies, provided in Appendix F: Geotechnical Study, Section 8.15 (page 28, and Appendix F.2, measures less than 0.3 in/hr after a safety factor is applied.** **Due to the low infiltration rate, the site will provide a multi-system (treatment train). Areas with heavy truck traffic and higher flow rates will have a proprietary pre-treatment device to remove polluatnts and contain them within the system. Bypass and treated flows will surface onto a basin with amended soils with agravel subsurface. For added volume, perforated metal pipes will create a void in the gravel. The DCV will remain on site and infiltrate. Underdrains are provided to release the treated flows west to Central Road.**

Section 2 Project Description

2.1 Project Information

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

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

2.1.1 Project Sizing Categorization

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

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

Form 2.1-1 Description of Proposed Project

1 Regulated Development Project Category (Select all that apply):

☑	#1 New development involving the creation of 5,000 ft2 or more of impervious surface collectively over entire site	☐	#2 Significant re-development involving the addition or replacement of 5,000 ft2 or more of impervious surface on an already developed site	☐ #3 Road Project – any road, sidewalk, or bicycle lane project that creates greater than 5,000 square feet of contiguous impervious surface
☐	#4 LUPs – linear underground/overhead projects that has a discrete location with 5,000 sq. ft. or more new constructed impervious surface			
☐	Site Design Only (Project Total Square Feet > 2,500 but < 5,000 sq.ft.) Will require source control Site Design Measures. Use the "PCMP" Template. Do not use this WQMP Template.			

2	Project Area (ft2):	**2,545,940**	**3** Number of Dwelling Units:	**0**	**4** SIC Code: **4225**

5 Is Project going to be phased? ☐ **Yes** ☑ **No**

If yes, ensure that the WQMP evautes phase as a distinct DA, requiring LID BMPS to address runoff at time of completion.

Notes:

Item # 4 SIC Code description is General Warehouse and Storage

This SIC Code may require coverage under the NPDES Industrial General Permit.

The facility will operate as a disturbution center with office. Parking and traffic to and from facility include heavy haul trucks, trailers, and employees.

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:

AP Investors Group LLC
9220 Winnetka Avenue
Los Angeles, CA 91311
(310) 980-7206
Leon Benrimon
Leon@uncommondevelopers.com

is the Land Owner and Developer of the project, and will over see the construction.

The Owner will continue site and facility management after construction is completed and occupancy is approved.

The Owner will assign an onsite manager that will assist in maintenance and upkeep of the day to day operations and inform the owner of necessary actions.
Although tasks may be assigned and interests shared, the sole financial and legal resposibility (care and maintenance of the BMPs will be the Owner's until the land is sold or transfers to another.
Right of way improvements made by the Owner are per the Town of Apple Valley requirements and will remain the City's/Town's to maintain and care for.

The divertion channel on the north and northwest of the property will be maintained by the Owner in accordance to the permits and requirments obtained.

2.3 Potenial Stormwater Pollutants

Best Management Practices (BMP) measures for pollutant generating activities and sources shall be designed consistent with recommendations from the CASQA Stormwater BMP Handbook for New Development and Redevelopment (or an equivalent manual). Pollutant generating activities must be considered when determining the overall pollutants of concern for the Project as presented in Form 2.3-1.

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-2 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
	E	N	
Pathogens (Bacterial / Virus)	☑	☐	**Expected due to uncovered parking and vehicle access on pavement runoff.**
Nutrients - Phosphorous	☑	☐	**Expected to be minimal: Due to drought tolerant landscape and zeriscape (drip) irrigation within concrete curbed parking islands and applications only as needed.**
Nutrients - Nitrogen	☑	☐	**Expected to be minimal: Due to drought tolerant landscape and zeriscape (drip) irrigation within concrete curbed parking islands and applications only as needed.**
Noxious Aquatic Plants	☑	☐	**Expected to be minimal: Due to drought tolerant landscape and zeriscape (drip) irrigation. Applications will be only as needed. There are no waterbodies near site where algae/organic matter is harmed due to site's run-off. See Appendixes A.3 & A.4.**
Sediment	☑	☐	**Expected: Surrounding properties remain undeveloped. Strong winds occasionally create wind-blown transfer.**
Metals	☑	☐	**Expected: Heavy truck traffic, parking of truck trailers, and employee vehicle parking.**
Oil and Grease	☑	☐	**Expected: Long running heavy haul trucks are prone to occationally drip/leak vehicle fluids, especially during hot weather.**
Trash/Debris	☑	☐	**Expected: Strong winds occasionally create wind-blown transfer. Employee outdoor break-areas, and long haul trucks are prone to create additional onsite debris.**
Pesticides / Herbicides	☑	☐	**Expected to be minimal: Due to landscaping and general care of the facility. Applications will be only as needed.**
Organic Compounds	☑	☐	**See Pesticides/Herbicides. No other Organic Compounds expected on site as part of operations.**
Other:	☐	☐	
Other:	☐	☐	

Section 3 Site and Watershed Description

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

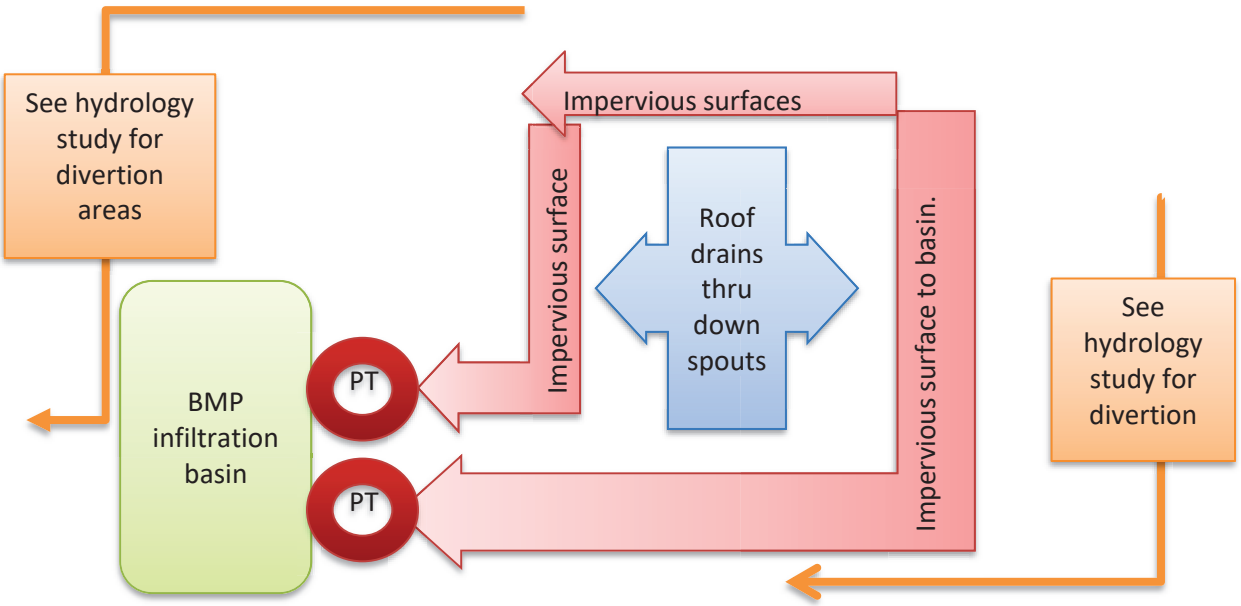
Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude: **34.597001**	Longitude: **-117.169613**	Thomas Bros Map page **4208**

1 San Bernardino County climatic region: ☑ Desert

2 Does the site have more than one drainage area (DA): ☐ Yes ☑ No

If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached



Surface Types:		Description
Impervious	**New Roof**	**ridged in the center drains east and west into downspouts on on impervious surfaces.**
Impervious	**New Impervious Paved Surfaces**	**includes asphalt and concrete areas**
Pervious	**New Curbed Landscape (Self-treating)**	**includes areas with 6" curbs (landscaped parking islands)**
Pervious	**Bioretention Basin**	**west along Central Road.**
Pervious	**Landscaped sloped area**	**areas that are sloped (e.g., perimeters and basin sides)**

PT = Pretreatment system

BMP - Bioretention with underdrains

Form 3-2: Existing Hydrologic Characteristics for Drainage Management Areas 1				
For Drainage Management Area 1's sub-watershed DMA, provide the following information:	**Entire Site**			
1 DMA drainage area (ft2)	2,545,940			
2 Existing site impervious area (ft2)	0			
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/2_0100412_map.pdf*	II			
4 Hydrologic soil group *Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/2 0100412_addendum.pdf*	A			
5 Longest flowpath length (ft)	966			
6 Longest flowpath slope (ft/ft)	0.021			
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Barren			
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50%* ***Attach photos of site to support rating***	Poor <50% cover with mostly weeds			

Notes: Existing topography provided relatively uniform sheet flow and entire site was undeveloped. Information for Item 3 provided as Attachment A, AMC Maps, and Item 4 is provided as Attachment B, Web Soils Survey.

For 3-2 Existing Hydrologic Characteristics for Drainage Area 1 (use only as needed for additional DMA w/in DA1)

For Drainage Area 1's sub-watershed DMA, provide the following characteristics	-	-	-	**Totals Verified**
1 DMA drainage area (ft2)	0	0	-	**2,545,940**
2 Existing site impervious area (ft2)	0	0	-	-
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/2_0100412_map.pdf*	#REF!	#REF!	-	-
4 Hydrologic soil group *Refer to County Hydrology Manual Addendum for Arid Regions – http://www.sbcounty.gov/dpw/floodcontrol/pdf/2 0100412_addendum.pdf*	A	A	-	-
5 Longest flowpath length (ft)	0	0	-	-
6 Longest flowpath slope (ft/ft)	0.00	0.00	-	-
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	0	0	-	-
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50%* ***Attach photos of site to support rating***	0	0	-	N/A

Form 3-3 Watershed Description for Drainage Area

Receiving waters Refer to SWRCB site: http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	**Per State water Board GAMA Map, the project is located in the Apple Pond-Apple Valley Dry Lake, a closed basin HUC12#: 180902080304. See Appendix C.3** **Larger storms and street flow from the surrounding area may potentially enter:** **Mojave River (Mojave Forks Reservoir outlet to Upper Narrows) CAR628200002008081619514 8** **Downstream reach is also listed, which is named:** **Mojave River (Upper Narrows to Lower Narrows) (CAR628200002008081714215 8).** **The following reaches (Below Lower Narrows toward north) are not listed as 303(d) Impaired waterbodies.** **Refer to Appendix C.1:** **Google Map of overland 10.0 miles from Mojave River**	
Applicable TMDLs http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	**Per 2020-2022 California Intergrated Report 303(d) & 305(b) Report, found:** https://www.waterboards.ca.gov/water_issues/programs/water_quality_assessment/2020_2022_integrated_report.html **5A: "listed but TMDL still required/not yet completed, for at least one of the pollutants being listed in the segment"**	
303(d) listed impairments http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml	**Fluoride: Unknown Sources** **Sodium: Unknown Sources** **Sulfates: Unknown Sources** **Manganese: Unknown Sources,** **Oxygen, Dissolved: Unknown Sources,** **Total Dissolved Solids: Unknown Sources**	
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool –* http://sbcounty.permitrack.com/WAP	**Desert Tortoise - Category 2.** **See Appendix A.3**	
Hydromodification Assessment	☑	**Yes** *Complete Hydromodification Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-9 in submittal*
	☐	**No**

Notes: **Information above provided as Appendixes to this document.**

Section 4 Best Management Practices (BMP)

4.1 Source Control BMPs and Site Design Measures

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

4.1.1 Source Control BMPs

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

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

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

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☑	☐	Property Owner shall ensure that facility manager(s) in charge of the site is/are aware of the site's BMP function and maintenance requirements. This includes, but not limited to, familiarizing themselves with the system's function, placement and network, maintenance schedules, and contracting professional personnel. Employee training, including but not limited to, site good-house keeping, proper materials use, storage and disposal, establishing protocols for spills/leak detection and clean-up shall be scheduled with two-weeks of new hire and annually reminder.
N2	Activity Restrictions	☑	☐	Activities are minimized to site operations only. Owner shall contract a licensed professional when using and applying pesticides, and herbicides.
N3	Landscape Management BMPs	☑	☐	Landscape management includes weed maintenance, irrigation system maintenance and replacing unhealthy vegetation. Owner shall contract licensed professionals familiar with local and state regulations.
N4	BMP Maintenance	☑	☐	Owner shall ensure a professional service provider is obtained for inspection and maintenance of the underground BMPs. Service reports (maintenance logs) and onsite inspections will be stored onsite, and available upon request from the site manager. The landscaped areas and swale shall remain at design elevations to ensure capacity. Landscape shall remain healthy and weed free. No ponding shall be evident after 72 hours after rainfall has stopped to ensure infiltration is per original design and vector/mosquito hazards are avoided.

N5	Title 22 CCR Compliance (How development will comply)	☐	☑	There are no outdoor hazardous waste materials or storage designed at this site/facility, and this site site's SIC Code does not describe the manufacturing or use of materials described in Title 22 CCR. In the event medical and biohazard waste is onsite, it shall be handled and disposed of inaccordance with Local, State, and Federal requirments relevant to Health & Safety of Hazardous materials. Owner shall provide a licensed waste hauler for said materials.
N6	Local Water Quality Ordinances	☑	☐	Facility and site operations shall follow all local water quality ordinances throughout the implementation of the WQMP, and replace/repair water use structures in accordance with conservation and water use laws.
N7	Spill Contingency Plan	☑	☐	The Owner and facility site manager(s) shall ensure appropriate spill-kits, materials and clean-up tools are readily available and employees are knowledgable in safety protocols, and proper disposal requirments.
N8	Underground Storage Tank Compliance	☐	☑	No underground storage tank is proposed for this site containing greases, oils or gas. APSA and CUPA are Non applicable
N9	Hazardous Materials Disclosure Compliance	☑	☐	The Owner and facility site manager(s) shall comply and provide required documentation and / or obtain proper permits in accordance with all local, state and federal laws meeting local fire protection enforcement agencies standards for hazardous materials and hazardous waste materials anticipated or suspected within the facility/site.

4-2.b

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	☑	☐	This project's site plan shall be reviewed by the Town of Apple Valley various departments and shall provide the proper permits. Storage, use and handing of any flammable and non-flammable materials, and/or compressed gasses shall be in accordance with local, state, and federal regulations.
N11	Litter/Debris Control Program	☑	☐	Facility shall adhere to local waste control regulations (including hazardous waste and/or recycling programs) at time of occupancy. Operations and Maintenance Program shall address Good Housekeeping practices which will include regular scheduled waste pick-up and disposal by a licensed waste hauler. Trash enclosure(s) are designed per Town of Apple Valley standards and shall remain in good condition to ensure protection of wind and precipitation. Regular sweeping and cleaning of the structure(s) shall be conducted to ensure protection form run-off, vector and rodent potentials. Outdoor trash containers (such as those in employees break-areas, and convenient to daily operations) shall be securely lidded, leak/damage free, properly labeled (if recyclable) and secure from tipping, and wind. All trash and debris (including wind-blown) shall be removed from site and from perimeters of site on a regular basis.
N12	Employee Training	☑	☐	Within 2 months of new hire and annually for all employees. See N1.

N13	Housekeeping of Loading Docks	☑	☐	Part of grounds maintenance and good house keeping practices, area(s) will be swept and visually inspected for stains and debris. Regular street sweeping cleaning shall take place as part of Ground Maintenances and Operations. See N15.
N14	Catch Basin Inspection Program	☑	☐	Part of grounds maintenance and good house keeping practices, inlets and surface grates shall be inspected and cleared of debris or any blockage.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☑	☐	Part of grounds maintenance and good house keeping practices, and shall be scheduled by Owner/Site Manager(s) to keep site orderly.
N16	Other Non-structural Measures for Public Agency Projects	☐	☑	Not a Public Agency Project
N17	Comply with all other applicable NPDES permits	☑	☐	This project is subject to the Construction General Permit where Water Discharge Identification (WDID) provisions apply while the project is under construction. Standard Indentification Code (SIC) shown in Form 2.1-1, Item #4 is not listed as a Potentially Regulated Project as defined by the industrial General Permit. However, in the event the facility's operations become subject to the General Industrial Permit a WDID shall be obtained by the Owner. This facility's owner's and operation manager's are dedicated to maintaining and complying with local, state and federal regulations.

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 stenciling and signage (CASQA New Development BMP Handbook SD-13)	☑	☐	Glued (epoxy) plate, stamped message on steel grates, or stenciled painted message near inlet will be applied.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☑	There is no raw, loose or hazardous materials expected to be stored outdoors. Parking of truck trailers is described in N11, N13, & N15 as good house keeping.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☑	☐	Trash enclosure will have permanent roofing as per Town of Apple Valley standards. Waste containers shall be covered (lid), and area maintained regularly. Site design has trash area with significant distance from treatment system to detect visual pollutants.
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)	☑	☐	Irrigation system and controllers shall adhere to local and state conservation standards and shall drought tolerant items per Town of Apple Valley plant list. Resetting irrigation controls shall be in accordance to season changes and regularly observed for needed repairs.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☑	☐	6-inch curb will surround parking islands and finished surfaces will remain more than 4-inches from top of curb. Any other (non-curb ,including curb-cut openings, where impervious surfaces transition to pervious) surfaces shall provide a minimum of 2-inches below and drop in elevation to promote impervious to pervious dissipation. Design upkeep shall be part of regular landscaping maintenance.

S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☑	☐	Basin slopes shall include surface covering that may provide wind erosion as well as energy dissipation (rill-erosion control). Inlets and curb-openings shall include larger rip-rap gravels.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☑	Per architectural building plans, loading doors are set at truck height where trailers are backed up so that unloading and loading are indoors as much as possible. This will limit the spill of delivery goods outdoors.
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☑	☐	The exterior grade and impervious slope of the heavy truck areas does not provide for a dead sump or containment. Therefore loading areas shall be regularly inspected for spills and stains. Regular sweeping and spill absorbent materials shall be part of regular good housekeeping practices. The vegetated basin will provide biotreatment.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☑	There are no vehicle washing as part of their operation(s).
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☑	No outdoor processing on this project.

4-4.b

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☑	No outdoor designated area and not expected to have as day-to-day operations.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☑	☐	No outdoor or covered commercial fueling is expected on this site. However, small loading equipment (e.g., fork-lifts, tow tractors, carts, etc.), that are to be fuel powered shall be done in a designated area by trained personnel with appropriate spill kits and containment materials in place.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☑	☐	Sloped portions of the project are per compaction standards as shown in the civil design plans. Landscaping and surface covering are per the Landscape plans.
S14	Wash water control for food preparation areas	☐	☑	No food preparations on this site.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☑	No community car washing on this site.

4.1.2 Site Design BMPs

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

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

Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- A narrative of site design practices utilized or rationale for not using practices are included in WQMP

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

Form 4.1-3 Site Design Practices Checklist

Site Design Practices		
If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets		
Minimize impervious areas:	Yes ☑	No ☐
Explanation:	**Site design adhered to the minimal drive widths and centered the building for traffic flow. This provided perimeter pervious spacing to be used for basin and diversion purposes. The site also seperated operational traffic and parking from customer/employee parking where landscaped islands as more feasable and provided.**	
Maximize natural infiltration capacity; Including improvement and maintenance of soil:	☑	☐
Explanation:	**Existing soils (per Appendix B, is rated "A", and new landscaped areas will add new healthy top soils to promote transplanted vegetation, which are optimal conditions for natural infiltration. Parking islands will have surrounding curb to make these areas self-treating.**	
Preserve existing drainage patterns and time of concentration:	☑	☐
Explanation:	**Run-on from the east will be managed around the site and basins will provide extended detention to mimic the pre-development conditions.**	
Disconnect impervious areas. Including rerouting of rooftop drainage pipes to drain stormwater to storage or infiltration BMPs instead of to storm drain :	☑	☐
Explanation:	**Surface drainage on the western site sheet flow into the pervious surfaces evapotranspiration and infiltration.**	
Use of Porous Pavement.:	☐	☑
Explanation:	**Porous pavement was not in this site design. Surrounding areas are undeveloped and maintenance is not practical.**	
Protect existing vegetation and sensitive areas:	☐	☑
Explanation:	**No substantial (existing) vegetation. There is spare low growth creosote bushes and invasive weeds.**	
Re-vegetate disturbed areas. Including planting and preservation of drought tolerant vegetation. :	☑	☐
Explanation:	**Site improvements includes Town of Apple Valley landscape standards. The site will have new drought tolerant trees, bushes, and foliage as part of facility design per Owner and landscape architect's designs.**	

	Yes	No
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas:	☑	☐
Explanation: **Basin bottoms will be shown No Compaction. Areas will be shown in Erosion Control Plans.**		
Utilize naturalized/rock-lined drainage swales in place of underground piping or imperviously lined swales:	☑	☐
Explanation: **Drainage swale is utilized on the western portion of the project and in addition to underground piping.**		
Stake off areas that will be used for landscaping to minimize compaction during construction	☑	☐
Explanation: **During construction, shown on Erosion Control Plans, landscaped and basin bottom(s) will be off -limits to heavy equipment travel, and no compaction. During final landscape installation loosening compacted soil activities will occur when placing/planting new vegetation.**		
Use of Rain Barrels and Cisterns, Including the use of on-site water collection systems.:	☐	☑
Explanation: **Not feasible to site conditions**		
Stream Setbacks. Includes a specified distance from an adjacent stream: :	☑	☐
Explanation: **No named streams, however the north eastern corner will have a diversion channel to keep any large storm run-on potential from comingling with new site and its' operations. The design surfaces will remain as close to existing yet provide long-term structure since a berm will separate the diversion channel from the site. The diversion channel's elevations will match the existing elevations at ingress (northeast) and egress (west).**		

It is noted that, in the Phase II Small MS4 Permit, site design elements for green roofs and vegetative swales are required. Due to the local climatology in the Mojave River Watershed, proactive measures are taken to maximize the amount of drought tolerant vegetation. It is not practical in this region to have green roofs or vegetative swales. As part of site design the project proponent should utilize locally recommended vegetation types for landscaping. Typical landscaping recommendations are found in following local references:

San Bernardino County Special Districts:

Guide to High Desert Landscaping

http://www.specialdistricts.org/Modules/ShowDocument.aspx?documentid=795

Recommended High-Desert Plants -

http://www.specialdistricts.org/modules/showdocument.aspx?documentid=553

Mojave Water Agency:

Desert Ranch: http://www.mojavewater.org/files/desertranchgardenprototype.pdf

Summertree: http://www.mojavewater.org/files/Summertree-Native-Plant-Brochure.pdf

Thornless Garden: http://www.mojavewater.org/files/thornlessgardenprototype.pdf

Mediterranean Garden: http://www.mojavewater.org/files/mediterraneangardenprototype.pdf

Lush and Efficient Garden: http://www.mojavewater.org/files/lushandefficientgardenprototype.pdf

Alliance for Water Awareness and Conservation (AWAC) outdoor tips –

http://hdawac.org/save-outdoors.html

4.2 Treatment BMPs

After implementation and design of both Source Control BMPs and Site Design BMP measures, any remaining runoff from impervious DMAs must be directed to one or more on-site, treatment BMPs (LID or biotreatment) designed to infiltrate, evaportranspire, and/or bioretain the amount of runoff specified in Permit Section E.12.e (ii)(c) Numeric Sizing Criteria for Storm Water Retention and Treatment.

4.2.1 Project Specific Hydrology Characterization

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

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

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

Methods applied in the following forms include:

For LID BMP Design Capture Volume (DCV), San Bernardino County requires use of the P6 method (Form 4.2-1) For pre- and post-development hydrologic calculation, San Bernardino County requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 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 hydromodification performance criteria.

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

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

1	Project area DA 1 (ft²): **2,545,940**	**2**	Imperviousness after applying preventative site design practices (Imp%): **2,109,646** **82.86%**	**3**	Runoff Coefficient (Rc): **0.634** *Rc = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4	Determine 1-hour rainfall depth for a 2-year return period P2yr-1hr (in): http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html				**0.346**
5	Compute P6, Mean 6-hr Precipitation (inches): *P6 = Item 4 *C1, where C1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)*				**0.428**
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 (ft3): *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C2], where C2 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*				**113,013**

Form 4.2-2 Summary of Hydromodification Assessment (DA1)

Is the change in post- and pre- condition flows captured on-site? :	☑	Yes
If "Yes", then complete Hydromodification assessment of site hydrology for 10yr storm event using Forms 4.2-3 through 4.2-5 and insert results below (Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual- Addendum 1)	☐	No

If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft³)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	**1** **170,991** *Form 4.2-3 Item 12*	**2** **17.82** *Form 4.2-4 Item 13*	**3** **2.22** *Form 4.2-5 Item 10*
Post-development	**4** **206,582** *Form 4.2-3 Item 13*	**5** **10.64** *Form 4.2-4 Item 14*	**6** **28.02** *Form 4.2-5 Item 14*
Difference	**7** **35,591** *Item 4 – Item 1*	**8** **7.18** *Item 2 – Item 5*	**9** **25.81** *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** **21%** *Item 7 / Item 1 %*	**11** **40%** *Item 8 / Item 2 %*	**12** **1165%** *Item 9 / Item 3 %*

NOTES:

Form 4.2-3 HCOC Assessment for Runoff Volume (DA1)

Weighted Curve Number Determination: for Pre-developed DA	**DMA - East**	**DMA - West**	**DMA - North**	DMA D	DMA E	DMA F
1a Land Cover Type	**Barren**	**Barren**	**Barren**	N/A	N/A	N/A
2a Hydrologic Soil Group (HSG)	**A**	**D**	**A**	N/A	N/A	N/A
3a DMA Area ft2 *Sum of areas of DMA should equal area of DA*	**1,320,122**	**963,892**	**261,926**	0	0	0
4Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	**78**	**93**	**78**	0	0	0

Weighted Curve Number Determination: Post-developed DA	**DA1 (Entire Site)**					
1b Land Cover Type	**New Roof**	**New Impervious Paved Surfaces**	**New Curbed Landscape (Self-treating)**	**Bioretention Basin**	**Landscaped sloped area**	
2b Hydrologic Soil Group (HSG)	**N/A**	**N/A**	**A**	**A**	**A**	
3b DMA Area ft2 *sum of areas of DMA should equal area of*	**1,080,000**	**1,029,646**	**53,174**	**64,657**	**318,463**	
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	**98**	**98**	**32**	**32**	**32**	

5 Pre-Developed area-weighted CN:	**7** Pre-developed soil storage capacity, *S (in): S=(1000/item 5) - 10*	**9** Initial abstraction, Ia(in): *Ia=0.2*Item 7*
84	**1.95**	**0.39**
6 Post Developed area weighted CN:	**8** Post developed soil storage capacity, S (in): *S=(1000/Item 6) - 10*	**10** Initial abstraction, Ia (in): *Ia = 0.2*Item 8*
87	**1.54**	**0.31**

11 Precipitation for 10 yr, 24 hr storm (in): Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html	**2.11**
12 Pre-developed Volume (ft3): *V pre =(1/12)*(Item sum of Item 3) * [Item 11- Item 9)^2 / ((Item 11 - Item 9 + Item 7)*	170,991.10
13 Post developed Volume (ft3): *V pre =(1/12) * (Item sum of Item 3) * [(Item 11 - Item 10)^2 / ((Item 11 - Item 10 + Item 8)*	206,581.63
14 Volume Reduction needed to meet hydromodification requirement, (ft3): *Vhydro = (Item 13 * 0.95) - Item 12*	**25,261.5**

Notes:

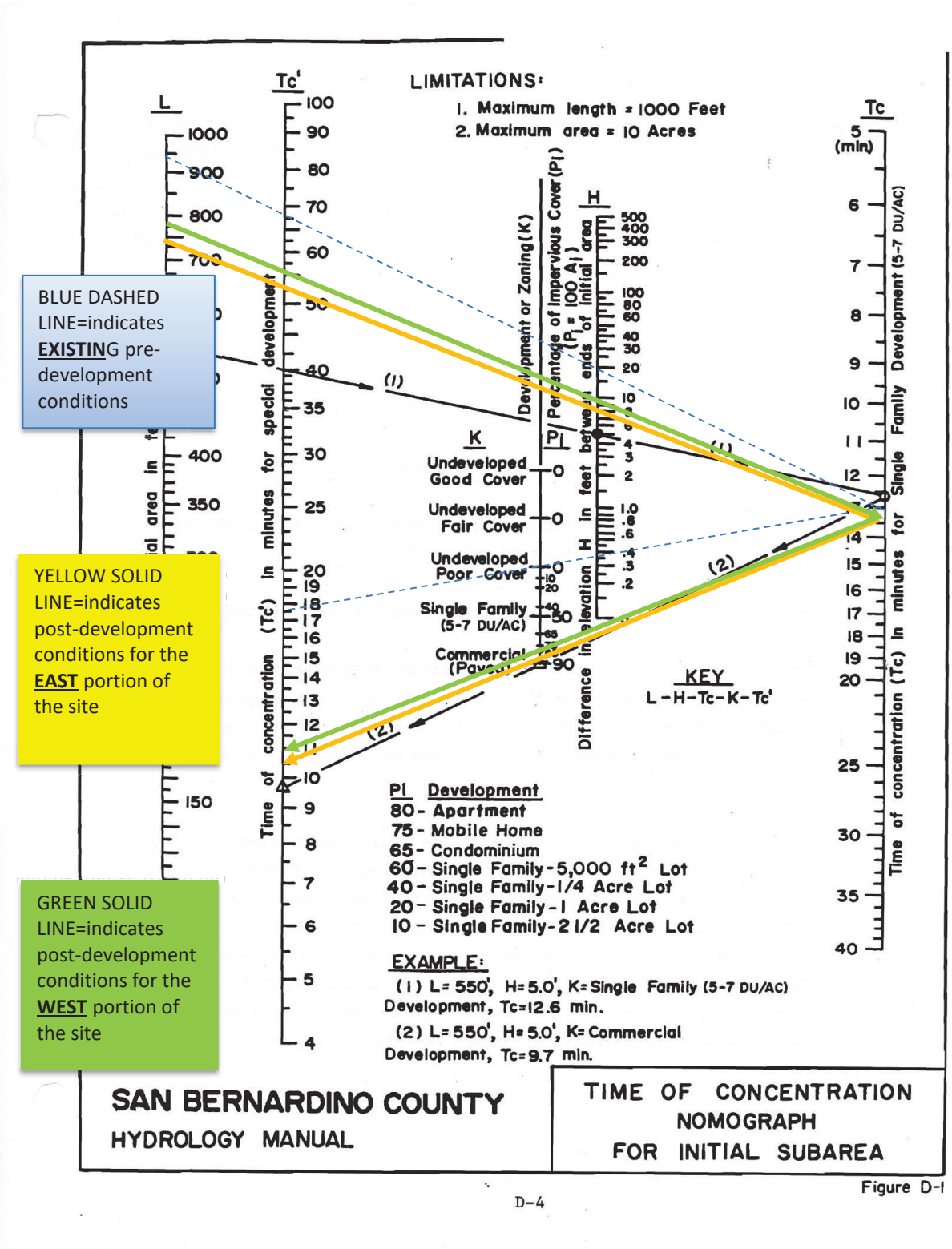
Form 4.2-4 HCOC Assessment for Time of Concentration (DA1)

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			Post-developed DA1		
	Entire Site	DMA B	DMA C	**DMA - East**	**DMA - West**	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*	**966**			**740**	**793**	
2 Change in elevation (ft)	**20**			**8**	**9**	
3 Slope (ft/ft), *So = Item 2 / Item 1*	**0.021**			**0.010**	**0.011**	
4 Land cover	**Existing Surface: Native-Undeveloped**			**Commercial**	**Commercial**	
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*	**17.8**			**10.6**	**10.9**	
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*	**0**			**0**	**0**	
7 Cross-sectional area of channel (ft_2)	**0**			**0**	**0**	
8 Wetted perimeter of channel (ft)	**0**			**0**	**0**	
9 Manning's roughness of channel (n)	**0**			**0**	**0**	
10 Channel flow velocity (ft/sec) $V_{fps} = (1.49 / Item\ 9) * (Item\ 7/Item\ 8)^{0.67} * (Item\ 3)^{0.5}$	**0**			**0**	**0**	
11 Travel time to outlet (min) $T_t = Item\ 6 / (Item\ 10 * 60)$	**0**			**0**	**0**	
12 Total time of concentration (min) $T_c = Item\ 5 + Item\ 11$	**17.82**			**10.64**	**10.85**	
13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA*						17.82
14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA*						10.64
15 Additional time of concentration needed to meet HCOC requirement (min): $T_{C\text{-}HCOC} = (Item\ 13 * 0.95) - Item\ 14$						6.3

Notes:

Refer to Nomograph Figure D-1, following sheet. Two larger DMAs included.



BLUE DASHED LINE=indicates **EXISTING** pre-development conditions

YELLOW SOLID LINE=indicates post-development conditions for the **EAST** portion of the site

GREEN SOLID LINE=indicates post-development conditions for the **WEST** portion of the site

Figure D-1

D-4

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

Compute peak runoff for pre- and post-developed conditions

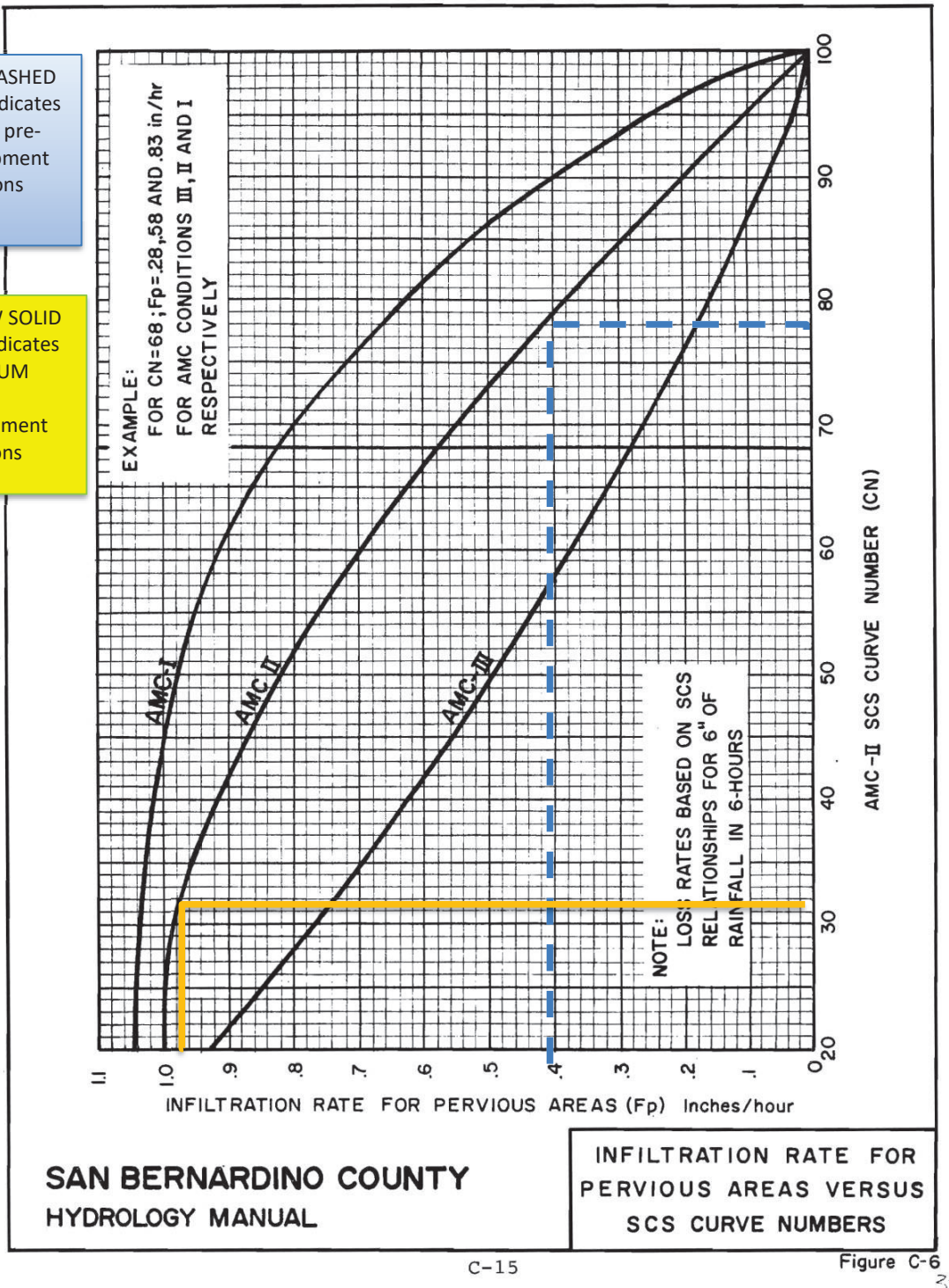
Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA*)		Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA*)			
		Entire Site		**DMA - East**	**DMA - West**		
1 Rainfall Intensity for storm duration equal to time of concentration/ $_{peak}$ = 10^(LOG Form 4.2-1 Item 4 - 0.7 LOG Form 4.2-4 Item 5 /60)		**0.81**		**1.16**	**1.15**		
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		**6.01**		**30.31**	**22.13**		
Pervious area (Acres)		**58.45**		**4.15**	**2.14**		
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		**1.00**		**0.14**	**0.10**		
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*		**0.40**		**0.98**	**0.98**		
5 Maximum loss rate (in/hr) *F $_m$ = Item 3 * Item 4* *Use area-weighted F $_m$ from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		**0.40**		**0.13**	**0.09**		
6 Peak Flow from DMA (cfs) *Q $_p$ =Item 2 * 0.9 * (Item 1 - Item 5)*		**2.22**		**28.02**	**20.92**		
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*	0	*n/a*	0	0	0.00
	DMA B	0.00	*n/a*	0	*n/a*	0	0.00
	DMA C	0	0	0	0	*n/a*	0.00
8 Pre-developed Q_p at T_c for DMA A: *Q $_p$ = Item 6 $_{DMAA}$ + [Item 6 $_{DMAB}$ * (Item 1 $_{DMAA}$ - Item 5 $_{DMAB}$)/(Item 1 $_{DMAB}$ - Item 5 $_{DMAB}$)* Item 7 $_{DMAA/2}$] + [Item 6 $_{DMAC}$ * (Item 1 $_{DMAA}$ - Item 5 $_{DMAC}$)/(Item 1 $_{DMAC}$ - Item 5 $_{DMAC}$)* Item 7 $_{DMAA/3}$]*							2.22
9 Pre-developed Q_p at T_c for DMA B: *Q $_p$ = Item 6 $_{DMAB}$ + [Item 6 $_{DMAA}$ * (Item 1 $_{DMAB}$ - Item 5 $_{DMAA}$)/(Item 1 $_{DMAA}$ - Item 5 $_{DMAA}$)* Item 7 $_{DMAB/1}$] + [Item 6 $_{DMAC}$ * (Item 1 $_{DMAB}$ - Item 5 $_{DMAC}$)/(Item 1 $_{DMAC}$ - Item 5 $_{DMAC}$)* Item 7 $_{DMAB/3}$]*							0.00
10 Pre-developed Q_p at T_c for DMA C: *Q $_p$ = Item 6 $_{DMAC}$ + [Item 6 $_{DMAA}$ * (Item 1 $_{DMAC}$ - Item 5 $_{DMAA}$)/(Item 1 $_{DMAA}$ - Item 5 $_{DMAA}$)* Item 7 $_{DMAC/1}$] + [Item 6 $_{DMAB}$ * (Item 1 $_{DMAC}$ - Item 5 $_{DMAB}$)/(Item 1 $_{DMAB}$ - Item 5 $_{DMAB}$)* Item 7 $_{DMAC/2}$]*							
10 Peak runoff from pre-developed condition confluence analysis (cfs): *Maximum of Item 8, 9, and 10 (including additional forms as needed)*							**2.22**
11 Post-developed Q_p at T_c for DMA A: *Same as Item 8 for post-developed values*							28.02
12 Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*							20.92
13 Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*							0.00
14 Peak runoff from post-developed condition confluence analysis (cfs): *Maximum of Item 11, 12, and 13 (including additional forms as needed)*							**28.02**
15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): $Q_{p\text{-}hydro}$ = *(Item 14 * 0.95) – Item 10*							**24.41**

Notes:

Refer to Figure C-6, following sheet. CN was taken from Form 4.2-3, Item 4b. AMC per Form 3-2, Item 3 and Appendix A map. Refer to Hydrology Study that provided Calculations for 100 yr storm. Seperate engineering calcuations are provided to determine inlet and adequate by-pass sizing per storm drain plans.

BLUE DASHED LINE=indicates existing pre-development conditions

YELLOW SOLID LINE=indicates MAXIMUM post-development conditions



C-15

Figure C-6

4.3 BMP Selection and Sizing

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

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

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

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

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

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

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

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

4.3.1 Exceptions to Requirements for Bioretention Facilities

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

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

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

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

Form 4.3-1 Infiltration BMP Feasibility (DA 1)		
Feasibility Criterion – Complete evaluation for each DA on the Project Site		
1 Would infiltration BMP pose significant risk for groundwater related concerns? *Refer to Section 5.3.2.1 of the TGD for WQMP* If Yes, Provide basis: (attach)	Yes ☐	No ☑
2 Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? (Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert): • The location is less than 50 feet away from slopes steeper than 15 percent • The location is less than eight feet from building foundations or an alternative setback. • A study certified by a geotechnical professional or an available watershed study determines that If Yes, Provide basis: (attach)	☐	☑
3 Would infiltration of runoff on a Project site violate downstream water rights? 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? 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)? If Yes, Provide basis: (attach)	☑	☐
6 Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? *See Section 3.5 of the TGD for WQMP and WAP* If Yes, Provide basis: (attach)	☐	☑
7 Any answer from Item 1 through Item 3 is "Yes": *If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 8 below.*	☐	☑
8 Any answer from Item 4 through Item 6 is "Yes": *If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, 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.*		

4.3.2 Site Design BMP

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

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

Form 4.3-2 Site Design 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 *If yes, complete Items 2-5;* ☐ No *If no, proceed to Item 6*	**DMA North parking draining into landscaped channel**	DA BMP Type	DA BMP Type
2	Total impervious area draining to pervious area (ft^2)	**99,785**	0	0
3	Ratio of pervious area receiving runoff to impervious area	**0.1**		
4	Retention volume achieved from impervious area dispersion (ft^3) *V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff*	**323**	0	0
5	Sum of retention volume achieved from impervious area dispersion (ft3): *Vretention =Sum of Item 4 for all BMPs*			**323**
6	Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): ☑ Yes *if yes, complete Items 7- 13 for aggregate of all on-lot infiltration BMP in each DA;* ☐ No *If no, proceed to Item 14*	**DMA - East** **New Curbed Landscape (Self-treating)**	**DMA - West** **New Curbed Landscape (Self-treating)**	**DMA - North** **New Curbed Landscape (Self-treating)**
7	Ponding surface area (ft2)	**32,493**	0	**20,681**
8	Ponding depth (ft)	**0.25**	0	**0.25**
9	Surface area of amended soil/gravel (ft2)	**32,493**	0	**20,681**
10	Average depth of amended soil/gravel (ft)	**0.5**	0	**0.5**
11	Average porosity of amended soil/gravel	**0.33**	0	**0.33**
12	Retention volume achieved from on-lot infiltration (ft3) *Vretention = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*	**13,485**	0	**8,583**
13	Runoff volume retention from on-lot infiltration (ft3): *Vretention =Sum of Item 12 for all BMPs*			**22,067**
14	Implementation of Street Trees: ☐ Yes *If yes, complete Items 22-25.* ☑ No *If no, proceed to Item 26*	DA BMP Type	DA BMP Type	DA 5 BMP Type
15	Number of Street Trees	0	0	0
16	Average canopy cover over impervious area (ft2)	0	0	0
17	Runoff volume retention from street trees (ft3) *Vretention = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*	0	0	0
18	Runoff volume retention from street tree BMPs (ft3): *Vretention = Sum of Item 24 for all BMPs*			0
19	Total Retention Volume from Site Design Hydrologic Source Control BMPs: *Sum of Items 5, 13, 20, 25 and 29*			**22,390**

Notes: Item #13 includes self-treating areas that will not comingle with surface sheet flows. Amended soils depth (#10) is the anticipated average depth of healthy topsoils to promote healthy growth of the new vegetation. Cross section "Landscaped Island Detail" is provided in WQMP Exhibit.

4.3.3 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix C of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

4.3.3.1 Allowed Variations for Special Site Conditions

The bioretention system design parameters of this Section may be adjusted for the following special site conditions:

1) Facilities located within 10 feet of structures or other potential geotechnical hazards established by the geotechnical expert for the project may incorporate an impervious cutoff wall between the bioretention facility and the structure or other geotechnical hazard.

2) Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical hazard, and facilities located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the subsurface drainage/storage layer (this configuration is commonly known as a “flow-through planter”).

3) Facilities located in areas of high groundwater, highly infiltrative soils or where connection of underdrain to a surface drain or to a subsurface storm drain are infeasible, may omit the underdrain.

4) Facilities serving high-risk areas such as fueling stations, truck stops, auto repairs, and heavy industrial sites may be required to provide adequate pretreatment to address pollutants of concern unless these high-risk areas are isolated from storm water runoff or bioretention areas with no chance of spill migration.

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

1	Form 4.2-1 Item 7	**113,013**			
	- Form 4.3-2 Item 19	**22,390**			
	Remaining LID DCV not met by site design HSC BMP (ft3):	**90,623**			
	BMP Type Use columns to the right to compute runoff volume retention from proposed infiltration BMP - Use additional forms for more BMPs		DMA-West (North Basin)	DMA-East (South Basin)	
			Infiltrating soils under the bioretention area	Infiltrating soils under the bioretention area	DA
2	Infiltration rate of underlying soils (in/hr)		0.01	0.01	
3	Infiltration safety factor		2	2	
4	Design percolation rate (in/hr) *Pdesign = Item 2 / Item 3*		0.005	0.005	
5	Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*		48	48	
6	Maximum ponding depth (ft) *6 ft maximum per City code*		0.0	0.00	
7	Ponding Depth (ft) *dBMP = Minimum of (1/12*Item 4*Item 5) or Item 6*		0.020	0.020	
8	Infiltrating surface area, *SA BMP (ft2)*		35,257	29,400	
9	Amended soil depth, dmedia (ft) *Only included in certain BMP types*		0.00	0.00	
10	Amended soil porosity		0.00	0.00	
11	Gravel depth, dmedia (ft) *Only included in certain BMP types*		0.00	0.00	
12	Gravel porosity		0.00	0.00	
13	Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*		3	3	
14	Above Ground Retention Volume (ft3) *Vretention = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*		749	625	
15	Underground Retention Volume (ft3) *Volume determined using manufacturer's specifications and calculations*				
16	Total Retention Volume from LID Infiltration BMPs: *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*		**0**		
17	Fraction of DCV achieved with infiltration BMP: *% Retention% = Item 16 / Form 4.2-1 Item 7*				
18	Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs?				☐ Yes ☑ No

Note:

Item #2 is found in Appendix F.1 Geotechnical Study, Section 8.15.2 (page 28) to design depth. Basin is located in Test site IT-2. An addition Infiltration Study was conducted at deeper depth and was found to be low. The totals in Item #14 are not included as volume. This Form provides feasibilty to use Form 4.3-5 Infiltration with underdrains. Refer to Form 4.3-5.

4.3.4 Biotreatment BMPs

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

Use Form 4.3-4 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV. Biotreatment computations are included as follows:

Use Form 4.3-5 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);

Use Form 4.3-6 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);

Use Form 4.3-7 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-4 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design, or inflitration, BMP for potential biotreatment (ft3):	**90,623**	List pollutants of concern *Copy from Form 2.3-1.*	Vortex Pre-treatment has addressed: Sediment, Metals, Trash /Debris thru Particulate Settling, Floatable Capture and removal. Bioretention Form 4.3-5: Nutrients, Pesticides, Pathogens and Compounds by Vegetative Filtration.

2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-5 and 4.3-6 to compute treated volume*		Flow-based biotreatment *Use Form 4.3-7 to compute treated volume*	
	✓	Bioretention with underdrain		Vegetated swale
		Planter box with underdrain		Vegetated filter strip
		Constructed wetlands		Proprietary biotreatment
		Wet extended detention		
		Dry extended detention		

3 Volume biotreated in volume based biotreatment BMP (ft3): *Form 4.3- 5 Item 15 + Form 4.3-6 Item 13*	124,465
4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft3): *Item 1 – Item 3*	**-33,842**
5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: *% Item 4 / Item 1*	**0%**
6 Flow-based biotreatment BMP capacity provided (cfs): *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*	**0**
7 Metrics for MEP determination:	**See 4.3-8 for Conformance Summary.**

• Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development:

If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribedminimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.

Form 4.3-5 Volume Based Biotreatment (DA 1)
Bioretention and Planter Boxes with Underdrains

Form 4.2-1 Item 7		**113,013**	
- Form 4.3-2 Item 19		**22,390**	
- Form 4.3-3 Item 16		**-**	
Remaining LID DCV not met by site design HSC BMP (ft3):		**90,623**	
Biotreatment BMP Type *(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)*		**DMA-West (North Basin)**	**DMA-East (South Basin)**
		After Pre-treatment system flow enters bioretention basin	**After Pre-treatment system flow enters bioretention basin**
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP*	**Vortex Pre-treatment has addressed: Sediment, Metals, Trash /Debris thru Particulate Settling, Floatable Capture and removal. Bioretention below will provide additional treatment for: Nutrients, Pesticides, Pathogens and Compounds by Vegetative Filtration.**		
2 Amended soil infiltration rate *Typical ~ 5.0*		**5.0**	**5.0**
3 Amended soil infiltration safety factor *Typical ~ 2.0*		**2.0**	**2.0**
4 Amended soil design percolation rate (in/hr) P_{design} = *Item 2 / Item 3*		**2.5**	**2.5**
5 Ponded water drawdown time (hr) *Copy Item 6 from Form 4.2-1*		**48**	**48**
6 Maximum ponding depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*		**0**	**0**
7 Ponding Depth (ft) d_{BMP} = *Minimum of (1/12 * Item 4 * Item 5) or Item 6*		10	10
8 Amended soil surface area (ft_2)		**35,257**	**29,400**
9 Amended soil depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*		**2.00**	**2.00**
10 Amended soil porosity, *n*		**0.25**	**0.25**
11 Gravel depth (ft) *see Table 5-6 of the TGD for WQMP for reference to BMP design details*		**2.00**	**2.00**
12 Gravel porosity, *n*		**0.40**	**0.40**
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*		**3**	**3**
14 Biotreated Volume (ft_3) $V_{biotreated}$ = *Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12)+ (Item 13 * (Item 4 / 12))]*		**67,870**	**56,595**
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: *Sum of Item 14 for all volume-based BMPs included in this form*	**124,465**		

Notes:

Item #6 is zero although basin provides depth. Zero is provides a minimum volume calculation, and is used in the Volume Calculation (#14). See following sheet, Form 4.3-5 Calculation breakdown.

Basin retention volume

35,257	SF North Basin
29,400	SF South Basin
64,657	Total SF

Volume in Amended Soil Layer

129,314	CF	Volume of amended soil (2' deep)
0.25		Void factor (space for water)
32,329	CF	Volume of water storage

Volume in Rock

61,553	CF	Volume of rock (2' deep minus the pipe space)
0.40		Void factor (space for water)
24,621	CF	Volume of water storage

Volume in Pipe

21,550	LF	Length of pipe
3.14	CF/LF	Volume per foot
67,667	CF	Volume of water storage

Total Volume

124,617 CF

The infiltration testing determined that the existing conditions in the basins will not infiltrate. We are proposing to use a combination of amended soils and underground pipe storage areas with a means of allowing the bottom of the storage area to drain to the street.
After the retention basin water passes through the amended soils and rock storage area the hydraulic head will push the water out the 3" diameter perforated drainage pipes which will move the water to the curb face in the street, allowing the basins to drain at a slow rate.

Form 4.3-6 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention

Biotreatment BMP Type *Constructed wetlands, extended wet detention, extended dry detention,* *or other comparable proprietary BMP. If BMP includes multiple modules* *(e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.*	DA DMA BMP TYPE		DA DMA BMP TYPE	
	Forebay	Basin	Forebay	Basin
1 Pollutants addressed with BMP forebay and basin *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes*				
2 Bottom width (ft)	0	0	0	0
3 Bottom length (ft)	0	0	0	0
4 Bottom area (ft^2) *A_{bottom} = Item 2 * Item 3*	0	0	0	0
5 Side slope (ft/ft)	0	0	0	0
6 Depth of storage (ft)	0	0	0	0
7 Water surface area (ft^2) *$A_{surface}$ =(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))*	0	0	0	0
8 Storage volume (ft^3) *For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details* *V =Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]*	0	0	0	0
9 Drawdown Time (hrs) *Copy Item 6 from Form 2.1*	48		48	
10 Outflow rate (cfs) *Q_{BMP} = (Item 8 $_{forebay}$ + Item 8 $_{basin}$) / (Item 9 * 3600)*	0.00		0.00	
11 Duration of design storm event (hrs) *All default shown in Table 5-6 of the TGD for detetion types*	3		3	
12 Biotreated Volume (ft^3) *$V_{biotreated}$ = (Item 8 $_{forebay}$ + Item 8 $_{basin}$) +(Item 10 * Item 11 * 3600)*	0		0	
13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention : *(Sum of Item 12 for all BMP included in plan)*				0

Form 4.3-7 Flow Based Biotreatment (DA 1)

Drainage Areas	**DA**	**DA**	**DA**
Biotreatment BMP Type : *Vegetated swale, vegetated filter strip, or other comparable proprietary BMP*	DMA	DMA	DMA
1 Pollutants addressed with BMP *List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5*			
2 Flow depth for water quality treatment (ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	0		
3 Bed slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	0		
4 Manning's roughness coefficient	0		
5 Bottom width (ft) *b_w = (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item 2 $^{\wedge 1.67}$ * Item 3 $^{\wedge 0.5}$)*	0.000		
6 Side Slope (ft/ft) *BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	0		
7 Cross sectional area (ft_2) *A = (Item 5 * Item 2) + (Item 6 * Item 2 $^{\wedge 2}$)*	0.000		
8 Water quality flow velocity (ft/sec) *V = Form 4.3-5 Item 6 / Item 7*	0.000		
9 Hydraulic residence time (min) *Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details*	0		0
10 Length of flow based BMP (ft) *L = Item 8 * Item 9 * 60*	0.00		
11 Water surface area at water quality flow depth (ft_2) *SA_{top} = (Item 5 + (2 * Item 2 * Item 6)) * Item 10*	0.0		

Notes: Not used

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (ENTIRE SITE)		
1 Total LID DCV for the Project DA (ft_3): *Copy Item 7 in Form 4.2-1*	113,013	
Needed Retention to meet hydromodification requirement, per Form 4.3-2	**25,261**	
2 On-site retention with site design BMP (ft_3): *Copy Item 19 in Form 4.3-2*	22,390	
3 On-site retention with LID infiltration BMP (ft_3): *Copy Item 16 in Form 4.3-3*	0	
4 On-site biotreatment with volume based biotreatment BMP (ft_3): *Copy Item 3 in Form 4.3-4*	124,465	
5 Flow capacity provided by flow based biotreatment BMP (cfs): C*opy Item 6 in Form 4.3-4*	0	
6 LID BMP performance criteria are achieved if answer to any of the following is "Yes":	Yes	No
☐ Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: *If yes, sum of Items 2, 3, and 4 is greater than Item 1*	☑	☐
☐ Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: *If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized*	☑	☐
☐ On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: *If yes, Form 4.3-1 Items 7 and 8 were both checked yes*	☑	☐
7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance:		
☐ Combination of Site Design, retention and infiltration, and biotreatment BMPs provide less than full LID DCV capture: *Checked "Yes" if Form 4.3-4 Item 7 is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2,3,4, and 5 is less than 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)%*	N/A	
☐ Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ55 Feburary 5, 2013 measures of equivalent effectiveness are demonstrated:		
1) Equal or greater amount of runoff infiltrated or evapotranspired;	N/A	
2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment;	N/A	
3) Equal or greater protection against shock loadings and spills;	N/A	
4) Equal or greater accessibilty and ease of inspection and maintenance	N/A	
Notes:		

4.3.6 Hydromodification Control BMP Conformance Summary

Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-9 Hydromodification Control BMPs (ENTIRE SITE)			
1 Volume reduction needed for HCOC performance criteria (ft_3): *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**25,261**	**2** On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft_3): *Sum of Form 4.3-8 Items 2, 3, and 4 Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*	**146,855**
3 Remaining volume for HCOC volume capture (ft_3): *Item 1 – Item 2*	**(121,594)**	**4** Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft3):	**0**

	Yes	No
5 Is Form 4.2-2 Item 11 less than or equal to 5%: *If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:*	☐	☑
Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP	☑	☐
Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities	☑	☐
6 Form 4.2-2 Item 12 less than or equal to 5%: *If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:*	☐	☑
Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs	☑	☐

Hydromodification requirements have been met, and exceed as shown in Item #3. Increased Time of Concentration is met by retaining project flows on site through retention (infiltration) and detention.

Peak Runoff is reduced by increasing the path of travel but mostly from the detention time in the proposed BMP structures (weirs, and basin seperations), controlled structural overflows for larger storm disscharges, and controlled underdrain outflows for treated flows. Refer to Onsite Hydrology Study for Software calcuations that address the 100yr storm.

4.4 Alternative Compliance Plan (if applicable)

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

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

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

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

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

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

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

Section 5 Inspection and Maintenance Responsibility for Post Construction BMP

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

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

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

BMP	Responsible Party(s)	Inspection / Maintenance Activities Required	Minimum Frequency of Activities
Site Good Housekeeping & Ground Maintenance See CASQA BMP Fact Sheets: SC-10 SC-11 SC-30 SC-34/SD-32 SC-41/SD-10 & SD-12 SC-43	Owner & Assigned Manager, and Site Crew (contracted and/or employed)	Owner shall contract/provide grounds maintenance activities that may include, but not limited to: Cleaning of spills/leaks, Dry sweeping parking lots and vehicle paths, Removal of Trash & debris on grounds, Ensuring trash enclosure(s) are secure (lidded) from birds, wind-blow, and vandalism, leak/spill free. Landscape Maintenance and cuttings not entering the storm drain inlets by sweeping or blower, Inspect Landscaping vegetation remains healthy, and weed-free, Ensure Effective Irrigation Controls and timers are set per Town of Apple Valley's requirements, and replace vegetation and broken sprinklers, Replacing landscape coverings (gravels and rip-rap) where erosion or movement has occurred. General Grounds Maintenance of outdoor employee rest-areas, smoking area(s), etc., and provide a safe site with asthetic curb appeal per Town of Apple Valley standards.	Weekly

BMP	Responsible Party(s)	Inspection / Maintenance Activities Required	Minimum Frequency of Activities
Employee Training See CASQA BMP Fact Sheets: SC-10 SC-11 SC-30 SC-34/SD-32 SC-41/SD-10 & SD-12 SC-43	Owner and Site Manager	Care takers and assigned site managing personnel shall bring concerns to Owner or Site Manager assigned to the facility and have permission and means to repair/replace the situation as needed. Facility employees shall be informed of the outdoor drainage structures, their function and purpose. Employees, staff and visitors shall be informed of proper spill kits, storage of outdoor materials and understand that polltants entering the systems will cause additional maintenance and servicing. Outdoor receptacles for wastes, storages, and signs shall be provided. Landscapers and parking lot street sweepiners shall be well informed that blowing or sweeping cuttings, dust, and debris shall be conducted at the source. Blowing, or sweeping cuttings, dust and debris towards the catch basin inlets is STRONGLY PROHIBITTED.	As needed at time of new hire, and contracted.
Roof-downspouts, drains, pipes See CASQA BMP Fact Sheet: SC-41 SC-44	Owner & Site Manager	As part of the regular site inspections and ground maintenance, the Owner shall instruct (or contract) regular inspection of the roof downspouts, and the velocity desipation devices. Site Management should be aware and visually ensure that the downspouts are not clogged and flowing during rain events. Rip-rap, dissipation devices and pipes, and flow openings shall be kept clear of blockage. The care-takers (assigned or contracted) shall be informed to correct situations immediately.	Bi-annually, prior to rainy seasons
Drainage Controls and BMP Basins SC-44 SD-20	Owner and assigned site manager(s)	Surface inspection shall include all storm drain inlets are free of debris, sediment and other blockage.	Monthly Minimum

BMP	Responsible Party(s)	Inspection / Maintenance Activities Required	Minimum Frequency of Activities
Drainage Controls and BMP Basins See CASQA BMP Fact Sheets: SC-41/SD-10 & SD-12 SC-43 SC-44 SD-10 TC-11/TCM-11 TC-22/TCM-22 TC-32/TCM-32	Owner and assigned site manager(s)	Inspection of channels and slopes to ensure structure and stability, Inspection of basin to ensure depth and capacity remain as designed, After rain inspection of basins to ensure no ponding water remains after 48 hours. If stagnation is occuring, the Owner shall provide maintenance to the system to include, but not limited to, removal of top soils fines, replacement of top soil materials, removal and/or replacement of vegetation to obtain the original capacity and function.	Twice Annually (Before Rainy Season, and After)
Pollution Prevention Controls and Source Control See CASQA BMP Fact Sheets: SC-10 SC-11 SC-30 SC-34 SC-41/SD-10 & SD-12 SC-43 SC-44 SD-20 SD-32	Owner and assigned site care manager(s)	Site Manager shall visually inspect the site and address pollutant potentials, any reoccuring obstructions, and new pollutants. Pollutant potentials may include (but not limited to): Outdoor employee break (rest/smoking) area. Ensure readily available and appropriate waste containers and proper disposal. Excessive leaf shedding near storm drain inlets that could easily clog the inlet(s). Replacements shall be approved by Town of Apple Valley and on the approved plant list. Repair or removal of leaky equipment used/stored outdoors or providing drippans. Drip pans shall be secure from wind-blow away and shall provide 6" or more freeboard at all times. Loading areas and long-haul truck parking/stopping areas require additional visual observations, stewardship and poteantially more conveniently located waste containers. All walk-up waste containers shall be secure from tipping, wind blow-over and securely lidded.	Weekly (monthly minimum)

BMP	Responsible Party(s)	Inspection / Maintenance Activities Required	Minimum Frequency of Activities
Trash Storage Areas See CASQA Fact Sheets SC-34 SD-32	Owner and assigned manager	Owner shall contract/provide a regularly scheduled waste haul provider approved by Town of Apple Valley. Outdoors containers, including rest area bins and entrance containers shall be secure (lidded) from birds, wind-blow, and leak/spill free. Dumpster and Recycling enclosures shall be clean and secure. If washing is necessary, ensure soaps and washwater do not leave site or enter non-filtering BMP.	Small containers to be inspected and emptied Weekly Minimum Dumspter inspection Monthly Minimum
Extended Detention & Infiltration (Surface) Basin TC-22/TCM-22 TC-32/TCM-32	Owner and assigned site care manager(s)	Insect after storm events for bank and slope stability. Inspect inlet, weirs, outlets for erosion. Remove trash and unwanted vegetation (weeds). Infiltration is to occur 48 hours after storm event. If ponding is visable after 72 hours after a storm event, bottom of the basin has differential settlement or cracking of dry soils, and/or depth of basin is less than original design depth, the basin requires maintenance. Maintenance requires (at minimum) the removal of a sediment yield to original depth and capacity.	Visual inspections after major rain events. Annual assessment of structural stability, vegetation growth, and decrease of capacity and infiltration rate.
Extended Detention & Infiltration (Surface) Basin TC-22/TCM-22 TC-32/TCM-32	Owner and assigned site care manager(s)	If trash or debris is visible on the surface of the bioretention surface, the Owner / Site Manager shall inspect and schedule for maintenance of the Vortex system. See MPM-51.	Annually, at minimum
Extended Detention & Infiltration (Surface) Basin TC-22/TCM-22 TC-32/TCM-32	Owner and assigned site care manager(s)	Owner / Site manager shall schedule a professional service provider to snake, vaccum the under drains from the underground infiltation basin to the curb outlets. Clean out accesses are along the top of the earth berm (Central Road)	Bi-annually, prior to rainy seasons

BMP	Responsible Party(s)	Inspection / Maintenance Activities Required	Minimum Frequency of Activities
Underground Vortex Seperation Pre-treatment system(s), Access and Inspection Ports MP-51/MPM-51 & MPM-60	Owner	Owner shall contract a professional service provider to come to site for inspections, vacuuming and removal of collected pollutants, and servicing of the system(s). Increase services as needed to maintain optimal performances. Owner shall ensure the Site Manager is aware of the scheduling and provide needed access to each of the systems. This may include but not limited to, temporary "No Parking" in stalls with access ports, scheduling services during non-busy/business hours, etc. Owner shall instruct Site Manager to make aware signs that the system(s) need increased servicing (e.g., smells, clogging, increased vector problems, clogging, pondings or sitting water longer than 72 hours after rain event, sinking of asphalt, concrete cracks, and as described in the Owner's manuals of each drainage structure. Repairs or replacements of drainage design features shall not be in contrary to original design and function. OWNER SHALL KEEP ALL SERVICING RECORDS.	per manufactures recommendations, and recorded
Covenant & Agreement	Owner	The Owner shall ensure compliance with the Covenant & Agreement regarding water quality management and the stormwater best management practices described in this document. This may include, but not limited to, providing documentation (such as self-certification, or copies of maintenance records) to local jurisdiction upon request or annually.	as required by City

BMP Rows to Form 5-1 = 12

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 connection

6.2. Electronic data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their Local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3. Post ConstructionElectronic data Submittal

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

6.4. Other Support Documentation

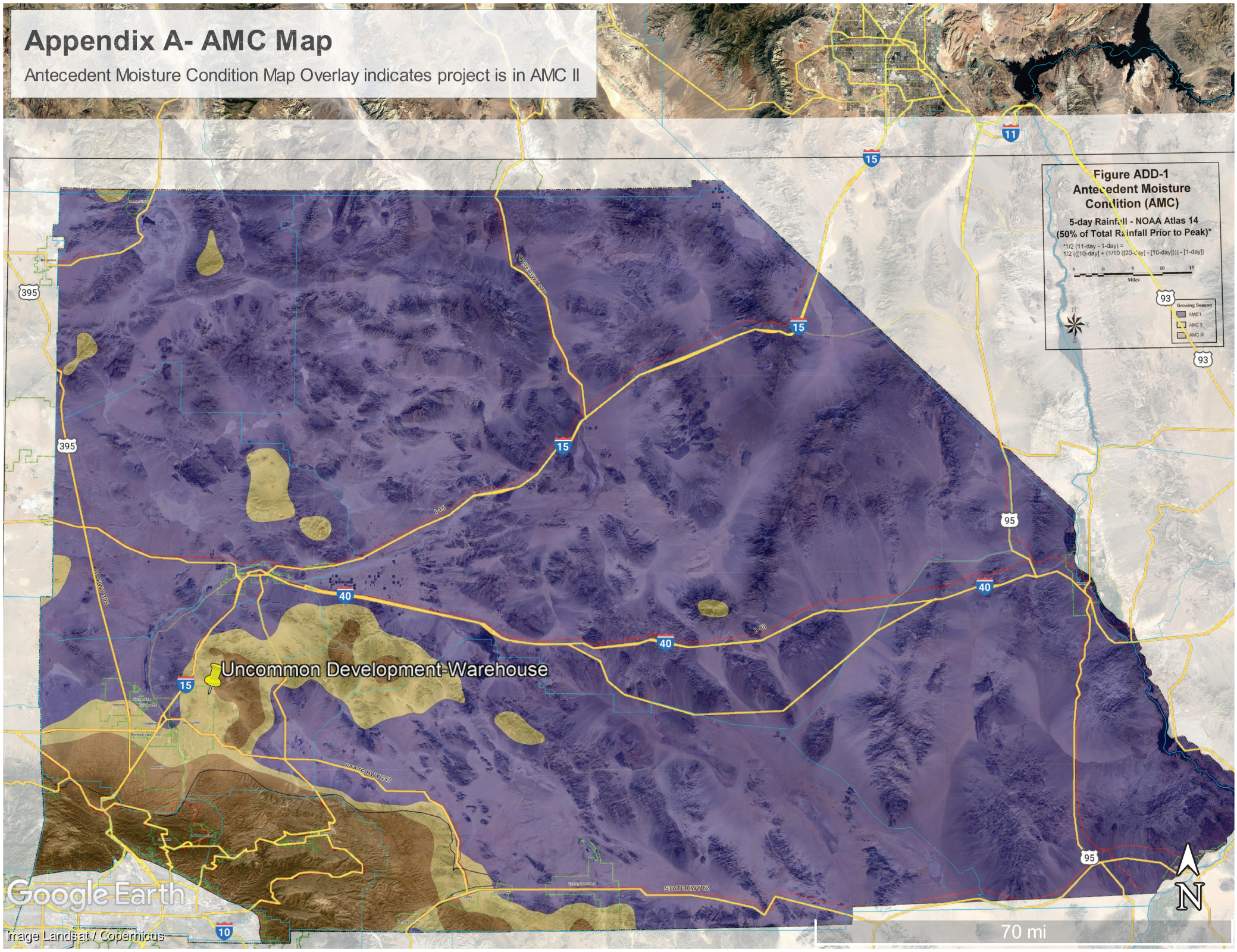
- BMP Education Materials
- Activity Restriction - C,C&R's & Lease Agreements

Appendix A: Antecedent Moisure Condition (AMC) Map

Appendix A.1: Town of Apple Valley Zoning Map in relation to project site
Appendix A.2: Google Earth Map - Site perimeters
Appendix A.3: San Bernardino County Eviromentally Sensitive Area Map
Appendix A.4: USGS Groundwater Watch

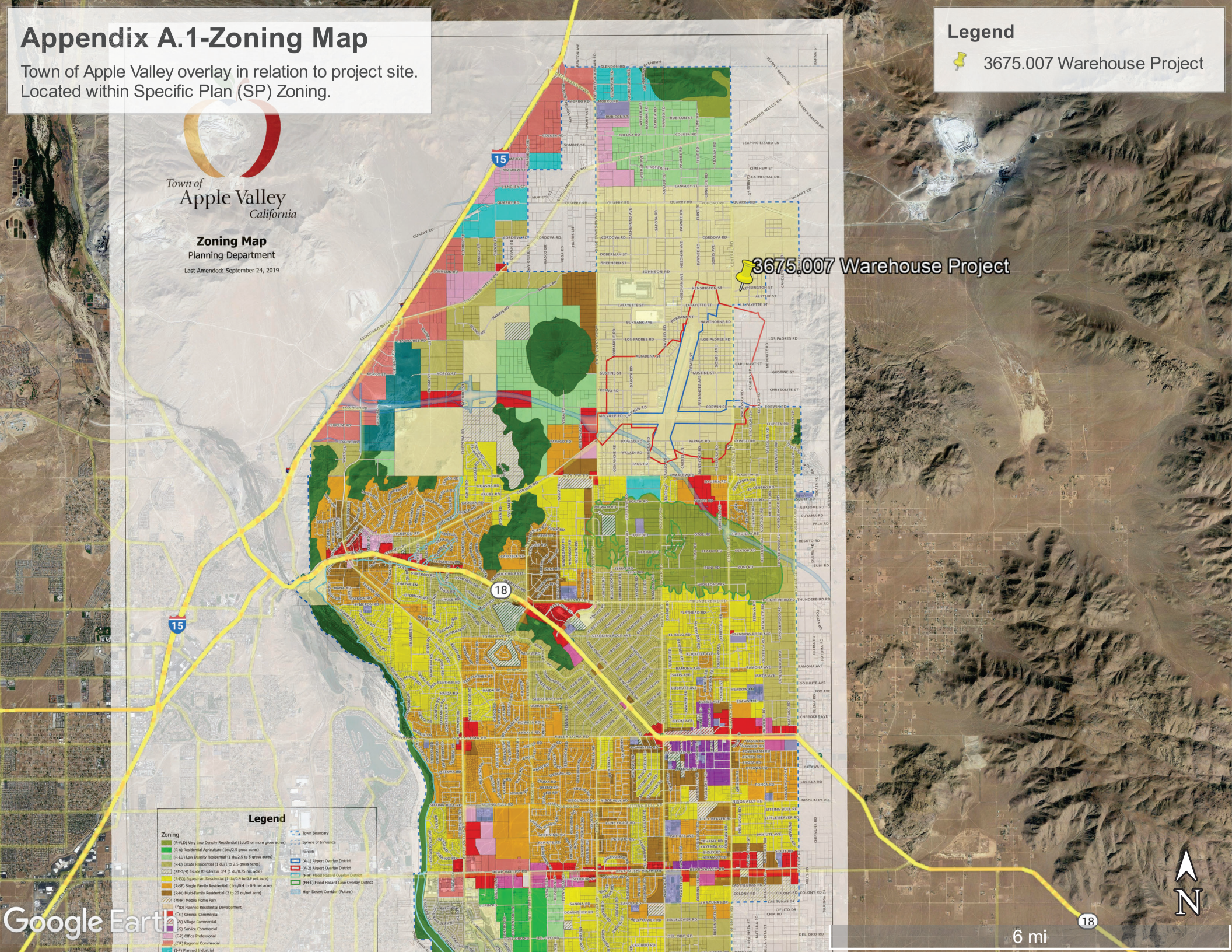
Appendix A- AMC Map

Antecedent Moisture Condition Map Overlay indicates project is in AMC II

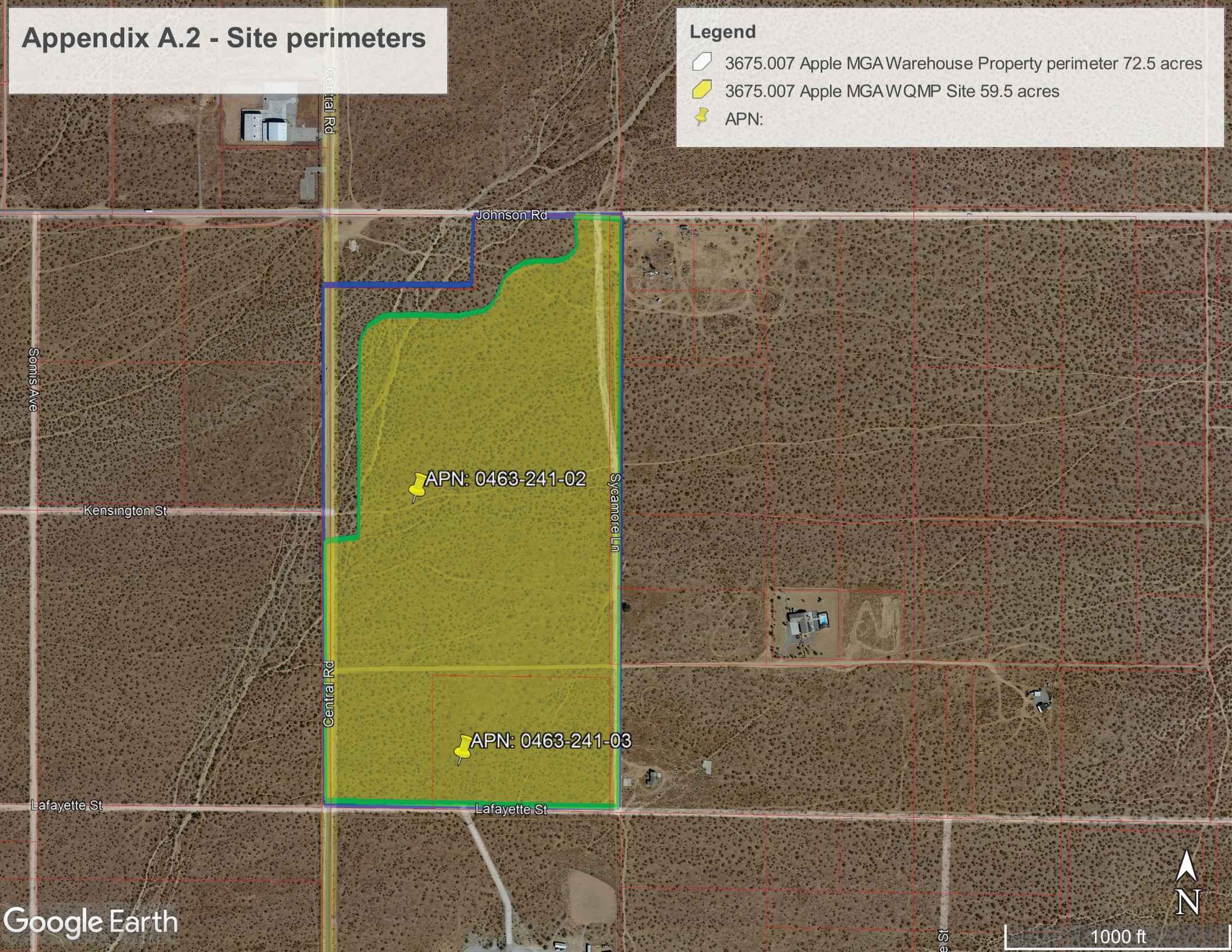


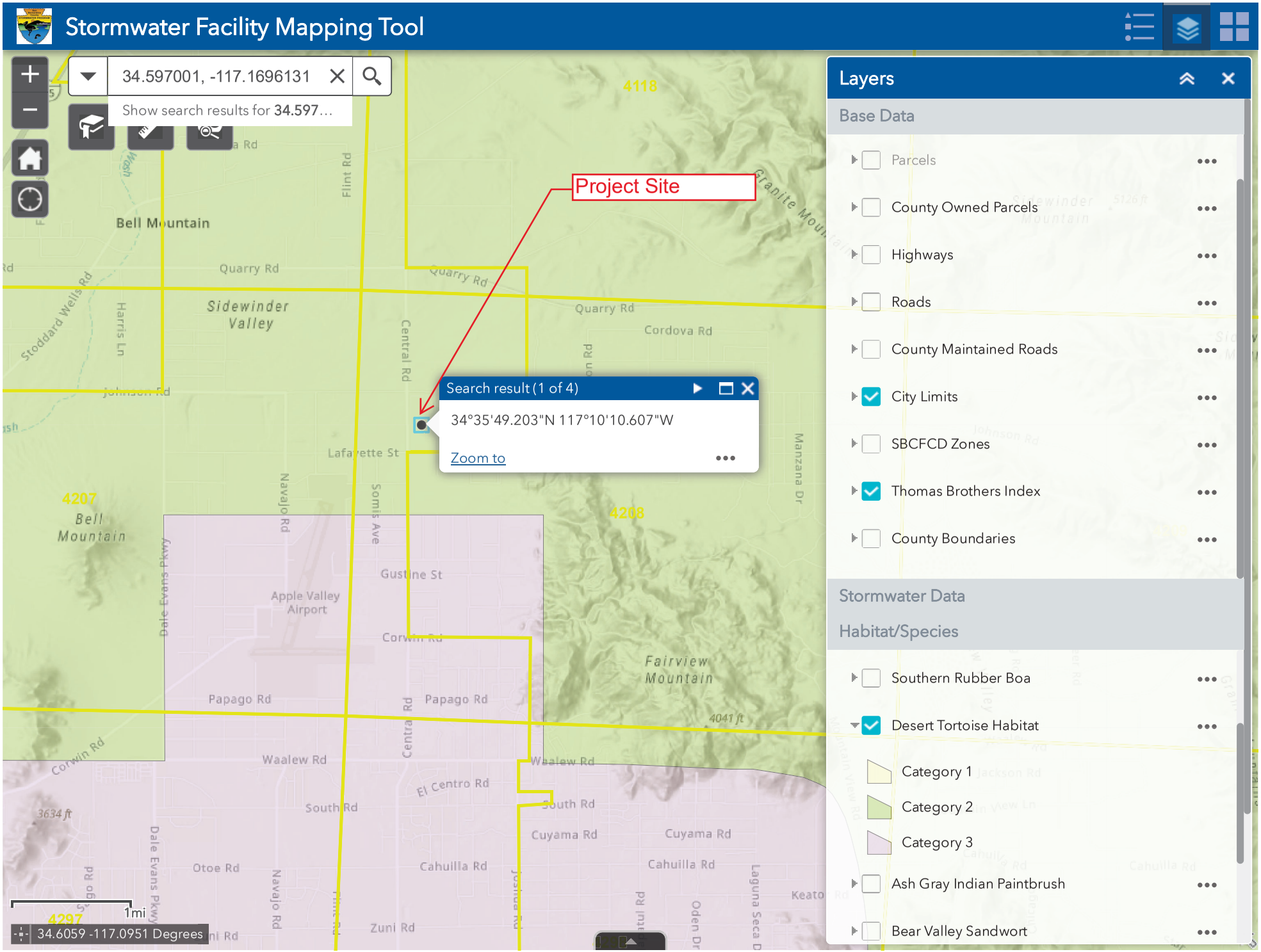
Appendix A.1-Zoning Map

Town of Apple Valley overlay in relation to project site.
Located within Specific Plan (SP) Zoning.



Appendix A.2 - Site perimeters





Appendix A.3 Environmetally Sensitive Areas Map

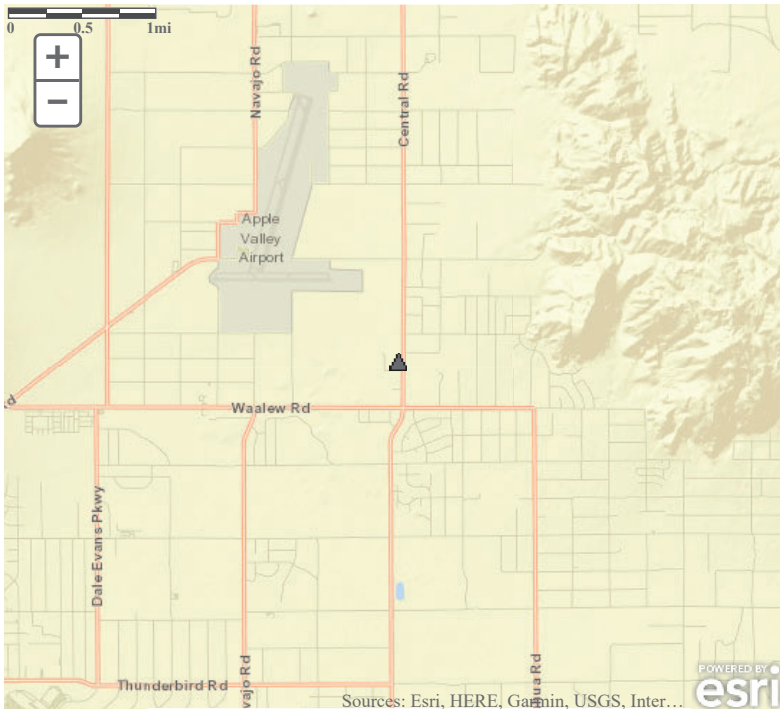
USGS science for a changing world

USGS Home
Contact USGS
Search USGS

Groundwater Watch Latest News...

Groundwater Watch is currently experiencing technical issues. Data, graphics, and calculations may not be accurate. Thank you for your patience while we work to resolve these issues.

Site Number: 343341117101601 - 006N003W34J003S



DESCRIPTION:
Latitude 34°33'41", Longitude 117°10'16" NAD27
San Bernardino County, California, Hydrologic Unit 18090208
Well depth: 305 feet
Hole depth: 310 feet
Land surface altitude: 2,978feet above NAVD88.
Well completed in "Basin and Range basin-fill aquifers" (N100BSNRGB) national aquifer.

AVAILABLE DATA:

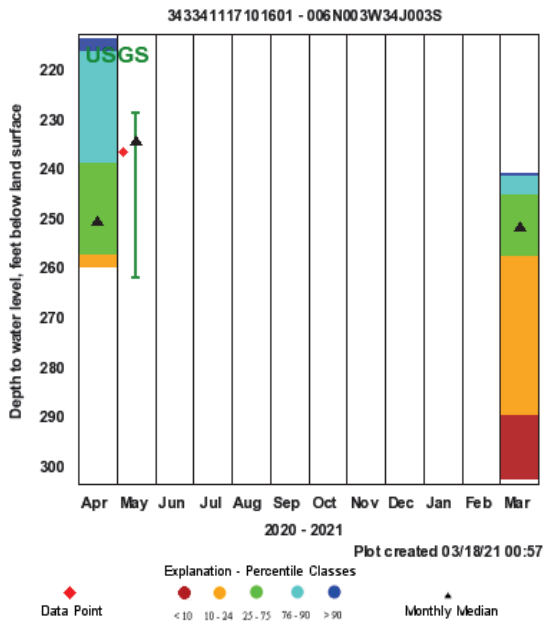
Data Type	Begin Date	End Date	Count
Field groundwater-level measurements	1988-05-12	2022-06-24	44
Field/Lab water-quality samples			

Additional Data Sources		Begin Date	End Date	Count
Groundwater Watch	**offsite**	1988	2021	42

OPERATION:
Record for this site is maintained by the USGS California Water Science Center
Email questions about this site to California Water Science Center Water-Data Inquiries

Groundwater Watch Help Page

Site Statistics



Most recent data value: 233.35 on 6/24/2022
Period of Record Monthly Statistics for 343341117101601
Depth to water level, feet below land surface
All Approved Continuous & Periodic Data Used In Analysis
Note: Highlighted values in the table indicate closest statistic to the most recent data value.

Month	Lowest Median	10th %ile	25th %ile	50th %ile	75th %ile	90th %ile	Highest Median	Number of Years
Mar	302.50	289.54	257.45	251.86	245.07	241.31	240.68	12
Apr	260.00	259.87	257.36	250.49	238.77	216.15	213.77	10
May	262.00	-	-	-	-	-	228.55	9

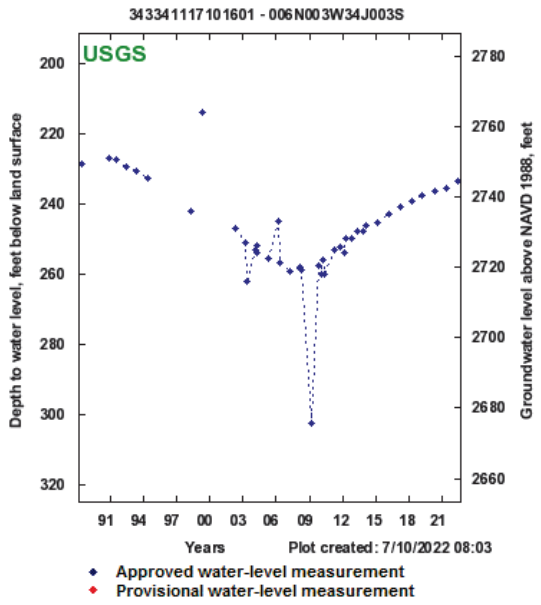
.As of 4/30/2022 05:15:2

Statistics Options

View month/year statistics

Periodic Groundwater Data

Summary for Period of Record Periodic Water Levels Depth to water level, feet below land surface Approved Periodic Water Level Values		
Begin Date	End Date	Number of Values
05/12/88	06/24/22	44



Highest WL	Date of Highest WL	Lowest WL	Date of Lowest WL
213.77	04/15/99	302.5	03/25/09

Groundwater Levels Options

View latest data on NWISWeb

Download groundwater levels in text format

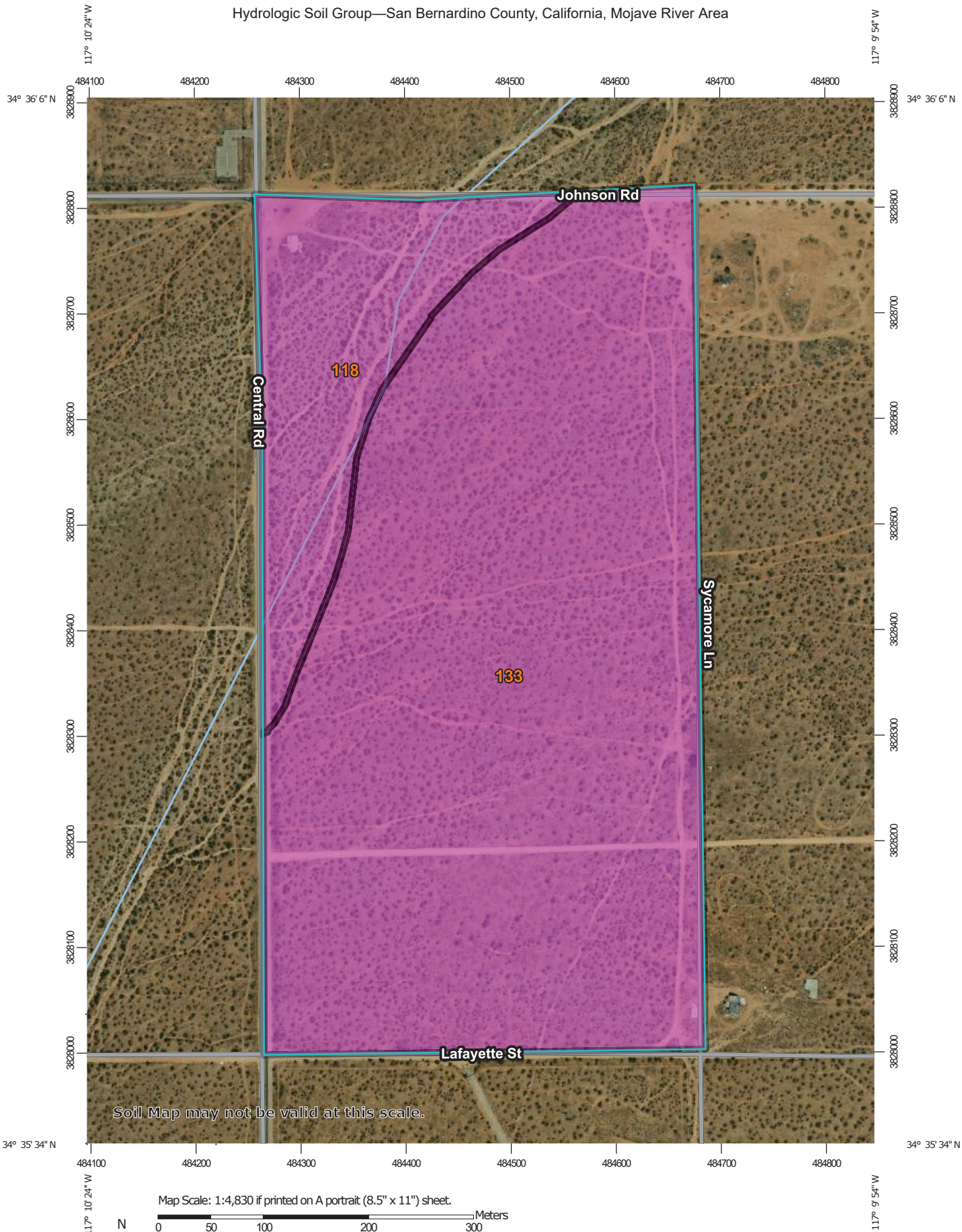
Note: The most recent measurement on 06/24/2022 has the following status:
''

Return to Groundwater Watch | Return to County Page | Return to State Page

*References to non-Department of the Interior (DOI) products do not constitute an endorsement by the DOI.

Accessibility FOIA Privacy Policies and Notices
U.S. Department of the Interior | U.S. Geological Survey
URL: https://groundwaterwatch.usgs.gov/AWLSites.asp
Last update: Monday, March 8, 2021 at 15:43
Page Contact Information: Contact the GroundWater Watch Support Team

Appendix B: Hydrologic Soil Group Data



Map Scale: 1:4,830 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 13, Sep 13, 2021

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

Date(s) aerial images were photographed: Mar 27, 2021—May 24, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
118	CAJON-ARIZO COMPLEX, 2 TO 15 PERCENT SLOPES*	A	14.2	16.9%
133	HELENDALE-BRYMAN LOAMY SANDS, 2 TO 5 PERCENT SLOPES*	A	69.9	83.1%
Totals for Area of Interest			**84.1**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

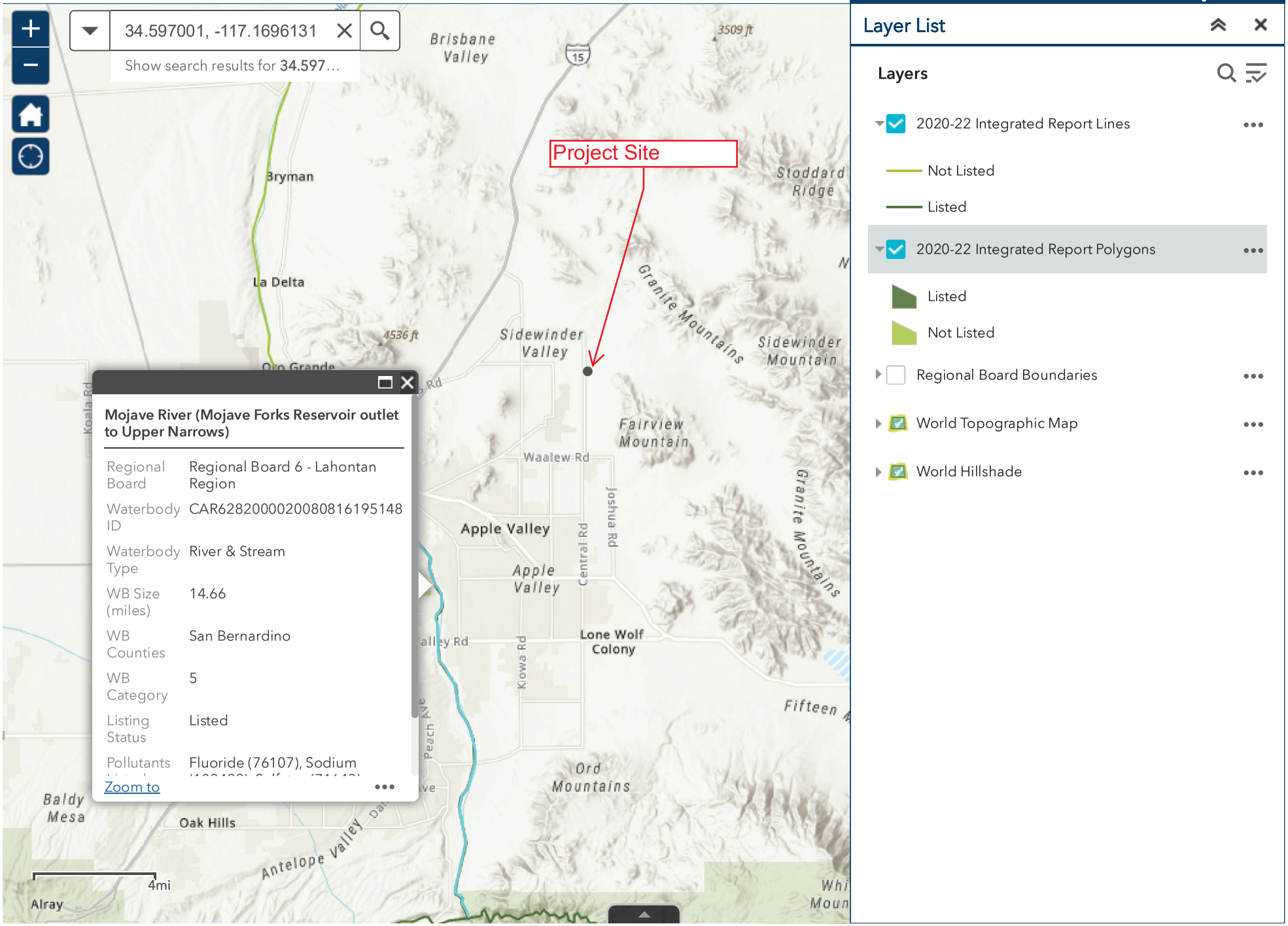
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix C: State Water Resources Control Board 303(d) Map in relation to site

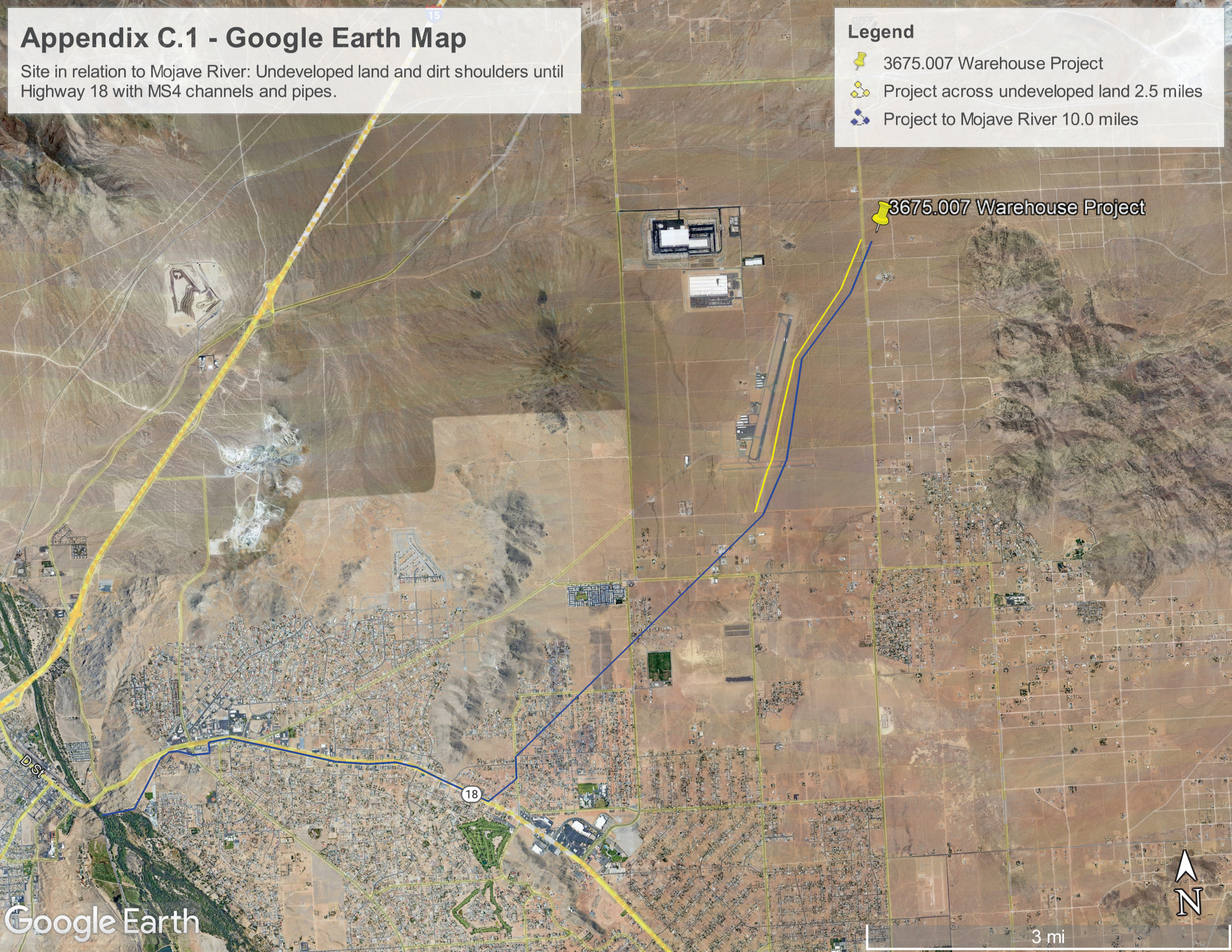
California 2020-2022 Integrated Report



Appendix C - 303(d) Listed Map in relation to Site

Appendix C.1 - Google Earth Map

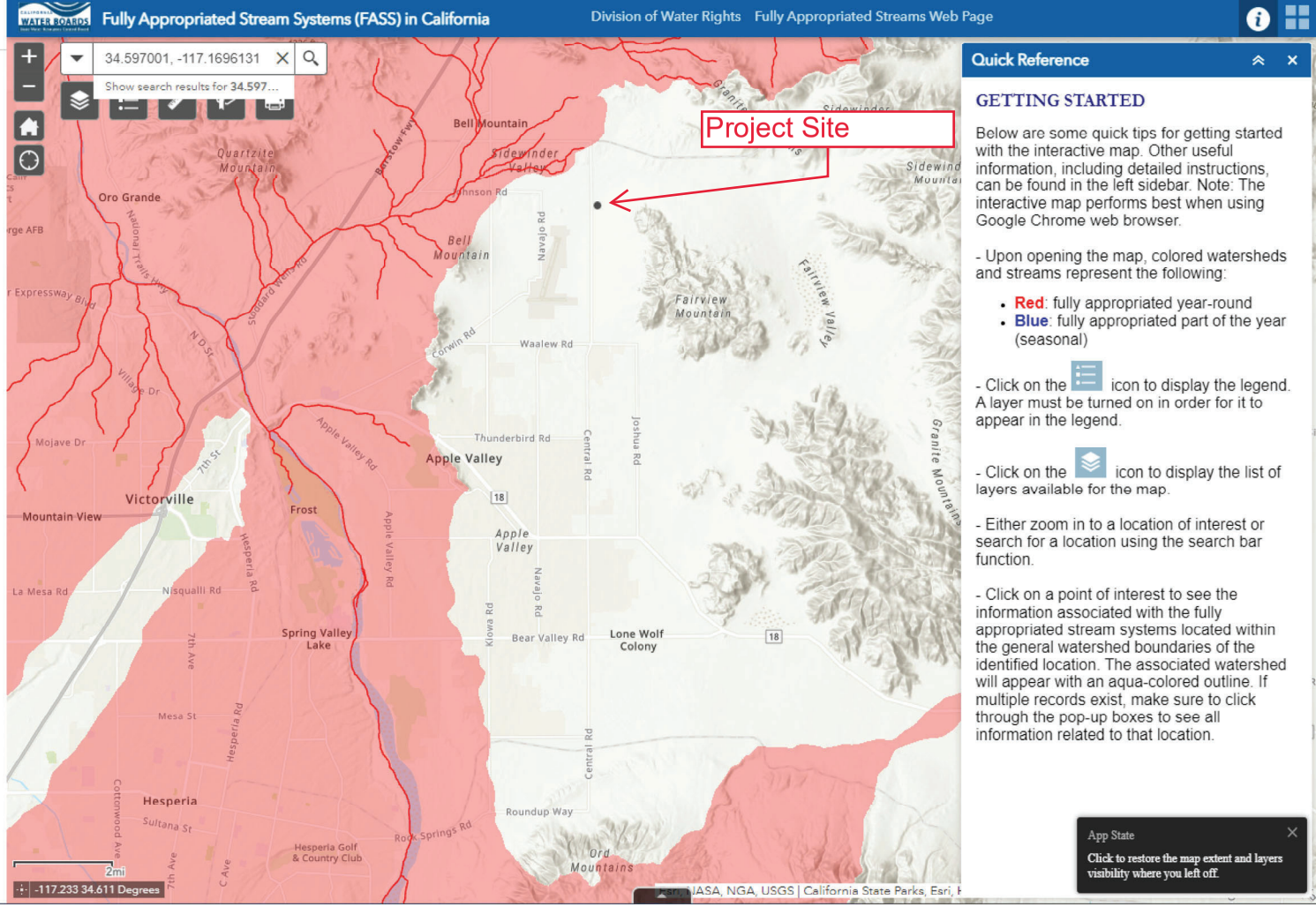
Site in relation to Mojave River: Undeveloped land and dirt shoulders until Highway 18 with MS4 channels and pipes.



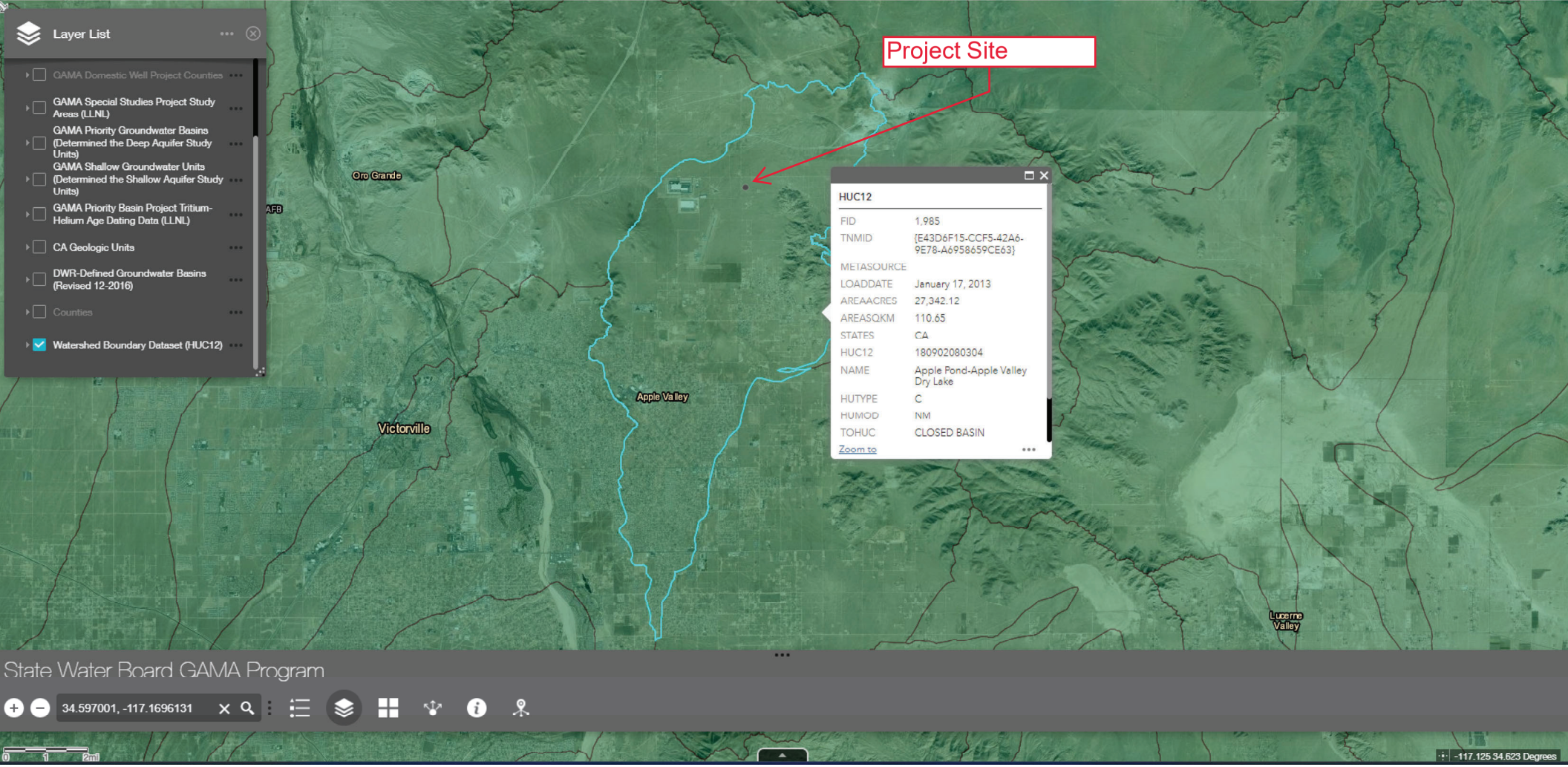
Contact Us

STREAM SYSTEMS DECLARED FULLY APPROPRIATED BY THE STATE WATER BOARD

This interactive map displays information regarding fully appropriated stream systems (FASS) in California. On November 19, 1998, the State Water Resources Control Board (State Water Board) adopted Water Right Order 98-08, which was based on prior decisions and orders that determined no water remains available for appropriation from certain sources during specified months. **Exhibit A of Water Right Order 98-08 defines the critical reaches of each FASS listing, including the seasons in which water is unavailable for appropriation.** The FASS Streams layer is for general reference purposes only; potential



Appendix C.2 - FASS Site Map in relation to project site



Appendix C.3 - State Water Board Hydrologic Unit Map in relation to project location

Appendix D: NOAA Precipitation Frequency Estimates Sheet

NOAA Atlas 14, Volume 6, Version 2
Location name: Apple Valley, California, USA*
Latitude: 34.597°, Longitude: -117.1696°
Elevation: 3147.36 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.082** (0.067-0.100)	**0.115** (0.094-0.141)	**0.161** (0.132-0.198)	**0.201** (0.163-0.249)	**0.258** (0.203-0.331)	**0.305** (0.235-0.399)	**0.355** (0.268-0.476)	**0.410** (0.300-0.564)	**0.488** (0.344-0.701)	**0.553** (0.376-0.821)
10-min	**0.117** (0.096-0.144)	**0.165** (0.135-0.202)	**0.231** (0.189-0.284)	**0.287** (0.234-0.357)	**0.370** (0.291-0.474)	**0.437** (0.337-0.572)	**0.509** (0.384-0.682)	**0.587** (0.431-0.809)	**0.700** (0.493-1.00)	**0.793** (0.539-1.18)
15-min	**0.142** (0.117-0.174)	**0.199** (0.164-0.244)	**0.279** (0.229-0.343)	**0.348** (0.283-0.431)	**0.447** (0.352-0.573)	**0.528** (0.408-0.692)	**0.616** (0.464-0.825)	**0.710** (0.521-0.978)	**0.846** (0.596-1.22)	**0.959** (0.652-1.42)
30-min	**0.194** (0.160-0.239)	**0.273** (0.225-0.335)	**0.383** (0.314-0.471)	**0.477** (0.389-0.593)	**0.614** (0.484-0.787)	**0.726** (0.560-0.950)	**0.845** (0.637-1.13)	**0.975** (0.715-1.34)	**1.16** (0.818-1.67)	**1.32** (0.896-1.95)
60-min	**0.247** (0.203-0.302)	**0.346** (0.285-0.425)	**0.485** (0.398-0.598)	**0.605** (0.492-0.751)	**0.778** (0.613-0.998)	**0.920** (0.710-1.20)	**1.07** (0.808-1.44)	**1.24** (0.906-1.70)	**1.47** (1.04-2.11)	**1.67** (1.14-2.48)
2-hr	**0.349** (0.287-0.428)	**0.471** (0.388-0.578)	**0.640** (0.525-0.788)	**0.785** (0.639-0.974)	**0.992** (0.781-1.27)	**1.16** (0.895-1.52)	**1.34** (1.01-1.79)	**1.53** (1.12-2.11)	**1.80** (1.27-2.59)	**2.02** (1.38-3.01)
3-hr	**0.424** (0.349-0.519)	**0.564** (0.464-0.693)	**0.758** (0.622-0.933)	**0.923** (0.751-1.15)	**1.16** (0.912-1.49)	**1.35** (1.04-1.76)	**1.55** (1.17-2.08)	**1.76** (1.29-2.43)	**2.07** (1.45-2.96)	**2.31** (1.57-3.43)
6-hr	**0.575** (0.474-0.705)	**0.758** (0.624-0.931)	**1.01** (0.826-1.24)	**1.22** (0.991-1.51)	**1.51** (1.19-1.94)	**1.75** (1.35-2.29)	**2.00** (1.51-2.68)	**2.26** (1.66-3.12)	**2.63** (1.85-3.78)	**2.93** (1.99-4.35)
12-hr	**0.737** (0.607-0.904)	**0.976** (0.803-1.20)	**1.30** (1.07-1.60)	**1.57** (1.28-1.95)	**1.94** (1.53-2.49)	**2.24** (1.73-2.93)	**2.55** (1.92-3.42)	**2.87** (2.11-3.96)	**3.32** (2.34-4.77)	**3.68** (2.50-5.46)
24-hr	**0.968** (0.858-1.11)	**1.30** (1.15-1.50)	**1.74** (1.54-2.01)	**2.11** (1.85-2.45)	**2.61** (2.21-3.14)	**3.01** (2.50-3.69)	**3.41** (2.77-4.30)	**3.84** (3.02-4.97)	**4.42** (3.34-5.97)	**4.88** (3.57-6.82)
2-day	**1.15** (1.02-1.32)	**1.57** (1.39-1.80)	**2.12** (1.87-2.45)	**2.58** (2.26-3.00)	**3.20** (2.71-3.86)	**3.69** (3.06-4.53)	**4.19** (3.39-5.27)	**4.70** (3.71-6.09)	**5.41** (4.09-7.31)	**5.97** (4.36-8.34)
3-day	**1.25** (1.11-1.43)	**1.72** (1.52-1.98)	**2.34** (2.07-2.71)	**2.86** (2.50-3.33)	**3.56** (3.01-4.28)	**4.10** (3.40-5.04)	**4.65** (3.77-5.86)	**5.23** (4.12-6.77)	**6.02** (4.55-8.12)	**6.64** (4.85-9.27)
4-day	**1.32** (1.17-1.52)	**1.83** (1.62-2.11)	**2.50** (2.21-2.89)	**3.05** (2.67-3.55)	**3.80** (3.22-4.57)	**4.37** (3.63-5.38)	**4.97** (4.02-6.25)	**5.58** (4.40-7.23)	**6.42** (4.85-8.67)	**7.08** (5.17-9.89)
7-day	**1.44** (1.28-1.66)	**1.98** (1.75-2.28)	**2.69** (2.38-3.11)	**3.28** (2.88-3.82)	**4.09** (3.47-4.93)	**4.72** (3.92-5.80)	**5.36** (4.35-6.76)	**6.03** (4.75-7.81)	**6.95** (5.25-9.38)	**7.67** (5.60-10.7)
10-day	**1.52** (1.35-1.75)	**2.08** (1.85-2.40)	**2.83** (2.50-3.27)	**3.45** (3.03-4.02)	**4.31** (3.66-5.19)	**4.98** (4.13-6.12)	**5.66** (4.59-7.13)	**6.38** (5.03-8.26)	**7.36** (5.57-9.94)	**8.13** (5.94-11.4)
20-day	**1.74** (1.54-2.00)	**2.39** (2.12-2.76)	**3.28** (2.90-3.79)	**4.01** (3.52-4.67)	**5.04** (4.27-6.06)	**5.84** (4.85-7.18)	**6.67** (5.41-8.41)	**7.55** (5.95-9.77)	**8.74** (6.61-11.8)	**9.69** (7.08-13.5)
30-day	**1.97** (1.74-2.26)	**2.71** (2.40-3.13)	**3.73** (3.30-4.31)	**4.59** (4.02-5.34)	**5.79** (4.90-6.96)	**6.73** (5.59-8.28)	**7.72** (6.25-9.72)	**8.75** (6.90-11.3)	**10.2** (7.70-13.7)	**11.3** (8.26-15.8)
45-day	**2.32** (2.05-2.66)	**3.20** (2.84-3.69)	**4.42** (3.91-5.11)	**5.46** (4.78-6.35)	**6.93** (5.87-8.34)	**8.10** (6.72-9.96)	**9.32** (7.56-11.7)	**10.6** (8.36-13.7)	**12.4** (9.39-16.8)	**13.8** (10.1-19.3)
60-day	**2.54** (2.25-2.92)	**3.50** (3.10-4.03)	**4.84** (4.27-5.59)	**5.98** (5.24-6.96)	**7.61** (6.45-9.16)	**8.93** (7.41-11.0)	**10.3** (8.36-13.0)	**11.8** (9.29-15.3)	**13.9** (10.5-18.7)	**15.5** (11.3-21.7)

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

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

Please refer to NOAA Atlas 14 document for more information.

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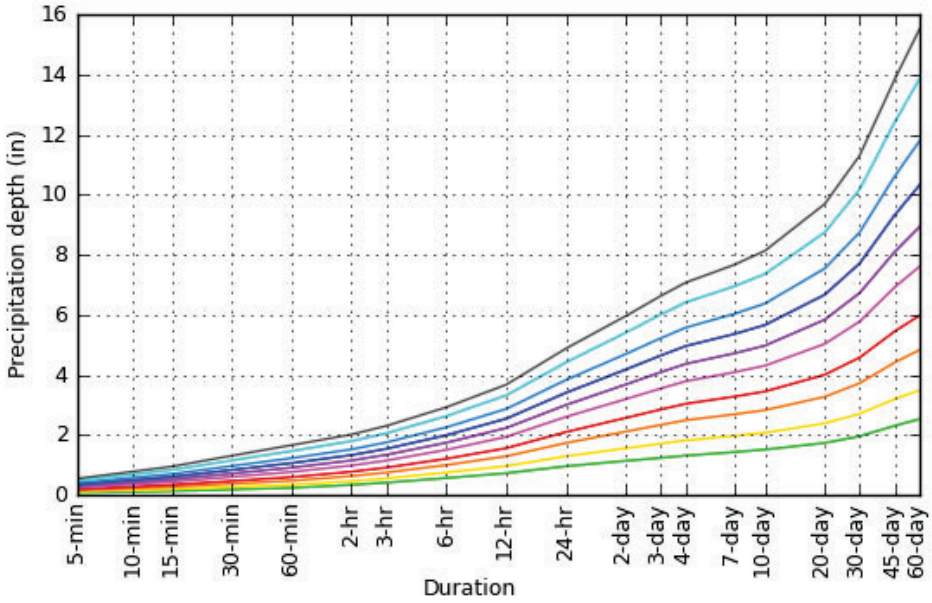
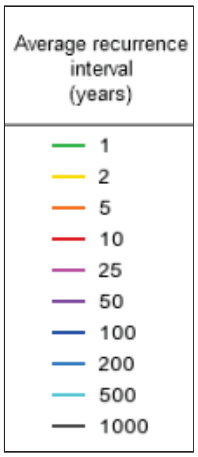
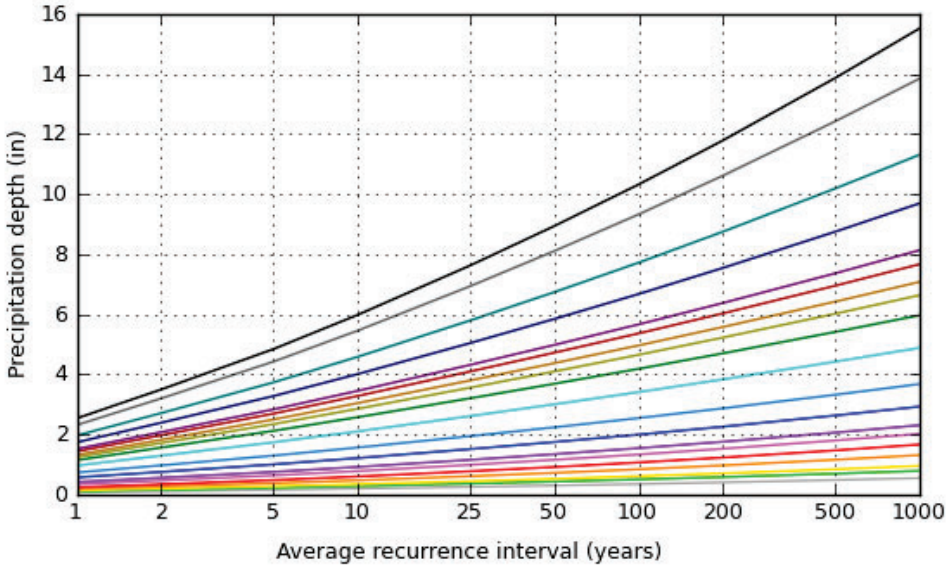
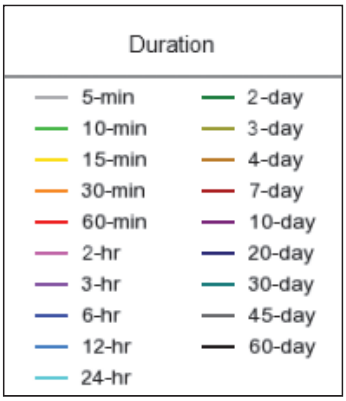
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 34.5970°, Longitude: -117.1696°









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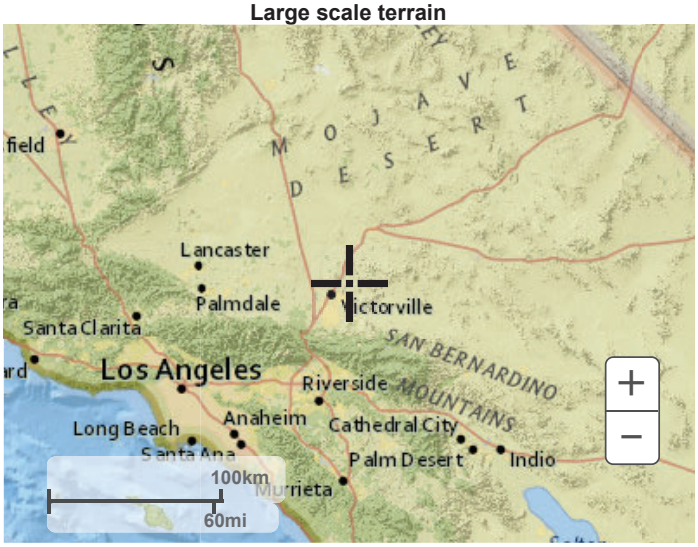
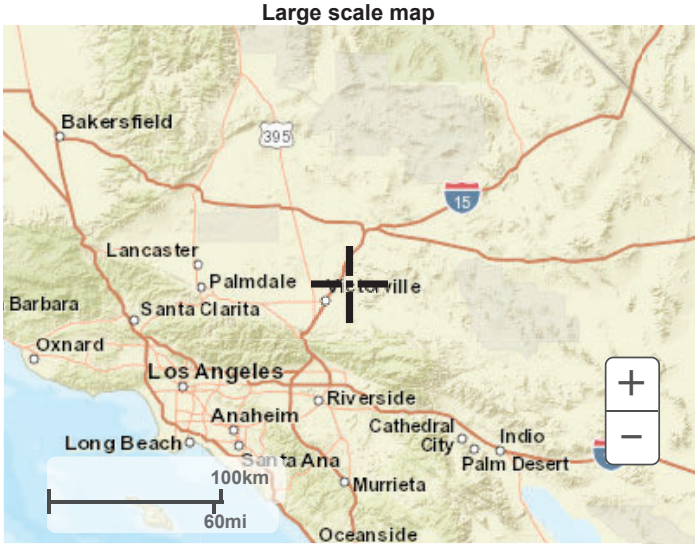
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



Large scale aerial

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

Disclaimer

Appendix E: Pre-Project Site Photos

Appendix E.1 - Google Earth Street Photos

Corner of Central Rd & Lafayette St, facing northeast.

Appendix E.2 - Google Earth Street Photos

On Central Rd, facing east. Approximate location of proposed driveway.

Appendix E.3 - Google Earth Street Photos

On Central Rd, at northwest property corner, facing southeast.

Appendix E.4 - Google Earth Street Photos

On Johnson Rd, facing southwest at northeast property corner.

Appendix F: Geotechnical Report/Study & Infiltration Test

GEOTECHNICAL INVESTIGATION

PROPOSED WAREHOUSE BUILDING NORTHEAST CORNER OF CENTRAL ROAD AND LAFAYETTE STREET, APPLE VALLEY, CALIFORNIA

APN: 0463-241-03

GEOCON
WEST, INC.

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

UNCOMMON DEVELOPERS
LOS ANGELES, CALIFORNIA

PROJECT NO. W1523-99-01A

DECEMBER 5, 2022

Project No. W1523-99-01A
December 5, 2022

Mr. Opher Benrimon
Uncommon Developers
9220 Winnetka Avenue
Los Angeles, California 91311

Subject: GEOTECHNICAL INVESTIGATION
PROPOSED WAREHOUSE BUILDING
NORTHEAST CORNER OF CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA
APN: 0463-241-03

Dear Mr. Benrimon:

In accordance with our proposal dated October 7, 2022, we have prepared this geotechnical investigation report for the proposed warehouse building located at the northeast corner of Central Avenue and Lafayette Street in the City of Apple Valley, California. The accompanying report presents the findings of our study, and our conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction. Based on the results of our investigation, it is our opinion that the site can be developed as proposed, provided the recommendations of this report are followed and implemented during design and construction.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.

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(EMAIL) Addressee

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LIMITATIONS AND UNIFORMITY OF CONDITIONS

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- PRIOR REPORT

GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for the proposed warehouse building located at the northeast corner of Central Avenue and Lafayette Street in the City of Apple Valley, California (see Vicinity Map, Figure 1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the site and, based on conditions encountered, to provide conclusions and recommendations pertaining to the geotechnical aspects of design and construction.

The scope of this investigation included a site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored on November 1 and 2, 2022, by excavating ten 8-inch diameter borings to depths ranging from approximately 14½ to 49½ feet below the existing ground surface utilizing a truck-mounted hollow-stem auger drilling machine. Also, three test pits were excavated on November 9, 2022, using a rubber-tired backhoe to depths ranging from 4½ to 5½ feet below existing grade. The locations of the exploratory borings and test pits are depicted on the Site Plan (see Figure 2). A detailed discussion of the field investigation, including the boring logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

The subject site is a rectangular parcel located at the northeast corner of Central Road and Lafayette Street in the City of Apple Valley, California. The approximately 7.1-acre site is currently undeveloped. The site is bounded by Sycamore Lane to the east, by Central Road to the west, by Johnson Road to the north, and by Lafayette Street to the south. The site is relatively level, with no pronounced highs or lows. Surface water drainage at the site appears to follow the existing ground contours to the west. Onsite vegetation consists of native grasses, shrubs, and Joshua trees.

Based on the information provided by the Client, it is our understanding that the proposed project will consist of an on-grade industrial warehouse with associated exterior improvements. A large-scale infiltration basin is planned along the Central Road portion of the site, which will introduce water at a depth of 4 feet below the existing grade. The proposed site conditions are depicted on the Site Plan (see Figure 2).

Preliminary column and wall loads have been provided by the project structural engineer and are indicated to range from 6.6 kip/ft to 10.5 kip/ft for exterior continuous footings and 80.6 kips to 156 kips for interior column footings.

Once the design phase and foundation loading configuration proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

3. PRIOR REPORT

The site was previously evaluated as part of a preliminary limited geotechnical investigation by Geocon West, Inc. (Geocon) in March 2022. The scope of the prior evaluation included the drilling of nine 8-inch diameter borings to a depth of up to approximately 24½ feet below the existing ground surface using a truck-mounted hollow-stem auger drilling machine. Refusal was encountered in two of the borings at depths of 9½ and 19½ feet. In addition, twenty test pits were excavated to depths of up to approximately 9½ feet below the existing ground surface using a backhoe. These excavations were performed across 19 parcels, covering 565 acres. Prior explorations performed on the subject site are indicated on the Site Plan (see Figure 2). The preliminary limited geotechnical investigation report is included at the end of this report, as Appendix C.

4. GEOLOGIC SETTING

The site is located in the southwestern portion of the Mojave Desert, approximately 20 miles northeast of the San Gabriel Mountains. The Mojave Desert province is bounded by the Garlock Fault on the north, and the San Andreas Fault Zone and Transverse Ranges on the southwest and the California-Nevada border on the east. The province is characterized by broad alluvial basins that are derived from the adjacent uplands. The site is underlain by alluvial fan deposits incised by young stream wash deposits derived from the surrounding mountains and corresponding drainage systems (Hernandez and Tan, 2007).

5. SOIL AND GEOLOGIC CONDITIONS

Based on our field investigation and published geologic maps of the area, the site is underlain by Holocene age alluvial wash deposits and Pleistocene age alluvial fan deposits (Hernandez and Tan, 2007). Detailed stratigraphic profiles of the materials encountered at the site are provided on the test pit and boring logs in Appendix A.

5.1 Young Alluvial Wash Deposits

Young alluvial wash deposits are present in the northwest corner of the site but are not mapped as being within the proposed building footprint. As encountered in prior Test Pit 9, the alluvial wash deposits consist of light brown to brown well-graded sand and poorly graded silty sand with various amounts of fine gravel. The alluvial wash deposits are characterized as dry to moist and loose.

5.2 Older Alluvial Fan Deposits

Pleistocene age alluvial fan deposits were encountered in the borings and test pits to the maximum depth explored. The older alluvial deposits are generally composed of light brown to grayish brown, yellowish brown and reddish brown interbedded poorly graded to well-graded sand, sand with silt, and silty sand. Locally cobbles were encountered in Boring 6 below a depth of 18 feet. The older alluvial deposits are predominantly fine- to coarse-grained, locally highly cemented and characterized as dry to slightly moist and very loose to loose in the upper 3 to 5 feet, grading to dense or very dense below.

6. GROUNDWATER

Review of the California Department of Water Resources (CDWR) Water Data Library website (CDWR, 2022) indicates a groundwater monitoring well (Well No. 345956N1171659W001) is within the property vicinity. Groundwater levels were last measured in this well on May 14, 1957, when the depth to groundwater was at 86.7 feet below the existing ground surface. Also, information provided in the Apple Valley General Plan (2007) indicate groundwater beneath the site and in the immediate area has historically been greater than 50 feet beneath the ground surface.

Groundwater was not encountered in our borings and test pits excavated to a maximum depth of 49½ feet beneath the existing ground surface. Considering the lack of groundwater in our explorations, the reported historic high groundwater levels (CDWR, 2022; Apple Valley, 2007), and the depth of the proposed construction, static groundwater is not anticipated to impact the proposed development. However, it is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed, especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall. In addition, recent requirements for stormwater infiltration could result in shallower seepage conditions in the immediate site vicinity. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the S*urface Drainage* section of this report (see Section 8.16).

7. GEOLOGIC HAZARDS

7.1 Surface Fault Rupture

The numerous faults in Southern California include Holocene-active, pre-Holocene, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018). By definition, a Holocene-active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A pre-Holocene fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years) but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The site is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CDMG, 1979; CGS, 2016; CGS, 2022b) for surface fault rupture hazards. No Holocene-active or pre-Holocene faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

The closest surface trace of a Holocene-active fault to the site is the Helendale-South Lockhart Fault Zone located approximately 2.3 miles to the northeast (CGS, 2016). Other nearby active faults are the North Frontal Thrust System, the Lenwood-Lockhart Fault Zone, and the Camp Rock-Emerson-Copper Mountain Fault Zone located approximately 10.4 miles south, 17.4 miles east-northeast, and 21.9 miles northeast of the site, respectively (USGS, 2006). The active San Andreas Fault Zone is located approximately 27 miles southwest of the site (USGS, 2006).

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Southern California area at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987 M_w 5.9 Whittier Narrows earthquake and the January 17, 1994 M_w 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. These thrust faults and others in Southern California area are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site.

7.2 Seismicity

As with all of Southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 4, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the Southern California area within the last 100 years is included in the following table.

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Near Redlands	July 23, 1923	6.3	41	S
Long Beach	March 10, 1933	6.4	82	SW
Tehachapi	July 21, 1952	7.5	108	WNW
San Fernando	February 9, 1971	6.6	71	W
Whittier Narrows	October 1, 1987	5.9	64	SW
Sierra Madre	June 28, 1991	5.8	53	WSW
Landers	June 28, 1992	7.3	50	ESE
Big Bear	June 28, 1992	6.4	33	SE
Northridge	January 17, 1994	6.7	82	WSW
Hector Mine	October 16, 1999	7.1	51	E
Ridgecrest	July 5, 2019	7.1	84	NNW

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be minimized if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

7.3 Seismic Design Criteria

The following table summarizes site-specific design criteria obtained from the 2019 California Building Code (CBC; Based on the 2018 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application *Seismic Design Maps*, provided by OSHPD. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2019 CBC and Table 20.3-1 of ASCE 7-16. The values presented on the following page are for the risk-targeted maximum considered earthquake (MCE_R).

2019 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2019 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.036g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.396g	Figure 1613.2.1(2)
Site Coefficient, F_A	1.086	Table 1613.2.3(1)
Site Coefficient, F_V	1.904*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.125g	Section 1613.2.3 (Eqn 16-36)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	1.1325g*	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.75g	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.7545g*	Section 1613.2.4 (Eqn 16-39)
*Per Supplement 3 of ASCE7-16, a ground motion hazard analysis (GMHA) shall be performed for projects on Site Class "D" sites with 1-second spectral acceleration (S_1) greater than or equal to 0.2g, which is true for this site. However, Supplement 3 of ASCE 7-16 provides an exception stating that that the GMHA may be waived provided that the parameter S_{M1} is increased by 50% for all applications of S_{M1}. The values for parameters S_{M1} and S_{D1} presented above have been increased in accordance with Supplement 3 of ASCE 7-16.		

The table below presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.445g	Figure 22-7
Site Coefficient, F_{PGA}	1.155	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.514g	Section 11.8.3 (Eqn 11.8-1)

The Maximum Considered Earthquake Ground Motion (MCE) is the level of ground motion that has a 2 percent chance of exceedance in 50 years, with a statistical return period of 2,475 years. According to the 2019 California Building Code and ASCE 7-16, the MCE is to be utilized for the evaluation of liquefaction, lateral spreading, seismic settlements, and it is our understanding that the intent of the Building code is to maintain "Life Safety" during a MCE event. The Design Earthquake Ground Motion (DE) is the level of ground motion that has a 10 percent chance of exceedance in 50 years, with a statistical return period of 475 years.

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2014 Conterminous U.S. Dynamic edition (v4.2.0). The result of the deaggregation analysis indicates that the predominant earthquake contributing to the MCE peak ground acceleration is characterized as a 6.76 magnitude event occurring at a hypocentral distance of 20.2 kilometers from the site.

Deaggregation was also performed for the Design Earthquake (DE) peak ground acceleration, and the result of the analysis indicates that the predominant earthquake contributing to the DE peak ground acceleration is characterized as a 6.83 magnitude occurring at a hypocentral distance of 28.78 kilometers from the site.

Conformance to the criteria in the above tables for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

7.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California" and "Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California" requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The Apple Valley North quadrangle has not been evaluated for liquefaction hazards by the California Geological Survey (CGS, 2022a). However, the City of Apple Valley General Plan (2007) indicates the project is not located within an area designated as having potential for liquefaction. The historic high groundwater level in the vicinity of the site is reported to be at a depth of greater than 50 feet (CDWR, 2022; Apple Valley, 2007). Additionally, the Pleistocene age older alluvial fan deposits, located either at the ground surface or at shallow depths across the property, are well consolidated and locally highly cemented and not prone to liquefaction. Based on these considerations, the potential for liquefaction and associated ground deformations beneath the site is considered very low.

7.5 Seismically Induced Settlement

Dynamic compaction of dry and loose sands may occur during a major earthquake. Typically, settlements occur in thick beds of such soils. The Pleistocene age older alluvial fan deposits located at shallow depths across the property, are well consolidated and would not be prone to dry seismically induced settlements. The proposed building footprint is located within older alluvial fan deposits and therefore the potential for future dry seismically induced settlement damage to the proposed structure is considered low.

7.5 Slope Stability

The topography at the site is relatively level and the topography in the immediate site vicinity slopes gently to the west at a grade of approximately 2%. The Apple Valley General Plan (2007) indicates the site is not located within a "hillside and mountainous area" or within an area identified as having a potential for slope instability. There are no known landslides near the site, nor is the site in the path of any known or potential landslides (USGS, 2022a). Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

7.6 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. The City of Apple Valley General Plan (2007) and the San Bernardino County Safety Element (2010a) indicate the project property is not located within an area of possible inundation due to a seismically induced dam failure.

7.7 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up-gradient from the project site. Therefore, flooding resulting from a seismic-induced seiche is considered unlikely.

The site is located within a Zone D flood hazard area. As defined by the Federal Emergency Management Agency (FEMA, 2022), Zone D represents areas of undetermined flood hazards. Therefore, the potential for flooding at the site cannot be determined.

7.8 Oil Fields & Methane Potential

Based on a review of the California Geologic Energy Management Division (CalGEM) Well Finder Website, the site is not located within an oil field and active oil or gas wells are not documented in the immediate site vicinity (CalGEM, 2022). However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of the CalGEM.

Since the site is not located within the boundaries of a known oil field, the potential for the presence of methane or other volatile gases at the site is considered low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

7.9 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The site is not located within an area of known ground subsidence (USGS, 2022b). No known large-scale extraction of groundwater, gas, oil, or geothermal energy is occurring or planned at the site or in the general site vicinity. There appears to be little or no potential for ground subsidence due to withdrawal of fluids or gases at the site.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 General

8.1.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude the construction of the proposed development provided the recommendations presented herein are followed and implemented during design and construction.

8.1.2 Artificial fill was not encountered during the site investigation. However, existing fill may exist in other areas of the site that were not directly explored. The existing site soils encountered during our limited investigation are suitable for re-use as engineered fill provided the recommendations in the *Grading* section of this report are followed (see Section 8.4).

8.1.3 Groundwater was not encountered during site exploration and the historic high groundwater table is sufficiently deep that it not expected to be encountered during construction. However, local seepage could be encountered during excavation of subterranean features, especially if conducted during the rainy season.

8.1.4 Based on our observations onsite and our knowledge of the geologic setting, difficult excavation should be anticipated during earthwork at the subject site where high concentrations of cemented soils are encountered in the older alluvial fan deposits. Additionally, based on our knowledge of the geologic setting and prior experience in this area, the presence of cobbles should be anticipated during earthwork. Occasional boulders may also be encountered in the alluvial soils. The presence of these materials and their impact on construction methods and equipment selection should be considered by both the developer and contractor prior to construction.

8.1.5 Please be aware that the use of hollow-stem auger drilling equipment utilized for this investigation does not allow for the identification of the size of rock or abundance of rock being encountered or the visual observation of caving conditions since the drilling method is a small diameter cased excavation. However, cobbles were observed in the test pit excavations in both the November 2022 exploration and the test pits performed during this investigation. It is recommended that the contractors bidding on earthwork for this project perform their own excavations with the intended earthwork equipment to verify the presence, abundance, and size of buried rock (cobbles and boulders), potential for caving, as well as the suitability of the proposed excavation and drilling equipment for the safe and efficient earthwork operations and installation of the shoring system.

8.1.6 Screening of the earth materials will likely be required to remove oversize (greater than 6 inches) rock, prior to placement and compaction. Generation of oversized material (greater than 6 inches) should be anticipated.

8.1.7 The alluvial soils encountered during our investigation consist primarily of loose silty sand which increase in density with depth. Based on laboratory testing (see Figures B10 to B27), the upper alluvial soils may be subject to hydro-collapse upon saturation. Hydro-consolidation is the tendency of a soil structure to collapse upon saturation, resulting in the overall settlement of the effected soils and any overlying soils, foundations, or improvements supported therein. The recommendations in this report are intended to reduce the effects of collapsible soils beneath the foundation systems.

8.1.8 Based on the potential for hydro-consolidation, maintaining proper surface drainage is critical to future performance of foundations and paving. Recommendations for drainage are provided in the S*urface Drainage* section of this report (see Section 8.16).

8.1.9 Based on these considerations, it is recommended that the upper 5 feet of existing earth materials within the building footprint areas be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any encountered fill or soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). Proposed building foundations should be underlain by a minimum of 3 feet of newly placed engineered fill. The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint areas, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities. Recommendations for earthwork are provided in the *Grading* section of this report (see Section 8.4).

8.1.10 Subsequent to the recommended grading, the proposed structure may be supported on a conventional foundation system deriving support in newly placed engineered fill. Proposed building foundations should be underlain by a minimum of 3 feet of newly placed engineered fill. All foundation excavations must be observed and approved in writing by the Geotechnical Engineer prior to placement of steel or concrete. Recommendations for the design of a conventional foundation system are provided in Section 8.6.

8.1.11 Due to the granular nature of the soils, moderate to excessive caving is anticipated during excavation activities. The contractor should be aware that formwork may be required to prevent caving of shallow spread foundation excavations.

8.1.12 Excavations up to 6 feet in vertical height are anticipated during grading activities and foundation excavations. It is anticipated that stable excavations can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 8.14).

8.1.13 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structure, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, foundations may derive support directly in the alluvial soils and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. Compaction of the exposed soils in the excavation bottom will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

8.1.14 Where new paving is to be placed, it is recommended that all existing fill and soft alluvial soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill and soft alluvial soils in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable alluvial soil may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of subgrade soil should be scarified and properly compacted for paving support. Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 8.11).

8.1.15 Based on the results of Double Ring Infiltrometer (DRI) testing performed at the site, a stormwater infiltration system is not considered feasible for this project. It is recommended that storm water be retained, filtered, and discharged in accordance with the requirements of the local governing agency. Results of percolation testing are provided in the *Stormwater Infiltration* section of this report (see Section 8.15).

8.1.16 Once the design and foundation loading configuration for the proposed structures proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Based on the final foundation loading configurations, the potential for settlement should be re-evaluated by this office.

8.1.17 Any changes in the design, location or elevation, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

8.2 Soil and Excavation Characteristics

8.2.1 The in-situ soils can be excavated with moderate effort using conventional excavation equipment. Caving should be anticipated in unshored excavations, due to the granular nature of the onsite soils. Formwork may be required to prevent caving of foundation excavations. The older alluvium is moderately to highly cemented and should be rippable with conventional equipment; however, concretions or well cemented layers may be encountered in the older alluvium which could make excavation of subterranean features difficult. Coring or jack-hammering may be required if concretions are encountered and the contractor should be prepared for these conditions.

8.2.2 Based on our knowledge of the geologic setting and experience on nearby projects, the presence of cobbles and boulders should be anticipated during earthwork. The contractor should be prepared for difficult excavation conditions during drilling and earthwork activities.

8.2.3 It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of existing adjacent improvements.

8.2.4 All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping or shoring. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 8.14).

8.2.5 The upper 5 feet of existing site soils encountered during this investigation are primarily granular in nature and are considered to have a “very low” expansive potential (EI = 0) and would be classified as “non-expansive” based on the 2019 California Building Code (CBC) Section 1803.5.3. Recommendations presented herein assume that the building foundations and slabs will derive support in these materials.

8.3 Minimum Resistivity, pH, and Water-Soluble Sulfate

8.3.1 Potential of Hydrogen (pH) and resistivity testing as well as chloride content testing were performed on representative samples of soil to generally evaluate the corrosion potential to surface utilities. The tests were performed in accordance with California Test Method Nos. 643 and 422 and indicate that the soils are considered "moderately corrosive" with respect to corrosion of buried ferrous metals on site. The results are presented in Appendix B (Figure B35) and should be considered for design of underground structures. Due to the corrosive potential of the soils, it is recommended that PVC, ABS or other approved plastic piping be utilized in lieu of cast-iron when in direct contact with the site soils.

8.3.2 Laboratory tests were performed on representative samples of the site materials to measure the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate tests are presented in Appendix B (Figure B35) and indicate that the on-site materials possess a sulfate exposure class of "S0" to concrete structures as defined by 2019 CBC Section 1904 and ACI 318-19 Chapter 19.

8.3.3 Geocon West, Inc. does not practice in the field of corrosion engineering and mitigation. If corrosion sensitive improvements are planned, it is recommended that a corrosion engineer be retained to evaluate corrosion test results and incorporate the necessary precautions to avoid premature corrosion of buried metal pipes and concrete structures in direct contact with the soils.

8.4 Grading

8.4.1 Grading is anticipated to include preparation of the building pad, excavation of site soils for proposed foundations and utility trenches, as well as placement of backfill for trenches.

8.4.2 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, civil engineer, geotechnical engineer, and, if applicable, building official in attendance. Special soil handling requirements can be discussed at that time.

8.4.3 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill encountered during exploration is suitable for re-use as an engineered fill, provided any encountered oversize material (greater than 6 inches) and any encountered deleterious debris is removed.

8.4.4 Based on our observations onsite and our knowledge of the geologic setting, difficult excavation should be anticipated during earthwork at the subject site where high concentrations of cemented soils are encountered in the older alluvial fan deposits. Additionally, based on our knowledge of the geologic setting and prior experience in this area, the presence of cobbles should be anticipated during earthwork. Occasional boulders may also be encountered in the alluvial soils. The presence of these materials and their impact on construction methods and equipment selection should be considered by both the developer and contractor prior to construction.

8.4.5 Please be aware that the use of hollow-stem auger drilling equipment utilized for this investigation does not allow for the identification of the size of rock or abundance of rock being encountered or the visual observation of caving conditions since the drilling method is a small diameter cased excavation. However, cobbles were observed in the test pit excavations in both the November 2022 exploration and the test pits performed during this investigation. It is recommended that the contractors bidding on earthwork for this project perform their own excavations with the intended earthwork equipment to verify the presence, abundance, and size of buried rock (cobbles and boulders), potential for caving, as well as the suitability of the proposed excavation and drilling equipment for the safe and efficient earthwork operations and installation of the shoring system.

8.4.6 Generation of oversized material (greater than 6 inches) should be anticipated. Screening of the earth materials will likely be required to remove rocks greater than 4 feet, prior to placement and compaction. The contractor should be prepared for difficult excavation conditions. The presence of these materials and their impact on construction methods and equipment selection should be considered by both the owner and contractor prior to construction.

8.4.7 Rocks larger than 6 inches but less than 4 feet in maximum dimension may be incorporated into the engineered fill provided the oversized material (larger than 6 inches) is placed so that voids between the rocks are not created. It is recommended that placement of oversized materials be performed in non-building areas, if available. Consideration should be given to placing oversized material at least 3 feet below the deepest foundation or utility.

8.4.8 The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved in writing by the Geotechnical Engineer prior to placement.

8.4.9 Grading should commence with the removal of all existing vegetation and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the fill soils. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. All existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

8.4.10 At a minimum, it is recommended that the upper 5 feet of existing earth materials within the proposed building footprint area be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any encountered fill or soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). Proposed building foundations should be underlain by a minimum of 3 feet of newly placed engineered fill. The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint areas, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities.

8.4.11 Additional grading should be conducted as necessary to maintain the required 3 feet of newly placed engineered fill below foundations. The grading contractor should verify all bottom of footing elevations prior to commencement of grading activities to ensure that grading is conducted deep enough to provide the required three foot of engineering fill below foundations.

8.4.12 Subsequent to the recommended grading, the proposed structure may be supported on conventional shallow spread foundations deriving support in newly placed engineered fill. All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon) prior to placing fill.

8.4.13 It is recommended that the subgrade exposed at all excavation bottoms be proof rolled with heavy equipment to reduce compressibility. All excavation bottoms must be approved in writing by the Geotechnical Engineer (a representative of Geocon) prior to placing fill or construction materials.

8.4.14 Stable excavations for the recommended grading can be achieved with sloping measures where properly line setbacks allow. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 8.14).

8.4.15 All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to near optimum moisture content, and properly compacted to at least 90 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

8.4.16 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structures, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, such as adjacent to property lines, foundations may be deepened as necessary to maintain a minimum 24-inch embedment below the ground surface, and a minimum 12-inch embedment into the undisturbed alluvial soils. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

8.4.17 Where new paving is to be placed, it is recommended that all existing fill and soft alluvial soils be excavated and properly compacted for paving support. As a minimum, the upper 12 inches of subgrade soil should be scarified, moisture conditioned to near optimum moisture content, and properly compacted to a minimum of 95 percent of the laboratory maximum dry density in accordance with ASTM D 1557 (latest edition). *Preliminary Pavement Recommendations* section of this report (see Section 8.11).

8.4.18 All imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Rocks larger than 6 inches in diameter shall not be used in the fill. If necessary, import soils used as structural fill should have an expansion index less than or equal to 20 and soil corrosivity properties that are equally or less detrimental to that of the existing onsite soils (see Figure B35). Imported soil placed in building pad areas must be placed uniformly across the pad at the direction of the Geotechnical Engineer (a representative of Geocon).

8.4.19 Utility trenches should be properly backfilled in accordance with the following requirements. The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of minimum 2-sack slurry as backfill is also acceptable. Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

8.4.20 All trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, pipes, fill, steel, gravel, or concrete.

8.5 Shrinkage

8.5.1 Shrinkage results when a volume of material removed at one density is compacted to a higher density. A shrinkage factor between 5 and 15 percent should be anticipated when excavating and compacting the upper 5 feet of existing earth materials on the site to an average relative compaction of 92 percent. The shrinkage factor does not include the removal of oversized material.

8.5.2 If import soils will be utilized in the building pad, the soils must be placed uniformly and at equal thickness at the direction of the Geotechnical Engineer (a representative of Geocon West, Inc.). Soils can be borrowed from non-building pad areas and later replaced with imported soils.

8.6 Conventional Foundation Design

8.6.1 Due to the granular nature of the soils, moderate to excessive caving is anticipated during excavation activities. The contractor should be aware that formwork may be required to prevent caving of shallow spread foundation excavations.

8.6.2 Subsequent to the recommended grading, a conventional shallow spread foundation system may be utilized for support of the proposed structure provided foundations derive support in newly placed engineered fill. All proposed foundations should be underlain by a minimum of 3 feet of newly placed engineered fill. All foundation excavations must be observed and approved by the Geotechnical Engineer (a representative of Geocon), prior to placing steel or concrete.

8.6.3 Continuous footings may be designed for an allowable bearing capacity of 3,000 pounds per square foot (psf), and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material.

8.6.4 Isolated spread foundations may be designed for an allowable bearing capacity of 3,500 psf, and should be a minimum of 24 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material.

8.6.5 The allowable soil bearing pressure may be increased by 500 psf and 1,000 psf for each additional foot of foundation width and depth, respectively, up to a maximum allowable soil bearing pressure of 5,000 psf.

8.6.6 The allowable bearing pressures may be increased by one-third for transient loads due to wind or seismic forces.

8.6.7 If depth increases are utilized for the exterior wall footings, this office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary. Additional grading should be conducted as needed in order to maintain the recommended 3-foot-thick blanket of engineered fill below proposed on-grade foundations.

8.6.8 Continuous footings should be reinforced with four No. 4 steel reinforcing bars, two placed near the top of the footing and two near the bottom. Reinforcement for spread footings should be designed by the project structural engineer.

8.6.9 The above foundation dimensions and minimum reinforcement recommendations are based on soil conditions and building code requirements only, and are not intended to be used in lieu of those required for structural purposes.

8.6.10 No special subgrade presaturation is required prior to placement of concrete. However, the slab and foundation subgrade should be sprinkled as necessary; to maintain a moist condition as would be expected in any concrete placement.

8.6.11 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

8.6.12 This office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

8.7 Foundation Settlement

8.7.1 The maximum expected static settlement for a structure supported on a conventional foundation system deriving support in the recommended bearing materials and designed with a maximum bearing pressure of 5,000 psf is estimated to be less than 1 inch and occur below the heaviest loaded structural element. Settlement of the foundation system is expected to occur on initial application of loading.

8.7.2 Based on the column and wall loads provided by the project structural engineer, differential settlement between columns and adjacent wall loading conditions is not expected to exceed ½ inch.

8.7.3 Once the design and foundation loading configurations for the proposed structures proceed to a more finalized plan, the estimated settlements presented in this report should be reviewed and revised, if necessary. If the final foundation loading configurations are greater than the assumed loading conditions, the potential for settlement should be reevaluated by this office.

8.8 Miscellaneous Foundations

8.8.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structures, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, foundations may derive support directly in the competent undisturbed alluvial soils, and should be deepened as necessary to maintain a minimum 24-inch embedment below the ground surface, and a minimum 12-inch embedment into the undisturbed alluvial soils.

8.8.2 If the soils exposed in the excavation bottom are soft, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative. Miscellaneous foundations may be designed for a bearing value of 1,500 psf, and should be a minimum of 12 inches in width,18 inches in depth below the lowest adjacent grade and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

8.8.3 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

8.9 Lateral Design

8.9.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.45 may be used with the dead load forces in the undisturbed alluvial soils or engineered fill.

8.9.2 Passive earth pressure for the sides of foundations and slabs poured against the alluvial soils or properly compacted engineered fill may be computed as an equivalent fluid having a density of 280 pcf with a maximum earth pressure of 2,800 pcf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

8.10 Concrete Slabs-on-Grade

8.10.1 Exterior concrete slabs-on-grade subject to vehicle loading should be designed in accordance with the recommendations in the *Preliminary Pavement Recommendations* section of this report (Section 8.11).

8.10.2 Subsequent to the recommended grading, concrete slabs-on-grade for structures, not subject to vehicle loading, should be a minimum of 4 inches thick and minimum slab reinforcement should consist of No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint.

8.10.3 Slabs-on-grade that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder placed directly beneath the slab. The vapor retarder and acceptable permeance should be specified by the project architect or developer based on the type of floor covering that will be installed. The vapor retarder selection and design should be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06) as well as ASTM E1745 and should be installed in general conformance with ASTM E 1643 (latest edition) and the manufacturer's recommendations. A minimum thickness of 15 mils extruded polyolefin plastic is recommended; vapor retarders which contain recycled content or woven materials are not recommended. The vapor retarder should have a permeance of less than 0.01 perms demonstrated by testing before and after mandatory conditioning. The vapor retarder should be installed in direct contact with the concrete slab with proper perimeter seal. If the California Green Building Code requirements apply to this project, the vapor retarder should be underlain by 4 inches of clean aggregate. It is important that the vapor retarder be puncture resistant since it will be in direct contact with angular gravel. As an alternative to the clean aggregate suggested in the Green Building Code, it is our opinion that the concrete slab-on-grade may be underlain by a vapor retarder over 4-inches of clean sand (sand equivalent greater than 30), since the sand will serve a capillary break and will minimize the potential for punctures and damage to the vapor barrier.

8.10.4 For seismic design purposes, a coefficient of friction of 0.45 may be utilized between concrete slabs and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.

8.10.5 Exterior slabs for walkways or flatwork, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 12 inches of subgrade should be moistened to near optimum moisture content and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. The project structural engineer should design construction joints as necessary.

8.10.6 The recommendations of this report are intended to reduce the potential for cracking of slabs due to settlement. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade may exhibit some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

8.11 Preliminary Pavement Recommendations

8.11.1 Where new paving is to be placed, it is recommended that all existing fill and soft or unsuitable alluvial materials be excavated and properly recompacted for paving support. The client should be aware that excavation and compaction of all existing artificial fill and soft alluvium in the area of new paving is not required; however, paving constructed over existing unsuitable material may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of paving subgrade should be scarified, moisture conditioned to near optimum moisture content, and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

8.11.2 The following pavement sections are based on an assumed R-Value of 30. Once site grading activities are complete an R-Value should be obtained by laboratory testing to confirm the properties of the soils serving as paving subgrade, prior to placing pavement.

8.11.3 The Traffic Indices listed below are estimates. Geocon does not practice in the field of traffic engineering. The actual Traffic Index for each area should be determined by the project civil engineer. If pavement sections for Traffic Indices other than those listed below are required, Geocon should be contacted to provide additional recommendations. Pavement thicknesses were determined following procedures outlined in the *California Highway Design Manual* (Caltrans). It is anticipated that the majority of traffic will consist of automobile and large truck traffic.

PRELIMINARY PAVEMENT DESIGN SECTIONS

Location	Estimated Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Automobile Parking And Driveways	4.0	3.0	4.0
Trash Truck & Fire Lanes	7.0	4.0	10.0

8.11.4 Asphalt concrete should conform to Section 203-6 of the "*Standard Specifications for Public Works Construction"* (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02A of the "*Standard Specifications of the State of California, Department of Transportation"* (Caltrans). The use of Crushed Miscellaneous Base in lieu of Class 2 aggregate base is acceptable. Crushed Miscellaneous Base should conform to Section 200-2.4 of the "*Standard Specifications for Public Works Construction"* (Green Book).

8.11.5 Unless specifically designed and evaluated by the project structural engineer, where exterior concrete paving will be utilized for support of vehicles, it is recommended that the concrete be a minimum of 6 inches of concrete reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The subgrade and base material should be compacted to 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

8.11.6 The performance of pavements is highly dependent upon providing positive surface drainage away from the edge of pavements. Ponding of water on or adjacent to the pavement will likely result in saturation of the subgrade materials and subsequent cracking, subsidence and pavement distress. If planters are planned adjacent to paving, it is recommended that the perimeter curb be extended at least 12 inches below the bottom of the aggregate base to minimize the introduction of water beneath the paving.

8.12 Retaining Wall Design

8.12.1 The recommendations presented below are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 5 feet. In the event that walls significantly higher than 5 feet are planned, Geocon should be contacted for additional recommendations.

8.12.2 Retaining wall foundations may be designed in accordance with the recommendations provided in the *Conventional Foundation Design* section of this report (see Section 8.6).

8.12.3 Retaining walls with a level backfill surface that are not restrained at the top should be designed utilizing a triangular distribution of pressure (active pressure). Restrained walls are those that are not allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall in feet) at the top of the wall. Where walls are restrained from movement at the top, walls may be designed utilizing a triangular distribution of pressure (at-rest pressure). The table below presents recommended pressures to be used in retaining wall design, assuming that proper drainage will be maintained.

RETAINING WALL WITH LEVEL BACKFILL SURFACE

HEIGHT OF RETAINING WALL (Feet)	ACTIVE PRESSURE EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot)	AT-REST PRESSURE EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot)
Up to 5	41	54

8.12.4 The wall pressures provided above assume that the proposed retaining walls will support relatively undisturbed alluvial soils or engineered fill derived from onsite soil. If import soil is used to backfill proposed walls, revised earth pressures may be required to account for the geotechnical properties of the soil placed as engineered fill. This should be evaluated once the use of import soil is established and once the geotechnical characteristics of the engineered backfill soils can be further evaluated.

8.12.5 The wall pressures provided above assume that the retaining wall will be properly drained preventing the buildup of hydrostatic pressure. If retaining wall drainage is not implemented, an at-rest equivalent fluid pressure of 100 pcf should be used in design of undrained walls for the full height of the wall. The value includes hydrostatic pressures plus buoyant lateral earth pressures. If a partially drained wall is proposed, Geocon should be contacted to provide additional recommendations.

8.12.6 Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures and should be designed for each condition as the project progresses.

8.12.7 It is recommended that line-load surcharges from adjacent wall footings, use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.20 \times \left(\frac{z}{H}\right)}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.28 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

where x is the distance from the face of the excavation or wall to the vertical line-load, H is the distance from the bottom of the footing to the bottom of excavation or wall, z is the depth at which the horizontal pressure is desired, Q_L is the vertical line-load and $\sigma_H(z)$ is the horizontal pressure at depth z.

8.12.8 It is recommended that vertical point-loads, from construction equipment outriggers or adjacent building columns use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.28 \times \left(\frac{z}{H}\right)^2}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.77 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)^2}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

then

$$\sigma'_H\,(z) = \sigma_H(z) cos^2(1.1\theta)$$

where x is the distance from the face of the excavation/wall to the vertical point-load, H is distance from the outrigger/bottom of column footing to the bottom of excavation, z is the depth at which the horizontal pressure is desired, Q_P is the vertical point-load, $\sigma_H(z)$ is the horizontal pressure at depth z, θ is the angle between a line perpendicular to the excavation/wall and a line from the point-load to location on the excavation/wall where the surcharge is being evaluated, and $\sigma_H(z)$ is the horizontal pressure at depth z.

8.12.9 In addition to the recommended earth pressure, the upper 10 feet of the retaining wall adjacent to the street or driveway areas should be designed to resist a uniform lateral pressure of 100 psf, acting as a result of an assumed 300 psf surcharge behind the shoring due to normal street traffic. If the traffic is kept back at least 10 feet from the wall, the traffic surcharge may be neglected.

8.12.10 Seismic lateral forces will be required for any retaining walls in excess of 6 feet. Recommendations for seismic lateral forces will be provided under separate cover should they become necessary.

8.13 Retaining Wall Drainage

8.13.1 Unless designed for hydrostatic pressures, retaining walls should be provided with a drainage system. At the base of the drain system, a subdrain covered with a minimum of 12 inches of gravel should be installed, and a compacted fill blanket or other seal placed at the surface (see Figure 5). The clean bottom and subdrain pipe, behind a retaining wall, should be observed by the Geotechnical Engineer (a representative of Geocon), prior to placement of gravel or compacting backfill.

8.13.2 As an alternative, a plastic drainage composite such as Miradrain or equivalent may be installed in continuous, 4-foot wide columns along the entire back face of the wall, at 8 feet on center. The top of these drainage composite columns should terminate approximately 18 inches below the ground surface, where either hardscape or a minimum of 18 inches of relatively cohesive material should be placed as a cap (see Figure 6). These vertical columns of drainage material would then be connected at the bottom of the wall to a 4-inch subdrain pipe.

8.13.3 Subdrainage pipes at the base of the retaining wall drainage system should outlet to an acceptable location via controlled drainage structures. Drainage should not be allowed to flow uncontrolled over descending slopes.

8.13.4 Moisture affecting below grade walls is one of the most common post-construction complaints. Poorly applied or omitted waterproofing can lead to efflorescence or standing water. Particular care should be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. The design and inspection of the waterproofing is not the responsibility of the geotechnical engineer. A waterproofing consultant should be retained in order to recommend a product or method, which would provide protection to subterranean walls, floor slabs and foundations.

8.14 Temporary Excavations

8.14.1 Excavations of up to 6 feet in height may be required during grading and construction activities, including foundation excavations. Due to the granular nature of the soils, moderate to excessive caving should be anticipated in vertical excavations. The contractor may attempt vertical excavations less than 5 feet; however, it is likely that sloping measures will be required to maintain a stable excavation. The contractor should be prepared for caving, sloughing, and raveling in open excavations. Due to the granular nature of soils and potential for caving, the contractor should also be prepared to form foundation excavations at the excavation bottom. In addition, due to the presence of cobbles, the contractor should be prepared for difficult excavation conditions.

8.14.2 Vertical excavations greater than 5 feet or where surcharged by existing structures will require sloping or shoring measures in order to provide a stable excavation. Where sufficient space is available, temporary unsurcharged slopes could be sloped back at a uniform 1:1 slope gradient or flatter up to maximum height of 7 feet; or at a uniform 1½:1 slope gradient or flatter to a maximum height of 15 feet. A uniform slope does not have a vertical portion.

8.14.3 If excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures such as shoring may be necessary in order to maintain lateral support of offsite improvements. If necessary, shoring recommendations can be provided under separate cover.

8.14.4 Where temporary construction slopes are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal di stance equal to the height of the slope. If the temporary slopes are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. Geocon personnel should inspect the soils exposed in the cut slopes during excavation so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations should be stabilized within 30 days of initial excavation.

8.15 Stormwater Infiltration

8.15.1 Three test pit excavations were conducted on November 9, 2022, using a rubber-tire backhoe. The test pits were excavated within the infiltration system footprint to the approximate invert elevations provided to us by the project civil engineer. Double Ring Infiltrometer (DRI) testing was performed at the bottom of the test pit excavations on November 10, 11 and 13, 2022. The locations of the infiltration tests (TP-1 through TP-3) are indicated on the Site Plan (see Figure 2). After testing was completed, the test pits were loosely backfilled with the understanding that the fill soils would be removed for the construction of an LID system. No groundwater was observed within the test pit excavations. Test pit logs are provided herein as Figures A11 through A13.

8.15.2 The Field test data and plots of the measured infiltration rates over the duration of the testing are provided on Figures 7 through 12. A summary of the measured infiltration rates is provided in the table below.

TEST ID	DEPTH (ft)	MEASURED INFILTRATION RATE (in/hr)
IT-1	15	0.01
IT-2	13	0.01
IT-3	6	0.12

8.15.3 The results of the DRI testing above indicate that the alluvial soils at the location and depths listed in the table above are not conducive to infiltration. It is recommended that storm water be retained, filtered, and discharged in accordance with the requirements of the local governing agency.

8.16 Surface Drainage

8.16.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.

8.16.2 All site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2019 CBC 1804.4 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over any descending slope. Discharge from downspouts, roof drains and scuppers are not recommended onto unprotected soils within 5 feet of the building perimeter. Planters which are located adjacent to foundations should be sealed to prevent moisture intrusion into the soils providing foundation support. Landscape irrigation is not recommended within 5 feet of the building perimeter footings except when enclosed in protected planters.

8.16.3 Positive site drainage should be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures.

8.16.4 Landscaping planters immediately adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Either a subdrain, which collects excess irrigation water and transmits it to drainage structures, or impervious above-grade planter boxes should be used. In addition, where landscaping is planned adjacent to the pavement, it is recommended that consideration be given to providing a cutoff wall along the edge of the pavement that extends at least 12 inches below the base material.

8.17 Plan Review

8.17.1 Grading, foundation, and shoring plans (if applicable) should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon West, Inc. should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon West, Inc.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

4. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

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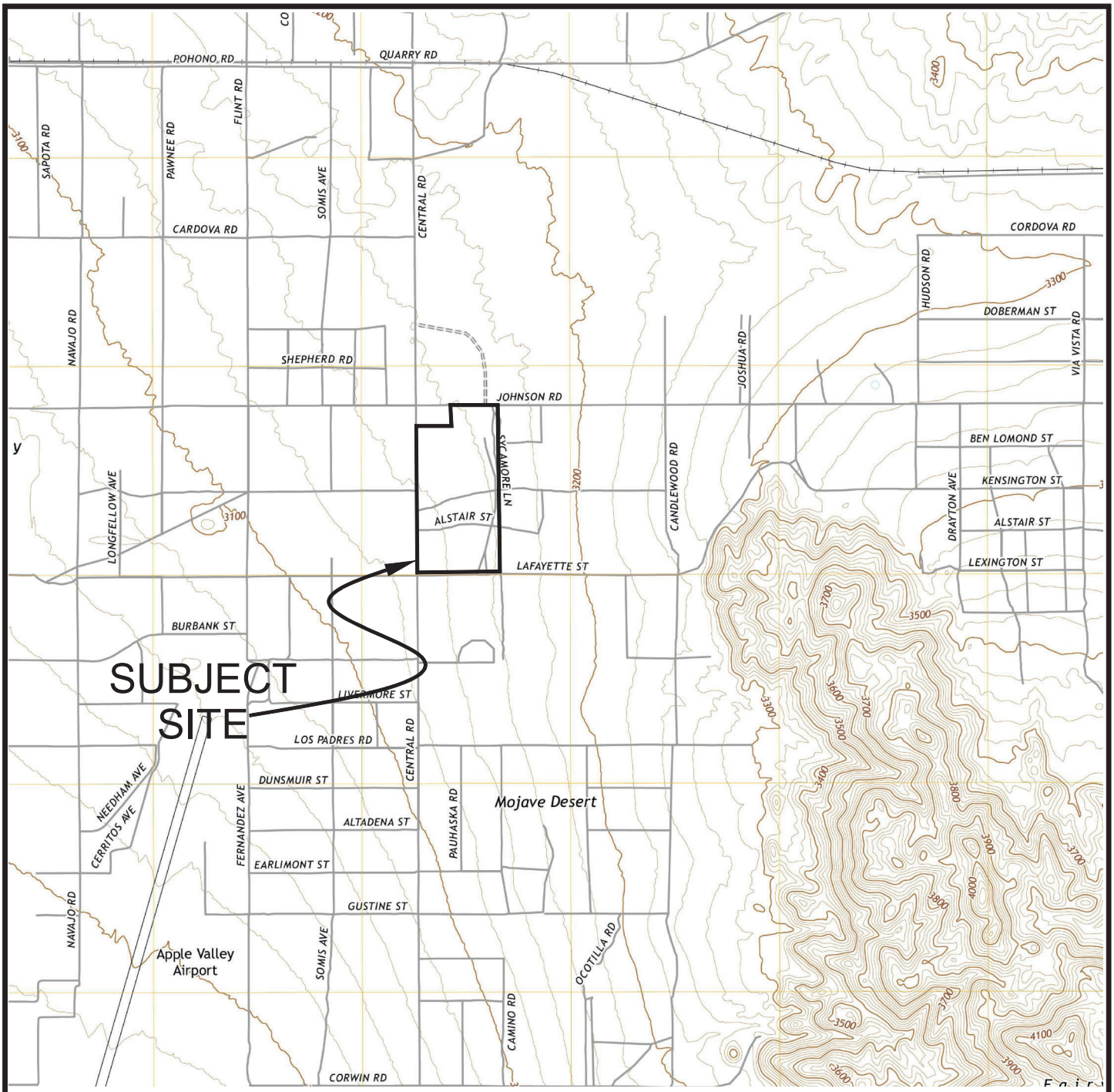

REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, APPLE VALLEY NORTH, CA QUADRANGLE

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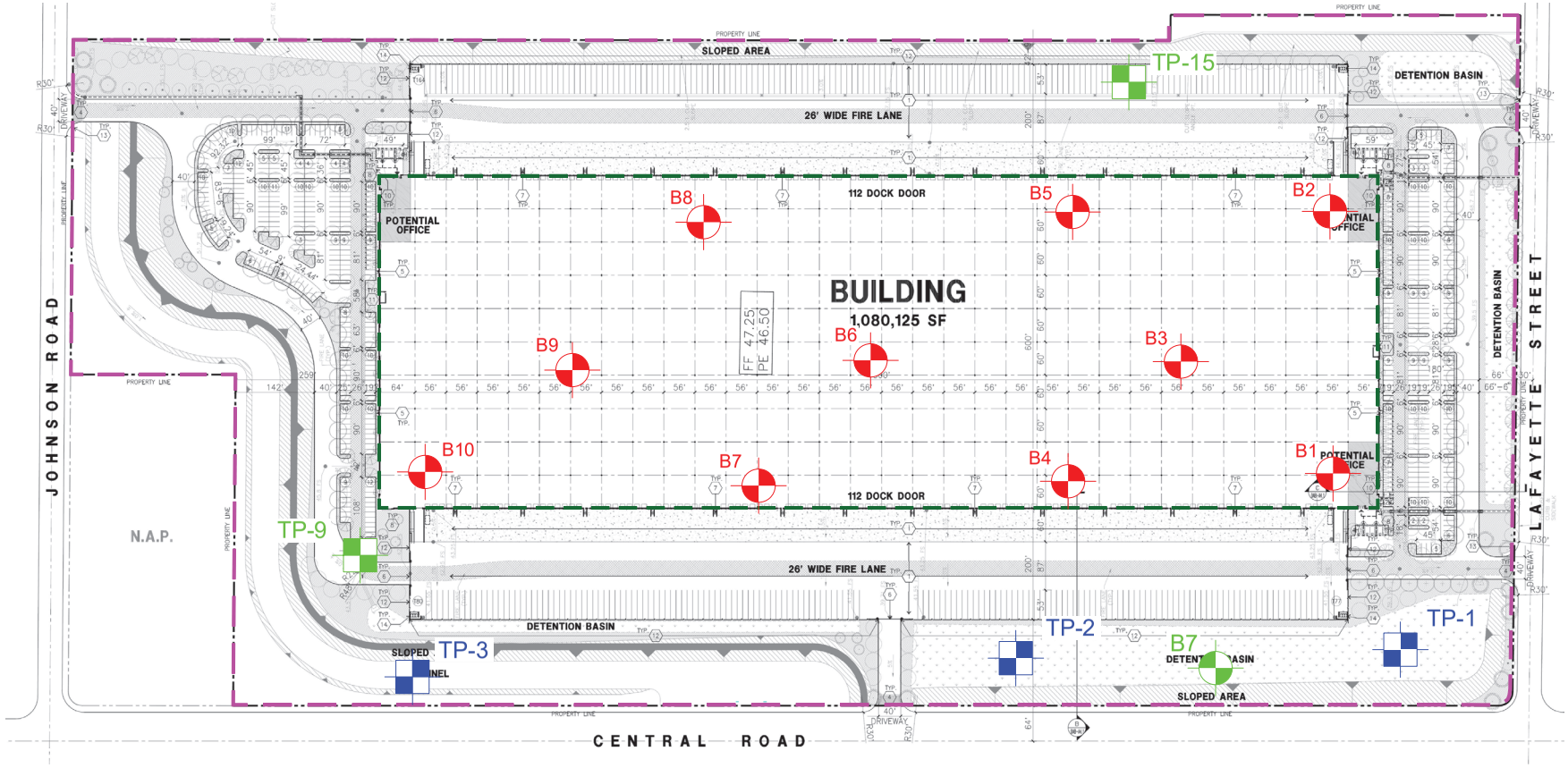
DRAFTED BY: CB	CHECKED BY: SFK

VICINITY MAP

NORTHEAST CORNER
CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

DEC. 2022	PROJECT NO. W1523-99-01A	FIG. 1



LEGEND

Property Limits	Limits of Proposed Structure
TP-9 — Test Pit Location and Number (Geocon, March 2022; Project No. W1523-99-01)	TP-2 — Test Pit Location and Number (Geocon, December 2022)
B7 — Boring Location and Number (Geocon, March 2022; Project No. W1523-99-01)	B10 — Boring Location and Number (Geocon, December 2022)

0 200 400

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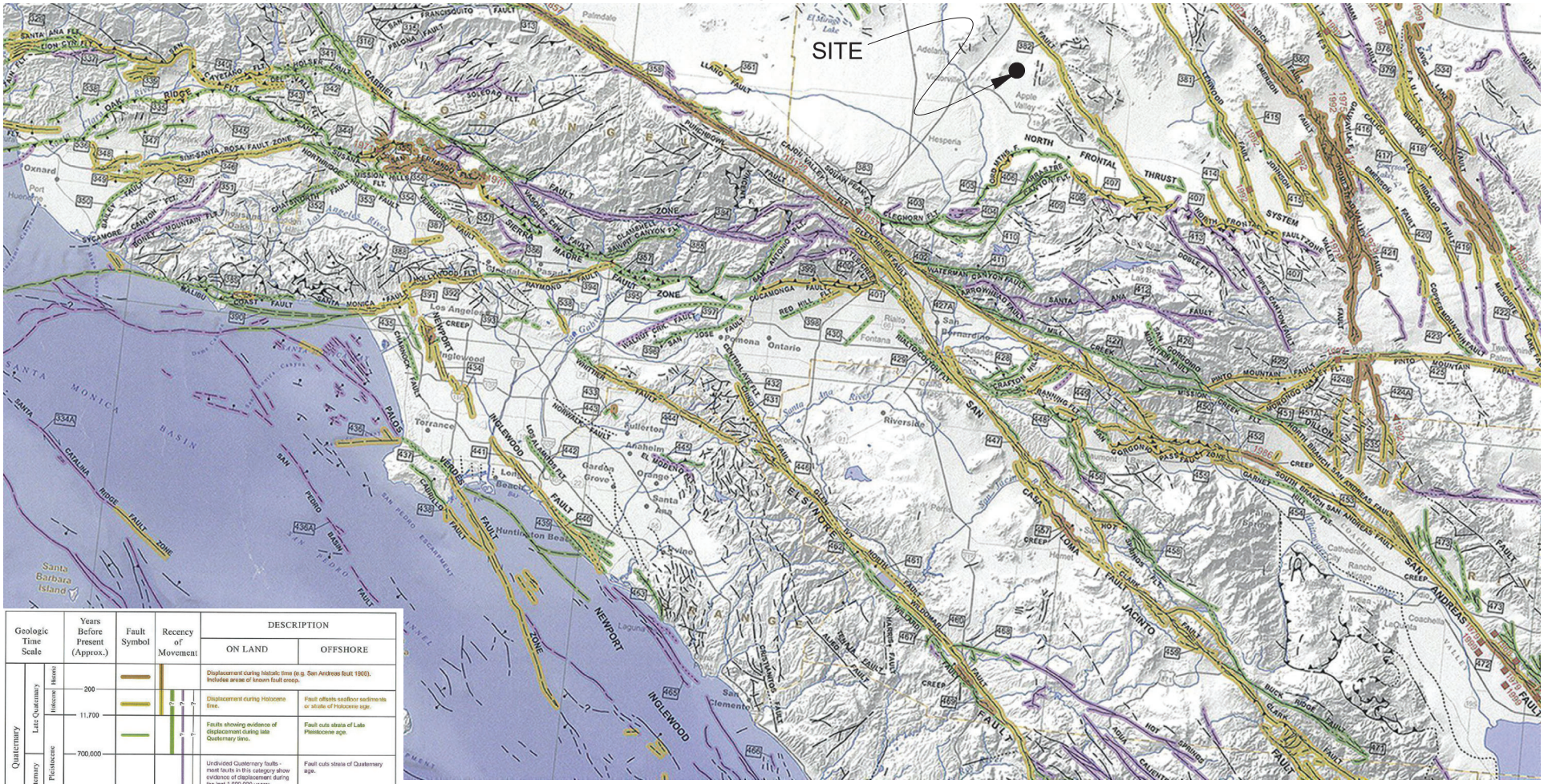
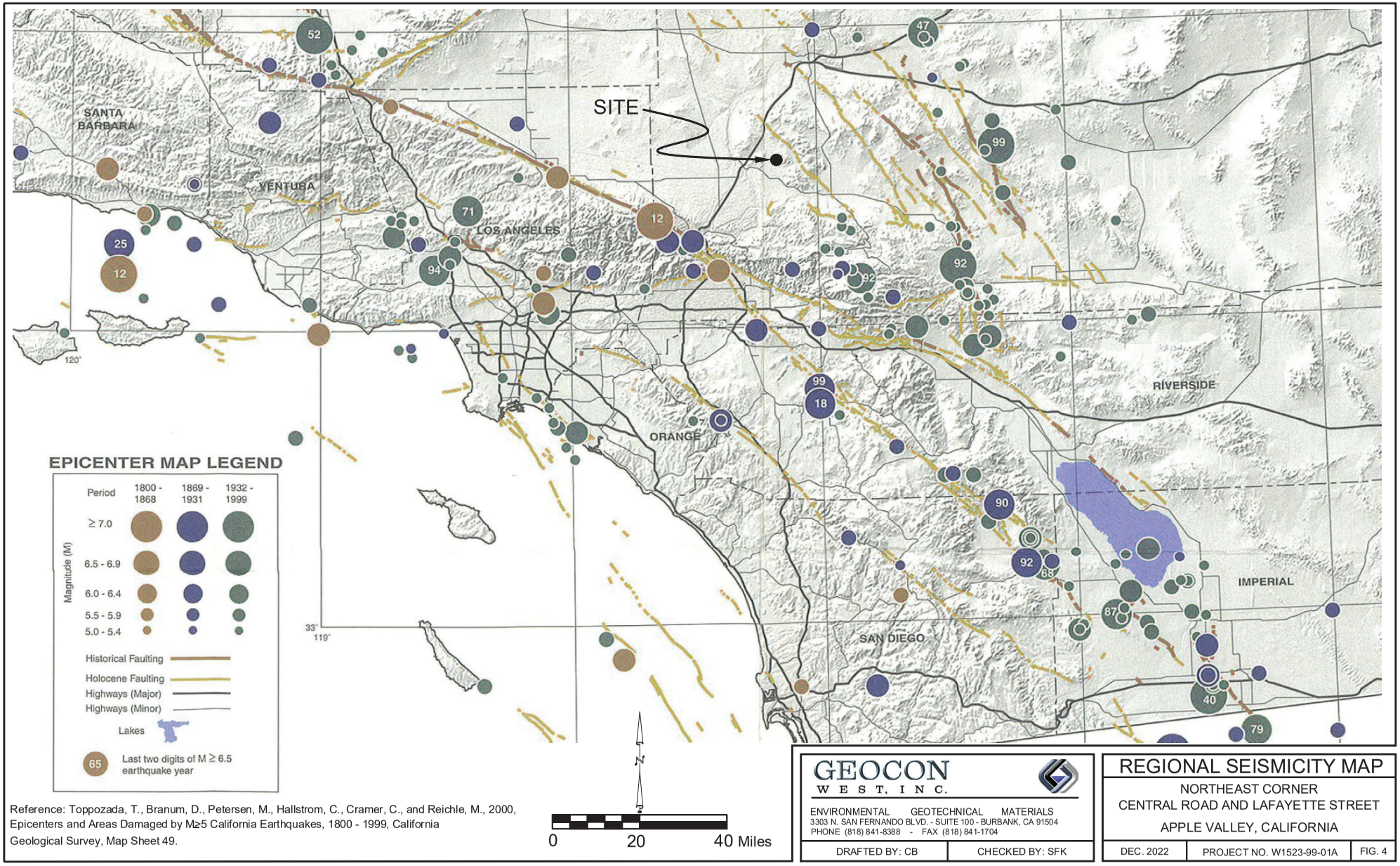
SITE PLAN

NORTHEAST CORNER OF CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

DEC. 2022 | PROJECT NO. W1523-99-01A | FIG. 2

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.


SITE
Palmdale
Lancaster
Apple Valley
Hesperia
Victorville
Oxnard
Port Hueneme
Los Angeles
Pasadena
Glendale
Burbank
San Fernando
Santa Clarita
Simi Valley
Thousand Oaks
Malibu
Santa Monica
Beverly Hills
Hollywood
Inglewood
Torrance
Long Beach
Anaheim
Orange
Santa Ana
Fullerton
Pomona
Ontario
Rialto
Fontana
San Bernardino
Redlands
Riverside
Corona
Moreno Valley
Perris
Lake Elsinore
Temecula
Murrieta
Menifee
Hemet
San Jacinto
Banning
Beaumont
Yucaipa
Cathedral City
Palm Springs
Indio
La Quinta
Coachella
Santa Barbara Island
SANTA MONICA BASIN
SAN PEDRO BASIN
SAN PEDRO ESCARPMENT
SANTA CATALINA ISLAND
SAN CLEMENTE ISLAND
SANTA ANA MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
SAN JACINTO MTNS
SANTA ROSA MTNS
SANTA MONICA MTNS
SANTA ANA FLT
ELSINORE FAULT
NEWPORT INGLEWOOD FAULT ZONE
SAN ANDREAS FAULT
SAN JACINTO FAULT
CHINO FAULT
CUCAMONGA FAULT
NORTH FRONTAL FAULT SYSTEM
SAN GABRIEL FAULT ZONE
SIERRA MADRE FAULT ZONE
RAYMOND FAULT
HOLLYWOOD FAULT
SANTA MONICA FAULT
MALIBU COAST FAULT
CHANNEL ISLANDS THRUST FAULT
PALOS VERDES FAULT
CATALINA FAULT ZONE
SAN PEDRO FAULT
NEWPORT FAULT
CORONADO BANK FAULT
SAN DIEGO TROUGH FAULT
SAN CLEMENTE FAULT
SAN ISIDRO FAULT
OAK RIDGE FAULT
SANTA ROSA FAULT ZONE
SIMI FAULT
SYCAMORE CANYON FAULT
BALLARD CANYON FAULT
MISSION HILLS FAULT
NORTHRIDGE HILLS FAULT
CHATSWORTH FAULT
SUSANA FAULT
VERDUGO FAULT
SIERRA MADRE FAULT
CLAMSHELL SAWPIT CANYON FAULT
LYTLE CREEK FAULT
SAN ANTONIO FAULT
CUCAMONGA FAULT
RED HILL FAULT
THIRTY-FIVE FAULT
SAN JOSE FAULT
CENTRAL AVE FAULT
NORTHRUP FAULT
NORWALK FAULT
LOS ALAMITOS FAULT
CHERRY HILL FAULT
EL MODENO FAULT
CARLSBAD FAULT
WHITTIER FAULT
CHINO FAULT
WATERMAN CANYON FAULT
SAN JACINTO FAULT ZONE
CLEGHORN FAULT
CAMP ROCK FAULT
CAMP ROCK-PETTIS FAULT
HELENDALE FAULT
LENWOOD FAULT
LLANO FAULT
CAMP ROCK FAULT
CAROL VALLEY FAULT
SQUAW PEAK FAULT
PUNCHBOWL FAULT
SOLEDAD FLT
SAN FRANCISQUITO FAULT
FALCONA FAULT
CASTAIC FLT
HOLSER FAULT
DEL VALLE FAULT
CABRILLO FAULT
OAK RIDGE FAULT
SANTA ANA FLT
ELSINORE FAULT
GLEN IVY FLT
CASTAIC FLT
SAN GABRIEL FAULT



Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M≥5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.

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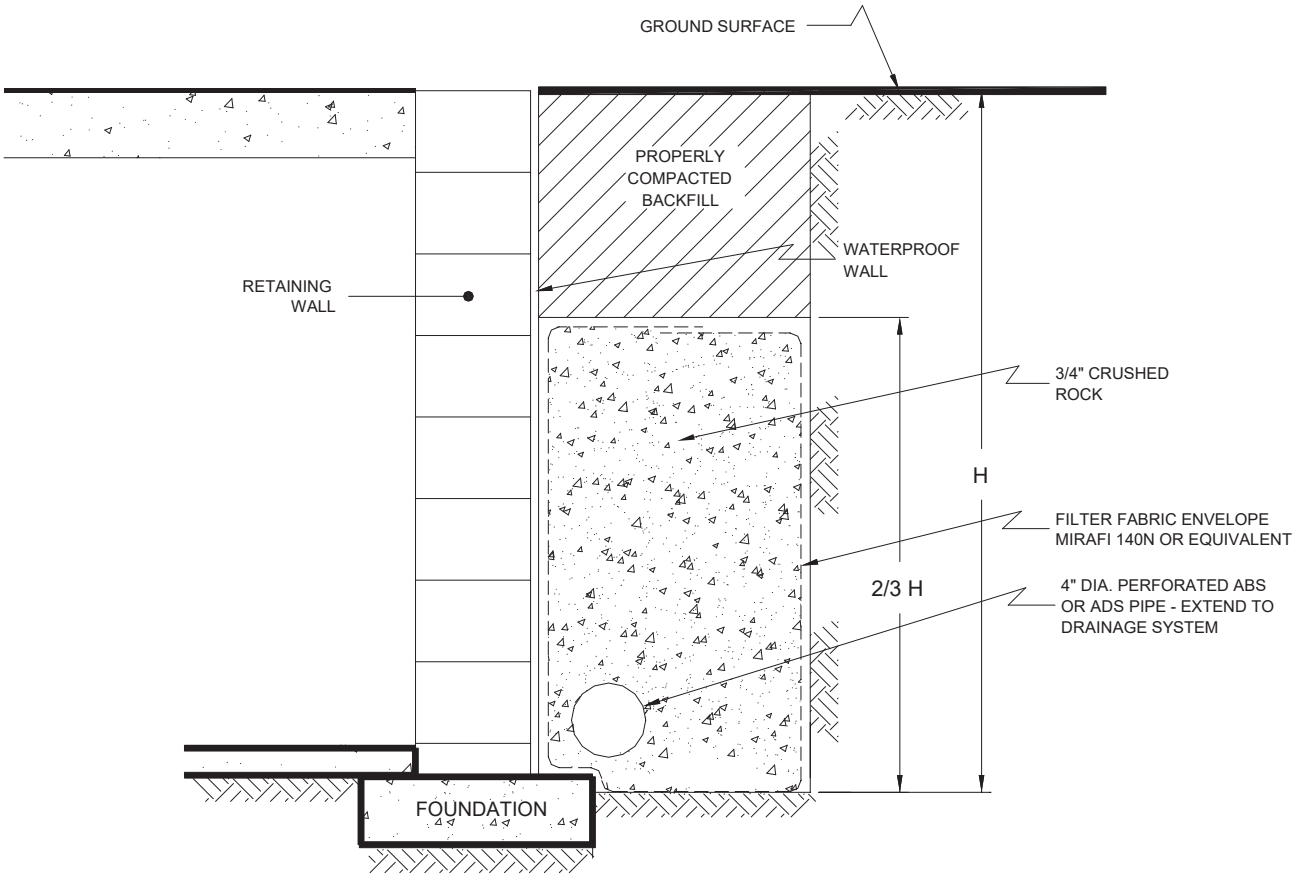
DRAFTED BY: CB | CHECKED BY: SFK

REGIONAL SEISMICITY MAP

NORTHEAST CORNER
CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

DEC. 2022 | PROJECT NO. W1523-99-01A | FIG. 4



NO SCALE

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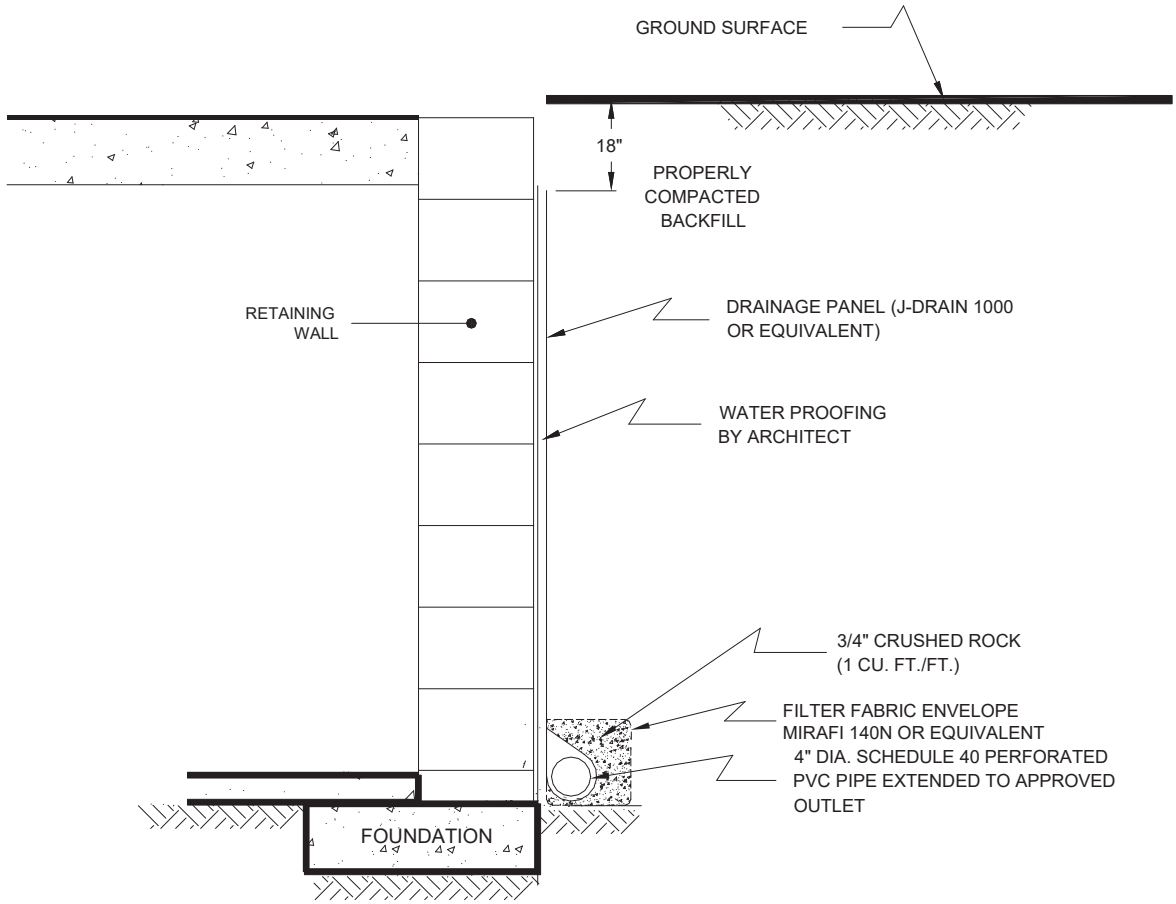
DRAFTED BY: JMH	CHECKED BY: HHD

RETAINING WALL DRAIN DETAIL

NORTHEAST CORNER OF CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

DEC. 2022	PROJECT NO. W1523-99-01A	FIG. 5



NO SCALE

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DRAFTED BY: JMH	CHECKED BY: HHD

RETAINING WALL DRAIN DETAIL

NORTHEAST CORNER OF CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

DEC. 2022	PROJECT NO. W1523-99-01A	FIG. 6

DOUBLE RING INFILTROMETER TEST DATA

Project Name:	Uncommon Apple Valley		Constants	Ring Data		Marriotte Tubes	
Project No.:	W1523-99-01A			Area, A_r (in^2)	Depth of Liquid (in.)	ID	Vol., V_r (in^3/in)
Test No.:	TP-1		Inner Ring:	113	7	Small	3,000 ml
Test Location:	See Figure 2		Annular Ring:	339	7	Large	60 cm
Test By: LW	USCS Class: SM						
Water Table Depth: N/A	Penetration of Rings into Soil (in.)			Inner:	1.25 in	Outer:	1.75 in
Date of Test: 11/14/2022	Liquid Used: Water	pH:		Ground Temp (◦F):		at Depth: 5'	

Liquid level maintained by using small Marriotte tube for inner ring; large Marriotte tube for annular ring.

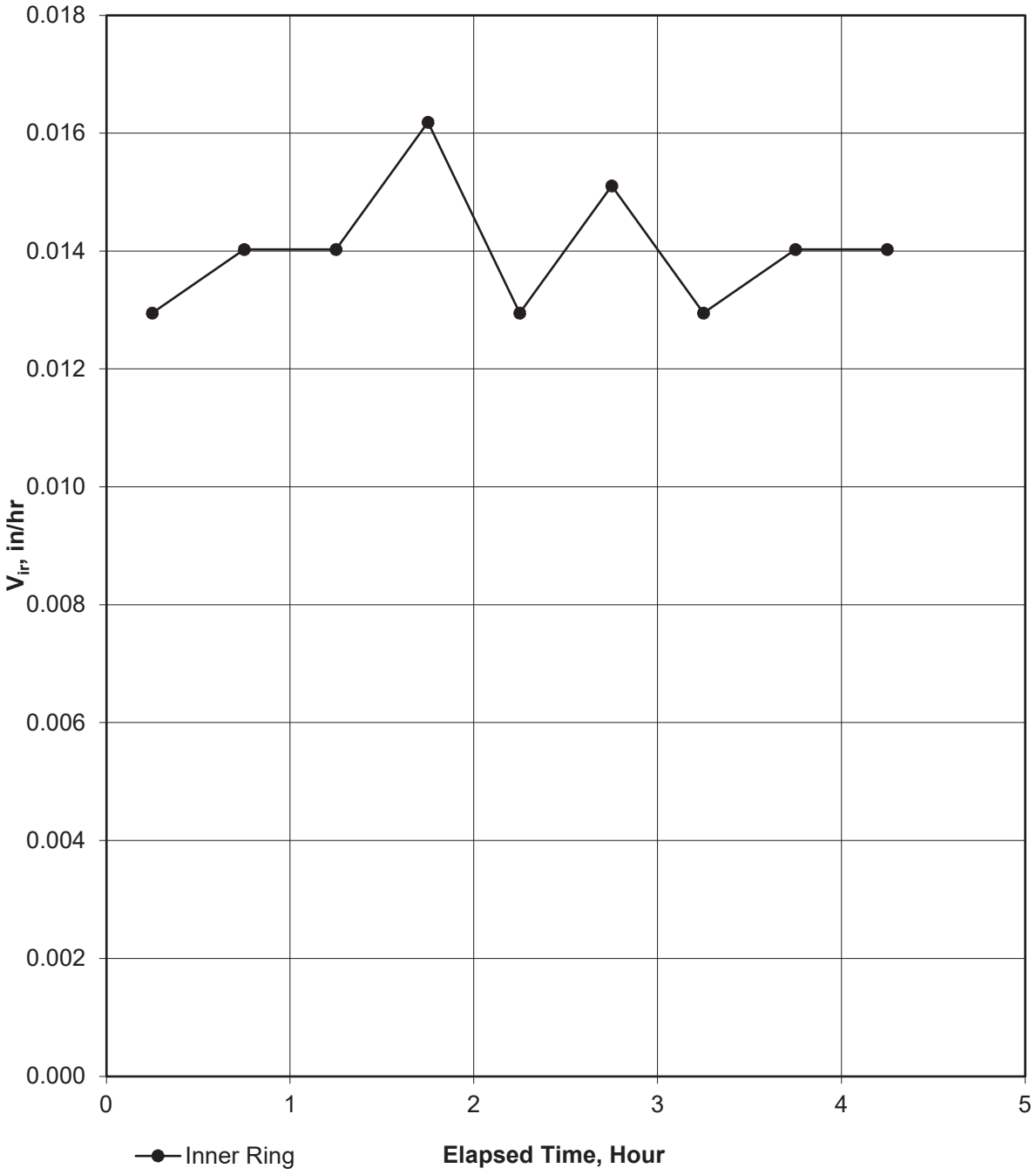
Additional Comments: Sunny; no cloud cover.

Time Interval	Time (hr.:min.)	Δt min. / total	Small Marriotte		Large Marriotte		Ambient Air Temp (◦F)†	Infiltration Rate, I**		Remarks
			Volume (V, cm^3)	ΔV (test & total)	Height (H, cm)	ΔH (test & total)		Inner (in./hr.)	Outer (in./hr.)	
1 - Start	7:15 AM	15	58	6	58.5	10	75	0.01	1.29	
End	7:30 AM		52		48.5		75			
2 - Start	7:30 AM	30	52	13	48.5	17	75	0.01	1.09	
End	8:00 AM		39		31.5		75			
3 - Start	8:00 AM	30	39	13	31.5	16.5	75	0.01	1.06	
End	8:30 AM		26		15.0		75			
4 - Start	8:30 AM	30	26	15	58.0	18	76	0.02	1.16	
End	9:00 AM		11		40.0		76			
5 - Start	9:00 AM	30	57	12	40.0	18	78	0.01	1.16	
End	9:30 AM		45		22.0		78			
6 - Start	9:30 AM	30	45	14	58.5	17	78	0.02	1.09	
End	10:00 AM		31		41.5		78			
7 - Start	10:00 AM	30	31	12	41.5	17.5	78	0.01	1.13	
End	10:30 AM		19		24.0		78			
8 - Start	10:30 AM	30	57	13	58.0	19	78	0.01	1.22	
End	11:00 AM		44		39.0		78			
9 - Start	11:00 AM	30	44	13	39.0	16.5	78	0.01	1.06	
End	11:30 AM		31		22.5		80			

*Flow, $Q_f = \Delta H \times V_r$ **Infiltration Rate, $I = (Q_f/A_r)/\Delta t$ † Proxy for Liquid Temperature

FIGURE 7

TP-1



MEASURED INFILTRATION RATE = 0.01 IN/HR

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DRAFTED BY: JMH	CHECKED BY: HHD

DOUBLE-RING INFILTROMETER TEST RESULTS

NORTH EAST CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

DEC. 2022	PROJECT NO. W1523-99-01A	FIG. 8

DOUBLE RING INFILTROMETER TEST DATA

Project Name:	Uncommon Apple Valley		Constants	Ring Data		Marriotte Tubes	
Project No.:	W1523-99-01A			Area, A_r (in^2)	Depth of Liquid (in.)	ID	Vol., V_r (in^3/in)
Test No.:	TP-2		Inner Ring:	113	7	Small	3,000 ml
Test Location:	See Figure 2		Annular Ring:	339	7	Large	60 cm
Test By: LW	USCS Class: SM						
Water Table Depth: N/A	Penetration of Rings into Soil (in.)			Inner:	1.25 in	Outer:	1.75 in
Date of Test: 11/14/2022	Liquid Used: Water	pH:		Ground Temp (◦F):		at Depth: 5'	

Liquid level maintained by using small Marriotte tube for inner ring; large Marriotte tube for annular ring.

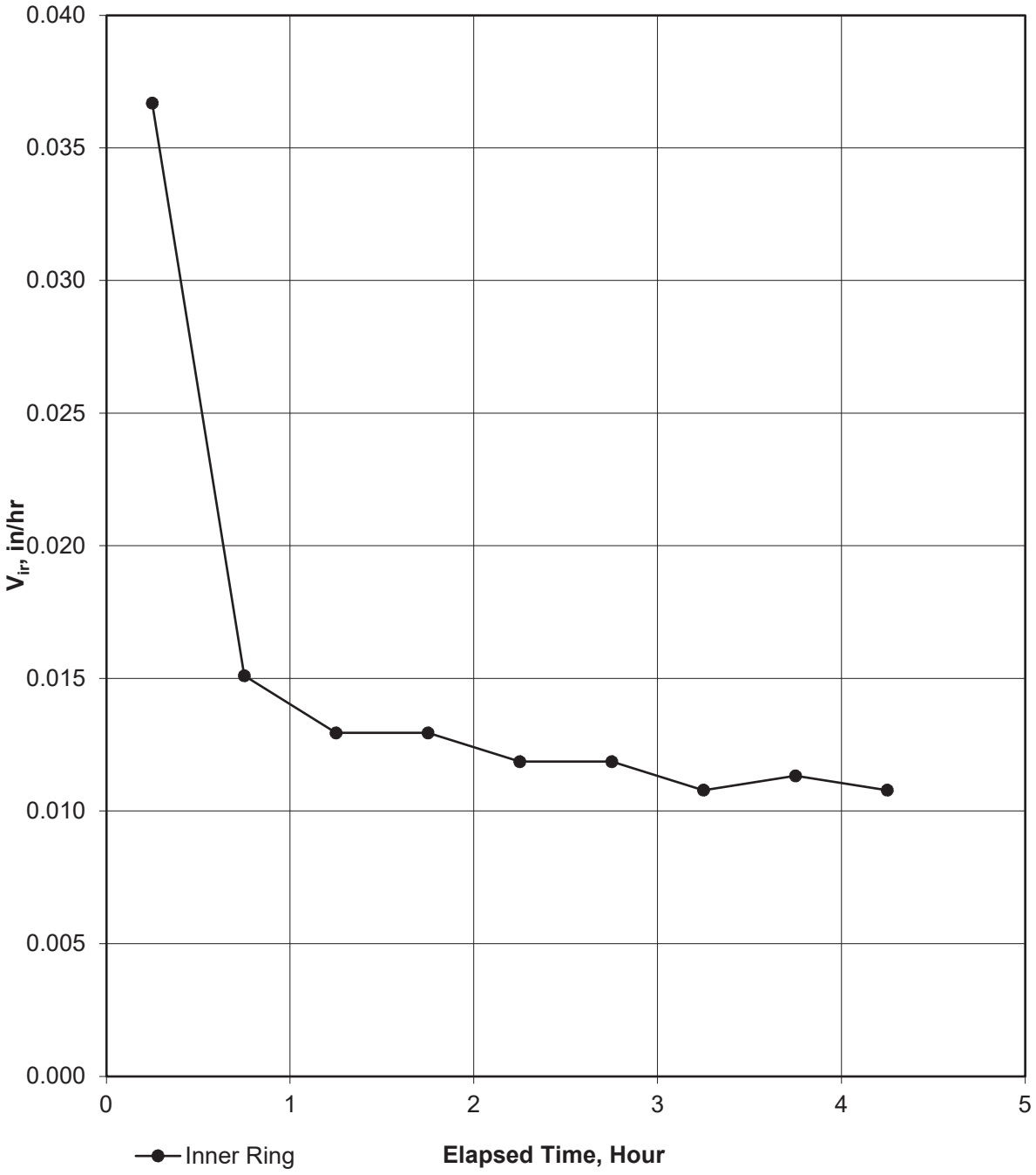
Additional Comments: Sunny; no cloud cover.

Time Interval	Time (hr.:min.)	Δt min. / total	Small Marriotte		Large Marriotte		Ambient Air Temp (◦F)†	Infiltration Rate, I**		Remarks
			Volume (V, cm^3)	ΔV (test & total)	Height (H, cm)	ΔH (test & total)		Inner (in./hr.)	Outer (in./hr.)	
1 - Start	11:30 AM	15	67	17	55.5	7.5	75	0.04	0.97	
End	11:45 AM		50		48.0		75			
2 - Start	11:45 AM	30	50	14	48.0	14.5	75	0.02	0.93	
End	12:15 PM		36		33.5		75			
3 - Start	12:15 PM	30	36	12	33.5	14	75	0.01	0.90	
End	12:45 PM		24		19.5		75			
4 - Start	12:45 PM	30	88	12	59.0	13.5	76	0.01	0.87	
End	1:15 PM		76		45.5		76			
5 - Start	1:15 PM	30	32.5	11	45.5	12.5	78	0.01	0.80	
End	1:45 PM		21.5		33.0		78			
6 - Start	1:45 PM	30	57	11	55.5	12	78	0.01	0.77	
End	2:15 PM		46		43.5		78			
7 - Start	2:15 PM	30	35	10	43.5	11.5	78	0.01	0.74	
End	2:45 PM		25		32.0		78			
8 - Start	2:45 PM	30	25	10.5	32.0	11	78	0.01	0.71	
End	3:15 PM		14.5		21.0		78			
9 - Start	3:15 PM	30	57	10	55.0	11	78	0.01	0.71	
End	3:45 PM		47		44.0		80			

*Flow, $Q_f = \Delta H \times V_r$ **Infiltration Rate, $I = (Q_f/A_r)/\Delta t$ † Proxy for Liquid Temperature

FIGURE 9

TP-2



MEASURED INFILTRATION RATE = 0.01 IN/HR

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DOUBLE-RING INFILTROMETER TEST RESULTS

NORTH EAST CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

DEC. 2022	PROJECT NO. W1523-99-01A	FIG. 10

DOUBLE RING INFILTROMETER TEST DATA

Project Name:	Uncommon Apple Valley		Constants	Ring Data		Marriotte Tubes	
Project No.:	W1523-99-01A			Area, A_r (in^2)	Depth of Liquid (in.)	ID	Vol., V_r (in^3/in)
Test No.:	TP-3		Inner Ring:	113	7	Small	3,000 ml
Test Location:	See Figure 2		Annular Ring:	339	7	Large	60 cm
Test By: LW	USCS Class: SM						
Water Table Depth: N/A	Penetration of Rings into Soil (in.)			Inner:	2.5 in	Outer:	3 in
Date of Test: 11/10/2022	Liquid Used: Water	pH:		Ground Temp (◦F):		at Depth: 5'	

Liquid level maintained by using small Marriotte tube for inner ring; large Marriotte tube for annular ring.

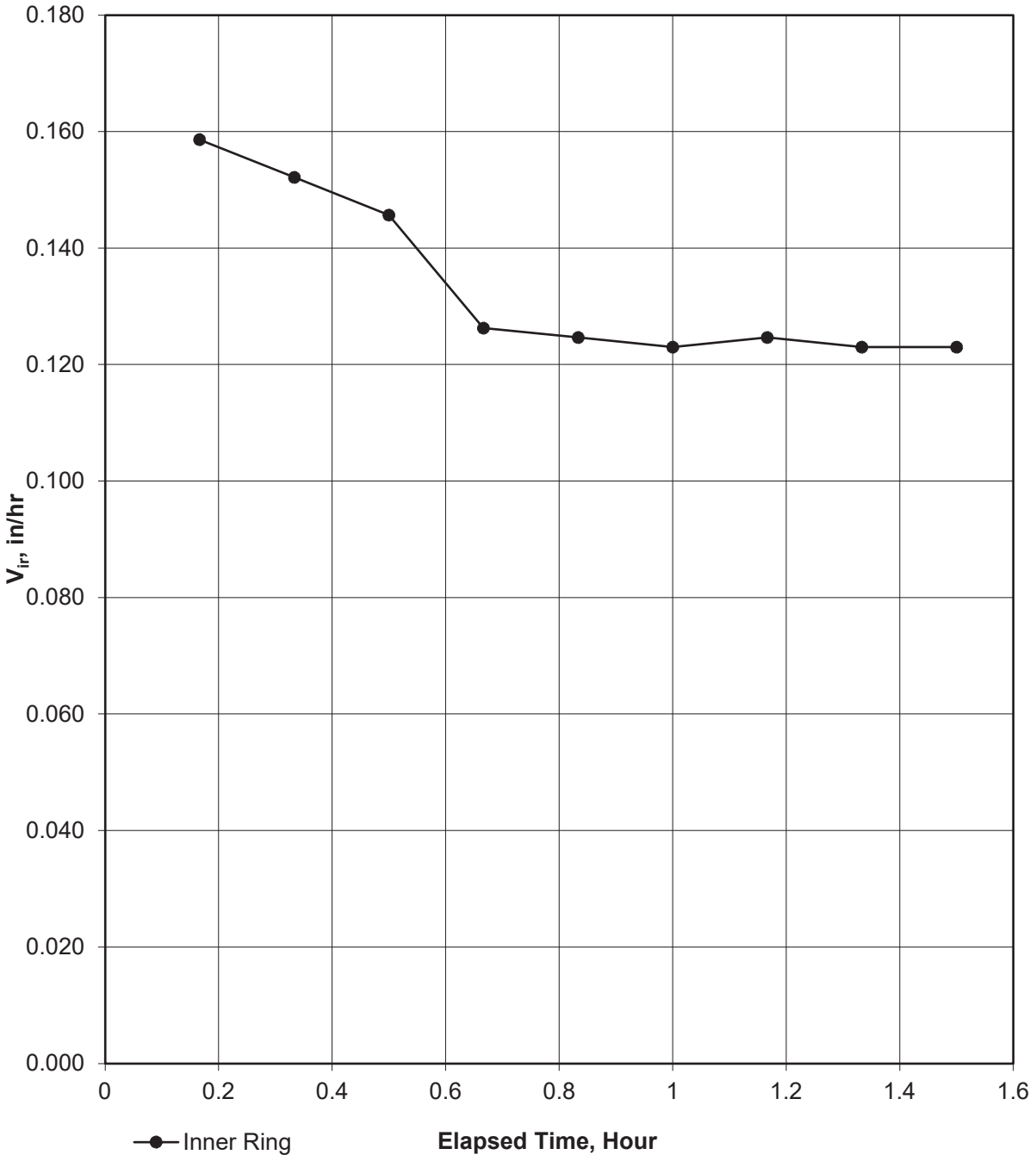
Additional Comments: Sunny; no cloud cover.

Time Interval	Time (hr.:min.)	Δt min. / total	Small Marriotte		Large Marriotte		Ambient Air Temp (◦F)†	Infiltration Rate, I**		Remarks
			Volume (V, cm^3)	ΔV (test & total)	Height (H, cm)	ΔH (test & total)		Inner (in./hr.)	Outer (in./hr.)	
1 - Start	7:50 AM	10	57.5	49	58.0	25.5	75	0.16	4.93	
End	8:00 AM		8.5		32.5		75			
2 - Start	8:00 AM	10	57.5	47	32.5	24.7	75	0.15	4.77	
End	8:10 AM		10.5		7.8		75			
3 - Start	8:10 AM	10	57.5	45	58.0	24	75	0.15	4.64	
End	8:20 AM		12.5		34.0		75			
4 - Start	8:20 AM	10	57.5	39	34.0	24	76	0.13	4.64	
End	8:30 AM		18.5		10.0		76			
5 - Start	8:30 AM	10	58.5	38.5	55.0	24.5	78	0.12	4.73	
End	8:40 AM		20		30.5		78			
6 - Start	8:40 AM	10	59	38	30.5	24.5	78	0.12	4.73	
End	8:50 AM		21		6.0		78			
7 - Start	8:50 AM	10	58.5	38.5	58.0	24.5	78	0.12	4.73	
End	9:00 AM		20		33.5		78			
8 - Start	9:00 AM	10	58	38	32.5	24	78	0.12	4.64	
End	9:10 AM		20		8.5		78			
9 - Start	9:10 AM	10	60	38	57.0	24	78	0.12	4.64	
End	9:20 AM		22		33.0		80			

*Flow, $Q_f = \Delta H \times V_r$ **Infiltration Rate, $I = (Q_f/A_r)/\Delta t$ † Proxy for Liquid Temperature

FIGURE 11

TP-3



MEASURED INFILTRATION RATE = 0.12 IN/HR

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DOUBLE-RING INFILTROMETER TEST RESULTS

NORTH EAST CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

DEC. 2022	PROJECT NO. W1523-99-01A	FIG. 12

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The site was explored on November 1 and 2, 2022, by excavating ten 8-inch diameter borings to depths ranging from approximately 14½ to 49½ feet below the existing ground surface utilizing a truck-mounted hollow-stem auger drilling machine. Also, three test pits were excavated on November 9, 2022, using a rubber-tired backhoe to depths ranging from 4½ to 5½ feet below existing grade. Representative and relatively undisturbed samples were obtained by driving a 3-inch O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a 140-pound auto-hammer falling 30 inches. The California Modified Sampler was equipped with 1-inch high by 2⅜-inch diameter brass rings to facilitate soil removal and testing. Standard Penetration Tests (SPT's) were obtained in boring B6. Bulk samples were also obtained.

The soil conditions encountered in the borings and test pits were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The boring and test pit logs are presented on Figures A1 through A13. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the log using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the logs were revised based on subsequent laboratory testing. The locations of the borings and test pits are shown on Figure 2.

PROJECT NO. W1523-99-01A

BORING 1

ELEV. (MSL.) -- DATE COMPLETED **11/01/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**OLDER ALLUVIUM** Silty Sand, poorly graded, loose, dry, yellowish reddish brown, fine- to medium-grained.			
2				SM				
	B1@3'				- very dense, slightly moist, light reddish brown, fine- to medium-grained, trace coarse-grained	50 (5")	108.2	3.0
4					Sand, poorly graded, very dense, slightly moist, yellowish brown, fine- to medium-grained, some coarse-grained and silt.			
	B1@5'					70	126.7	2.8
6	B1@6.5'				- trace silt, highly cemented	50 (6")	110.0	1.5
8				SP				
	B1@9'				- yellowish to light reddish brown, some silt	50 (6")	115.2	3.5
10								
12					Silty Sand, poorly graded, very dense, slightly moist, yellowish brown to light reddish brown, fine- to medium-grained, trace coarse-grained, cemented.			
14	B1@14'					50 (6")	111.9	4.4
16				SM				
18								
	B1@19'				- increase in sand	50 (6")	108.4	6.8

Total depth of boring: 19.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1523-99-01 BORING LOGS.GPJ

Figure A1,
Log of Boring 1, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

BORING 2

ELEV. (MSL.) -- DATE COMPLETED **11/01/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**OLDER ALLUVIUM**			
					Silty Sand, poorly graded, loose, dry, yellowish to reddish brown, fine- to medium-grained.			
2								
				SM				
4								
	B2@5'				- dense, slightly moist, light reddish brown, some coarse-grained	70	116.8	4.2
6								
	B2@6.5'				- very dense, yellowish to reddish brown, slight porosity, needle pin pores	50 (5")	116.1	2.1
8								
	B2@9'				Sand, poorly graded, very dense, slightly moist, light reddish brown, fine-to medium-grained, trace coarse-grained and silt, cemented.	50 (6")	101.8	1.6
10								
12								
				SP				
14	B2@14'				- some silt	50 (5")	111.8	2.7
16								
18								
20	B2@20'				- dense, trace silt	50	118.3	1.8
					Total depth of boring: 20.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1523-99-01 BORING LOGS.GPJ

Figure A2,
Log of Boring 2, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

BORING 3

ELEV. (MSL.) -- DATE COMPLETED **11/01/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**OLDER ALLUVIUM** Silty Sand, poorly graded, very dense, slightly moist, light yellowish to reddish brown, fine- to medium-grained, cemented.			
2								
4	B3@3'					50 (2")	118.7	4.5
6								
8	B3@6.5'				- some coarse-grained	50 (6")	117.3	2.9
10	B3@9'			SM	- light reddish brown	50 (5")	102.8	5.3
12								
14	B3@14'				- increase in silt	50 (6")	105.1	7.3
16								
18								
	B3@19'				- white chalky carbonate staining	50 (6")	107.1	7.7

Total depth of boring: 19.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1523-99-01 BORING LOGS.GPJ

Figure A3,
Log of Boring 3, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

BORING 4

ELEV. (MSL.) -- DATE COMPLETED **11/01/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**OLDER ALLUVIUM**			
2				SM	Silty Sand, poorly graded, dense, slightly moist, reddish brown to yellowish brown, fine-grained, trace coarse-grained.			
4	B4@3'					75	108.3	5.0
6					Sand, poorly graded, very dense, slightly moist, light reddish brown, fine- to medium-grained, trace silt, cemented.			
8	B4@6.5'					50 (6")	114.9	1.6
10	B4@9'			SP	- reddish brown, trace coarse-grained	50 (6")	103.9	5.9
12								
14	B4@14'				- dry, light brown to reddish brown, trace silt	50 (4")	101.1	3.9
16								
18								
	B4@19'				- light brown to light reddish brown	50 (4")	106.0	5.3

Total depth of boring: 19.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1523-99-01 BORING LOGS.GPJ

Figure A4,
Log of Boring 4, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

BORING 5

ELEV. (MSL.) -- DATE COMPLETED **11/01/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**OLDER ALLUVIUM** Silty Sand, poorly graded, loose, dry, yellowish reddish brown, fine- to medium-grained.			
2					Sand with Silt, poorly graded, dense, dry, light tan brown, fine- to medium-grained.			
4	B5@3'					71	120.0	2.8
6	B5@6.5'				- very dense, trace coarse-grained, cemented	50 (6")	117.2	2.3
8	B5@9'			SP-SM	- slightly moist, reddish brown	50 (3")	112.2	3.1
10								
12								
14	B5@14'				- light brown to reddish brown with white chalky carbonate staining	50 (5")	105.5	3.1
16								
18				SM	Silty Sand, poorly graded, very dense, light brown, fine- to medium-grained.			
	B5@19'					50 (6")	100.2	7.9

Total depth of boring: 19.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1523-99-01 BORING LOGS.GPJ

Figure A5,
Log of Boring 5, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

BORING 6

ELEV. (MSL.) -- DATE COMPLETED **11/01/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**OLDER ALLUVIUM** Silty Sand, poorly graded, loose, dry, yellowish to light reddish brown, fine- to medium-grained.			
2								
4	B6@4'			SM	- increase in sand, very dense, slightly moist, light reddish brown, cemented	50 (6")	109.1	2.8
6								
8					Sand, poorly graded, dense, slightly moist, light reddish brown, fine- to medium-grained, trace silt.			
10	B6@9.5'					35		
12								
14	B6@14'			SP	- very dense, light brown to light reddish brown, some silt, trace coarse-grained, cemented	50 (5")	102.4	7.2
16								
18					- cobble			
20	B6@19.5'				- medium dense, cemented	26		
22								
24	B6@24'				Silty Sand, poorly graded, very dense, slightly moist, light reddish brown, cemented.	50 (4")	102.2	5.5
26				SM				
28								

W1523-99-01 BORING LOGS.GPJ

Figure A6,
Log of Boring 6, Page 1 of 2

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

BORING 6

ELEV. (MSL.) -- DATE COMPLETED **11/01/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B6@29.5'			SM	- medium dense	20		
32								
34	B6@34'				Sand, poorly graded, very dense, grayish brown, some fine gravel fragments, moderately cemented.	50 (3")	108.3	3.7
36								
38								
40	B6@39.5'			SP		53		
42								
44	B6@44'				- light brown	50 (5")	118.4	3.3
46								
48								
50	B6@49.5'				- some coarse-grained	50 (4")		

Total depth of boring: 50.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1523-99-01 BORING LOGS.GPJ

Figure A6,
Log of Boring 6, Page 2 of 2

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

BORING 7

ELEV. (MSL.) -- DATE COMPLETED **11/01/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**OLDER ALLUVIUM**			
					Silty Sand, poorly graded, loose, dry, yellowish to reddish brown, fine- to medium-grained.			
2				SM				
	B7@3'				- very dense, slightly moist, light reddish brown, fine- to medium-grained, trace coarse-grained, moderately cemented	50 (4")	101.7	5.4
4								
					Sand, poorly graded, very dense, slightly moist, light reddish brown, fine- to medium-grained, some coarse-grained and silt, moderately cemented.			
6	B7@6'					50 (6")	109.1	6.0
8								
	B7@9'				- decrease in silt	50 (6")	98.3	6.1
10								
				SP				
12								
14								
	B7@14.5'				- light reddish brown	50 (4")	111.0	6.2
16								
18								
	B7@19.5'				- trace coarse-grained	50 (3")	96.3	6.8
20					Total depth of boring: 20 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped.			

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.

NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1523-99-01 BORING LOGS.GPJ

Figure A7,
Log of Boring 7, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

BORING 8

ELEV. (MSL.) -- DATE COMPLETED **11/02/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**OLDER ALLUVIUM**			
					Silty Sand, poorly graded, loose, dry, yellowish to reddish brown.			
2				SM				
4	B8@3.5'				- moderately cemented	50 (6")	108.4	5.0
6					Sand, poorly graded, dense, slightly moist, light reddish brown, fine- to medium-grained, trace coarse-grained.			
	B8@7'			SP		75	114.6	1.4
8								
	B8@9'				Silty Sand, poorly graded, very dense, slightly moist, light brown, fine- to medium-grained, trace coarse-grained, highly cemented.	50 (3")	109.4	2.8
10								
12								
				SM				
14	B8@14'					50 (6")	106.2	8.2
16								
18								
	B8@19'				- moderately cemented, light brown, some white carbonate staining	50 (4")	104.1	4.5
					Total depth of boring: 19.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1523-99-01 BORING LOGS.GPJ

Figure A8,
Log of Boring 8, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

BORING 9

ELEV. (MSL.) -- DATE COMPLETED **11/02/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**OLDER ALLUVIUM** Silty Sand, poorly graded, medium dense, dry, yellowish brown to light reddish brown, fine- to medium-grained.			
2								
4	B9@3'			SM		31	111.5	2.6
6	B9@6'				- increase in sand, very dense, light reddish brown, trace coarse-grained, highly cemented	50 (4")	101.6	4.1
8								
10	B9@9'				Sand, poorly graded, very dense, light reddish brown, fine- to medium-grained, trace coarse-grained and silt, moderately cemented.	50 (6")	105.0	4.8
12				SP				
14	B9@14'				- some silt	50 (5")	96.7	8.1
16								
18								
	B9@19'				- some coarse-grained	50 (6")	116.2	6.0

Total depth of boring: 19.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1523-99-01 BORING LOGS.GPJ

Figure A9,
Log of Boring 9, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

BORING 10

ELEV. (MSL.) -- DATE COMPLETED **11/02/2022**

EQUIPMENT **HOLLOW STEM AUGER** BY: **MR**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**OLDER ALLUVIUM** Silty Sand, poorly graded, loose, dry, yellowish to reddish brown, fine- to medium-grained.			
2								
4	B10@3.5'			SM	- very dense, slightly moist, light reddish brown, trace coarse-grained, root, moderately cemented	50 (4")	101.1	5.2
6	B10@6'				- increase in sand	50 (5")	104.1	4.0
8					Sand, poorly graded, very dense, slightly moist, light reddish brown, fine- to medium-grained, some coarse-grained, trace silt, moderately cemented.			
10	B10@10'			SP		50 (5")	117.5	1.5
12								
14	B10@14'				- some silt	50 (3")	104.8	2.8
					Total depth of boring: 14.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1523-99-01 BORING LOGS.GPJ

Figure A10,
Log of Boring 10, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TEST PIT TP1 ELEV. (MSL.) -- DATE COMPLETED 11/09/2022 EQUIPMENT BACKHOE BY: ATS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**OLDER ALLUVIUM** Silt, very loose, moist, grayish brown, fine- to medium-grained, trace coarse-grained, rootlets (upper 6").			
2				SP-SM	Sand with Silt, dense to very dense, slightly moist, light reddish brown, fine- to medium-grained, some coarse-grained, some calcium carbonate staining, some granite clasts (to 2"), porous, some cobbles.			
4					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1523-99-01 BORING LOGS.GPJ

Figure A11,
Log of Test Pit TP1, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◹ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

TEST PIT TP2

ELEV. (MSL.) -- DATE COMPLETED **11/09/2022**

EQUIPMENT **BACKHOE** BY: **ATS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**OLDER ALLUVIUM** Silty Sand, very loose, moist, grayish brown to reddish brown, fine- to medium-grained, some coarse-grained, rootlets (upper 1").			
2				SP-SM	Sand with Silt, dense to very dense, light reddish brown to white, fine- to medium-grained, some coarse-grained, some calcium carbonate staining and stringers, porous, some cobbles.			
4					Total depth of boring: 4.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1523-99-01 BORING LOGS.GPJ

Figure A12,
Log of Test Pit TP2, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1523-99-01A

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TEST PIT TP3 ELEV. (MSL.) -- DATE COMPLETED 11/09/2022 EQUIPMENT BACKHOE BY: ATS MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**OLDER ALLUVIUM** Sand with Silt, well-graded, very loose to loose, dry, grayish brown, fine- to coarse-grained, friable, rootlets (upper 2'), some angular gravel.			
2				SW-SM	- light yellowish brown, some cobbles			
4								
				SW	Sand, well-graded, medium dense to dense, light yellowish brown to reddish brown, fine- to coarse-grained, porous, thinly bedded, some gravel.			
					Total depth of boring: 5.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1523-99-01 BORING LOGS.GPJ

Figure A13,
Log of Test Pit TP3, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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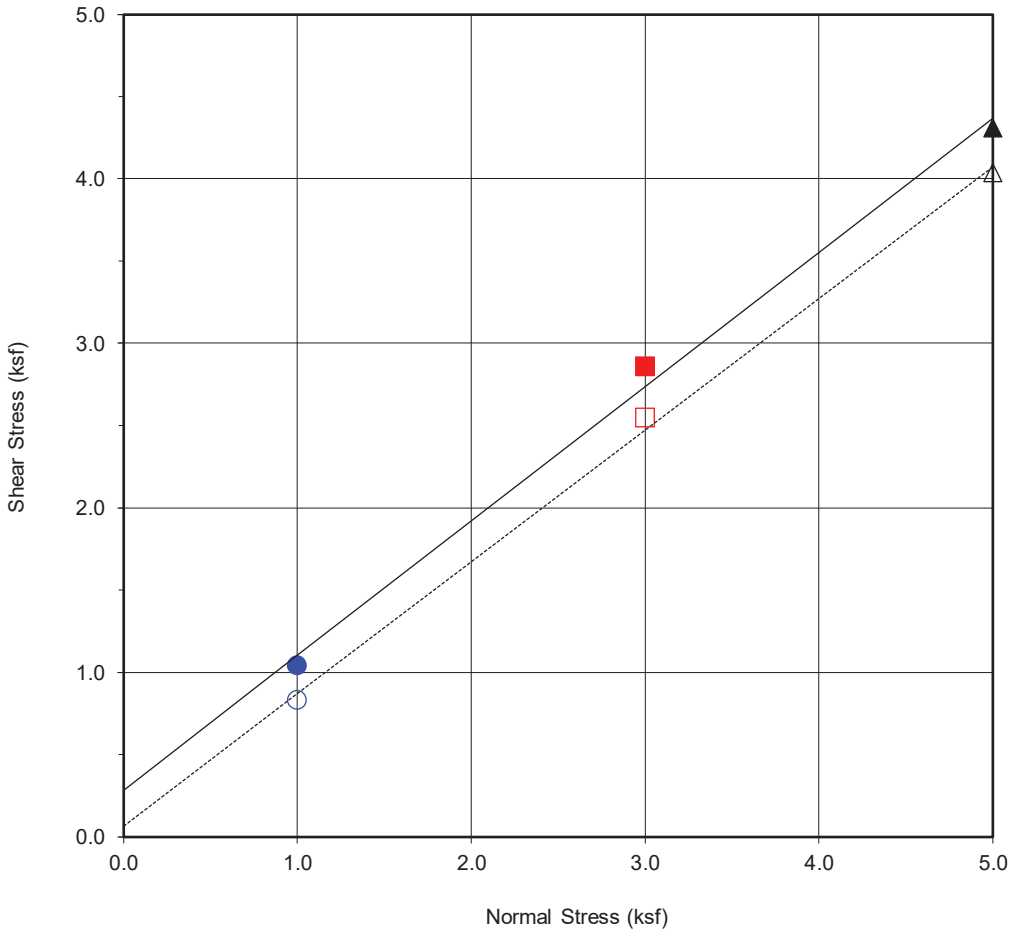
APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the "American Society for Testing and Materials (ASTM)", or other suggested procedures. Selected samples were tested for direct shear strength, moisture density relationship, maximum dry density and optimum moisture content, expansion and consolidation characteristics, corrosivity and in-place dry density and moisture content. The results of the laboratory tests are summarized in Figures B1 through B35. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.



Boring No.	**B2**
Sample No.	**B2@5'**
Depth (ft)	**5**
Sample Type:	Ring

Soil Identification:

Silty Sand (SM)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	287	39.2
Ultimate	68	38.7

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.04	■ 2.86	▲ 4.31
Shear Stress @ End of Test (ksf)	○ 0.83	□ 2.55	△ 4.04
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	4.1	5.0	4.2
Initial Dry Density (pcf)	114.5	114.6	116.3
Initial Degree of Saturation (%)	23.5	28.5	25.0
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	13.4	13.0	12.8

GEOCON

DIRECT SHEAR TEST RESULTS

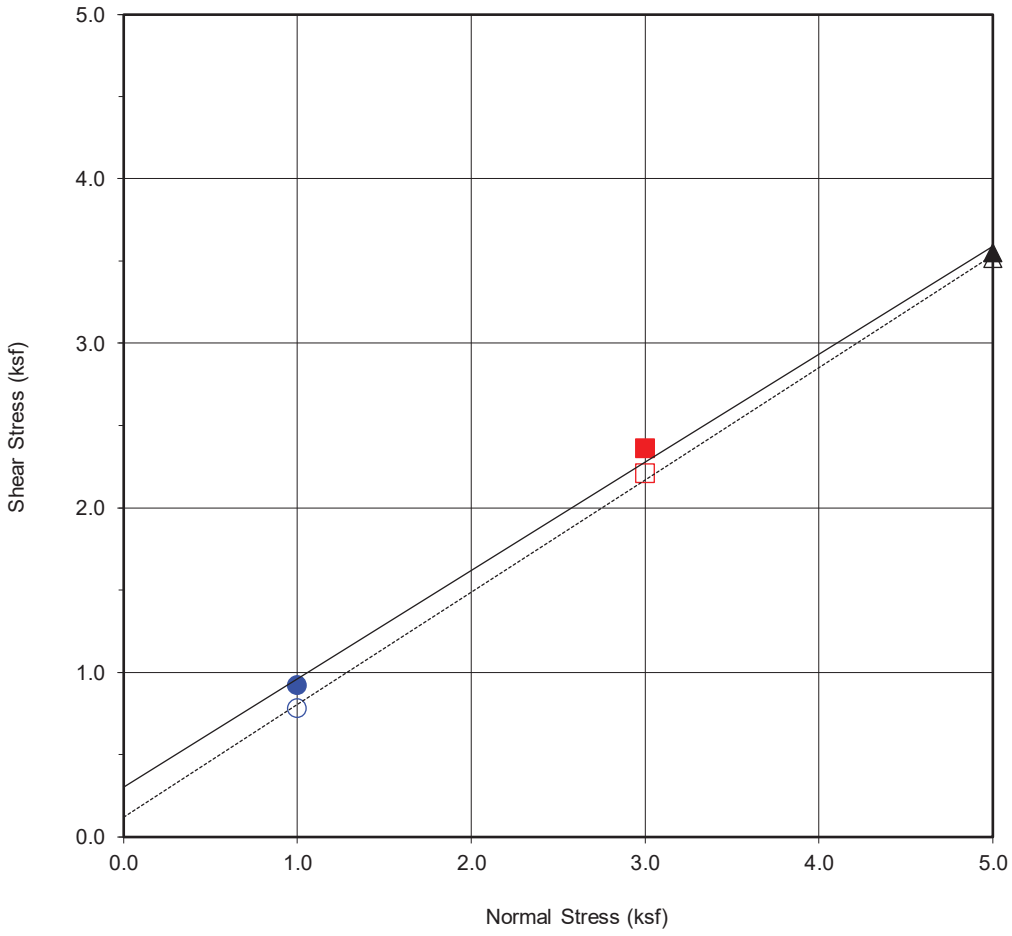
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B1



Boring No.	MIX B2 + B6
Sample No.	MIX B2+B6@0-5'
Depth (ft)	0-5'
Sample Type:	Bulk

Soil Identification:		
Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	302	33.3
Ultimate	120	34.3

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.92	■ 2.36	▲ 3.55
Shear Stress @ End of Test (ksf)	○ 0.78	□ 2.21	△ 3.51
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	7.6	7.5	7.5
Initial Dry Density (pcf)	120.0	120.0	120.0
Initial Degree of Saturation (%)	50.6	50.3	50.1
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	12.7	13.7	12.3

GEOCON

DIRECT SHEAR TEST RESULTS

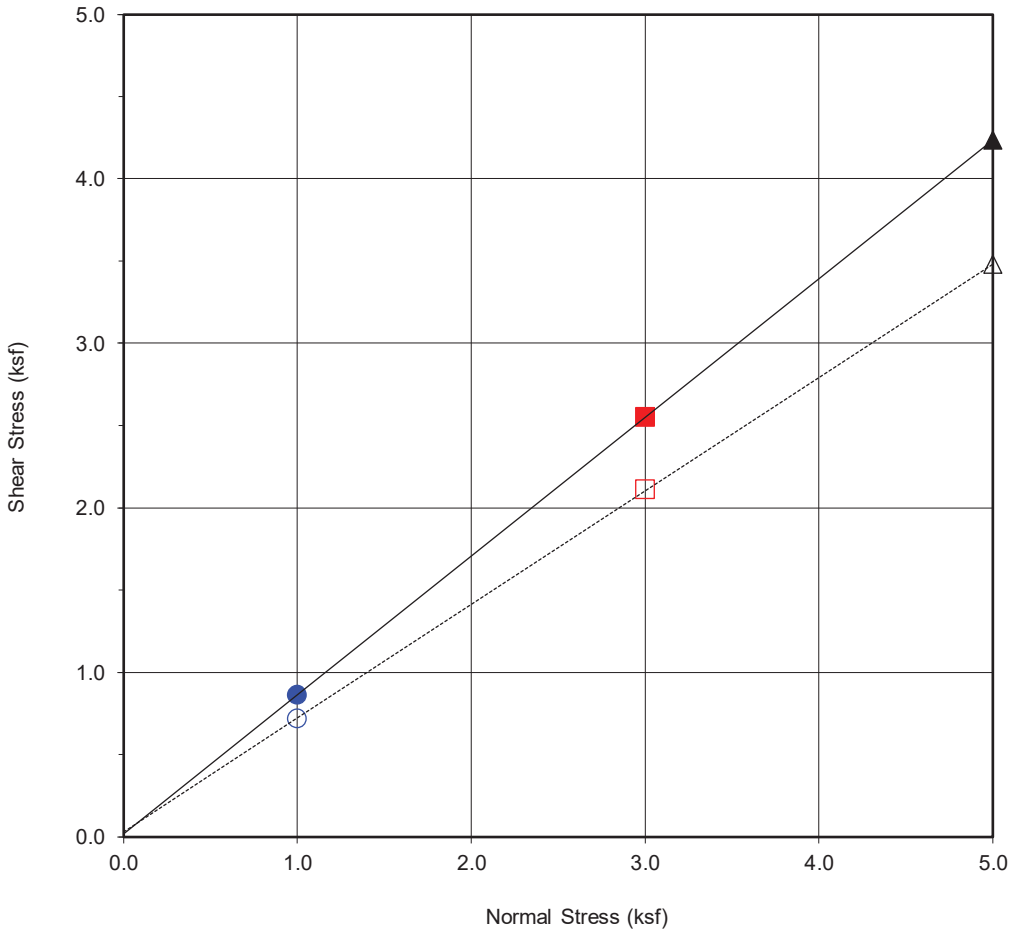
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B2



Boring No.	**B3**
Sample No.	**B3@3'**
Depth (ft)	**3**
Sample Type:	Ring

Soil Identification:		
Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	21	40.1
Ultimate	33	34.6

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.86	■ 2.55	▲ 4.24
Shear Stress @ End of Test (ksf)	○ 0.72	□ 2.11	△ 3.48
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	4.9	4.7	5.1
Initial Dry Density (pcf)	113.8	117.2	116.8
Initial Degree of Saturation (%)	27.7	28.8	31.2
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	17.1	14.4	14.9

GEOCON

DIRECT SHEAR TEST RESULTS

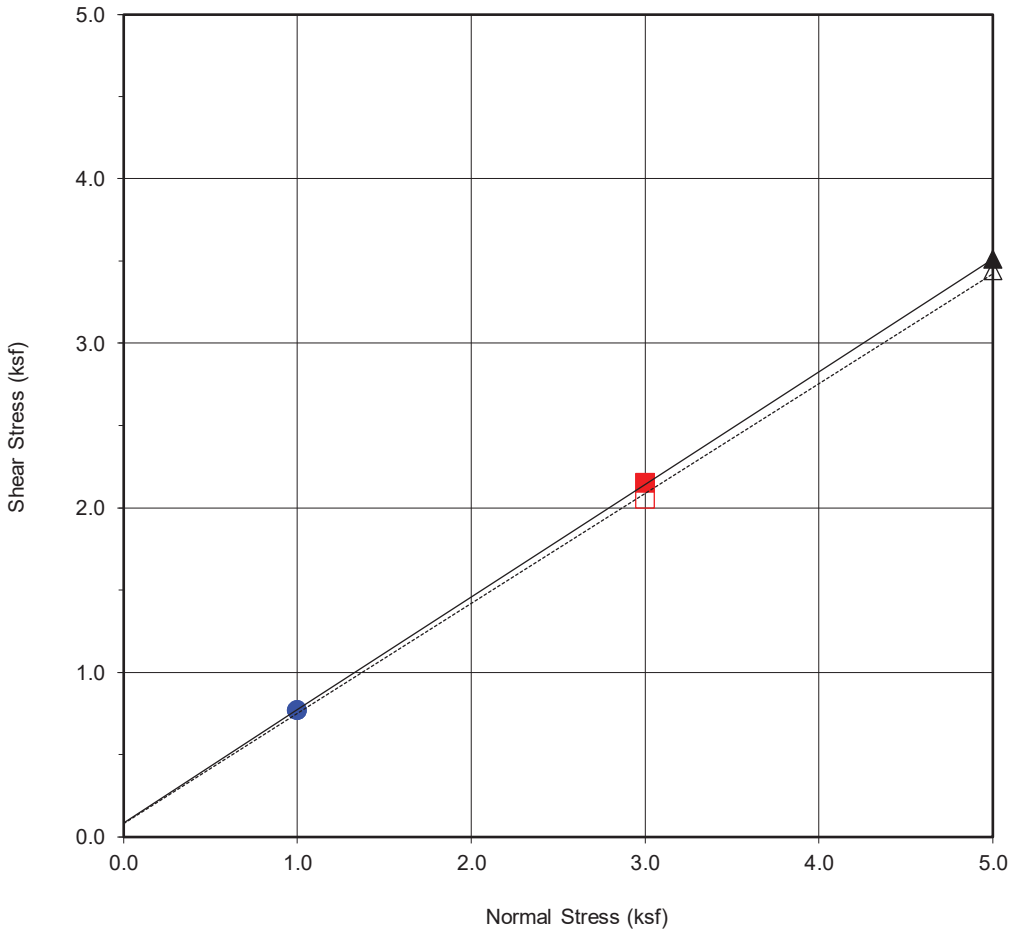
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B3



Boring No.	**B4**
Sample No.	**B4@3'**
Depth (ft)	**3**
Sample Type:	Ring

Soil Identification:		
Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	85	34.4
Ultimate	83	33.7

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.77	■ 2.15	▲ 3.51
Shear Stress @ End of Test (ksf)	○ 0.77	□ 2.05	△ 3.44
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	7.0	7.3	5.0
Initial Dry Density (pcf)	98.8	110.1	112.7
Initial Degree of Saturation (%)	26.7	37.3	27.3
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	18.4	17.2	14.8

GEOCON

DIRECT SHEAR TEST RESULTS

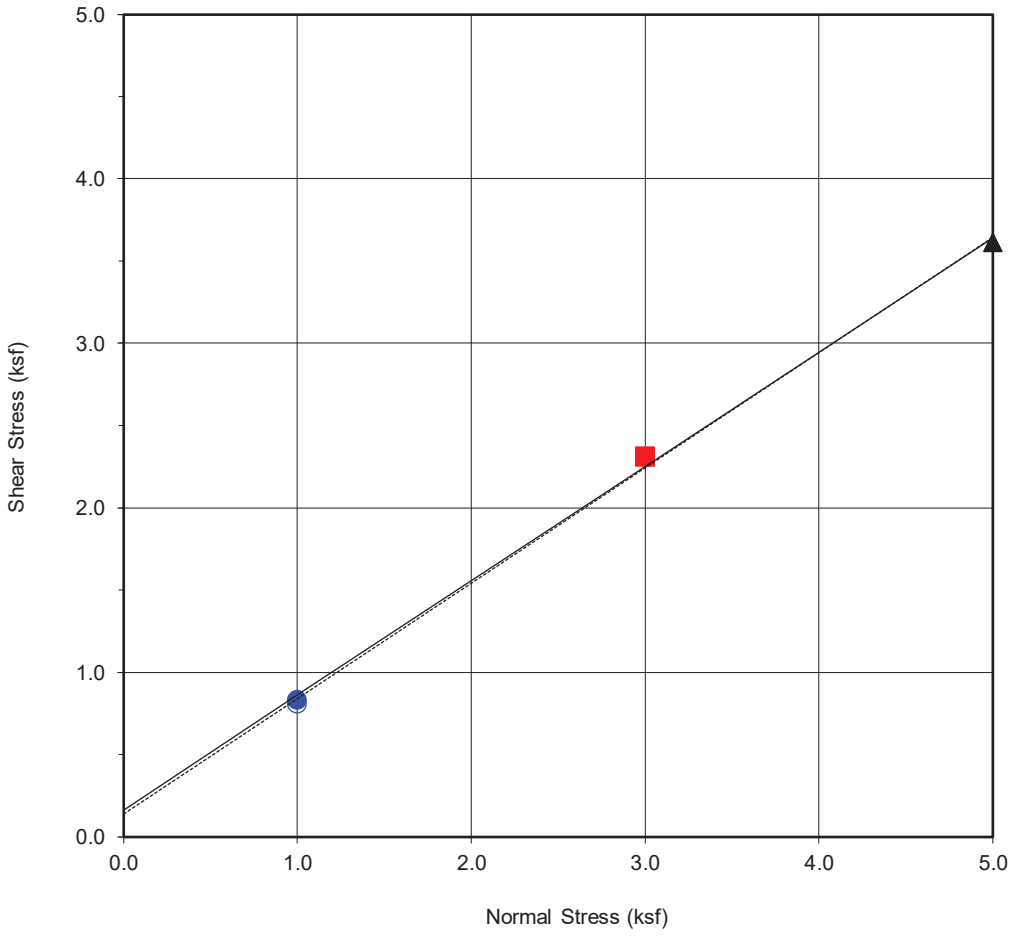
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B4



Boring No.	**B4**
Sample No.	**B4@9'**
Depth (ft)	**9**
Sample Type:	Ring

Soil Identification:		
Poorly Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	166	34.8
Ultimate	139	35.0

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.83	■ 2.31	▲ 3.61
Shear Stress @ End of Test (ksf)	○ 0.81	□ 2.31	△ 3.61
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	5.7	5.9	5.8
Initial Dry Density (pcf)	102.8	105.7	100.8
Initial Degree of Saturation (%)	24.1	26.9	23.5
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	17.4	15.8	15.5

GEOCON

DIRECT SHEAR TEST RESULTS

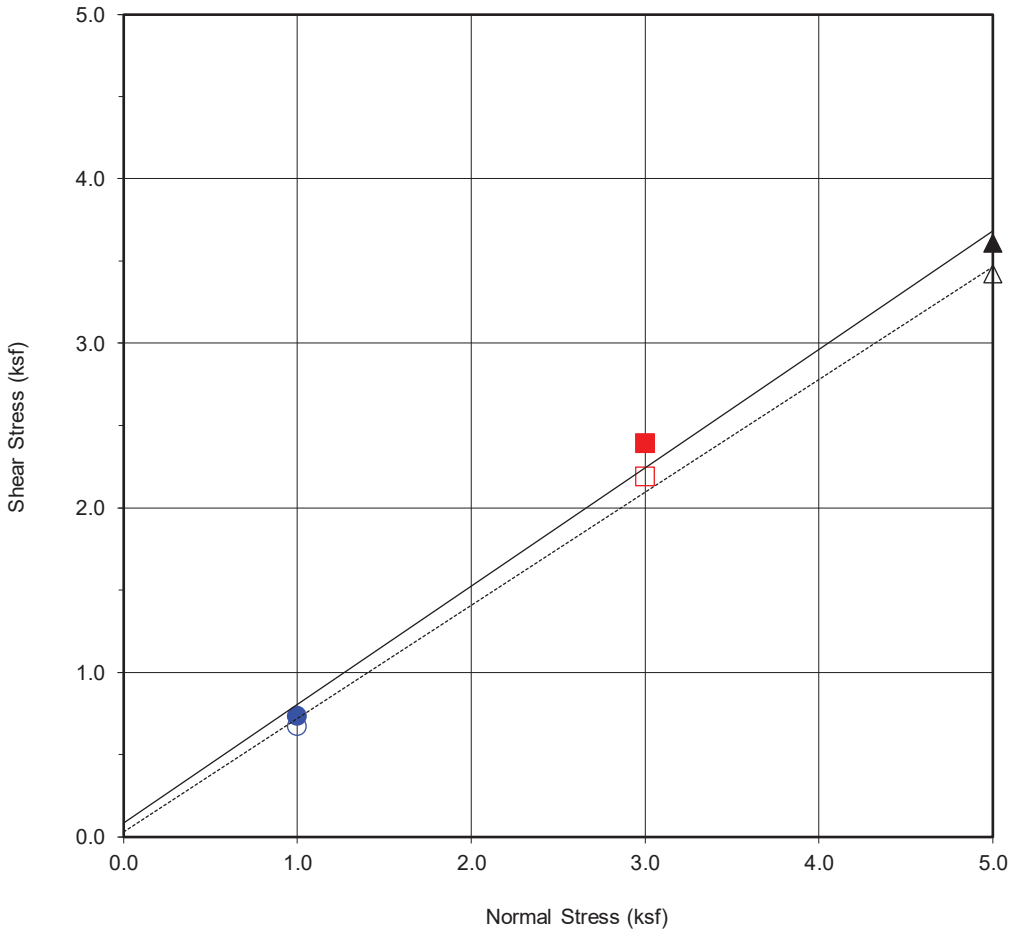
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B5



Boring No.	**B8**
Sample No.	**B8@3.5'**
Depth (ft)	**3.5**
Sample Type:	Ring

Soil Identification:		
Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	87	35.7
Ultimate	32	34.5

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.73	■ 2.39	▲ 3.61
Shear Stress @ End of Test (ksf)	○ 0.67	□ 2.19	△ 3.42
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	6.9	5.0	5.7
Initial Dry Density (pcf)	108.0	110.5	107.3
Initial Degree of Saturation (%)	33.3	25.5	27.0
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	13.8	13.6	15.2

GEOCON

DIRECT SHEAR TEST RESULTS

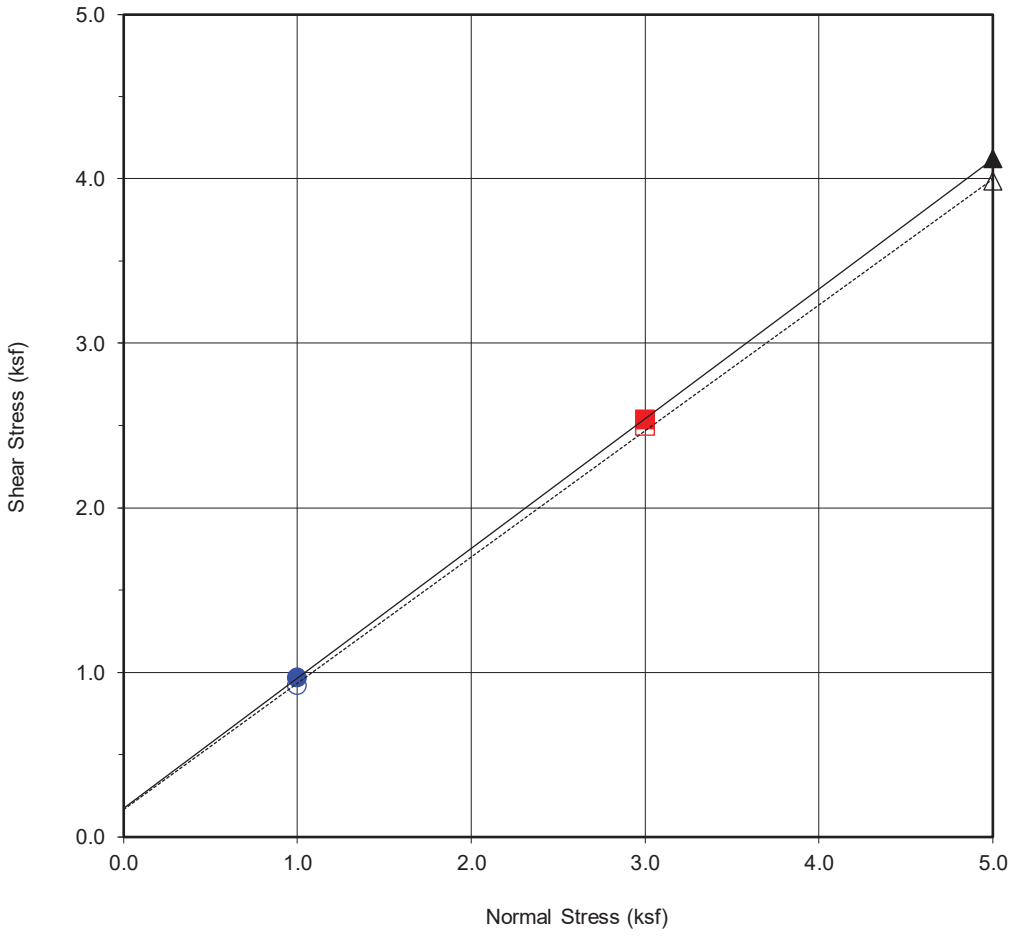
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B6



Boring No.	B9
Sample No.	B9@3'
Depth (ft)	3
Sample Type:	Ring

Soil Identification:		
Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	177	38.2
Ultimate	167	37.5

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.97	■ 2.53	▲ 4.12
Shear Stress @ End of Test (ksf)	○ 0.92	□ 2.50	△ 3.99
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	5.0	4.2	4.4
Initial Dry Density (pcf)	113.4	107.3	106.4
Initial Degree of Saturation (%)	27.9	19.8	20.4
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	13.7	14.2	14.7

GEOCON

DIRECT SHEAR TEST RESULTS

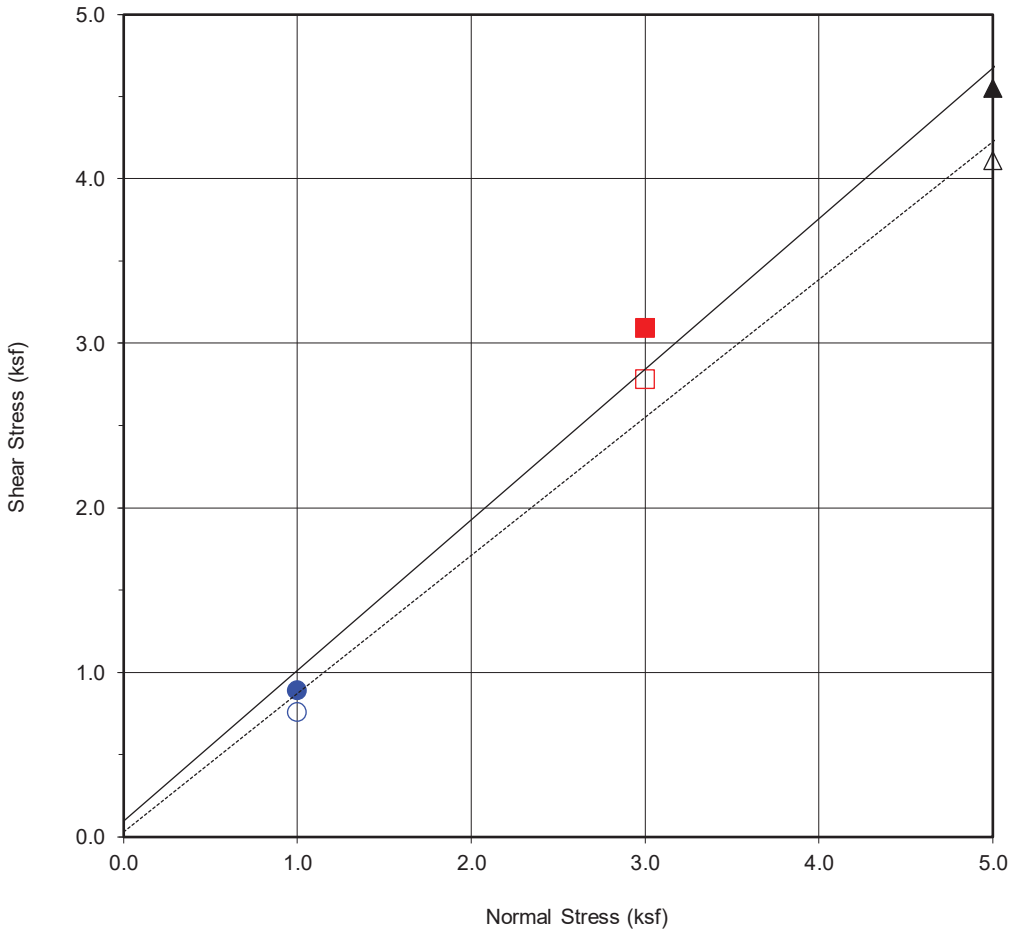
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B7



Boring No.	B9
Sample No.	B9@14'
Depth (ft)	14
Sample Type:	Ring

Soil Identification:
Poorly Graded Sand (SP)

Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	96	42.5
Ultimate	33	40.0

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.89	■ 3.09	▲ 4.55
Shear Stress @ End of Test (ksf)	○ 0.76	□ 2.78	△ 4.11
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	8.3	7.3	8.1
Initial Dry Density (pcf)	94.6	96.0	96.5
Initial Degree of Saturation (%)	28.5	26.0	29.3
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	19.7	18.6	19.4

GEOCON

DIRECT SHEAR TEST RESULTS

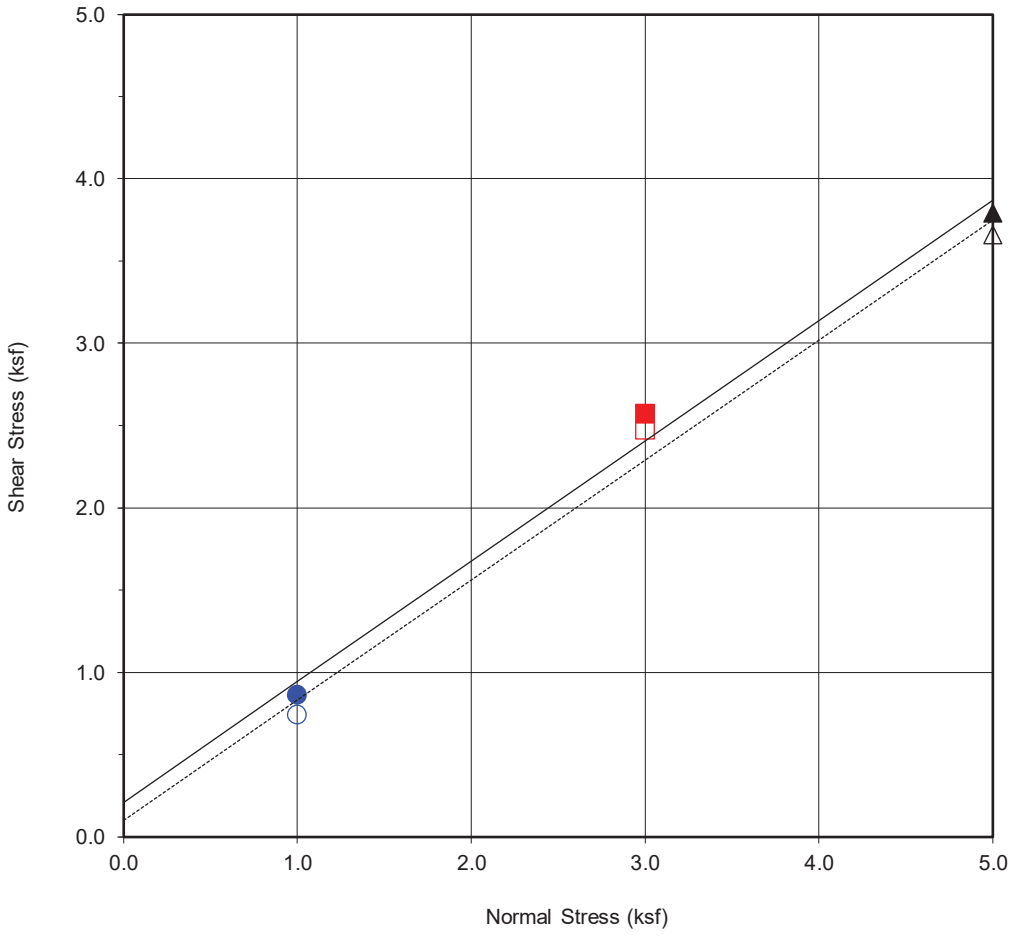
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B8



Boring No.	MIX B9 + B10
Sample No.	MIX B9+B10@0-5'
Depth (ft)	0-5'
Sample Type:	Bulk

Soil Identification:
Silty Sand (SM)

Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	212	36.2
Ultimate	101	36.1

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.86	■ 2.57	▲ 3.79
Shear Stress @ End of Test (ksf)	○ 0.74	□ 2.47	△ 3.66
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	7.5	7.6	7.6
Initial Dry Density (pcf)	120.0	120.0	120.0
Initial Degree of Saturation (%)	50.0	50.9	51.0
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	11.6	12.6	12.1

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

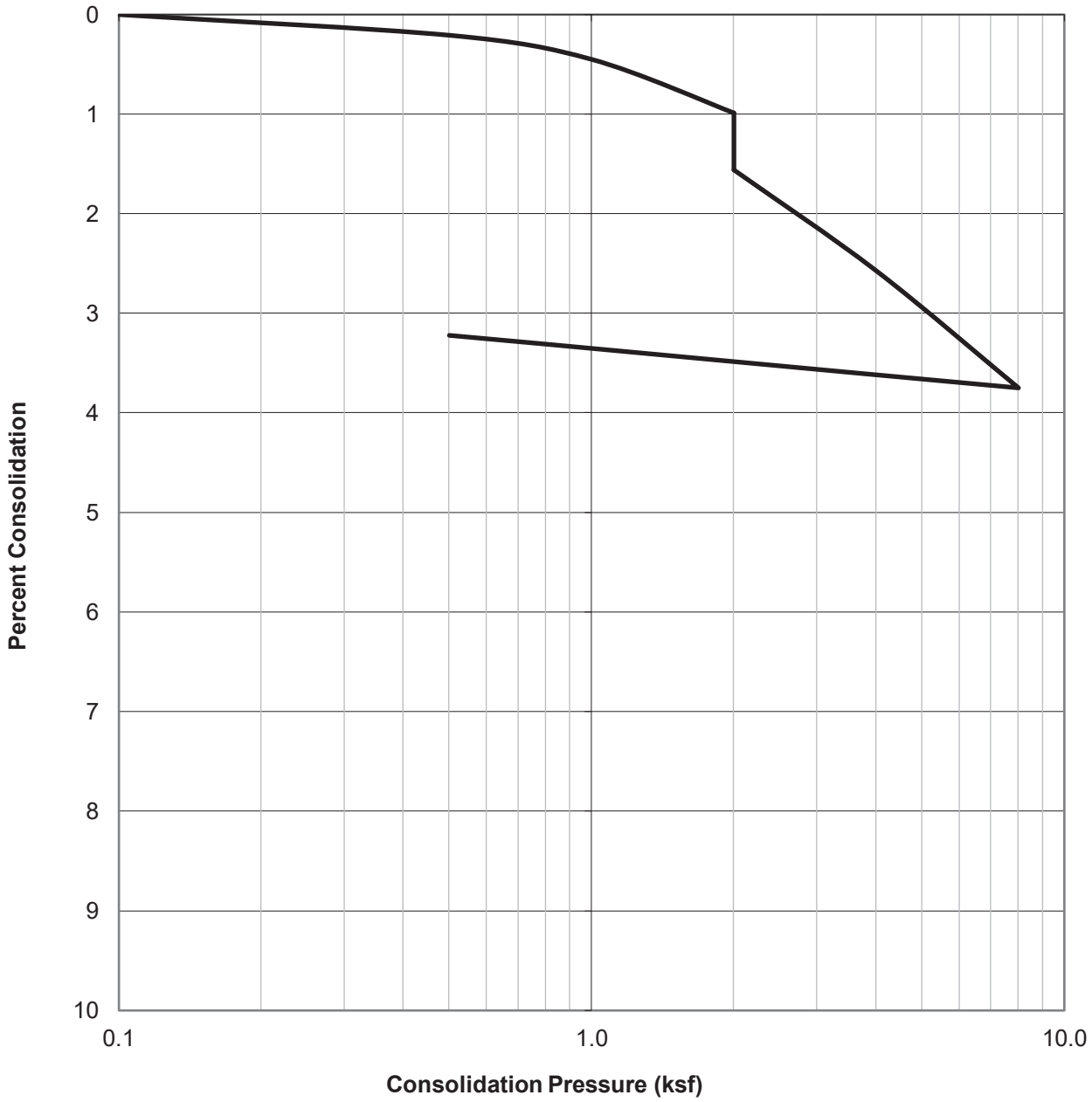
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B9

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@3	Silty Sand (SM)	111.9	3.0	12.4

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

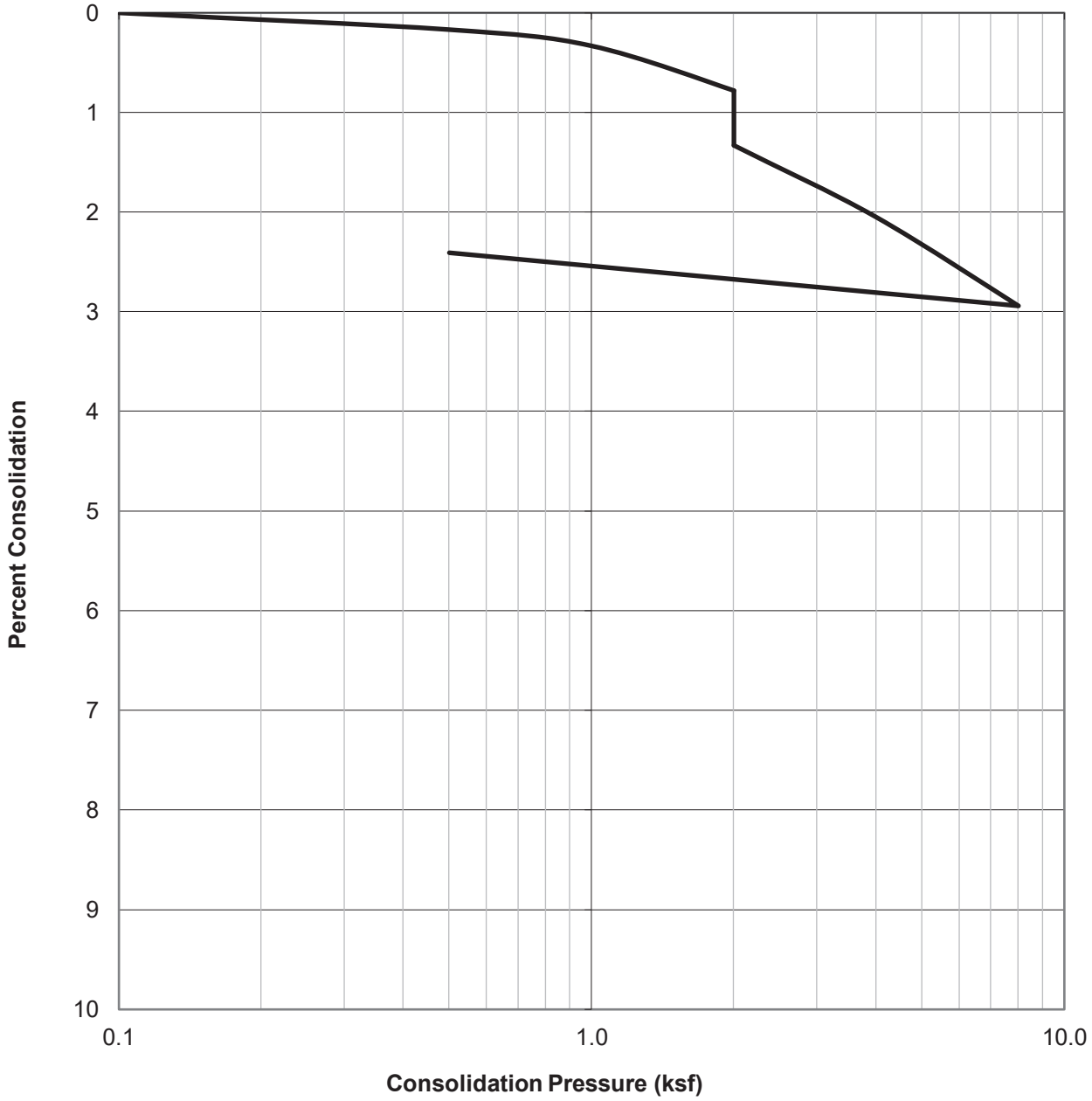
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B10

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@5	Poorly Graded Sand (SP)	119.4	2.8	11.9

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

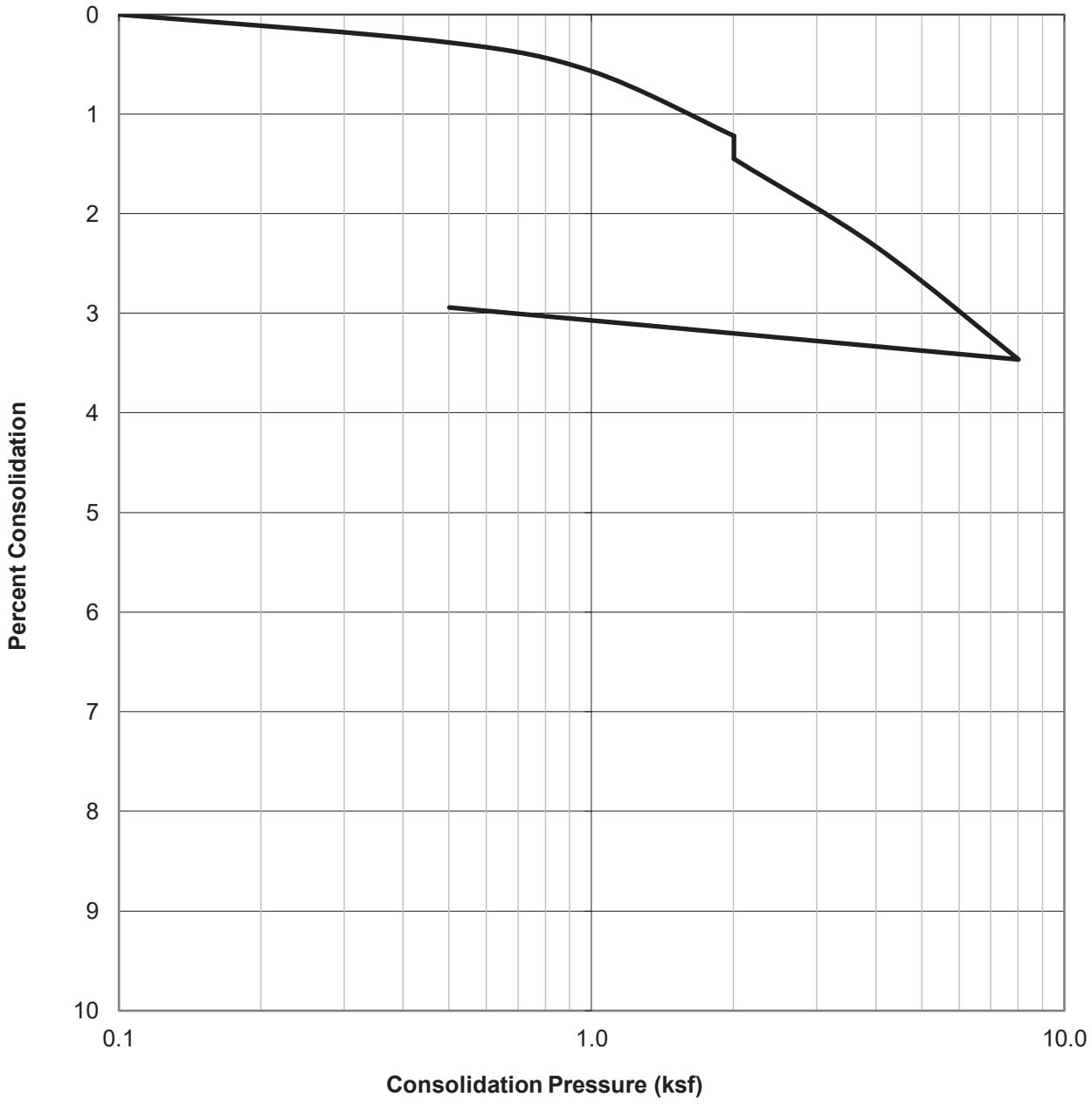
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B11

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@9	Poorly Graded Sand (SP)	109.5	3.5	13.2

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

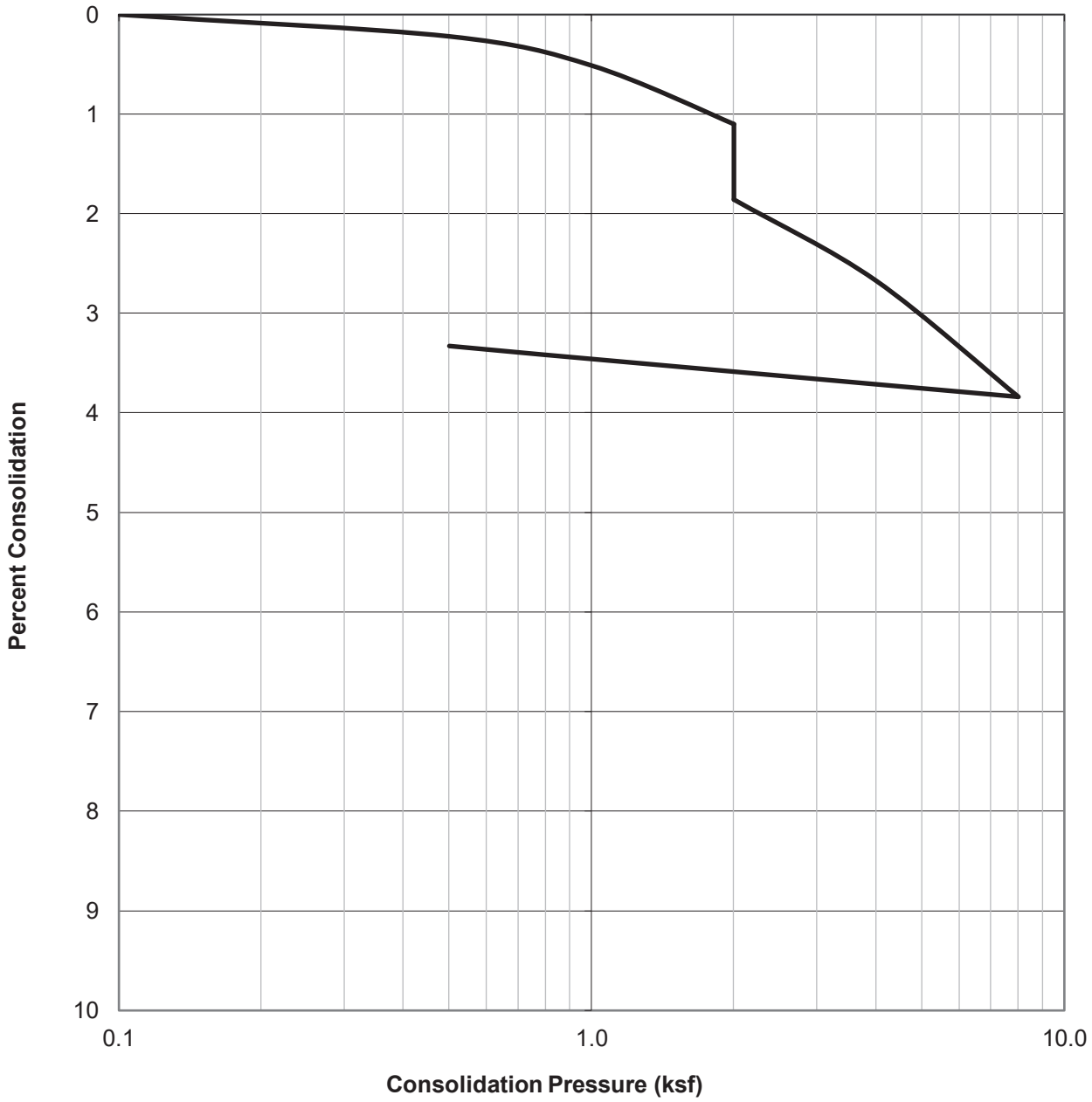
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B12

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@3	Silty Sand (SM)	111.4	4.5	13.9

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

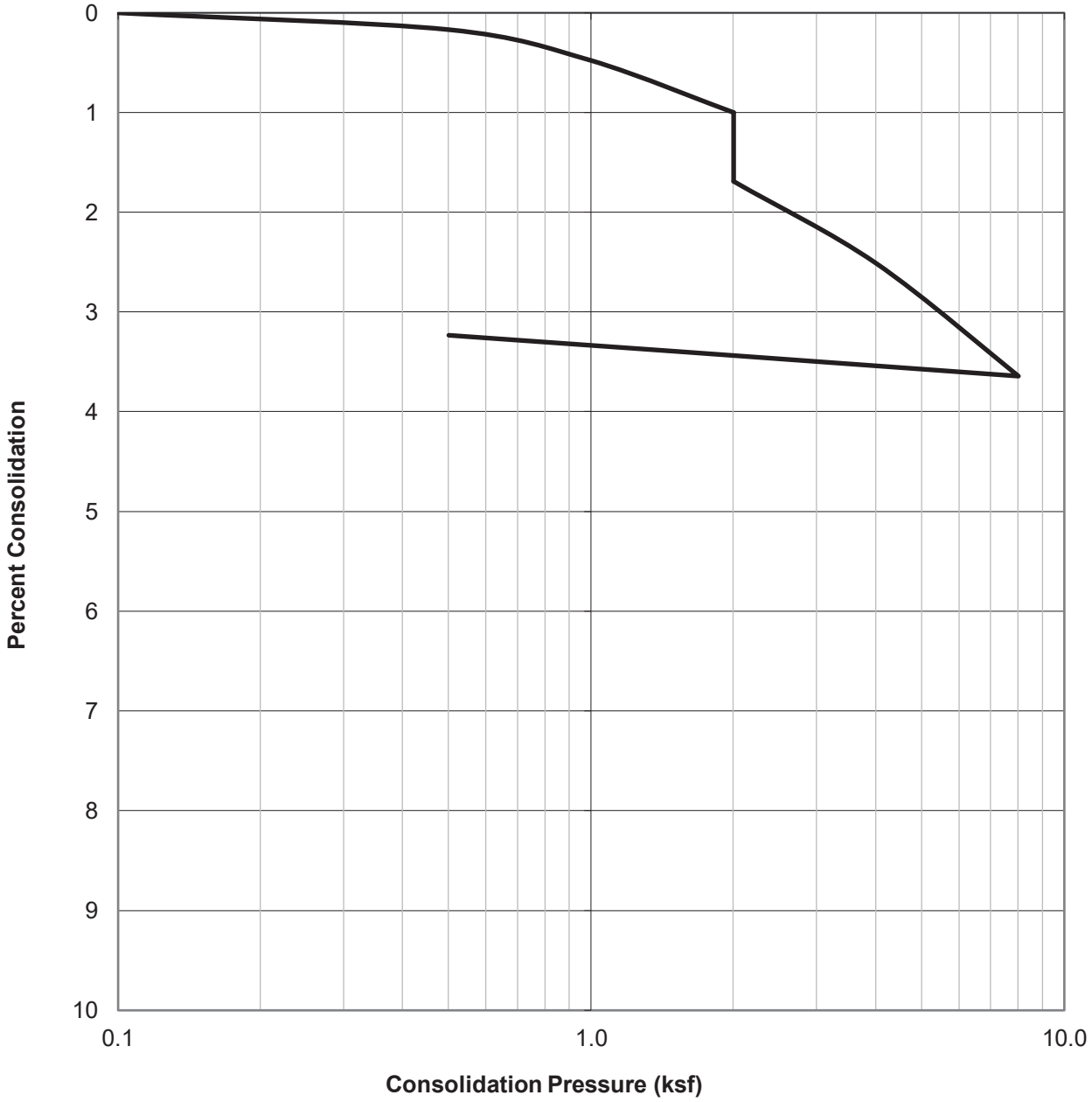
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B13

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@6.5	Silty Sand (SM)	109.5	2.9	12.3

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

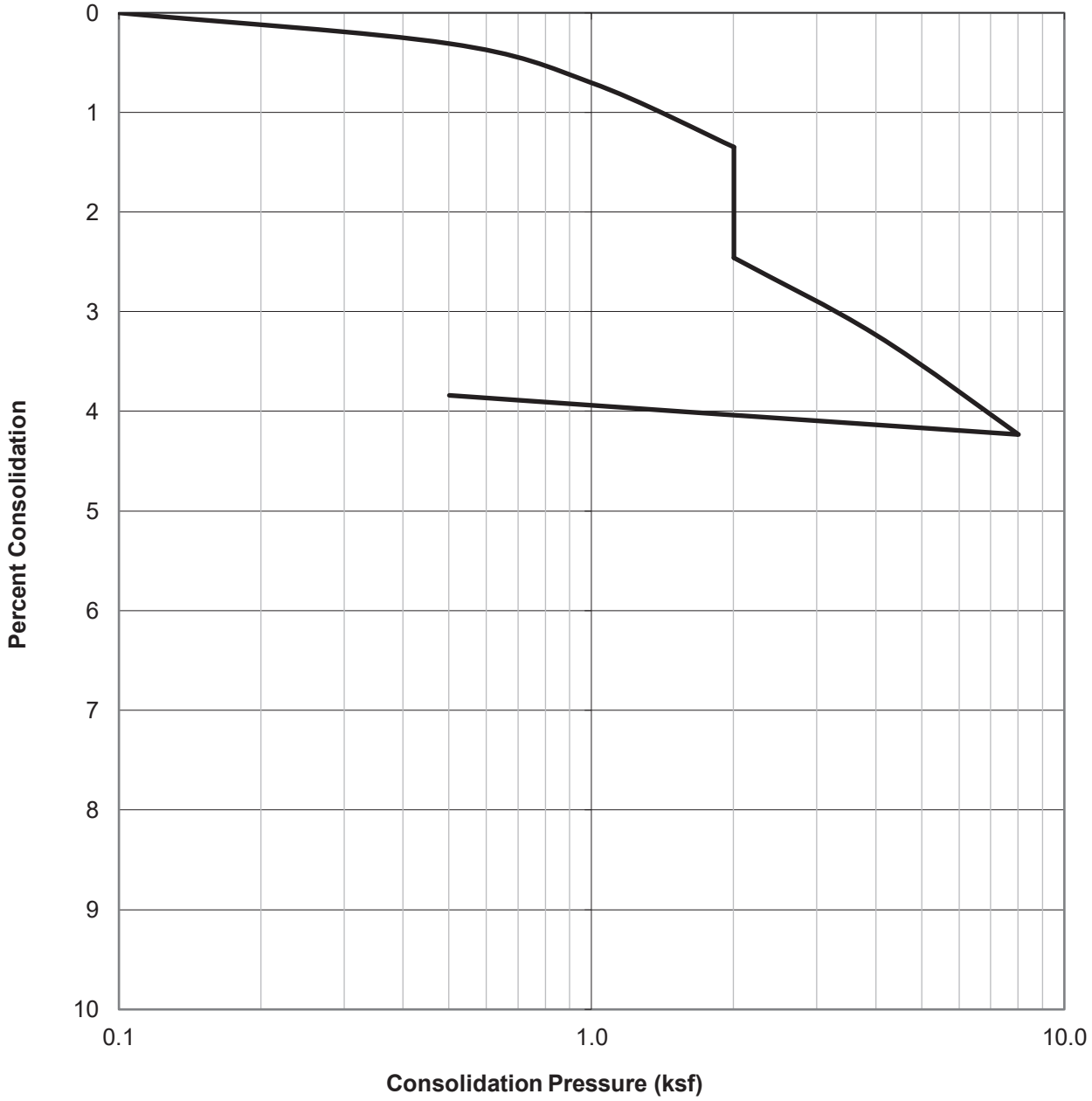
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B14

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@9	Silty Sand (SM)	99.2	5.3	15.5

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

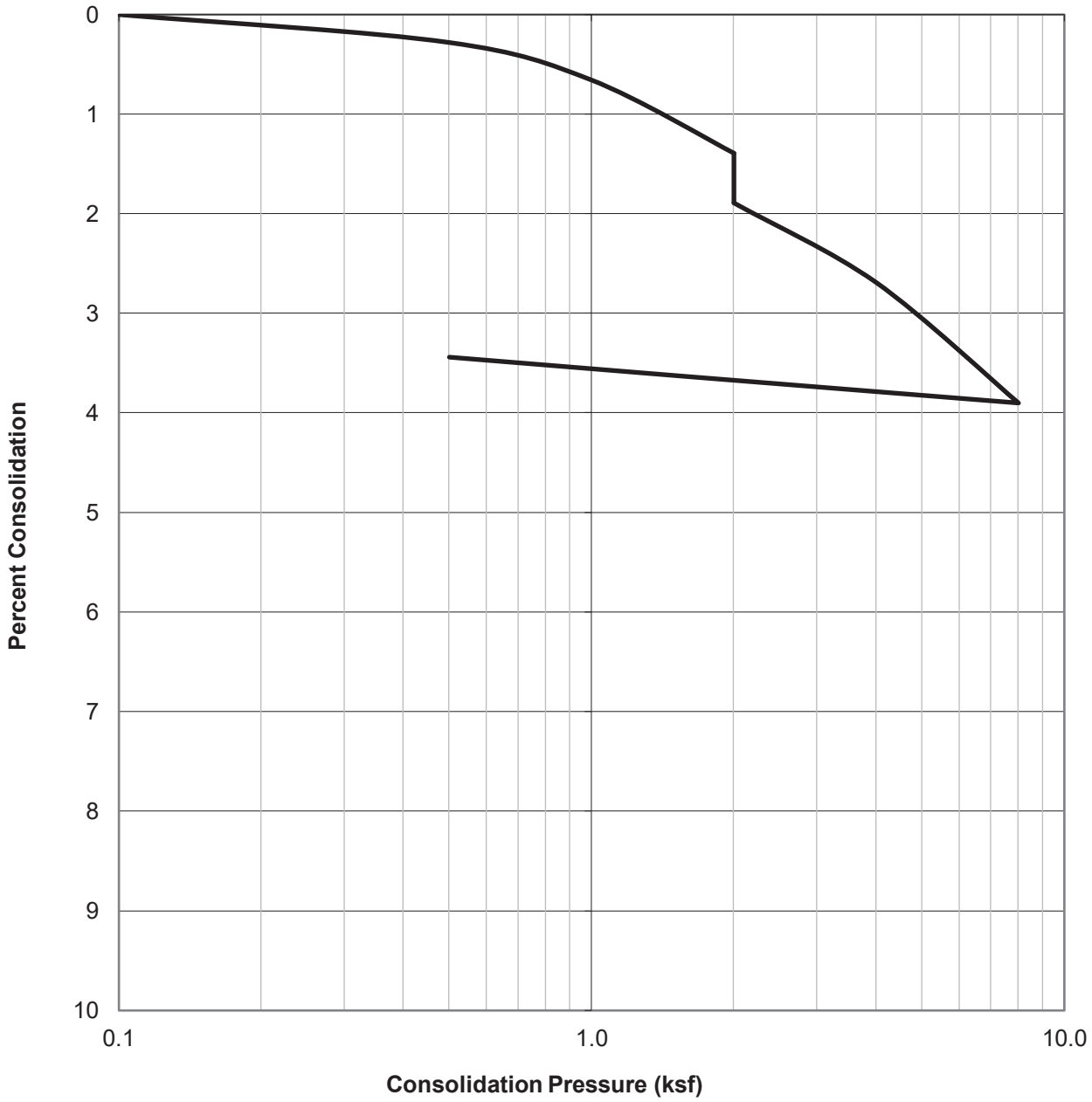
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B15

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@19	Silty Sand (SM)	100.3	7.7	19.3

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

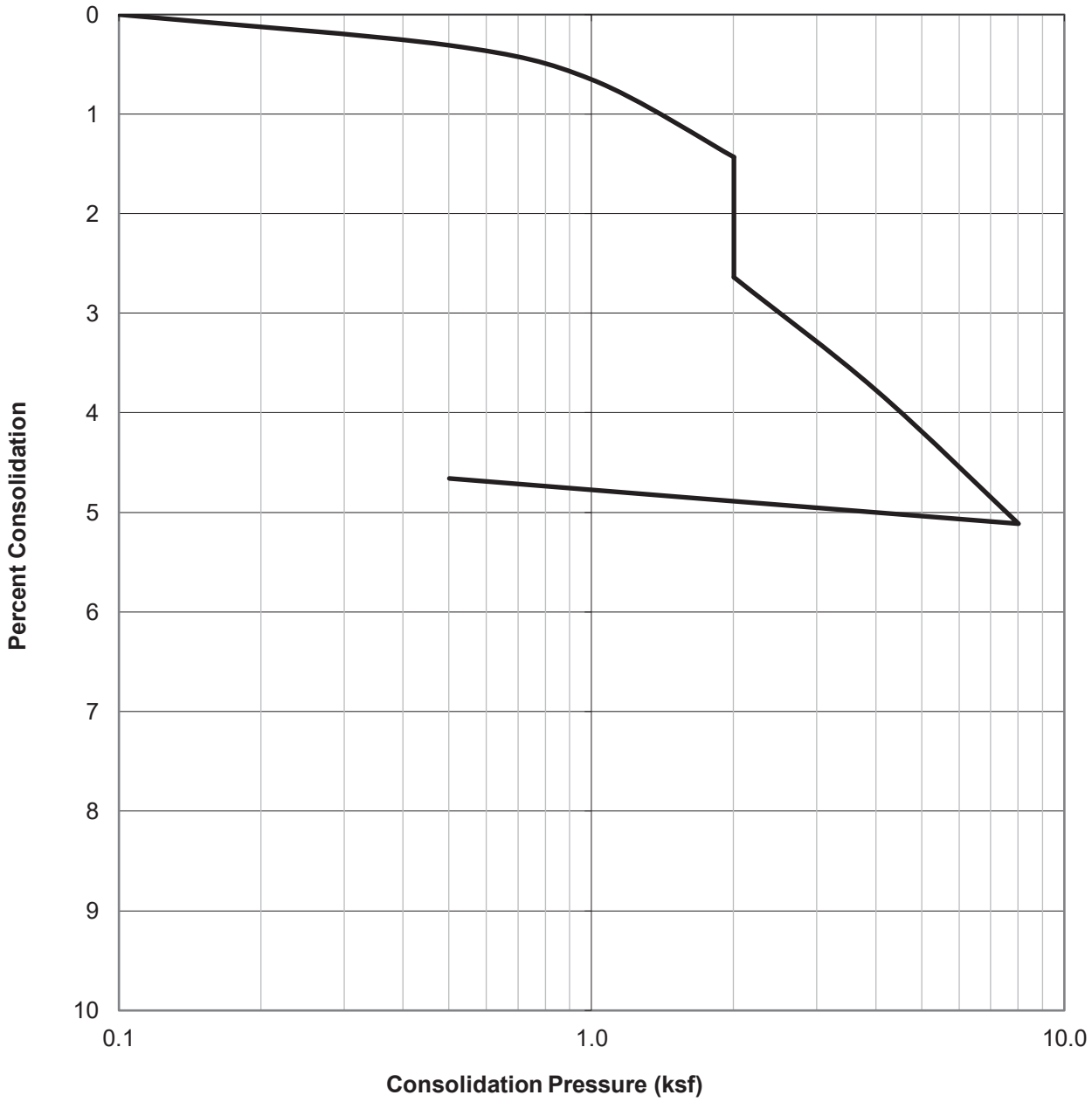
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B16

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@3	Poorly Graded Sand (SP)	112.2	3.6	13.2

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

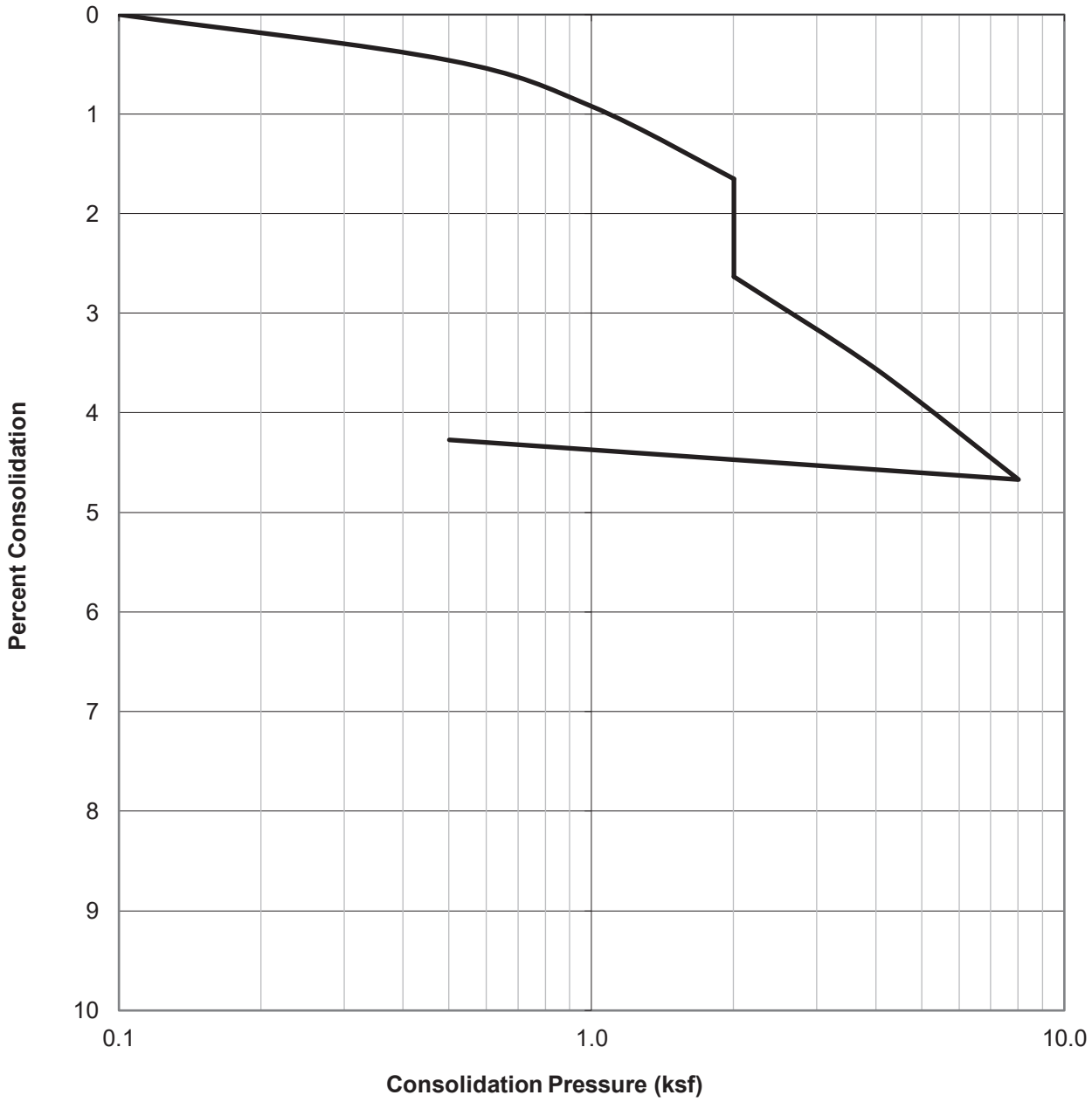
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B17

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@6.5	Poorly Graded Sand (SP)	114.5	2.3	13.9

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

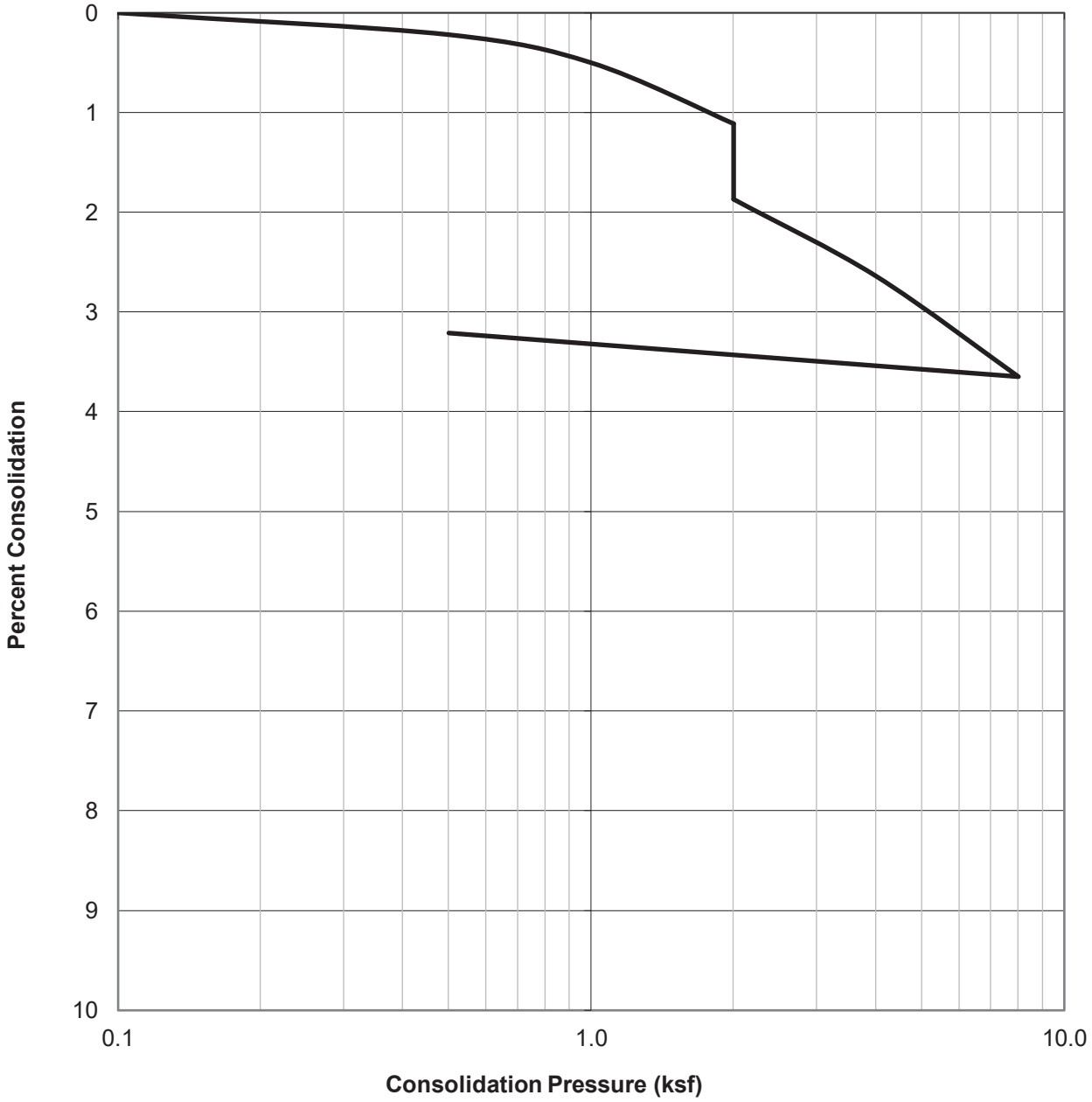
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B18

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@9	Poorly Graded Sand (SP)	111.3	3.1	12.1

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

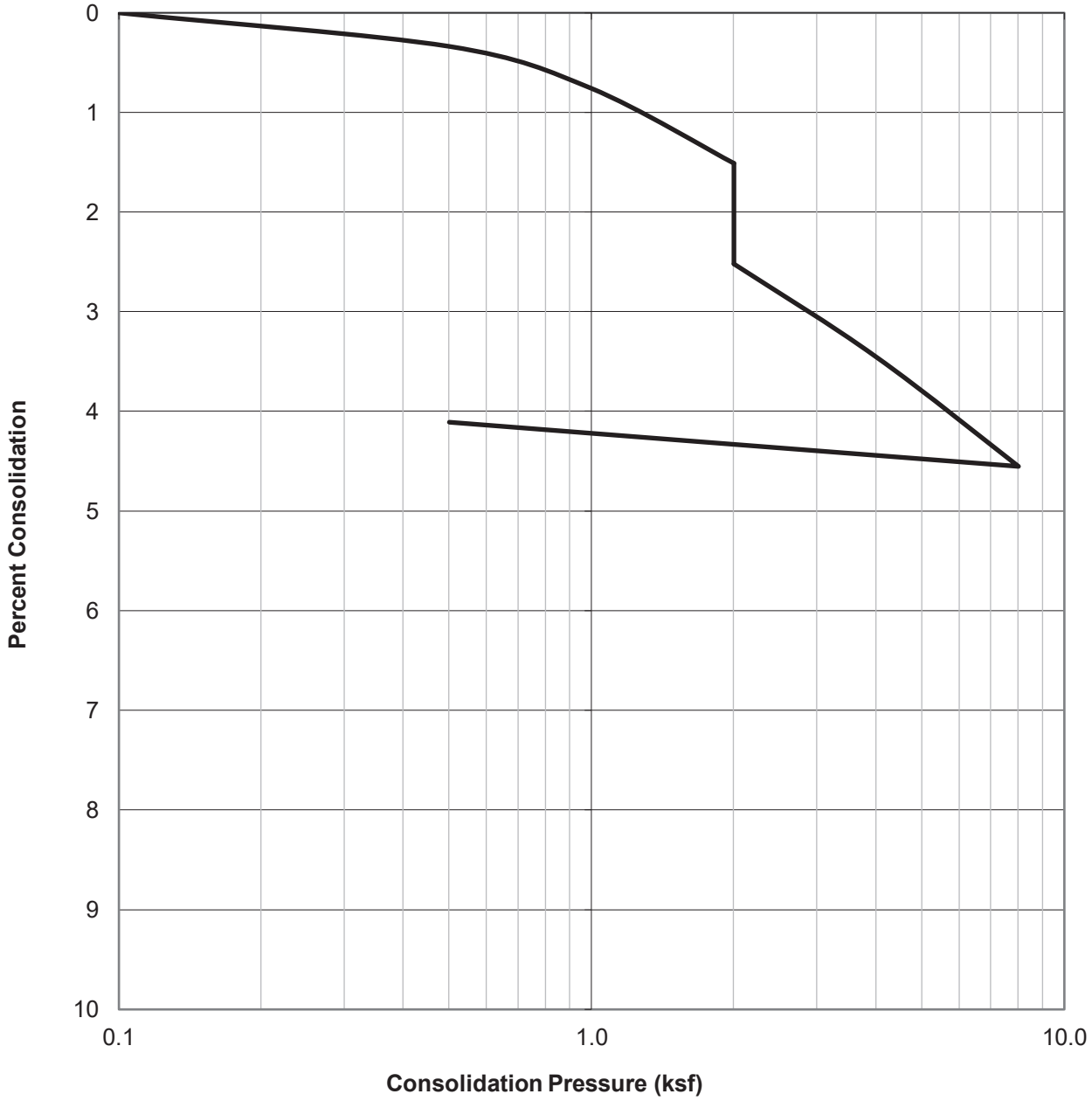
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B19

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B7@3	Silty Sand (SM)	104.9	5.4	14.3

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

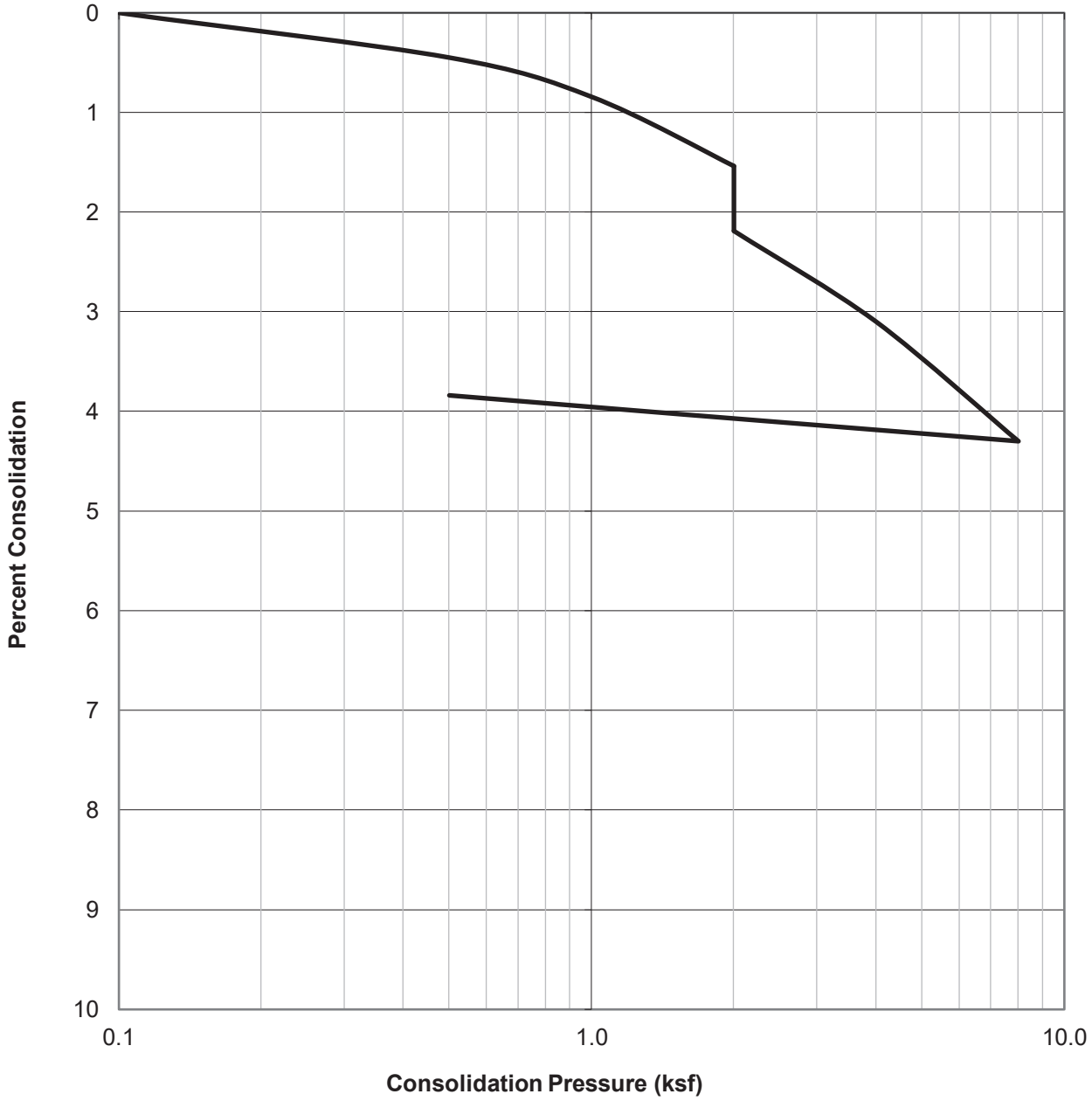
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B20

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B7@6	Poorly Graded Sand (SP)	101.4	6.0	15.5

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

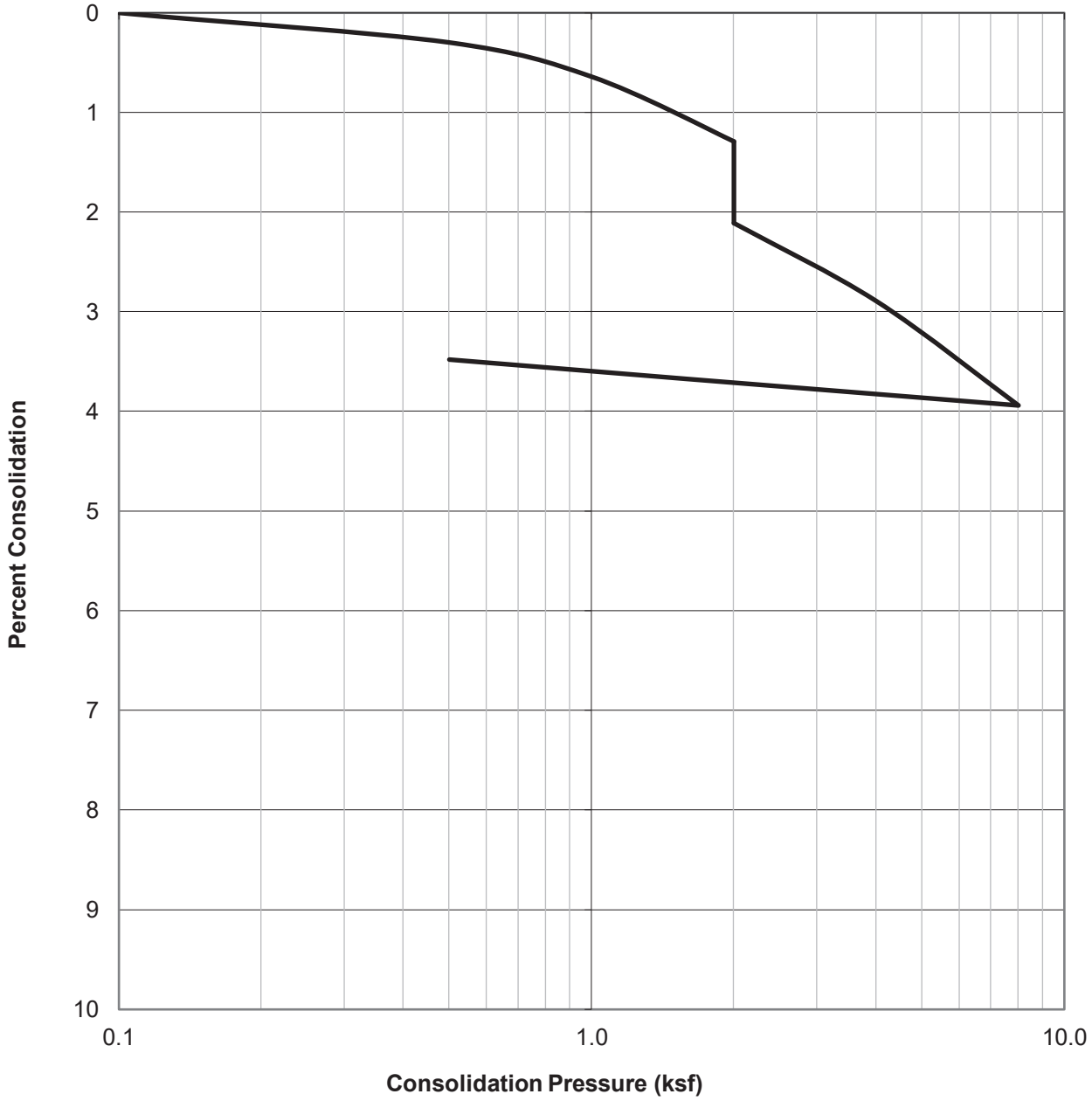
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B21

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B7@9	Poorly Graded Sand (SP)	101.1	6.1	17.7

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

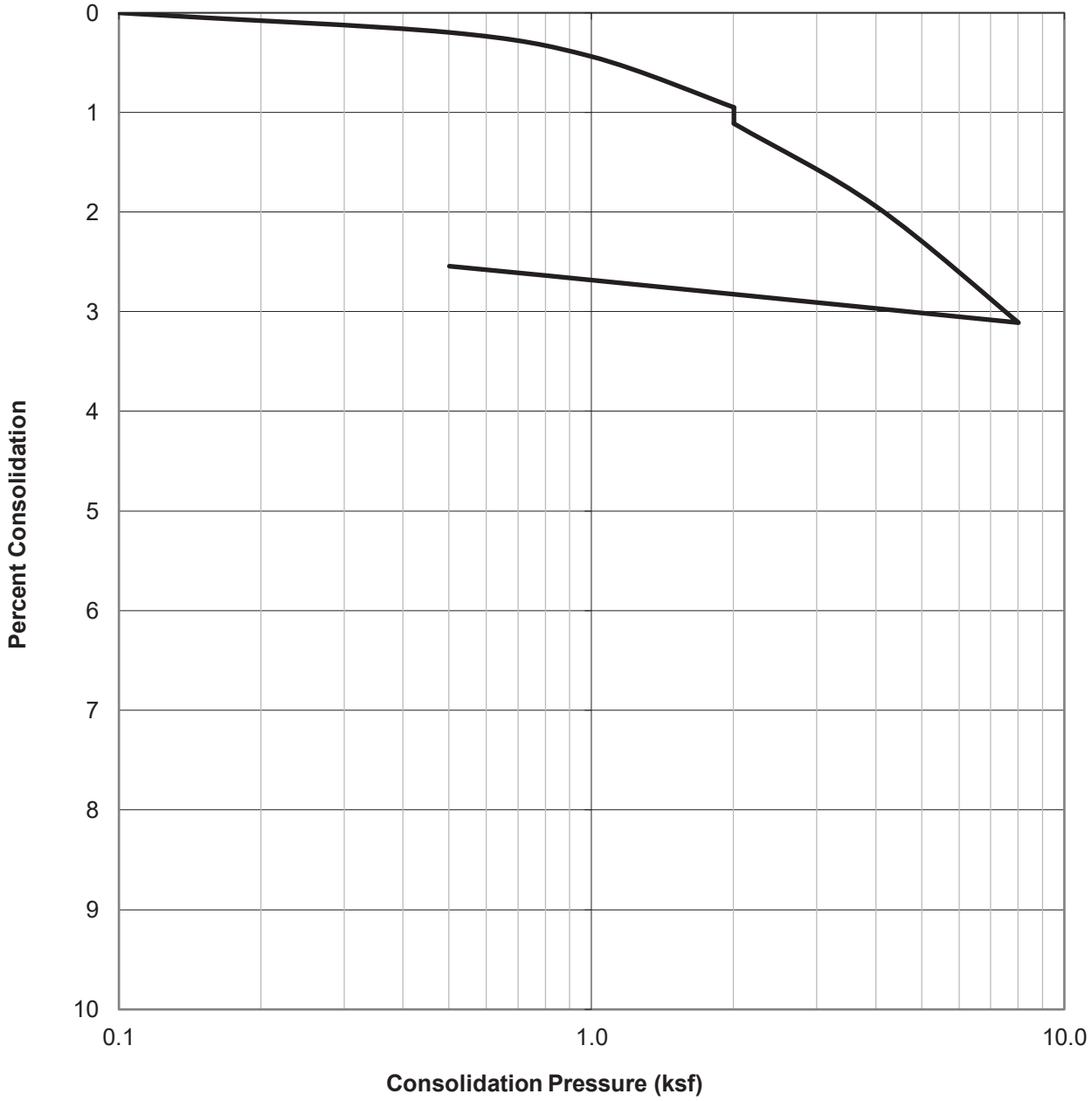
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B22

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B7@14.5	Poorly Graded Sand (SP)	106.4	6.2	18.8

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

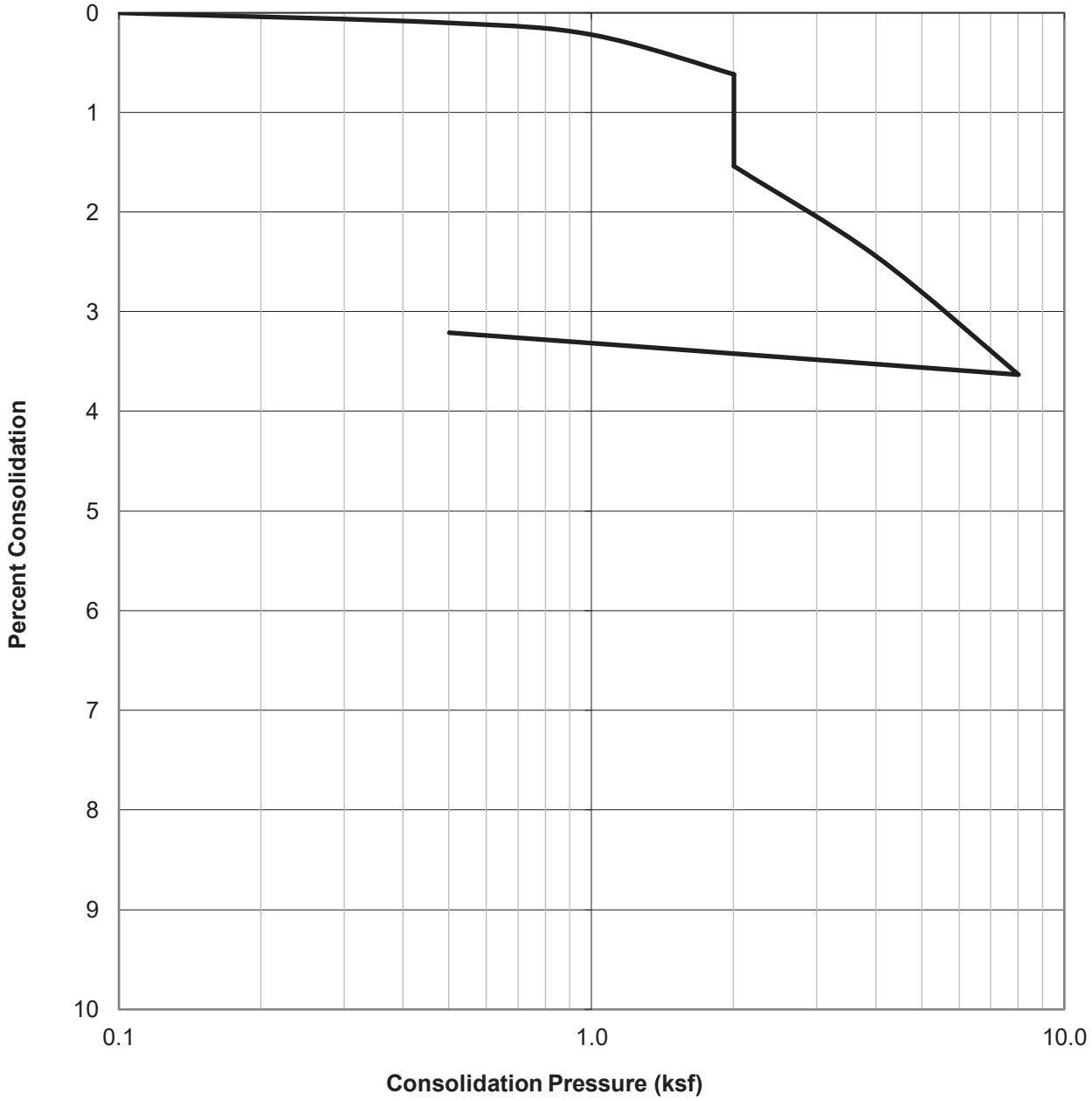
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B23

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B9@3	Silty Sand (SM)	115.5	2.6	11.8

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

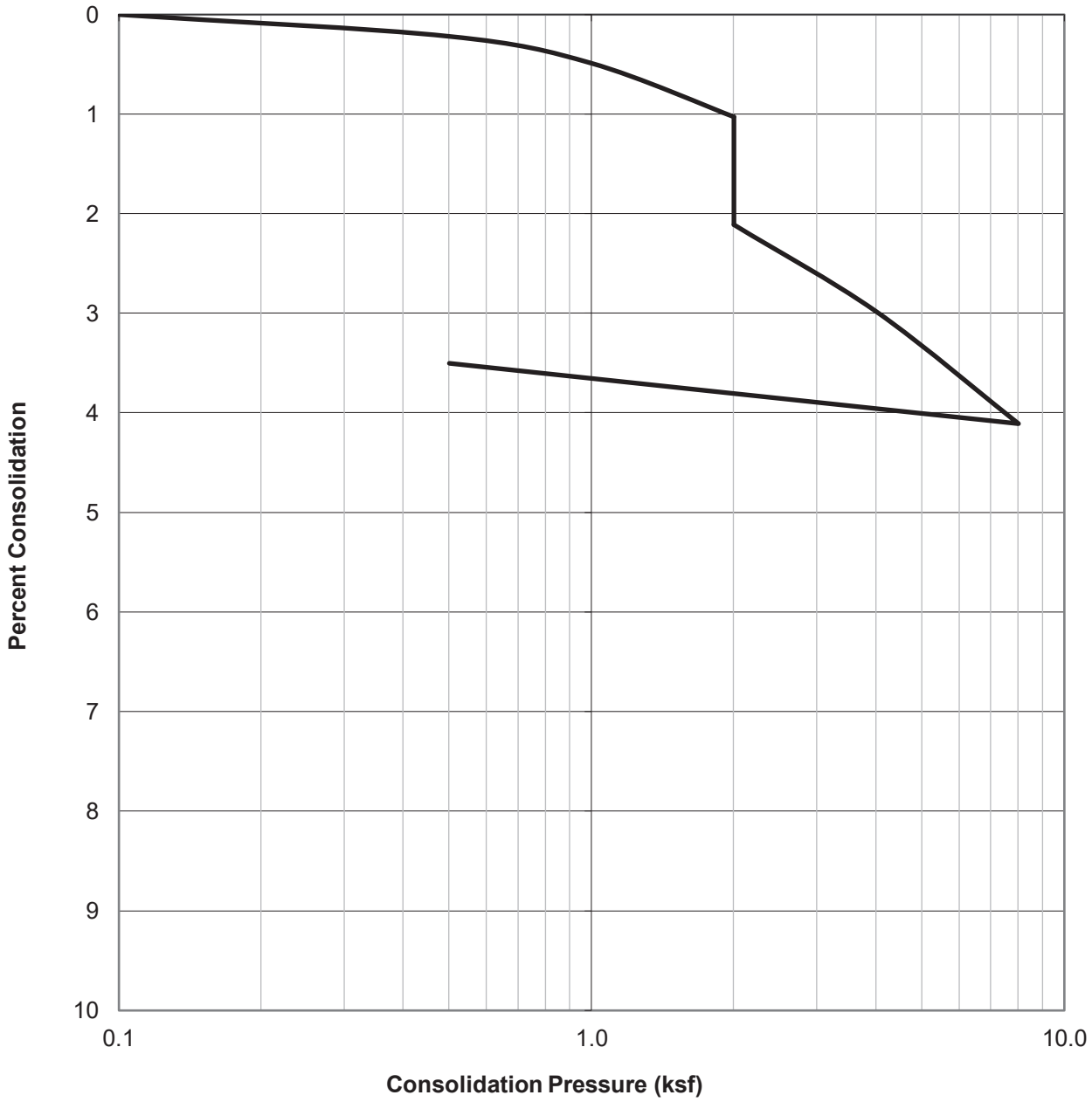
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B24

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B9@6	Silty Sand (SM)	100.5	4.1	16.4

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

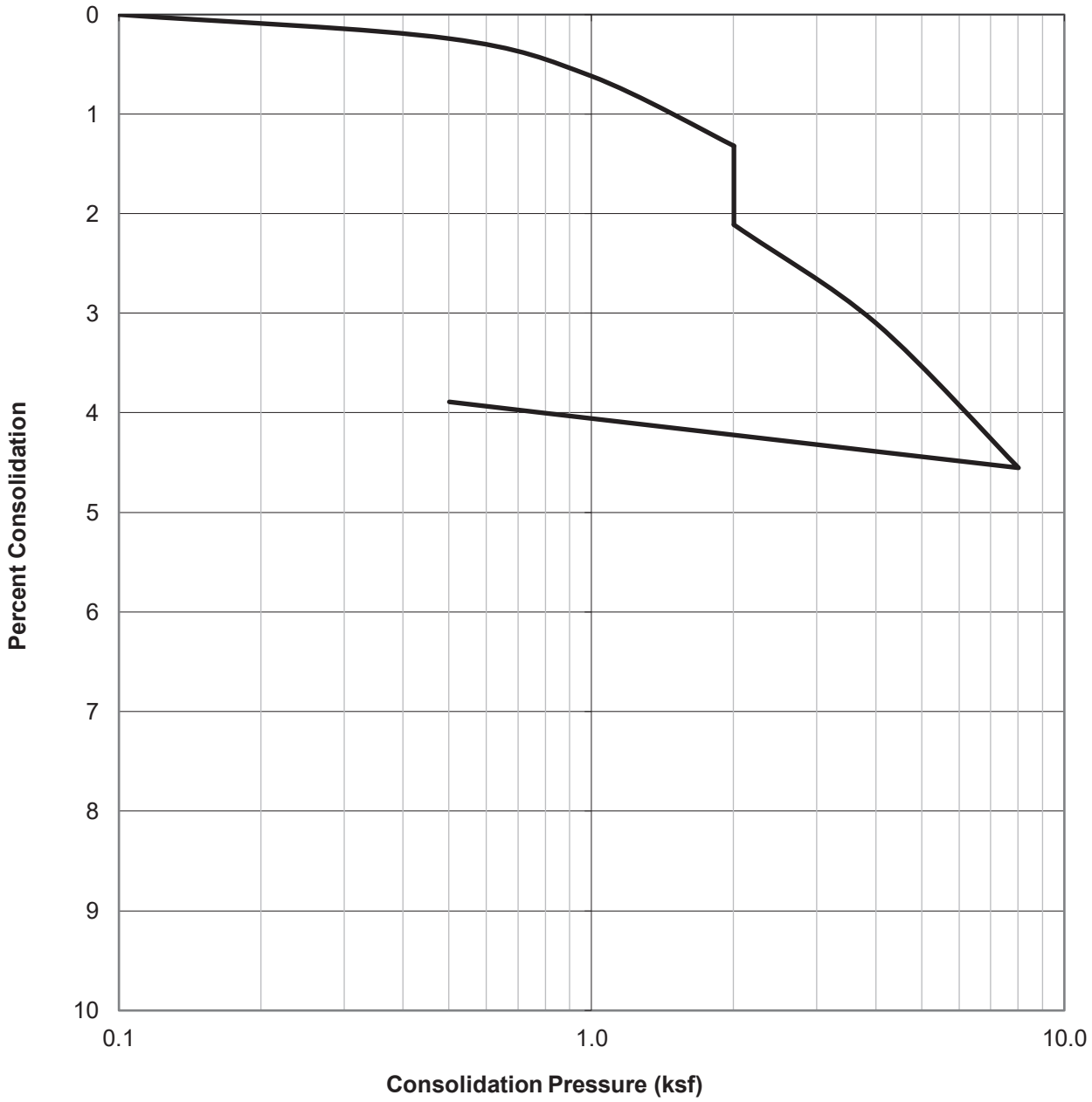
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B25

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B9@9	Poorly Graded Sand (SP)	104.5	4.8	16.3

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

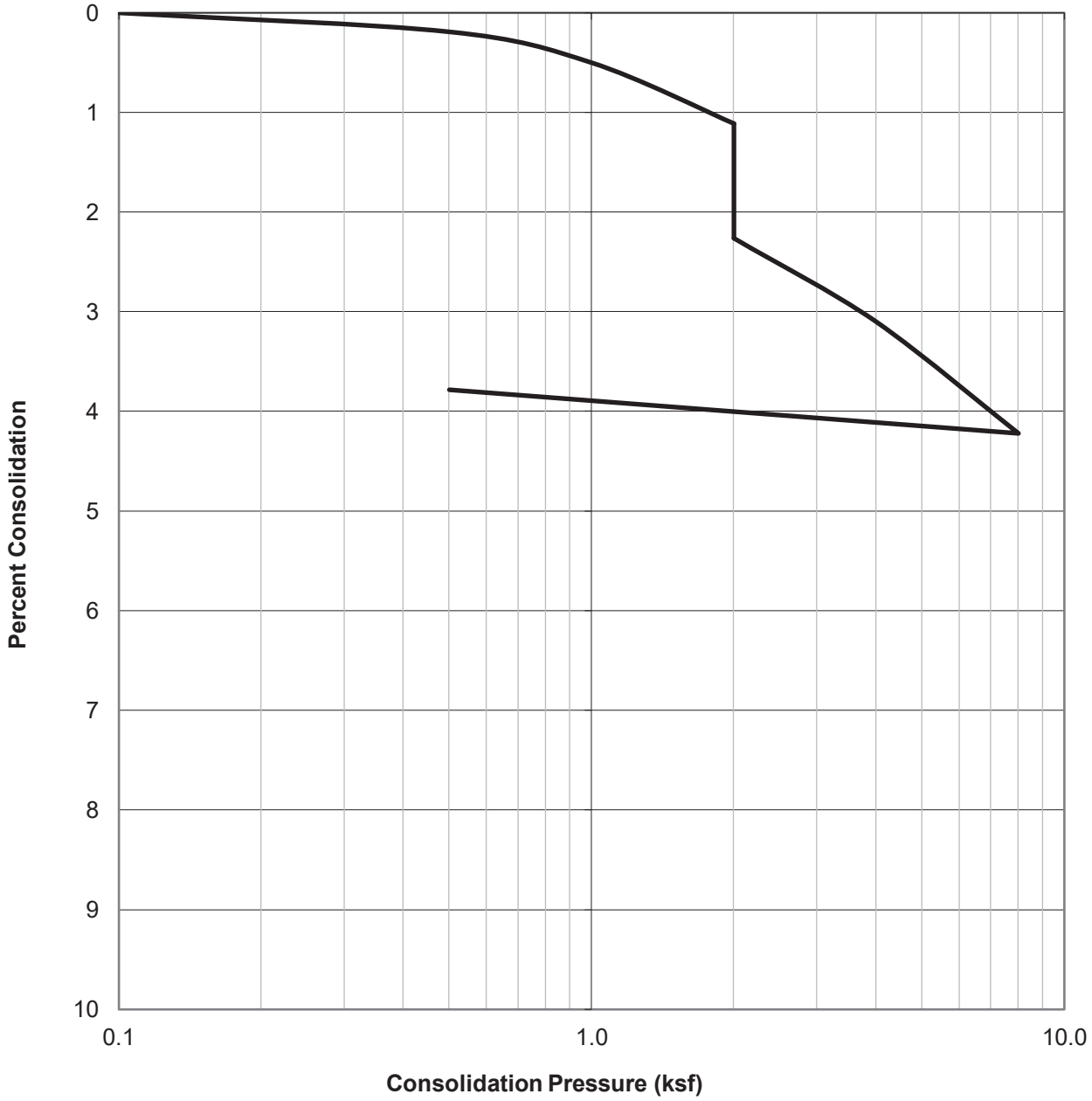
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B26

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B9@19	Poorly Graded Sand (SP)	102.7	6.0	17.1

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

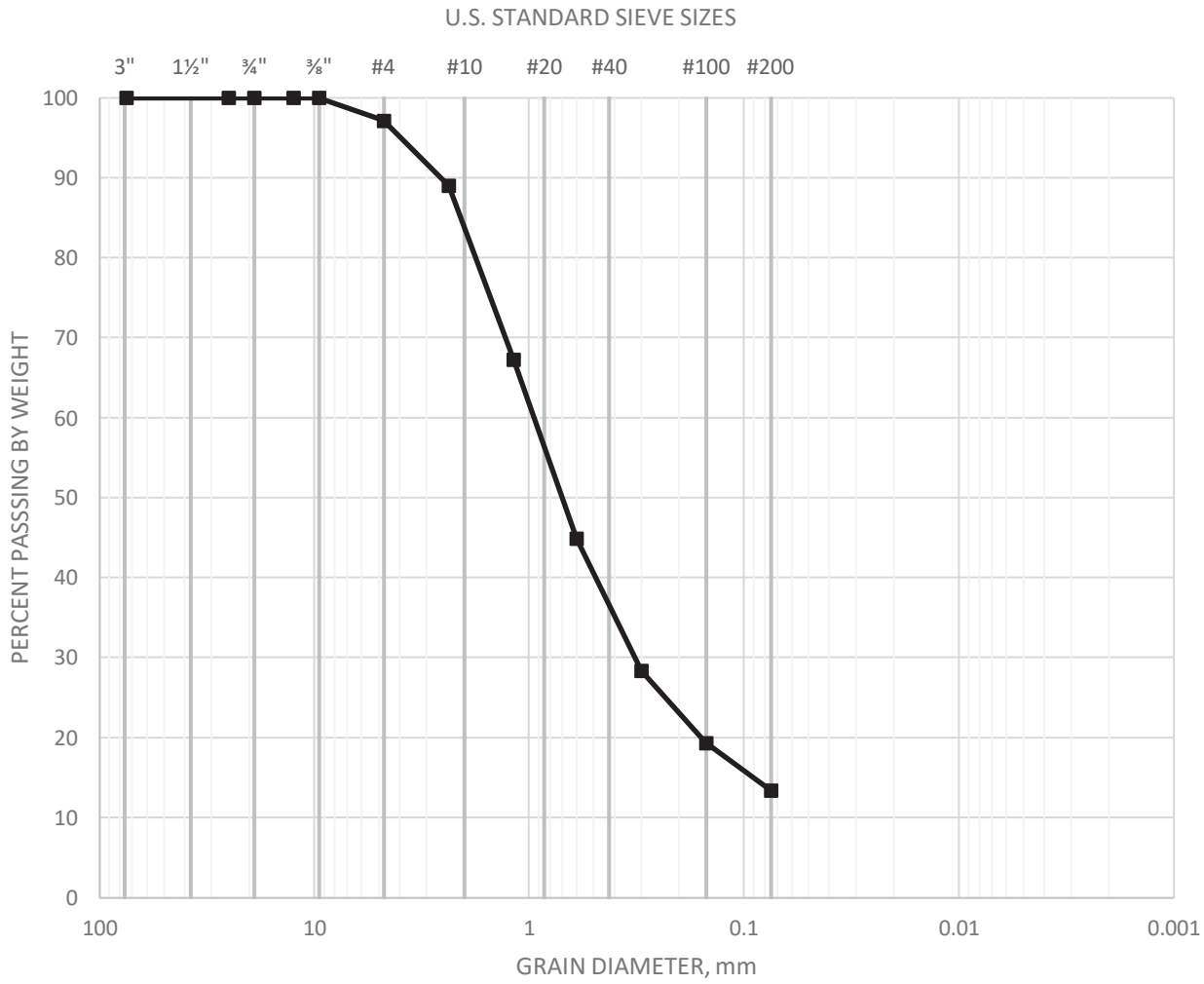
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B27

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	D60	D30	D10
TP-1@5'	Poorly Graded Sand (SP)	0.95	0.32	0.075

GEOCON

GRAIN SIZE DISTRIBUTION

ASTM D 6913

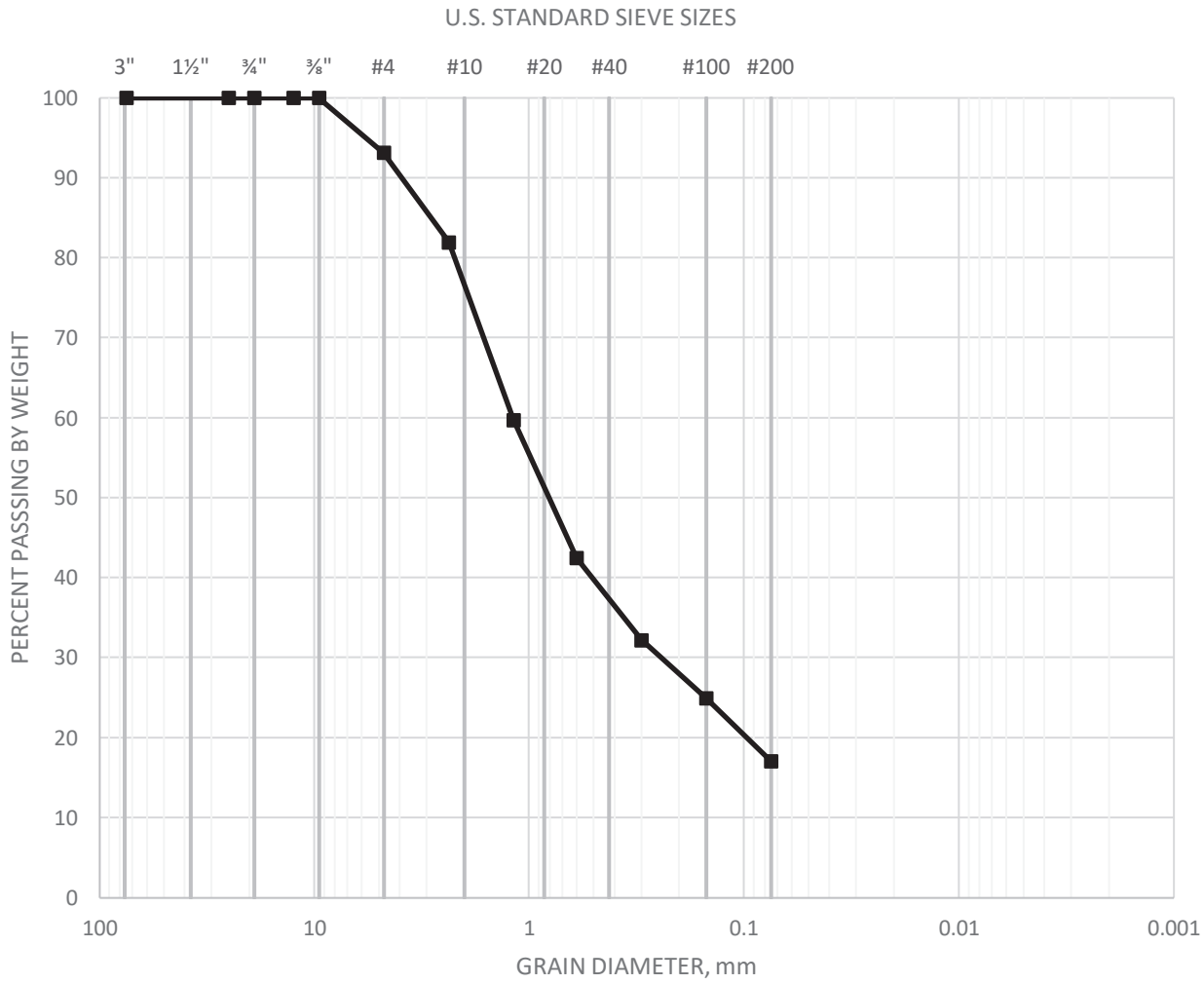
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B28

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	D60	D30	D10
TP-2@4.5'	Silty Sand (SM)	1.3	0.25	0.075

GEOCON

GRAIN SIZE DISTRIBUTION

ASTM D 6913

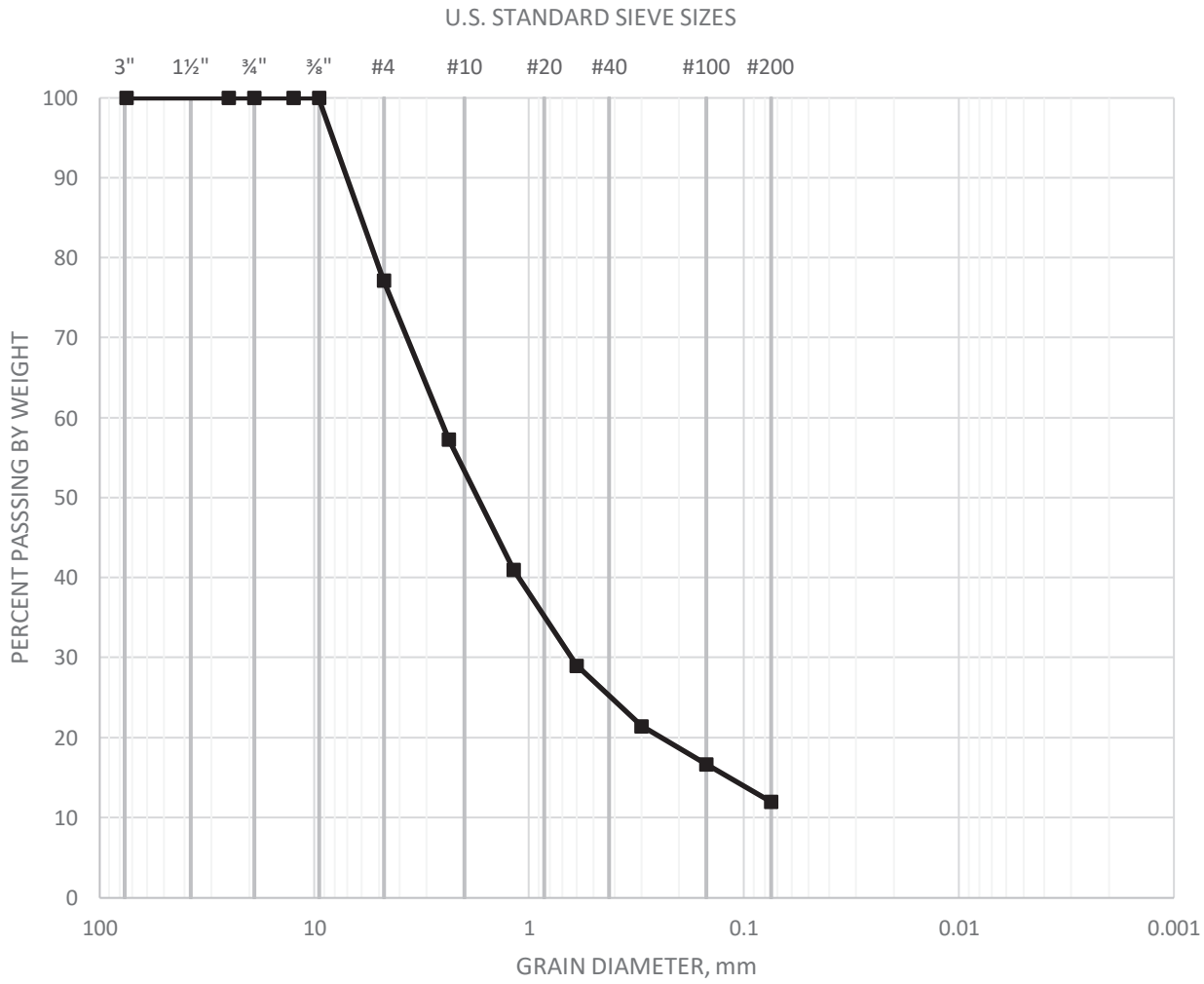
Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B29

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



SAMPLE	CLASSIFICATION	D60	D30	D10
TP-3@5.5'	Poorly Graded Sand with Some Gravel (SP)	2.6	0.65	0.075

GEOCON

GRAIN SIZE DISTRIBUTION

ASTM D 6913

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B30

MIX B2+B6@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.0
Wt. Comp. Soil + Mold	(gm)	795.6	811.8
Wt. of Mold	(gm)	367.8	367.8
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	491.9	811.8
Dry Wt. of Soil + Cont.	(gm)	472.0	399.4
Wt. of Container	(gm)	191.9	367.8
Moisture Content	(%)	7.1	11.2
Wet Density	(pcf)	129.0	133.8
Dry Density	(pcf)	120.5	120.3
Void Ratio		0.4	0.4
Total Porosity		0.3	0.3
Pore Volume	(cc)	59.1	58.1
Degree of Saturation	(%) [S_{meas}]	48.4	76.7

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
11/8/2022	10:00	1.0	0	0.355
11/8/2022	10:10	1.0	10	0.355
Add Distilled Water to the Specimen				
11/9/2022	10:00	1.0	1430	0.3505
11/9/2022	11:00	1.0	1490	0.3505

Expansion Index (EI meas) =	0
Expansion Index (Report) =	**0**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2019 California Building Code, Section 1803.5.3
** Reference: 1997 Uniform Building Code, Table 18-I-B.

GEOCON

EXPANSION INDEX TEST RESULTS
ASTM D-4829

Checked by: JMH

Project No.: W1523-99-01A
NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B31

MIX B9+B10@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.0
Wt. Comp. Soil + Mold	(gm)	795.0	810.8
Wt. of Mold	(gm)	367.7	367.7
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	491.9	810.8
Dry Wt. of Soil + Cont.	(gm)	471.8	398.6
Wt. of Container	(gm)	191.9	367.7
Moisture Content	(%)	7.2	11.2
Wet Density	(pcf)	128.9	133.5
Dry Density	(pcf)	120.2	120.1
Void Ratio		0.4	0.4
Total Porosity		0.3	0.3
Pore Volume	(cc)	59.4	59.3
Degree of Saturation	(%) [S_{meas}]	48.7	75.1

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
11/9/2022	10:00	1.0	0	0.2755
11/9/2022	10:10	1.0	10	0.275
Add Distilled Water to the Specimen				
11/10/2022	10:00	1.0	1430	0.2745
11/10/2022	11:00	1.0	1490	0.2745

Expansion Index (EI meas) =	0
Expansion Index (Report) =	**0**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2019 California Building Code, Section 1803.5.3

** Reference: 1997 Uniform Building Code, Table 18-I-B.

GEOCON

EXPANSION INDEX TEST RESULTS

ASTM D-4829

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B32

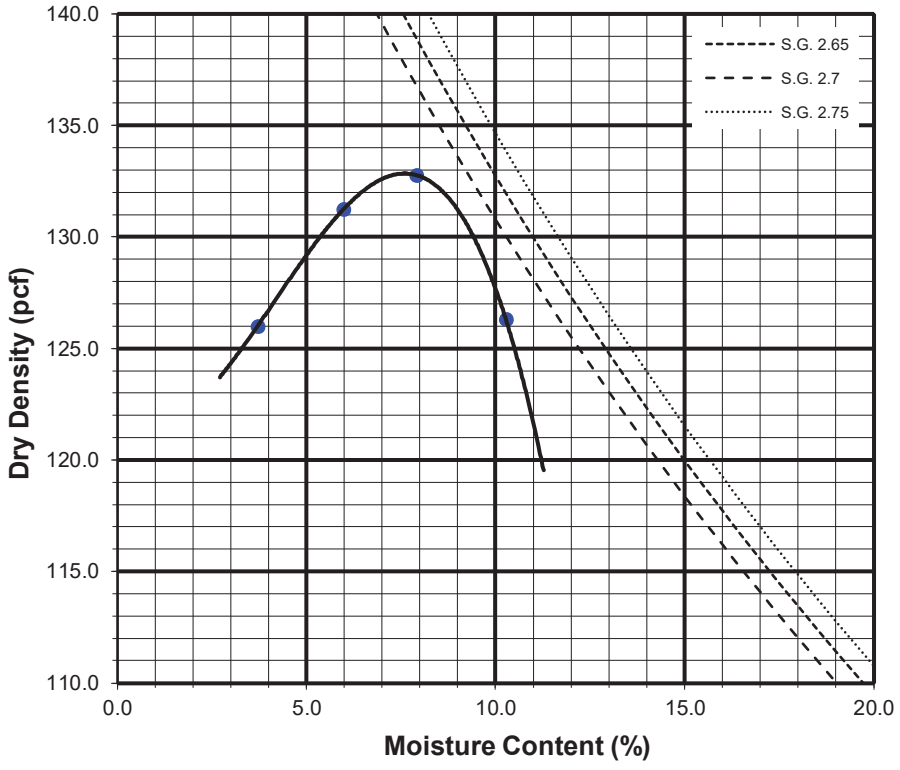
Sample No:

B2B6@0-5	Reddish Brown Silty Sand (SM)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6205	6311	6374	6314		
Weight of Mold	(g)	4210	4210	4210	4210		
Net Weight of Soil	(g)	1995	2101	2164	2104		
Wet Weight of Soil + Cont.	(g)	615.3	679.3	722.7	714.8		
Dry Weight of Soil + Cont.	(g)	598.2	649.3	680.3	662.0		
Weight of Container	(g)	137.4	147.5	144.8	148.1		
Moisture Content	(%)	3.7	6.0	7.9	10.3		
Wet Density	(pcf)	132.1	139.1	143.3	139.3		
Dry Density	(pcf)	126.0	131.2	132.8	126.3		

Maximum Dry Density (pcf)	**133.0**

Optimum Moisture Content (%)	**8.0**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B33

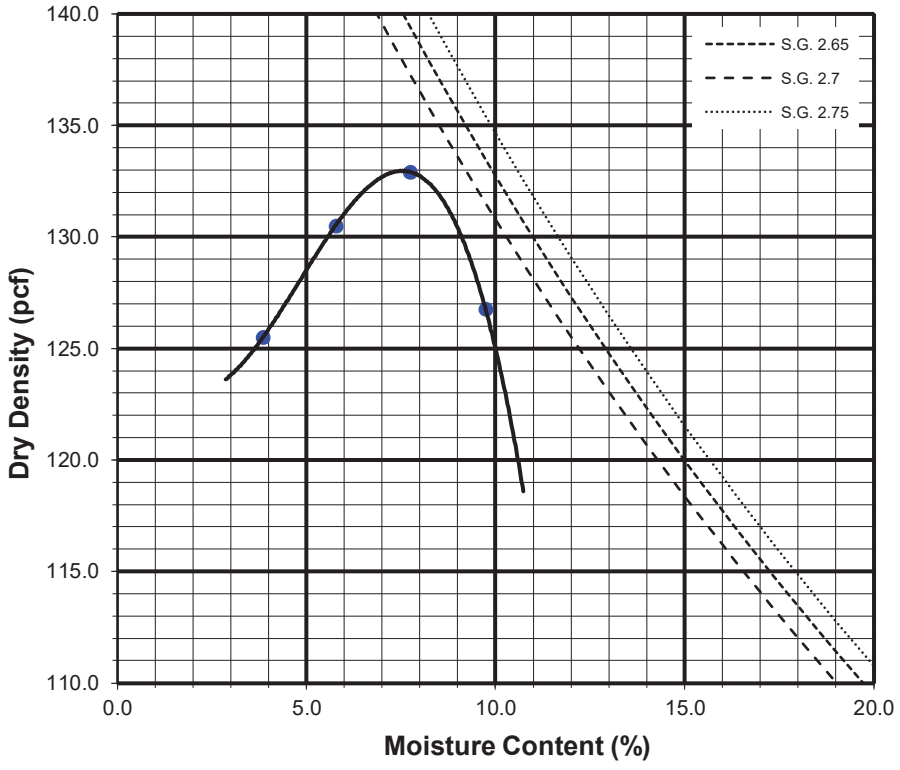
Sample No:

MIX B9+B10@0-5'	Light Brown Silty Sand (SM)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6189	6295	6373	6311		
Weight of Mold	(g)	4210	4210	4210	4210		
Net Weight of Soil	(g)	1979	2085	2163	2101		
Wet Weight of Soil + Cont.	(g)	620.0	671.2	702.5	782.1		
Dry Weight of Soil + Cont.	(g)	602.5	642.7	662.6	725.7		
Weight of Container	(g)	148.4	148.3	146.9	146.7		
Moisture Content	(%)	3.9	5.8	7.7	9.7		
Wet Density	(pcf)	131.0	138.0	143.2	139.1		
Dry Density	(pcf)	125.5	130.5	132.9	126.8		

Maximum Dry Density (pcf)	**133.0**

Optimum Moisture Content (%)	**8.0**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B34

SUMMARY OF LABORATORY
POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
AASHTO T289 ASTM D4972 and AASHTO T288 ASTM G187

Sample No.	pH	Resistivity (ohm centimeters)
B2B6@0-5'	7.6	2800 (Moderately Corrosive)
B9B10@0-5'	7.6	3500 (Moderately Corrosive)

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
AASHTO T291 ASTM C1218

Sample No.	Chloride Ion Content (%)
B2B6@0-5'	0.002
B9B10@0-5'	0.003

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
AASHTO T290 ASTM C1580

Sample No.	Water Soluble Sulfate (% SO_4)	Sulfate Exposure
B2B6@0-5'	0.000	S0
B9B10@0-5'	0.000	S0

GEOCON

CORROSIVITY TEST RESULTS

Checked by: JMH

Project No.: W1523-99-01A

NE CORNER OF CENTRAL ROAD
AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

Dec 22 Figure B35

APPENDIX C

APPENDIX C

PRIOR REPORT

PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED INDUSTRIAL DEVELOPMENT
565 ACRES
APPLE VALLEY, CALIFORNIA

APNS: 0463-201-20; -32; -42; -56
0462-241-02; -03; -06; -07; -11; -13; -19; -26; -39; -40
0463-242-02; -05
0463-243-20; -25

GEOCON
WEST, INC.

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

UNCOMMON DEVELOPERS
LOS ANGELES, CALIFORNIA

PROJECT NO. W1523-99-01

MARCH 29, 2022

Project No. W1523-06-01
March 29, 2022

Mr. Idan Perlman
Uncommon Developers
9220 Winnetka Avenue
Los Angeles, CA 91311

Subject: PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED INDUSTRIAL DEVELOPMENT
565 ACRES, APPLE VALLEY, CALIFORNIA
APNS: 0463-201-20; -32; -34; -42; -56
0462-241-02; -03; -06; -07; -11; -13; -19; -26; -39; -40
0463-242-02; -05
0463-243-20; -25

Dear Mr. Perlman:

In accordance with your authorization of our proposal dated February 8, 2022, we have performed a preliminary geotechnical investigation for the proposed industrial development located within the city of Apple Valley, California. The accompanying report presents the findings of our study and our conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction. Based on the results of our investigation, it is our opinion that the site can be developed as proposed, provided the recommendations of this report are followed and implemented during design and construction.

The primary intent of this study was to address potential geologic hazards and geotechnical conditions that could impact the project. A design level geotechnical study will be required once a conceptual site plan is available in order to provide updated geotechnical recommendations for design and construction.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.

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REGISTERED PROFESSIONAL ENGINEER
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(EMAIL) Addressee

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LIMITATIONS AND UNIFORMITY OF CONDITIONS

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PRELIMINARY GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a preliminary geotechnical investigation for the proposed industrial development located within the City of Apple Valley, California (see Vicinity Map, Figure 1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the site and, based on conditions encountered, to provide preliminary conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction. A design level geotechnical study will be required once a conceptual site plan is available in order to provide updated geotechnical recommendations for design and construction.

The scope of this investigation included a site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored on February 18, 2022 by excavating nine 8-inch diameter borings to a depth of up to approximately 24½ feet below the existing ground surface using a truck-mounted hollow-stem auger drilling machine. Refusal was encountered in two of the borings at depths of 9½ and 19½ feet. In addition, twenty test pits were excavated on March 2 and 3, 2022 to depths of up to approximately 9½ feet below the existing ground surface using a backhoe. The locations of the exploratory excavations are depicted on the Site Plan (see Figure 2). A detailed discussion of the field investigation, including test pit and boring logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

The subject site consists of 19 parcels covering 565 acres in the City of Apple Valley, California. Each of the parcels consist of vacant undeveloped land with limited access via dirt roads. The project area is bounded by Quarry Road to the north, by Hudson Road and Fairview Mountain to the east, by Los Padres Road to the south, and by Central Road to the west. The project dips gently to the west at a grade of about 2%. Surface water drainage appears to follow contours toward the west. Vegetation onsite consists of native grasses, shrubs, and Joshua trees.

Based on the information provided by the Client, it is our understanding that the proposed project will consist of several commercial or industrial structures constructed at or near the existing site grade. The design team is also considering subterranean or partial subterranean parking features under the proposed structures. At this time there is no preliminary layout or site configuration available. The existing site conditions are depicted on the Site Plan (see Figure 2).

Based on the preliminary nature of the design at this time, wall and column loads were not available. This proposal has assumed that column loads for the proposed structures will be up to 300 kips, and wall loads will be up to 3 kips per linear foot.

Once the design phase and foundation loading configuration proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

3. GEOLOGIC SETTING

The site is located in the southwestern portion of the Mojave Desert, approximately 20 miles northeast of the San Gabriel Mountains. The Mojave Desert province is bounded by the Garlock Fault on the north, and the northwest trending San Andreas Fault Zone and Transverse Ranges on the southwest, and extends east to the California-Nevada border. The province is characterized by broad alluviated basins that are for the most part derived from the adjacent uplands. The site is underlain by alluvial fan deposits incised by stream wash deposits, consisting of sediment derived from the surrounding mountains and corresponding drainage systems (Hernandez and Tan, 2007).

4. SOIL AND GEOLOGIC CONDITIONS

Based on our field investigation and published geologic maps of the area, the site is underlain by Holocene age wash deposits and Holocene to Pleistocene age alluvial fan deposits (Hernandez and Tan, 2007). Detailed stratigraphic profiles of the materials encountered at the site are provided on the test pit and boring logs in Appendix A.

4.1 Alluvial Wash Deposits

Holocene age alluvial wash deposits were encountered at the ground surface in test pits 4 through 9. The wash deposits generally consist of light brown to brown well-graded sand, poorly graded sand, and silty sand with varying amounts of gravel and cobbles (up to 12” in diameter). The wash deposits are characterized as dry to moist and loose.

4.2 Young Alluvial Fan Deposits

Holocene age alluvial fan deposits were encountered at the surface in test pits 1, 2, and 10 through 21 and in borings 2 and 8. The alluvium was encountered to a maximum depth of approximately 5½ feet and consists of light brown to brown, poorly to well-graded sand and silty sand with varying amounts of silt, gravel, and cobbles up to 10" in diameter. The alluvium is characterized as dry to slightly moist and loose to medium dense.

4.3 Older Alluvial Fan Deposits

Pleistocene age older alluvial fan deposits were encountered in the borings below the young alluvial fan deposits and wash deposits and at the ground surface in borings 1, 3 through 7 and 9. The older alluvial fan deposits are generally composed of light brown to brown, reddish brown or light gray to grayish brown poorly graded to well-graded sand and silty sand with varying amounts of gravel and cobbles (up to 10" in diameter). The older alluvial fan deposits are characterized as dry to slightly moist and medium dense to very dense and are locally highly cemented.

5. GROUNDWATER

Review of the California Department of Water Resources (CDWR) Water Data Library website (CDWR, 2022) shows two wells (345956N1171659W001 and 345919N1171573W001) in the property vicinity. Groundwater levels were last measured in these wells on May 14, 1957 when the depth to groundwater was at 61.5 and 86.7 feet below the existing ground surface. Also, information provided in the Apple Valley General Plan (2007) indicate groundwater beneath the site and in the immediate area has historically been greater than 50 feet beneath the ground surface.

Groundwater was not encountered in our borings or test pits excavated to a maximum depth of 24½ feet beneath the existing ground surface. Considering the lack of groundwater in our explorations, the reported historic high groundwater levels (CDWR, 2022; Apple Valley, 2007), and the depth of the proposed construction, static groundwater is not anticipated to impact the proposed development. However, it is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed, especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall. In addition, recent requirements for stormwater infiltration could result in shallower seepage conditions in the immediate site vicinity. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the S*urface Drainage* section of this report (see Section 7.17).

6. GEOLOGIC HAZARDS

6.1 Surface Fault Rupture

The numerous faults in Southern California include Holocene-active, pre-Holocene, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018). By definition, a Holocene-active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A pre-Holocene fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years) but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The site is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CDMG, 1979; CGS, 2016; CGS, 2022b) for surface fault rupture hazards. No Holocene-active or pre-Holocene faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region, and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

The closest surface trace of a Holocene-active fault to the site is the Helendale-South Lockhart Fault Zone, located approximately 1.3 miles to the northeast (CGS, 2016). Other nearby active faults are the North Frontal Thrust System, the Lenwood-Lockhart Fault Zone, and the Camp Rock-Emerson-Copper Mountain Fault Zone located approximately 11.2 miles south, 16 miles east-northeast, and 22 miles northeast of the site, respectively (USGS, 2006). The active San Andreas Fault Zone is located approximately 28 miles southwest of the site (USGS, 2006).

Published geologic maps (Hernandez and Tan, 2007) indicate there is an unnamed pre-Holocene fault mapped as traversing the northwest portion of the property. This fault has not been included in an Alquist-Priolo Earthquake Fault Zone for surface fault rupture hazards (CGS, 2016). Based on the current data, this fault is not considered active and is not anticipated to impact the site.

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Southern California area at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987 M_w 5.9 Whittier Narrows earthquake and the January 17, 1994 M_w 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. These thrust faults and others in the greater Los Angeles area are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site.

6.2 Seismicity

As with all of Southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 4, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the Southern California area within the last 100 years is included in the following table.

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Near Redlands	July 23, 1923	6.3	42	S
Long Beach	March 10, 1933	6.4	82	SW
Tehachapi	July 21, 1952	7.5	108	WNW
San Fernando	February 9, 1971	6.6	71	W
Whittier Narrows	October 1, 1987	5.9	64	SW
Sierra Madre	June 28, 1991	5.8	53	WSW
Landers	June 28, 1992	7.3	50	ESE
Big Bear	June 28, 1992	6.4	34	SE
Northridge	January 17, 1994	6.7	83	WSW
Hector Mine	October 16, 1999	7.1	51	E
Ridgecrest	July 5, 2019	7.1	84	NNW

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be mitigated if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

6.3 Seismic Design Criteria

The following table summarizes the site-specific design criteria obtained from the 2019 California Building Code (CBC; Based on the 2018 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application *Seismic Design Maps*, provided by OSHPD. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2019 CBC and Table 20.3-1 of ASCE 7-16. The values presented on the following page are for the risk-targeted maximum considered earthquake (MCE_R).

2019 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2019 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.037g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.397g	Figure 1613.2.1(2)
Site Coefficient, F_A	1.085	Table 1613.2.3(1)
Site Coefficient, F_V	1.903*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.125g	Section 1613.2.3 (Eqn 16-36)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.755g*	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.75g	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.503g*	Section 1613.2.4 (Eqn 16-39)

Note:

*Per Section 11.4.8 of ASCE/SEI 7-16, a ground motion hazard analysis shall be performed for projects for Site Class "E" sites with Ss greater than or equal to 1.0g and for Site Class "D" and "E" sites with S1 greater than 0.2g. Section 11.4.8 also provides exceptions which indicates that the ground motion hazard analysis may be waived provided the exceptions are followed. Using the code based values presented in the table above, in lieu of a performing a ground motion hazard analysis, requires the exceptions outlined in ASCE 7-16 Section 11.4.8 be followed.

The table below presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.445	Figure 22-9
Site Coefficient, F_{PGA}	1.155	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.514g	Section 11.8.3 (Eqn 11.8-1)

The Maximum Considered Earthquake Ground Motion (MCE) is the level of ground motion that has a 2 percent chance of exceedance in 50 years, with a statistical return period of 2,475 years. According to the 2019 California Building Code and ASCE 7-16, the MCE is to be utilized for the evaluation of liquefaction, lateral spreading, seismic settlements, and it is our understanding that the intent of the Building code is to maintain "Life Safety" during a MCE event. The Design Earthquake Ground Motion (DE) is the level of ground motion that has a 10 percent chance of exceedance in 50 years, with a statistical return period of 475 years.

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2014 Conterminous U.S. Dynamic edition (v4.2.0). The result of the deaggregation analysis indicates that the predominant earthquake contributing to the MCE peak ground acceleration is characterized as a 6.76 magnitude event occurring at a hypocentral distance of 19.9 kilometers from the site.

Deaggregation was also performed for the Design Earthquake (DE) peak ground acceleration, and the result of the analysis indicates that the predominant earthquake contributing to the DE peak ground acceleration is characterized as a 6.83 magnitude occurring at a hypocentral distance of 28.74 kilometers from the site.

Conformance to the criteria in the above tables for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

6.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California" and "Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California" requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The Apple Valley North quadrangle has not been evaluated for liquefaction hazard. However, the historic high groundwater level in the vicinity of the site is at a depth of greater than 50 feet (CDWR, 2022; Apple Valley, 2007). The City of Apple Valley General Plan (2007) indicates the project is not located within an area designated as having potential for liquefaction. Additionally, the Pleistocene age older alluvial fan deposits, located at shallow depths across the property, are well consolidated and not prone to liquefaction. Based on these considerations, the potential for liquefaction and associated ground deformations beneath the site is considered very low.

6.5 Seismically Induced Settlement

Dynamic compaction of dry and loose sands may occur during a major earthquake. Typically, settlements occur in thick beds of such soils. The Pleistocene age older alluvial fan deposits, located at shallow depths across the property, are well consolidated and would not be prone to dry seismically induced settlements. As the project progresses and the building configuration for the proposed development is finalized, dry seismically induced settlement analyses should be performed where proposed structures will be underlain by young alluvial wash deposits.

6.6 Slope Stability

The topography at the site is relatively level and the topography in the immediate site vicinity slopes gently to the west at a grade of approximately 2%. The Apple Valley General Plan (2007) indicates the site is not located within a “hillside and mountainous area” or within an area identified as having a potential for slope instability. There are no known landslides near the site, nor is the site in the path of any known or potential landslides. Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

6.7 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. The City of Apple Valley General Plan (2007) and the San Bernardino County Safety Element (2010a) indicate the project property is not located within an area of possible inundation due to a seismically induced dam failure.

6.8 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up-gradient from the project site. Therefore, flooding resulting from a seismic-induced seiche is considered unlikely.

The site is located within a Zone D flood hazard area. As defined by the Federal Emergency Management Agency (FEMA, 2022), Zone D represents areas of undetermined flood hazards. Therefore, the potential for flooding at the site cannot be determined.

6.9 Oil Fields & Methane Potential

Based on a review of the California Geologic Energy Management Division (CalGEM) Well Finder Website, the site is not located within an oil field and active oil or gas wells are not documented in the immediate site vicinity (CalGEM, 2022). However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of the CalGEM.

Since the site is not located within the boundaries of a known oil field, the potential for the presence of methane or other volatile gases at the site is considered low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

6.10 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The site is not located within an area of known ground subsidence. No known large-scale extraction of groundwater, gas, oil, or geothermal energy is occurring or planned at the site or in the general site vicinity. There appears to be little or no potential for ground subsidence due to withdrawal of fluids or gases at the site.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

7.1.1 This evaluation report is not a comprehensive geotechnical investigation report. The evaluation report provides our opinion regarding the site conditions and geotechnical aspects of proposed design and construction based on available published information and subsurface information collected during our limited site exploration. Once the configuration of the proposed improvements is finalized, additional exploration, laboratory testing, and engineering analyses will be required to prepare a comprehensive geotechnical investigation report. 7.1.1 Artificial fill was not encountered during the site investigation. However, existing fill may exist in other areas of the site that were not directly explored. The existing site soils encountered during our limited investigation are suitable for re-use as engineered fill provided the recommendations in the *Grading* section of this report are followed (see Section 7.4).

7.1.2 Groundwater was not encountered during site exploration and the historic high groundwater table is sufficiently deep that it not expected to be encountered during construction. However, local seepage could be encountered during excavation of subterranean features, especially if conducted during the rainy season.

7.1.3 Based on our observations onsite and our knowledge of the geologic setting, cobbles should be anticipated during earthwork at the subject site. Additionally, occasional boulders may be encountered in the existing fill or alluvial soils. The contractor should be prepared for difficult excavation conditions. The presence of these materials and their impact on construction methods and equipment selection should be considered by both the developer and contractor prior to construction.

7.1.4 Screening of the earth materials will likely be required to remove oversize (greater than 6 inches) rock, prior to placement and compaction. Generation of oversized material (greater than 6 inches) should be anticipated.

7.1.5 The upper young alluvial soils consist primarily of loose silty sand with an increase in density with depth. Based on laboratory testing (see Figures B11 to B23), the upper alluvial soils may be subject to excessive hydro-collapse upon saturation. Hydro-consolidation is the tendency of a soil structure to collapse upon saturation, resulting in the overall settlement of the effected soils and any overlying soils, foundations, or improvements supported therein. The recommendations in this report are intended to reduce the effects of collapsible soils beneath the foundation systems.

7.1.6 Based on the potential for hydro-consolidation, maintaining proper surface drainage is critical to future performance of foundations and paving. Recommendations for drainage are provided in the S*urface Drainage* section of this report (see Section 7.17).

7.1.7 Based on these considerations, a conventional spread foundation system is considered feasible for support of the proposed structures. The excavation bottom and all foundation excavations must be observed and approved in writing by the Geotechnical Engineer prior to placement of fill, waterproofing, reinforcing steel or concrete. Recommendations for the design of the foundation system are provided in Section 7.6 of this report.

7.1.8 If proposed structures will be underlain or partially underlain by young alluvial wash deposits, an evaluation of potential seismically induced settlements should be performed. Where improvements will transition across geologic units (alluvial wash to older alluvium), the potential for differential settlement must also be evaluated. Additional grading may be required to reduce the effects of differential settlement on the proposed structures. Alternatively, a reinforced concrete mat foundation system may be recommended where differential settlements are significant. Once the configuration of the proposed structures is finalized, a comprehensive geotechnical investigation should be prepared with specific recommendations for each building or parcel.

7.1.9 For on-grade construction, as a minimum, it is recommended that the upper 5 feet of existing earth materials within the building footprint areas be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any encountered fill or soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). Proposed building foundations should be underlain by a minimum of 3 feet of newly placed engineered fill. The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint areas, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities. Recommendations for earthwork are provided in the *Grading* section of this report (see Section 7.4).

7.1.10 For subterranean construction, the proposed structures may be supported on a conventional foundation system deriving support in the competent older alluvium generally found at and below a depth of 10 feet below the existing ground surface. Foundations should be deepened as necessary to penetrate through soft or unsuitable soils at the direction of the Geotechnical Engineer.

7.1.11 Due to the granular nature of the soils, moderate to excessive caving is anticipated during excavation activities. The contractor should be aware that formwork may be required to prevent caving of shallow spread foundation excavations.

7.1.12 Excavations up to approximately 15 feet in vertical height are anticipated for construction of the subterranean features, including foundation excavations. It is anticipated that stable excavations can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 7.15).

7.1.13 Due to the nature of the proposed design and intent for subterranean features, waterproofing of subterranean walls and slabs is recommended. Particular care should be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. The design and inspection of the waterproofing is not the responsibility of the geotechnical engineer. A waterproofing consultant should be retained in order to recommend a product or method, which would provide protection to subterranean walls, floor slabs and foundations.

7.1.14 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structure, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, foundations may derive support directly in the alluvial soils and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. Compaction of the exposed soils in the excavation bottom will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

7.1.15 Where new paving is to be placed, it is recommended that all existing fill and soft alluvial soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill and soft alluvial soils in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable alluvial soil may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of subgrade soil should be scarified and properly compacted for paving support. Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 7.11).

7.1.16 Based on the results of percolation testing performed at the site, a stormwater infiltration system is considered feasible for this project. Infiltration recommendations are provided in the *Stormwater Infiltration* section of this report (see Section 7.16).

7.1.17 Once the design and foundation loading configuration for the proposed structures proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Based on the final foundation loading configurations, the potential for settlement should be re-evaluated by this office.

7.1.18 Any changes in the design, location or elevation, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

7.2 Soil and Excavation Characteristics

7.2.1 The in-situ soils can be excavated with moderate effort using conventional excavation equipment. Caving should be anticipated in unshored excavations, due to the granular nature of the onsite soils. Formwork may be required to prevent caving of foundation excavations. The older alluvium is moderately to highly cemented and should be rippable with conventional equipment; however, concretions or well cemented layers may be encountered in the older alluvium which could make excavation of subterranean features difficult. Coring or jack-hammering may be required if concretions are encountered and the contractor should be prepared for these conditions. In addition, due to the presence of cobbles and possible boulders, the contractor should be prepared for difficult excavation conditions during drilling and earthwork activities.

7.2.2 It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of existing adjacent improvements.

7.2.3 All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping or shoring. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 7.15).

7.2.4 The upper 5 feet of existing site soils encountered during this investigation are primarily granular in nature and are considered to have a "very low" expansive potential and would be classified as "non-expansive" based on the 2019 California Building Code (CBC) Section 1803.5.3. Recommendations presented herein assume that the building foundations and slabs will derive support in these materials.

7.2.5 Expansion Index testing during the design-level report and/or subsequent to grading of the building pads should be considered to confirm the characteristics of the soil providing foundation and slab support.

7.3 Minimum Resistivity, pH, and Water-Soluble Sulfate

7.3.1 Potential of Hydrogen (pH) and resistivity testing as well as chloride content testing were performed on representative samples of soil to generally evaluate the corrosion potential to surface utilities. The tests were performed in accordance with California Test Method Nos. 643 and 422 and indicate that the soils are considered "moderately corrosive" to "severely corrosive" with respect to corrosion of buried ferrous metals on site. The results are presented in Appendix B (Figures B29 and B30) and should be considered for design of underground structures. Due to the corrosive potential of the soils, it is recommended that PVC, ABS or other approved plastic piping be utilized in lieu of cast-iron when in direct contact with the site soils.

7.3.2 Laboratory tests were performed on representative samples of the site materials to measure the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate tests are presented in Appendix B (Figures B29 and B30) and indicate that the on-site materials possess a sulfate exposure class of "S0" to concrete structures as defined by 2019 CBC Section 1904 and ACI 318-19 Chapter 19.

7.3.3 Geocon West, Inc. does not practice in the field of corrosion engineering and mitigation. If corrosion sensitive improvements are planned, it is recommended that a corrosion engineer be retained to evaluate corrosion test results and incorporate the necessary precautions to avoid premature corrosion of buried metal pipes and concrete structures in direct contact with the soils.

7.4 Grading

7.4.1 Grading is anticipated to include preparation of the building pad or excavation of site soils for the proposed subterranean features, excavation of site soils for proposed foundations and utility trenches, as well as placement of backfill for walls, ramps, and trenches.

7.4.2 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, civil engineer, geotechnical engineer, and, if applicable, building official in attendance. Special soil handling requirements can be discussed at that time.

7.4.3 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill encountered during exploration is suitable for re-use as an engineered fill, provided any encountered oversize material (greater than 6 inches) and any encountered deleterious debris is removed.

7.4.4 Generation of oversized material (greater than 6 inches) should be anticipated. Screening of the earth materials will likely be required to remove rocks greater than 4 feet, prior to placement and compaction. The contractor should be prepared for difficult excavation conditions. The presence of these materials and their impact on construction methods and equipment selection should be considered by both the owner and contractor prior to construction.

7.4.5 Rocks larger than 6 inches but less than 4 feet in maximum dimension may be incorporated into the engineered fill provided the oversized material (larger than 6 inches) is placed so that voids between the rocks are not created. It is recommended that placement of oversized materials be performed in non-building areas, if available. Consideration should be given to placing oversized material at least 3 feet below the deepest foundation or utility.

7.4.6 The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved in writing by the Geotechnical Engineer prior to placement.

7.4.7 Grading should commence with the removal of all existing vegetation and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the fill soils. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. All existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

7.4.8 For on-grade construction, as a minimum, it is recommended that the upper 5 feet of existing earth materials within the proposed building footprint area be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any encountered fill or soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). Proposed building foundations should be underlain by a minimum of 3 feet of newly placed engineered fill. The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint areas, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities.

7.4.9 Subsequent to the recommended grading, the proposed on-grade structures may be supported on conventional shallow spread foundations deriving support in newly placed engineered fill. All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon) prior to placing fill.

7.4.10 For subterranean construction, the proposed structures may be supported on a conventional spread foundation system bearing in competent undisturbed older alluvium generally found at and below a depth of 10 feet below the existing ground surface.

7.4.11 It is recommended that the subgrade exposed at all excavation bottoms be proof rolled with heavy equipment to reduce compressibility. All excavation bottoms must be approved in writing by the Geotechnical Engineer (a representative of Geocon) prior to placing fill or construction materials.

7.4.12 Stable excavations for the recommended grading can be achieved with sloping measures where properly line setbacks allow. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 7.15).

7.4.13 All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to near optimum moisture content, and properly compacted to at least 90 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

7.4.14 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structures, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, such as adjacent to property lines, foundations may be deepened as necessary to maintain a minimum 18-inch embedment below the ground surface, and a minimum 12-inch embedment into the undisturbed alluvial soils. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

7.4.15 Where new paving is to be placed, it is recommended that all existing fill and soft alluvial soils be excavated and properly compacted for paving support. As a minimum, the upper 12 inches of subgrade soil should be scarified, moisture conditioned to near optimum moisture content, and properly compacted to a minimum of 95 percent of the laboratory maximum dry density in accordance with ASTM D 1557 (latest edition). *Preliminary Pavement Recommendations* section of this report (see Section 7.11).

7.4.16 All imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Rocks larger than 6 inches in diameter shall not be used in the fill. If necessary, import soils used as structural fill should have an expansion index less than or equal to 20 and soil corrosivity properties that are equally or less detrimental to that of the existing onsite soils (see Figures B29 and 30). Imported soil placed in building pad areas must be placed uniformly across the pad at the direction of the Geotechnical Engineer (a representative of Geocon).

7.4.17 Utility trenches should be properly backfilled in accordance with the following requirements. The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of minimum 2-sack slurry as backfill is also acceptable. Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

7.4.18 All trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, pipes, fill, steel, gravel, or concrete.

7.5 Shrinkage

7.5.1 Shrinkage results when a volume of material removed at one density is compacted to a higher density. A shrinkage factor between 5 and 15 percent should be anticipated when excavating and compacting the upper 5 feet of existing earth materials on the site to an average relative compaction of 92 percent. The shrinkage factor does not include the removal of oversized material.

7.5.2 If import soils will be utilized in the building pad, the soils must be placed uniformly and at equal thickness at the direction of the Geotechnical Engineer (a representative of Geocon West, Inc.). Soils can be borrowed from non-building pad areas and later replaced with imported soils.

7.6 Conventional Foundation Design

7.6.1 If proposed structures will be underlain or partially underlain by young alluvial wash deposits, an evaluation of potential seismically induced settlements should be performed. Where improvements will transition across geologic units (alluvial wash to older alluvium), the potential for differential settlement should also be evaluated. Additional grading may be required to reduce the effects of differential settlement on the proposed structures. Alternatively, a reinforced concrete mat foundation system may be recommended where differential settlements are significant. If needed, recommendations for the design and construction of a mat foundation will be provided under separate cover. Once the configuration of the proposed structures is finalized, a comprehensive geotechnical investigation should be prepared with specific recommendations for each building or parcel. 7.6.1 Due to the granular nature of the soils, moderate to excessive caving is anticipated during excavation activities. The contractor should be aware that formwork may be required to prevent caving of shallow spread foundation excavations.

7.6.2 A conventional shallow spread foundation system may be utilized for support of the proposed structure provided foundations derive support in newly placed engineered fill or undisturbed older alluvium generally found at and below a depth of 10 feet below the ground surface. Where foundations will derive support in newly placed engineered fill, proposed foundations should be underlain by a minimum of 3 feet of newly placed engineered fill. All foundation excavations must be observed and approved by the Geotechnical Engineer (a representative of Geocon), prior to placing steel or concrete.

7.6.3 Continuous footings may be designed for an allowable bearing capacity of 2,500 pounds per square foot (psf), and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material.

7.6.4 Isolated spread foundations may be designed for an allowable bearing capacity of 2,000 psf, and should be a minimum of 24 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material.

7.6.5 The allowable soil bearing pressure may be increased by 400 psf and 800 psf for each additional foot of foundation width and depth, respectively, up to a maximum allowable soil bearing pressure of 3,500 psf.

7.6.6 The allowable bearing pressures may be increased by one-third for transient loads due to wind or seismic forces.

7.6.7 If depth increases are utilized for the exterior wall footings, this office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary. Additional grading should be conducted as needed in order to maintain the recommended 3-foot-thick blanket of engineered fill below proposed on-grade foundations.

7.6.8 Continuous footings should be reinforced with four No. 4 steel reinforcing bars, two placed near the top of the footing and two near the bottom. Reinforcement for spread footings should be designed by the project structural engineer.

7.6.9 The above foundation dimensions and minimum reinforcement recommendations are based on soil conditions and building code requirements only, and are not intended to be used in lieu of those required for structural purposes.

7.6.10 No special subgrade presaturation is required prior to placement of concrete. However, the slab and foundation subgrade should be sprinkled as necessary; to maintain a moist condition as would be expected in any concrete placement.

7.6.11 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

7.6.12 This office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

7.7 Foundation Settlement

7.7.1 The maximum expected static settlement for a structure supported on a conventional foundation system deriving support in the recommended bearing materials and designed with a maximum bearing pressure of 3,500 psf is estimated to be less than 1 inch and occur below the heaviest loaded structural element. Settlement of the foundation system is expected to occur on initial application of loading. Differential settlement is not expected to exceed ½ inch over a distance of 20 feet or between adjacent foundations.

7.7.2 If proposed structures will be underlain or partially underlain by young alluvial wash deposits, an evaluation of potential seismically induced settlements should be performed. Where improvements will transition across geologic units (alluvial wash to older alluvium), the potential for differential settlement should also be evaluated. Once the configuration of the proposed structures is finalized, a comprehensive geotechnical investigation should be prepared with specific recommendations for each building or parcel.

7.7.3 Once the design and foundation loading configurations for the proposed structures proceed to a more finalized plan, the estimated settlements presented in this report should be reviewed and revised, if necessary. If the final foundation loading configurations are greater than the assumed loading conditions, the potential for settlement should be reevaluated by this office.

7.8 Miscellaneous Foundations

7.8.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structures, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, foundations may derive support directly in the competent undisturbed alluvial soils, and should be deepened as necessary to maintain a minimum 18-inch embedment below the ground surface, and a minimum 12-inch embedment into the undisturbed alluvial soils.

7.8.2 If the soils exposed in the excavation bottom are soft, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative. Miscellaneous foundations may be designed for a bearing value of 1,500 psf, and should be a minimum of 12 inches in width,18 inches in depth below the lowest adjacent grade and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.8.3 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

7.9 Lateral Design

7.9.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.40 may be used with the dead load forces in the undisturbed alluvial soils or engineered fill.

7.9.2 Passive earth pressure for the sides of foundations and slabs poured against the alluvial soils or properly compacted engineered fill may be computed as an equivalent fluid having a density of 270 pcf with a maximum earth pressure of 2,700 pcf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third.

7.10 Concrete Slabs-on-Grade

7.10.1 Concrete slabs-on-grade subject to vehicle loading should be designed in accordance with the recommendations in the *Preliminary Pavement Recommendations* section of this report (Section 7.11).

7.10.2 Subsequent to the recommended grading, concrete slabs-on-grade for structures, not subject to vehicle loading, should be a minimum of 4 inches thick and minimum slab reinforcement should consist of No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint.

7.10.3 Slabs-on-grade that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder placed directly beneath the slab. The vapor retarder and acceptable permeance should be specified by the project architect or developer based on the type of floor covering that will be installed. The vapor retarder selection and design should be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06) as well as ASTM E1745 and should be installed in general conformance with ASTM E 1643 (latest edition) and the manufacturer's recommendations. A minimum thickness of 15 mils extruded polyolefin plastic is recommended; vapor retarders which contain recycled content or woven materials are not recommended. The vapor retarder should have a permeance of less than 0.01 perms demonstrated by testing before and after mandatory conditioning. The vapor retarder should be installed in direct contact with the concrete slab with proper perimeter seal. If the California Green Building Code requirements apply to this project, the vapor retarder should be underlain by 4 inches of clean aggregate. It is important that the vapor retarder be puncture resistant since it will be in direct contact with angular gravel. As an alternative to the clean aggregate suggested in the Green Building Code, it is our opinion that the concrete slab-on-grade may be underlain by a vapor retarder over 4-inches of clean sand (sand equivalent greater than 30), since the sand will serve a capillary break and will minimize the potential for punctures and damage to the vapor barrier.

7.10.4 For seismic design purposes, a coefficient of friction of 0.40 may be utilized between concrete slabs and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.

7.10.5 Exterior slabs for walkways or flatwork, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 12 inches of subgrade should be moistened to near optimum moisture content and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. The project structural engineer should design construction joints as necessary.

7.10.6 The recommendations of this report are intended to reduce the potential for cracking of slabs due to settlement. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade may exhibit some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

7.11 Preliminary Pavement Recommendations

7.11.1 Where new paving is to be placed, it is recommended that all existing fill and soft or unsuitable alluvial materials be excavated and properly recompacted for paving support. The client should be aware that excavation and compaction of all existing artificial fill and soft alluvium in the area of new paving is not required; however, paving constructed over existing unsuitable material may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of paving subgrade should be scarified, moisture conditioned to near optimum moisture content, and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

7.11.2 The following pavement sections are based on an assumed R-Value of 30. Once site grading activities are complete an R-Value should be obtained by laboratory testing to confirm the properties of the soils serving as paving subgrade, prior to placing pavement.

7.11.3 The Traffic Indices listed below are estimates. Geocon does not practice in the field of traffic engineering. The actual Traffic Index for each area should be determined by the project civil engineer. If pavement sections for Traffic Indices other than those listed below are required, Geocon should be contacted to provide additional recommendations. Pavement thicknesses were determined following procedures outlined in the *California Highway Design Manual* (Caltrans). It is anticipated that the majority of traffic will consist of automobile and large truck traffic.

PRELIMINARY PAVEMENT DESIGN SECTIONS

Location	Estimated Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Automobile Parking And Driveways	4.0	3.0	4.0
Trash Truck & Fire Lanes	7.0	4.0	10.0

7.11.4 Asphalt concrete should conform to Section 203-6 of the "*Standard Specifications for Public Works Construction"* (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02A of the "*Standard Specifications of the State of California, Department of Transportation"* (Caltrans). The use of Crushed Miscellaneous Base in lieu of Class 2 aggregate base is acceptable. Crushed Miscellaneous Base should conform to Section 200-2.4 of the "*Standard Specifications for Public Works Construction"* (Green Book).

7.11.5 Unless specifically designed and evaluated by the project structural engineer, where exterior concrete paving will be utilized for support of vehicles, it is recommended that the concrete be a minimum of 6 inches of concrete reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The subgrade and base material should be compacted to 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

7.11.6 The performance of pavements is highly dependent upon providing positive surface drainage away from the edge of pavements. Ponding of water on or adjacent to the pavement will likely result in saturation of the subgrade materials and subsequent cracking, subsidence and pavement distress. If planters are planned adjacent to paving, it is recommended that the perimeter curb be extended at least 12 inches below the bottom of the aggregate base to minimize the introduction of water beneath the paving.

7.12 Retaining Wall Design

7.12.1 The recommendations presented below are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 12 feet. In the event that walls significantly higher than 12 feet are planned, Geocon should be contacted for additional recommendations.

7.12.2 Retaining wall foundations may be designed in accordance with the recommendations provided in the *Conventional Foundation Design* section of this report (see Section 7.6).

7.12.3 Retaining walls with a level backfill surface that are not restrained at the top should be designed utilizing a triangular distribution of pressure (active pressure). Restrained walls are those that are not allowed to rotate more than 0.001H (where H equals the height of the retaining portion of the wall in feet) at the top of the wall. Where walls are restrained from movement at the top, walls may be designed utilizing a triangular distribution of pressure (at-rest pressure). The table below presents recommended pressures to be used in retaining wall design, assuming that proper drainage will be maintained.

RETAINING WALL WITH LEVEL BACKFILL SURFACE

HEIGHT OF RETAINING WALL (Feet)	ACTIVE PRESSURE EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot)	AT-REST PRESSURE EQUIVALENT FLUID PRESSURE (Pounds Per Cubic Foot)
Up to 12	44	57

7.12.4 The wall pressures provided above assume that the proposed retaining walls will support relatively undisturbed alluvial soils or engineered fill derived from onsite soil. If import soil is used to backfill proposed walls, revised earth pressures may be required to account for the geotechnical properties of the soil placed as engineered fill. This should be evaluated once the use of import soil is established and once the geotechnical characteristics of the engineered backfill soils can be further evaluated.

7.12.5 The wall pressures provided above assume that the retaining wall will be properly drained preventing the buildup of hydrostatic pressure. If retaining wall drainage is not implemented, the equivalent fluid pressure to be used in design of undrained walls is 92 pcf. The value includes hydrostatic pressures plus buoyant lateral earth pressures.

7.12.6 Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures and should be designed for each condition as the project progresses.

7.12.7 It is recommended that line-load surcharges from adjacent wall footings, use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.20 \times \left(\frac{z}{H}\right)}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.28 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

where x is the distance from the face of the excavation or wall to the vertical line-load, H is the distance from the bottom of the footing to the bottom of excavation or wall, z is the depth at which the horizontal pressure is desired, Q_L is the vertical line-load and $\sigma_H(z)$ is the horizontal pressure at depth z.

7.12.8 It is recommended that vertical point-loads, from construction equipment outriggers or adjacent building columns use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$For\ {}^{x}/_{H} \leq 0.4$$

$$\sigma_H(z) = \frac{0.28 \times \left(\frac{z}{H}\right)^2}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

and

$$For\ {}^{x}/_{H} > 0.4$$

$$\sigma_H(z) = \frac{1.77 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)^2}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2}$$

then

$$\sigma'_H(z) = \sigma_H(z) cos^2(1.1\theta)$$

where x is the distance from the face of the excavation/wall to the vertical point-load, H is distance from the outrigger/bottom of column footing to the bottom of excavation, z is the depth at which the horizontal pressure is desired, Q_p is the vertical point-load, $\sigma_H(z)$ is the horizontal pressure at depth z, θ is the angle between a line perpendicular to the excavation/wall and a line from the point-load to location on the excavation/wall where the surcharge is being evaluated, and $\sigma_H(z)$ is the horizontal pressure at depth z.

7.12.9 In addition to the recommended earth pressure, the upper 10 feet of the retaining wall adjacent to the street or driveway areas should be designed to resist a uniform lateral pressure of 100 psf, acting as a result of an assumed 300 psf surcharge behind the shoring due to normal street traffic. If the traffic is kept back at least 10 feet from the wall, the traffic surcharge may be neglected.

7.12.10 Seismic lateral forces should be incorporated into the design as necessary, and recommendations for seismic lateral forces are presented below.

7.13 Dynamic (Seismic) Lateral Forces

7.13.1 The structural engineer should determine the seismic design category for the project in accordance with Section 1613 of the CBC. If the project possesses a seismic design category of D, E, or F, proposed retaining walls in excess of 6 feet in height should be designed with seismic lateral pressure (Section 1803.5.12 of the 2019 CBC).

7.13.2 A seismic load of 4 pcf should be used for design of walls that support more than 6 feet of backfill in accordance with Section 1803.5.12 of the 2019 CBC. The seismic load is applied as an equivalent fluid pressure along the height of the wall and the calculated loads result in a maximum load exerted at the base of the wall and zero at the top of the wall. This seismic load should be applied in addition to the active earth pressure. The earth pressure is based on half of two-thirds of PGA_M calculated from ASCE 7-16 Section 11.8.3.

7.14 Retaining Wall Drainage

7.14.1 Unless designed for hydrostatic pressures, retaining walls should be provided with a drainage system. At the base of the drain system, a subdrain covered with a minimum of 12 inches of gravel should be installed, and a compacted fill blanket or other seal placed at the surface (see Figure 5). The clean bottom and subdrain pipe, behind a retaining wall, should be observed by the Geotechnical Engineer (a representative of Geocon), prior to placement of gravel or compacting backfill.

7.14.2 As an alternative, a plastic drainage composite such as Miradrain or equivalent may be installed in continuous, 4-foot wide columns along the entire back face of the wall, at 8 feet on center. The top of these drainage composite columns should terminate approximately 18 inches below the ground surface, where either hardscape or a minimum of 18 inches of relatively cohesive material should be placed as a cap (see Figure 6). These vertical columns of drainage material would then be connected at the bottom of the wall to a 4-inch subdrain pipe.

7.14.3 Subdrainage pipes at the base of the retaining wall drainage system should outlet to an acceptable location via controlled drainage structures. Drainage should not be allowed to flow uncontrolled over descending slopes.

7.14.4 Moisture affecting below grade walls is one of the most common post-construction complaints. Poorly applied or omitted waterproofing can lead to efflorescence or standing water. Particular care should be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. The design and inspection of the waterproofing is not the responsibility of the geotechnical engineer. A waterproofing consultant should be retained in order to recommend a product or method, which would provide protection to subterranean walls, floor slabs and foundations.

7.15 Temporary Excavations

7.15.1 Excavations of up to 15 feet in height may be required during construction activities, including foundation excavations. Due to the granular nature of the soils, moderate to excessive caving should be anticipated in vertical excavations. The contractor may attempt vertical excavations less than 5 feet; however, it is likely that sloping measures will be required to maintain a stable excavation. The contractor should be prepared for caving, sloughing, and raveling in open excavations. Due to the granular nature of soils and potential for caving, the contractor should also be prepared to form foundation excavations at the excavation bottom. In addition, due to the presence of cobbles, the contractor should be prepared for difficult excavation conditions.

7.15.2 Vertical excavations greater than 5 feet or where surcharged by existing structures will require sloping or shoring measures in order to provide a stable excavation. Where sufficient space is available, temporary unsurcharged slopes could be sloped back at a uniform 1:1 slope gradient or flatter up to maximum height of 7 feet; or at a uniform 1½:1 slope gradient or flatter to a maximum height of 15 feet. A uniform slope does not have a vertical portion.

7.15.3 If excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures such as shoring may be necessary in order to maintain lateral support of offsite improvements. If necessary, shoring recommendations can provided under separate cover.

7.15.4 Where temporary construction slopes are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary slopes are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. Geocon personnel should inspect the soils exposed in the cut slopes during excavation so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations should be stabilized within 30 days of initial excavation.

7.16 Stormwater Infiltration

7.16.1 During the February 18, 2022 site exploration, boring B2 was utilized to perform percolation testing. The boring was over excavated to collect soil samples and backfilled to the invert elevation with a bentonite seal placed at the bottom of the test elevation. Slotted casing was placed in the boring, and the annular space between the casing and excavation was filled with gravel. The boring was then filled with water to pre-saturate the soils. The casing was refilled with water and percolation test readings were performed after repeated flooding of the cased excavation. Based on the test results, the average infiltration rate (adjusted percolation rate), for the earth materials encountered, is provided in the following table. The field-measured percolation rate has been adjusted to infiltration rates in accordance with the County of San Bernardino Technical Guidance Document for Water Quality Management Plans (June 2013). Additional correction factors may be required and should be applied by the engineer in responsible charge of the design of the stormwater infiltration system and based on applicable guidelines. Percolation test field data and calculation of the measured percolation rate and design infiltration rate are provided on Figure 7.

Boring	Soil Type	Infiltration Depth (ft)	Average Infiltration Rate (in / hour)
B2	SP	1-5	2.91

7.16.2 The results of the percolation test indicate that the soils encountered at the location and depths listed in the table above, are conducive to infiltration. It is our opinion that the soil zone encountered at the depths and location, listed in the table above, is suitable for the infiltration of stormwater.

7.16.3 At this time, the location of the proposed stormwater infiltration system and the horizontal offset distance of the infiltration system to the proposed structures is unknown. Due to the presence of hydro-collapsible soils, it is recommended that the proposed infiltration system be located a minimum distance of 40 feet from proposed structures and 15 feet from proposed site improvements in order to reduce the potential for induced settlements to adversely impact the development. Provided these offsets are maintained, there is a very low potential for infiltration-related soil settlement to adversely affect the proposed structures; some settlement may occur locally within the area of the infiltration system. The civil engineer should also evaluate the impact on surface drainage should some soil settlement occur locally within the area of the infiltration system. It is suggested that flexible connections be utilized between the storm drain pipes and infiltration chambers. The project owner should understand that it is not our intent to completely prevent any soil settlement and associated distress of the overlying pavement as a result of stormwater infiltration as doing so would be prohibitive to the proposed project.

7.16.4 Subsequent to the placement of the infiltration system, it is acceptable to backfill the resulting void space between the excavation sidewalls and the infiltration system with minimum two-sack slurry provided the slurry is not placed in the infiltration zone. It is recommended that pea gravel be utilized adjacent to the infiltration zone so communication of water to the soil is not hindered.

7.16.5 Due to the preliminary nature of the project at this time, the type of stormwater infiltration system and location of the stormwater infiltration systems has not yet been determined. The design drawings should be reviewed and approved by the Geotechnical Engineer. The installation of the stormwater infiltration system should be observed and approved by the Geotechnical Engineer (a representative of Geocon).

7.17 Surface Drainage

7.17.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.

7.17.2 All site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2019 CBC 1804.4 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over any descending slope. Discharge from downspouts, roof drains and scuppers are not recommended onto unprotected soils within 5 feet of the building perimeter. Planters which are located adjacent to foundations should be sealed to prevent moisture intrusion into the soils providing foundation support. Landscape irrigation is not recommended within 5 feet of the building perimeter footings except when enclosed in protected planters.

7.17.3 Positive site drainage should be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures.

7.17.4 Landscaping planters immediately adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Either a subdrain, which collects excess irrigation water and transmits it to drainage structures, or impervious above-grade planter boxes should be used. In addition, where landscaping is planned adjacent to the pavement, it is recommended that consideration be given to providing a cutoff wall along the edge of the pavement that extends at least 12 inches below the base material.

7.18 Plan Review

7.18.1 Grading, foundation, and shoring plans (if applicable) should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon West, Inc. should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon West, Inc.

2. This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

4. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

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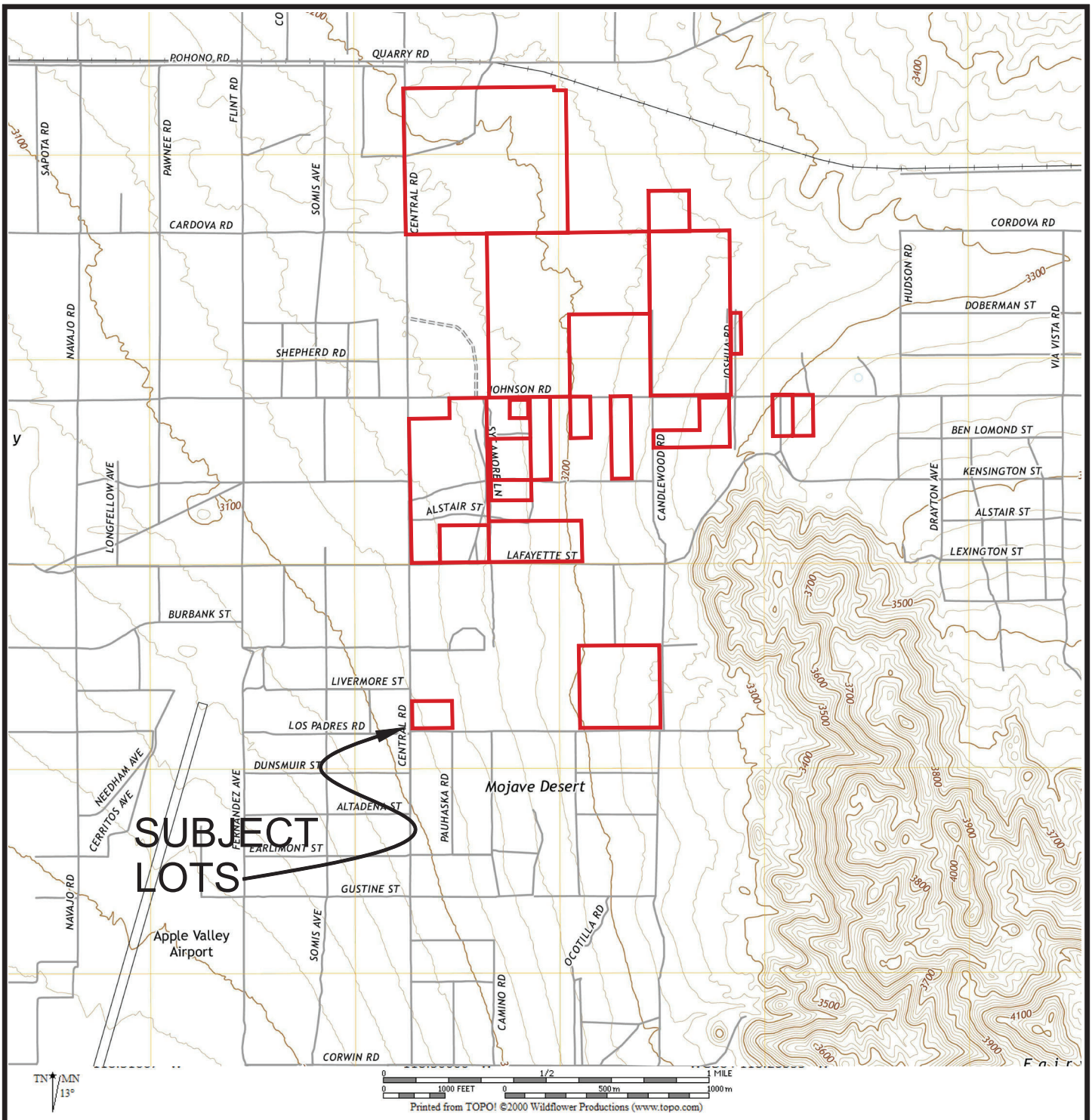

REFERENCE: U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, APPLE VALLEY NORTH, CA QUADRANGLE

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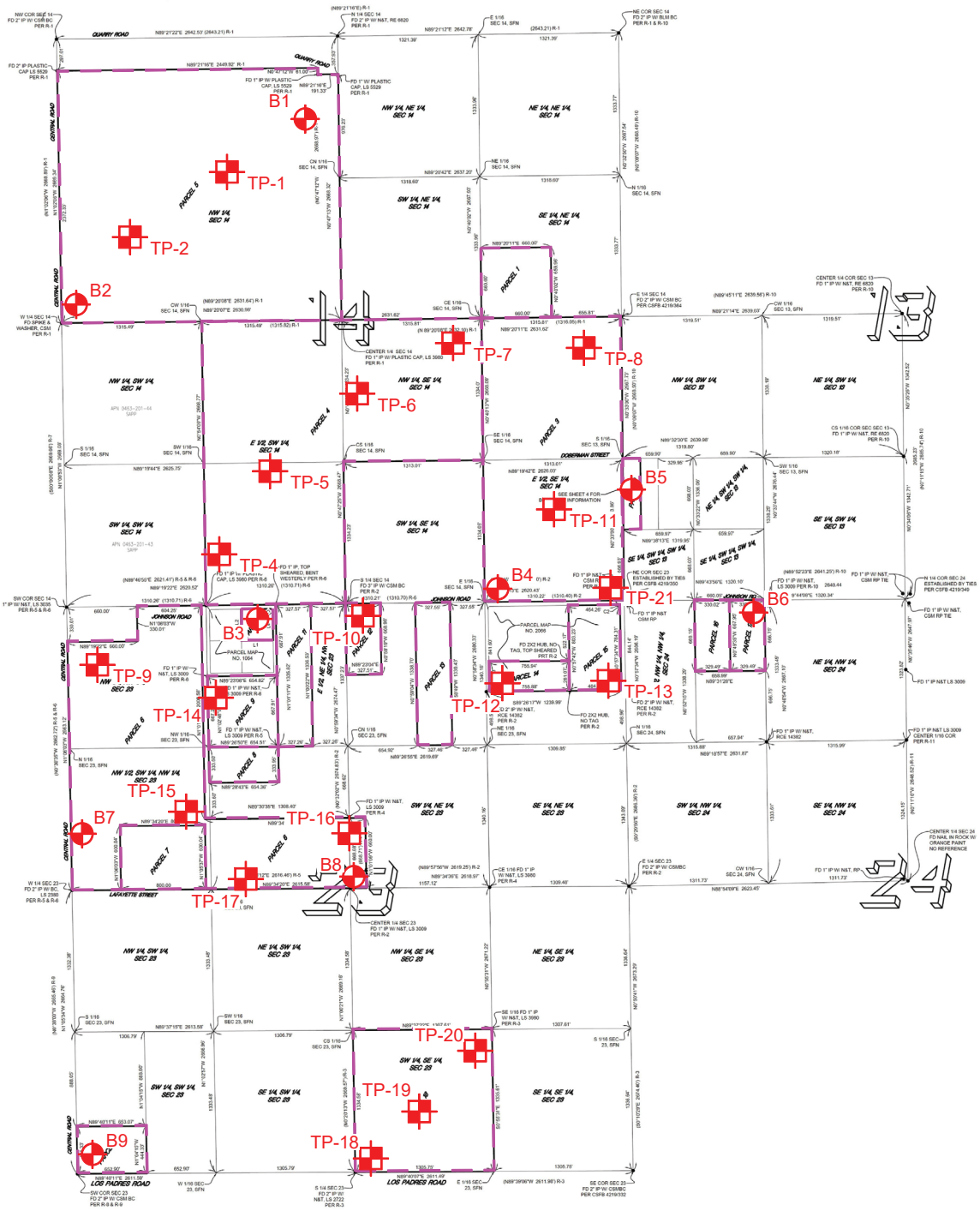
VICINITY MAP

565 ACRES

APPLE VALLEY, CALIFORNIA

MARCH 2022 | PROJECT NO. W1523-99-01 | FIG. 1



LEGEND

Approximate Location of Subject Property

B9 Approximate Location of Boring

TP-21 Approximate Location of Test Pit

0 1,000' 2,000'

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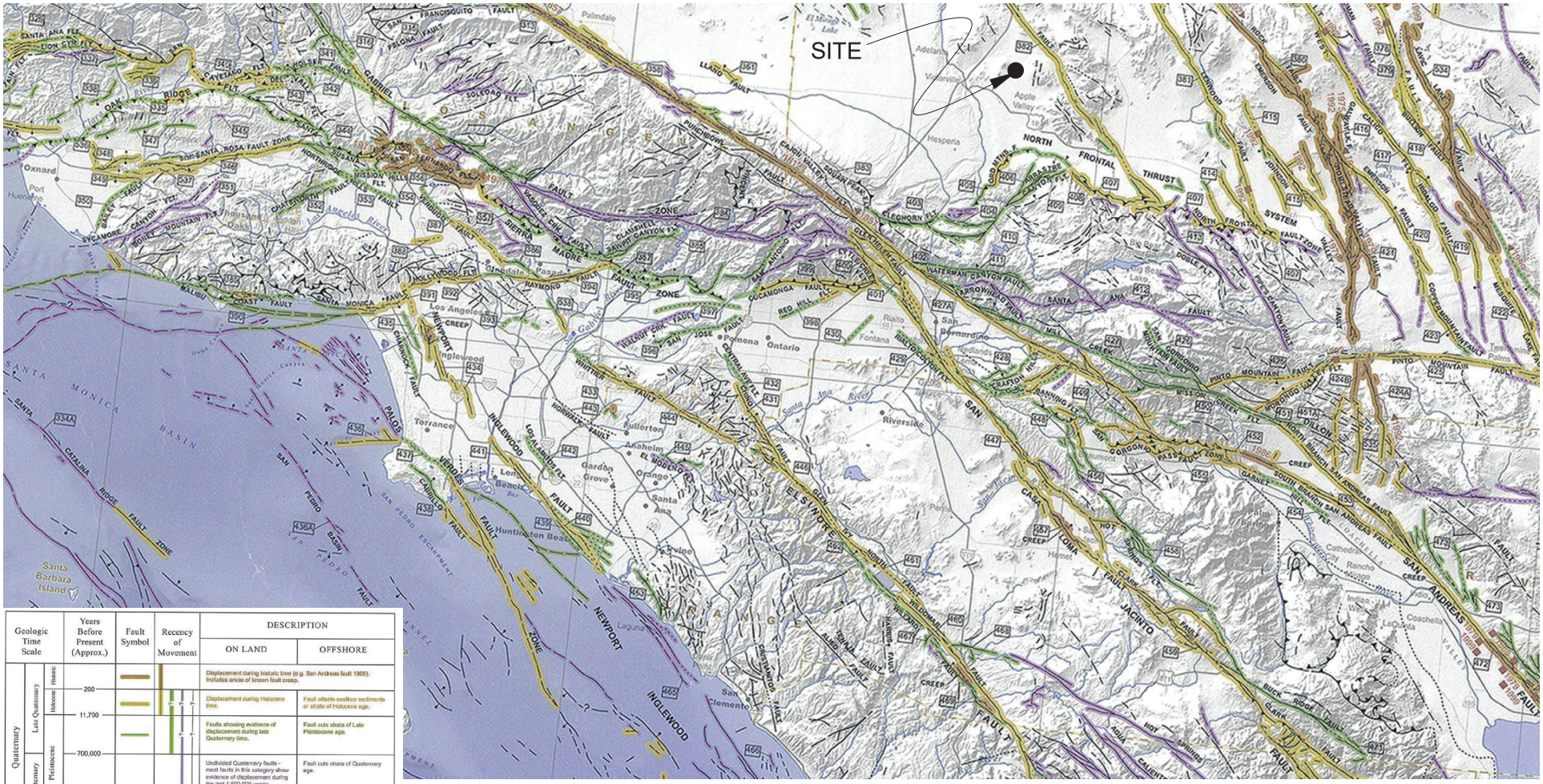
SITE PLAN

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 | PROJECT NO. W1523-99-01 | FIG. 2

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION	
						ON LAND	OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	11,700		? ? ?	Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
	Early Quaternary	Pleistocene	700,000		? ? ?	Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
			1,600,000*		? ?	Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			4.5 billion (Age of Earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

0 12 24 Miles

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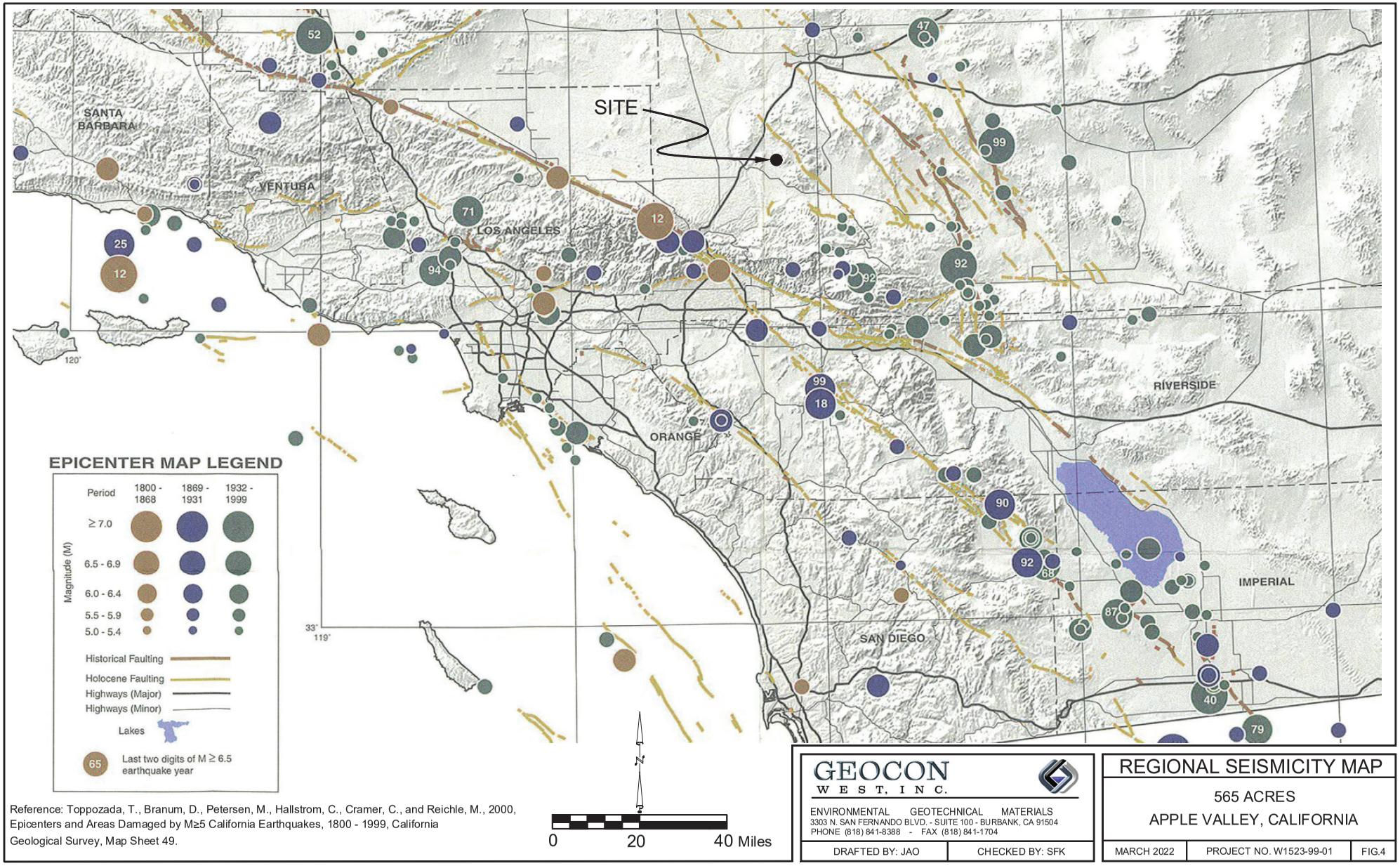
REGIONAL FAULT MAP

565 ACRES

APPLE VALLEY, CALIFORNIA

MARCH 2022 | PROJECT NO. W1523-99-01 | FIG. 3



Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M≥5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.

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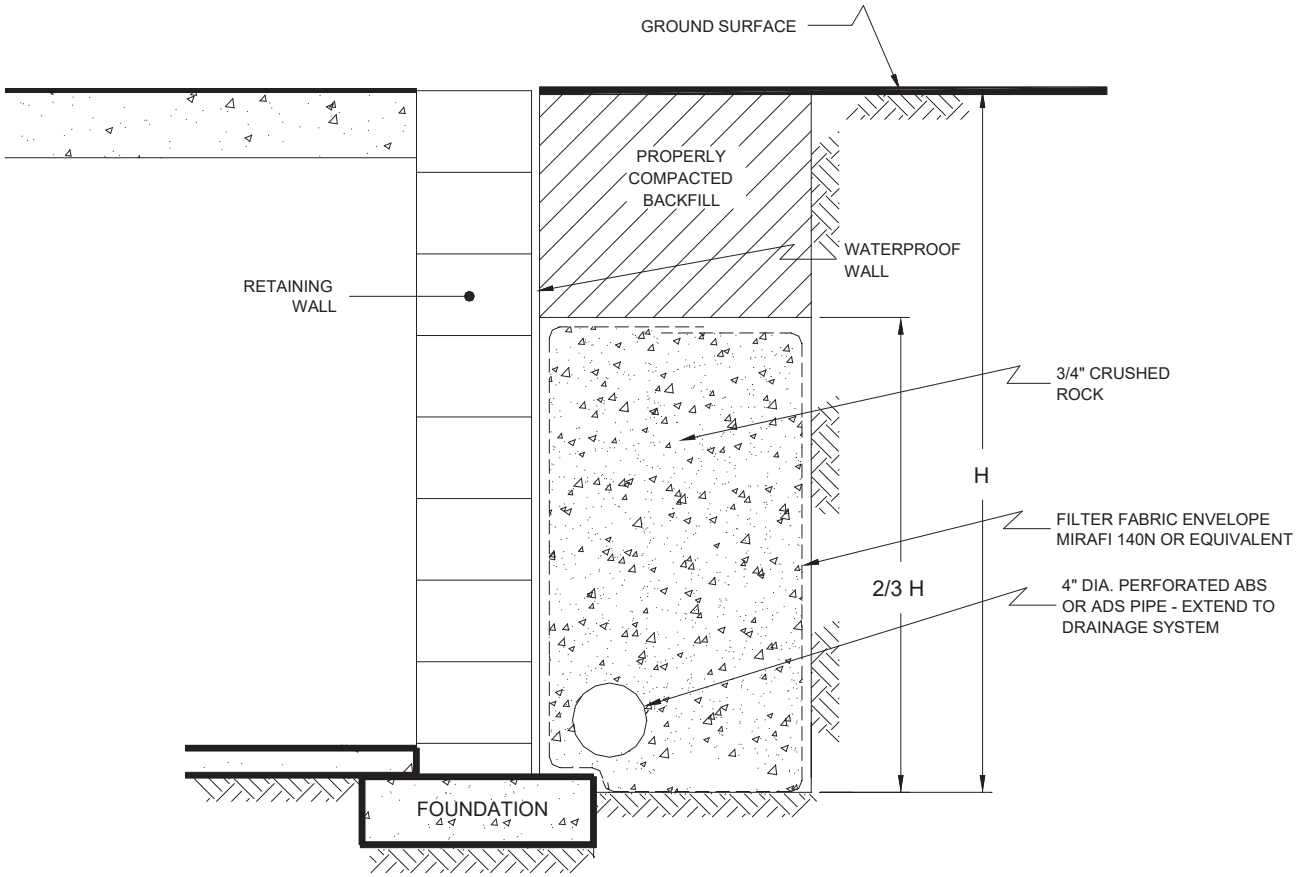
REGIONAL SEISMICITY MAP

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 | PROJECT NO. W1523-99-01 | FIG.4



NO SCALE

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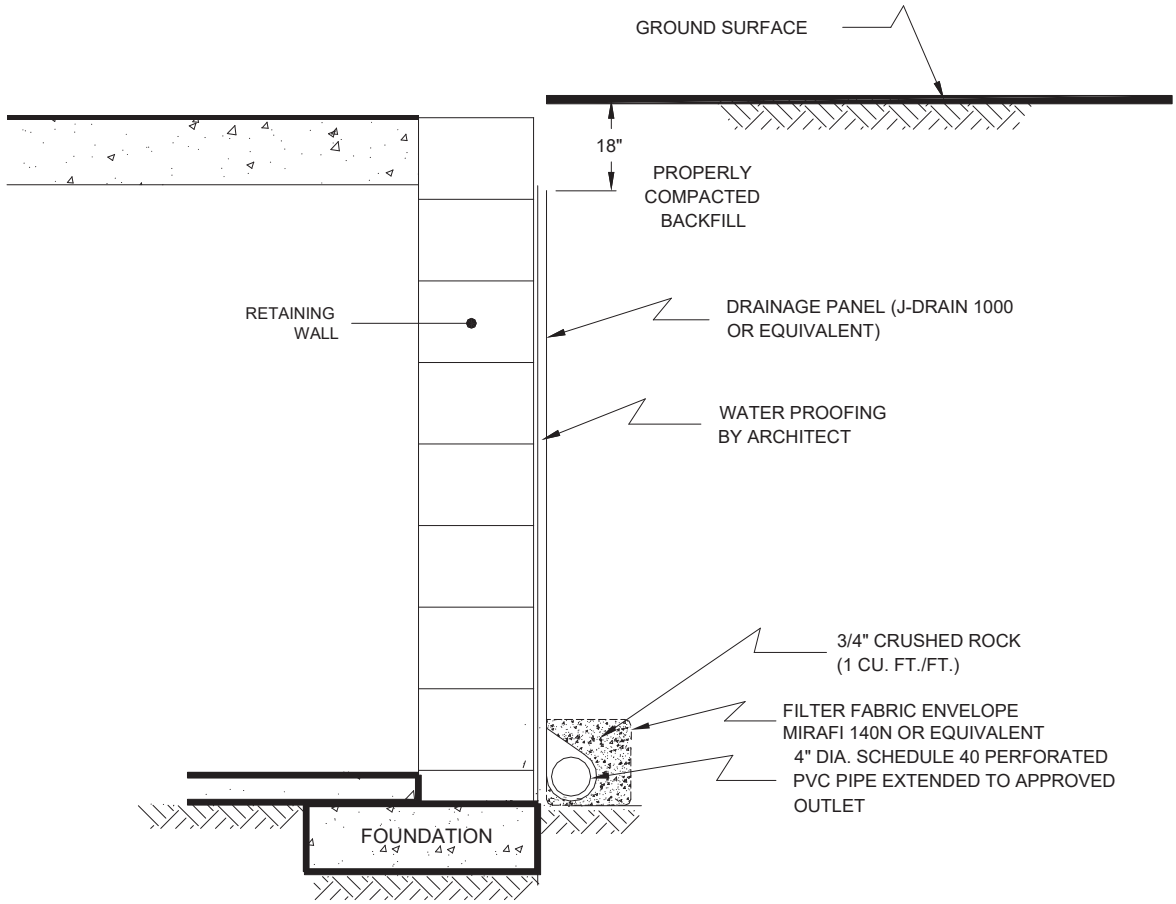
DRAFTED BY: JMH	CHECKED BY: HHD

RETAINING WALL DRAIN DETAIL

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022	PROJECT NO. W1523-99-01	FIG. 5



NO SCALE

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DRAFTED BY: JMH	CHECKED BY: HHD

RETAINING WALL DRAIN DETAIL

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022	PROJECT NO. W1523-99-01	FIG. 6

PERCOLATION TEST DATA SHEET

Project:	565 Acres	Project No:	W1523-99-01	Date:	7/30/2021
Test Hole No:	B2	Tested By:	JMH		
Depth of Test Hole, D_T:	5	USCS Soil Classification:	SP		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round) =	8	Sides (if rectangular) =	---	---	

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Δt Time Interval (min)	D_0 Initial Depth to Water (in)	D_f Final Depth to Water (in)	ΔD Change in Water Level (in)	Greater than or Equal to 6"? (y/n)
1	10:00	10:25	25	12.0	60.0	48.0	y
2	10:30	10:55	25	12.0	60.0	48.0	y

*If two consecutive measurements show that six inches of water seeps away in less than 25 minutes, the test shall be run for an additional hour with measurements, taken every 10 minutes. Otherwise, pre-soak (fill) overnight. Obtain at least twelve measurements per hole over at least six hours (approximately 30 minute intervals) with a precision of at least 0.25".

Trial No.	Start Time	Stop Time	Δt Time Interval (min)	D_0 Initial Depth to Water (in)	D_f Final Depth to Water (in)	ΔD Change in Water Level (in)	Percolation Rate (min/in)
1	12:00	12:10	10	12.0	30.1	18.1	795
2	12:15	12:25	10	12.0	27.7	15.7	916
3	12:30	12:40	10	12.0	24.6	12.6	1143
4	12:45	12:55	10	12.0	23.4	11.4	1263
5	13:00	13:10	10	12.0	23.2	11.2	1290
6	13:15	13:25	10	12.0	22.8	10.8	1333
7							
8							

Infiltration Rate Calculation:

Time Interval, Δt =	10	minutes	Ho =	48.0	inches
Final Depth to Water, Df =	22.8	inches	Hf =	37.2	inches
Test Hole Radius, r =	4	inches	ΔH =	10.8	inches
Initial Depth to Water, Do =	12.0	inches	Havg =	42.6	inches
Total Depth of Test Hole, DT =	60.0	inches			

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

Infiltration Rate, It = **2.91** inches/hour

Figure 7

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The site was explored on February 18, 2022 by excavating nine 8-inch diameter borings to a depth of up to approximately 24½ feet below the existing ground surface using a truck-mounted hollow-stem auger drilling machine. Refusal was encountered in two of the borings at depths of 9½ and 19½ feet. In addition, twenty test pits were excavated on March 2 and 3, 2022 to depths of up to approximately 9½ feet below the existing ground surface using a backhoe. Representative and relatively undisturbed samples were obtained by driving a 3-inch, O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a 140-pound auto-hammer falling 30 inches within the hollow stem auger drilling machine borings. The California Modified Sampler was equipped with 1-inch by 2$^{3}/_{8}$-inch diameter brass sampler rings to facilitate soil removal and testing. Bulk samples were also obtained.

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the test pits and borings are presented on Figures A1 through A29. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the logs were revised based on subsequent laboratory testing. The locations of the test pits and borings are shown on Figure 2.

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	TEST PIT 1 ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SP	**ALLUVIUM** Sand, poorly graded, loose, dry, light brown, fine- to medium-grained, some coarse-grained and silt.			
2				SM	**OLDER ALLUVIUM** Silty Sand, poorly graded, dense, dry, reddish brown, fine- to coarse-grained, some gravel.			
4				SW	Sand, well-graded, dense, dry, reddish brown, fine- to coarse-grained, some gravel (to 1"), trace silt.			
				SP	Sand, poorly graded, very dense, dry, light gray, fine- to medium-grained, well-cemented.			
					Total depth of boring: 5.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

WK/ 2* 5335 0K TEST PIT LOGS.GP-

Figure A1,
Log of Test Pit 1, Page 1 of 1

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... YHUN: SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

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PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	**TEST PIT 2** ELEV. (MSL.) - - DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SW	**ALLUVIUM** Sand, well-graded, loose, dry, light brown, fine- to coarse-grained.			
2								
4				SP	**OLDER ALLUVIUM** Sand, poorly graded, very dense, dry, light gray, fine- to medium-grained, some cobbles (to 10").			
					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A2,
Log of Test Pit 2, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

TEST PIT 4

ELEV. (MSL.) - - DATE YOMPLETED **3/2/22-3/3/22**

E8 UIPMENT **BACKHOE** B6 1 **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	MATERIAL DESYRIPTION	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
0					**WASH DEPOSITS** Sand, well-graded, loose, dry, light brown, fine- to coarse-grained, some fine gravel (to 1"), trace silt.			
2				SW				
4								
9					**OLDER ALLUVIUM** Silty Sand, poorly graded, medium dense, dry, brown to light brown, fine- to medium-grained, slightly cemented, some cobbles (to 8").			
				SM				
J					Total depth of boring: 8 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

WK/ 2* 5335 0K TEST PIT LOGS.GP-

Figure A3,
Log of Test Pit 4, Page 1 of 1

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... YHUN: SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	**TEST PIT 5** ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0					**WASH DEPOSITS** Sand, well-graded, loose, dry, brown, fine- to coarse-grained, some fine gravel (to 1") and cobbles (to 10"), trace silt.			
2				SW				
4								
9					Total depth of boring: 6 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A4,
Log of Test Pit 5, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◹ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	**TEST PIT 6** ELEV. (MSL.) - - DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SW	**WASH DEPOSITS** Sand, well-graded, loose, dry, brown, fine- to coarse-grained, some fine gravel (to 1").			
2								
4				SW	Sand with Gravel, well-graded, loose, dry, brown, fine- to coarse-grained, fine to coarse gravel, some cobbles (to 12").			
					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A5,
Log of Test Pit 6, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◹ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	TEST PIT 7 ELEV. (MSL.) - - DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0					**WASH DEPOSITS** Silty Sand, poorly graded, loose, dry, light brown, fine-grained, some medium-grained and fine gravel, trace cobbles (to 6").			
2				SM				
4								
9				SP	Sand, poorly graded, loose, dry, light brown, fine- to medium-grained, some gravel (to 3"), trace silt.			
					Total depth of boring: 6 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

WK/ 2* 5335 0K TEST PIT LOGS.GP-

Figure A6,
Log of Test Pit 7, Page 1 of 1

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... YHUN: SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	TEST PIT 8 ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0					**WASH DEPOSITS** Sand, well-graded, loose, dry, light brown, fine- to coarse-grained, some gravel (to 2") and cobbles (to 10").			
2				SW				
4								
9					Total depth of boring: 6 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A7,
Log of Test Pit 8, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... YHUN: SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

TEST PIT 9

ELEV. (MSL.) - - DATE YOMPLETED **3/2/22-3/3/22**

E8 UIPMENT **BACKHOE** B6 1 **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	MATERIAL DESYRIPTION	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
0								
				SW	**WASH DEPOSITS** Sand, well-graded, loose, dry, light brown to brown, fine- to coarse-grained.			
2				SM	Silty Sand, poorly graded, loose, moist, brown, fine- to medium-grained.			
4				SW	Sand, well-graded, loose, slightly moist, brown, fine- to coarse-grained, some gravel (to 1/2").			
9					Total depth of boring: 6 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

WK/ 2* 5335 0K TEST PIT LOGS.GP-

Figure A8,
Log of Test Pit 9, Page 1 of 1

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	**TEST PIT 10** ELEV. (MSL.) - - DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH** MATERIAL DESYRIPTION	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
0				SP	**ALLUVIUM** Silty Sand, poorly graded, loose, slightly moist, brown, fine- to medium-grained.			
2				SM	**OLDER ALLUVIUM** Silty Sand, poorly graded, very dense, slightly moist, brown to reddish brown, fine- to medium-grained, calcium stringers throughout.			
4								
9								
J				SP	Sand, poorly graded, very dense, dry, light gray, fine- to medium-grained, highly cemented.			
					Total depth of boring: 8 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

WK/ 2* 5335 0K TEST PIT LOGS.GP-

Figure A9,
Log of Test Pit 10, Page 1 of 1

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... YHUN: SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	**TEST PIT 11** ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SP	**ALLUVIUM** Sand, poorly graded, medium dense, dry, brown, fine- to medium-grained.			
2								
4				SP	**OLDER ALLUVIUM** Sand, poorly graded, very dense, dry, light gray, fine- to medium-grained, highly cemented.			
					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A10,
Log of Test Pit 11, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	TEST PIT 12	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**			
					MATERIAL DESYRIPTION			
0				SP	**ALLUVIUM** Sand, poorly graded, loose to medium dense, dry, brown, fine- to medium-grained, trace coarse-grained, some silt.			
2				SM	**OLDER ALLUVIUM** Silty Sand, poorly graded, very dense, dry, reddish brown, fine- to medium-grained, calcium stringers throughout, slightly cemented, some granitic gravel (to 3").			
4								
9				SP	Sand, poorly graded, very dense, dry, light gray, fine- to medium-grained, highly cemented.			
J					Refusal at 8 feet. No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A11,
Log of Test Pit 12, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... YHUN: SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	TEST PIT 13 ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SP	**ALLUVIUM** Sand, poorly graded, loose, dry, light brown, fine- to medium-grained, trace silt.			
2				SP	**OLDER ALLUVIUM** Sand, poorly graded, very dense, dry, light gray, fine- to medium-grained, highly cemented.			
4					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A12,
Log of Test Pit 13, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... YHUN: SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	**TEST PIT 14** ELEV. (MSL.) - - DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SW	**ALLUVIUM** Sand, well-graded, loose to medium dense, dry, brown, fine- to coarse-grained, some fine gravel (to 1").			
2					**OLDER ALLUVIUM** Silty Sand, poorly graded, very dense, reddish brown, slightly moist, fine- to medium-grained, slightly cemented.			
4				SM				
9								
J				SP	Sand, poorly graded, very dense, light gray, fine- to medium-grained, highly cemented.			
					Total depth of boring: 9.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A13,
Log of Test Pit 14, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... YHUN: SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	TEST PIT 15 ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH** MATERIAL DESYRIPTION	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
0				SP	**ALLUVIUM** Sand, poorly graded, loose to medium dense, slightly moist, brown, fine- to coarse-grained, some fine gravel (to 1").			
2				SM	**OLDER ALLUVIUM** Silty Sand, poorly graded, dense, slightly moist, reddish brown, fine- to medium-grained, calcium stringers throughout, slightly cemented.			
4				SP	Sand, poorly graded, very dense, dry, light grayish brown, fine- to medium-grained, highly cemented.			
					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A14,
Log of Test Pit 15, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	**TEST PIT 16** ELEV. (MSL.) - - DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SP	**ALLUVIUM** Sand, poorly graded, medium dense, dry, light brown, fine- to medium-grained, some fine gravel.			
2								
4				SP	**OLDER ALLUVIUM** Sand, poorly graded, very dense, dry, light grayish brown, fine- to medium-grained, highly cemented.			
9					Total depth of boring: 6 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A15,
Log of Test Pit 16, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◹ ... YHUN: SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	**TEST PIT 17** ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SM	**ALLUVIUM** Silty Sand, poorly graded, loose to medium dense, slightly moist, brown, fine-grained, some medium-grained.			
2				SM	**OLDER ALLUVIUM** Silty Sand, poorly graded, dense to very dense, slightly moist, reddish brown, fine-grained, some medium-grained and granitic gravel (to 3").			
4					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A16,
Log of Test Pit 17, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS
- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	TEST PIT 18 ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH** MATERIAL DESYRIPTION	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
0				SM	**ALLUVIUM** Silty Sand, poorly graded, medium dense, slightly moist, light brown, fine-grained.			
2				SP	**OLDER ALLUVIUM** Sand, poorly graded, very dense, dry, light grayish brown, fine- to medium-grained, highly cemented.			
4					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A17,
Log of Test Pit 18, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

TEST PIT 19

ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22**

E8 UIPMENT **BACKHOE** B6 1 **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	MATERIAL DESYRIPTION	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
0					**ALLUVIUM**			
					Sand, well-graded, loose, slightly moist, brown, fine- to coarse-grained, some gravel (to 3") and cobbles (to 10"), trace silt and rootelts (to 3').			
2				SW	- decrease in silt			
4								
					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A18,
Log of Test Pit 19, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◹ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	TEST PIT 20 ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SM	**ALLUVIUM** Silty Sand, poorly graded, medium dense, slightly moist, brown, fine-grained, some medium-grained and fine gravel (to 1/2").			
2				SP	**OLDER ALLUVIUM** Sand, poorly graded, very dense, dry, light grayish brown, fine- to medium-grained, highly cemented, trace oxidation staining.			
4					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A19,
Log of Test Pit 20, Page 1 of 1

WK/ 2* 5335 0K TEST PIT LOGS.GP-

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◹ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

PRO- EYT NO. WK/ 2* 5335 0K

DEPTH IN FEET	SAMPLE NO.	LITHOLOG6	GROUNDWATER	SOIL YLASS (USYS)	TEST PIT 21 ELEV. (MSL.) -- DATE YOMPLETED **3/2/22-3/3/22** E8 UIPMENT **BACKHOE** B6 1 **JMH**	PENETRATION RESISTANYE (BLOWSGFT%)	DR6 DENSIT6 (P.Y.F.)	MOISTURE YONTENT (Q)
					MATERIAL DESYRIPTION			
0				SP	**ALLUVIUM** Sand, poorly graded, loose, brown, dry, fine- to medium-grained, some silt.			
2				SM	**OLDER ALLUVIUM** Silty Sand, poorly graded, medium dense to dense, dry, reddish brown, fine- to medium-grained, calcium stringers throughout, slightly cemented.			
4				SP	Sand, poorly graded, very dense, dry, light grayish brown, fine- to medium-grained, highly cemented.			
					Total depth of boring: 5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

WK/ 2* 5335 0K TEST PIT LOGS.GP-

Figure A20,
Log of Test Pit 21, Page 1 of 1

SAMPLE S6MBOLS

- ☐ ... SAMPLING UNSUYYESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... YHUN: SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE1 THE LOG OF SUBSURFAYE YONDITIONS SHOWN HEREON APPLIES ONL6 AT THE SPEYIFIY BORING OR TRENYH LOYATION AND AT THE DATE INDIYATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFAYE YONDITIONS AT OTHER LOYATIONS AND TIMES.

GEOCON

BORING 1

ELEV. (MSL.) - - DATE : OMPLETED **02/18/2021**

EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	MATERIAL DES: RIPTION	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C.)
0	BULK 0-5' B1@1'			SM	**OLDER ALLUVIUM** Silty Sand with Gravel, poorly graded, very dense, dry, reddish brown, fine- to medium-grained.	50 (6")		
2								
4	B1@4.5'				- light brown	50 (5")	164.0	7.5
6								
8	B1@9'				- cobbles	50 (3")	120.8	3.7
					Refusal at 9.5 feet. No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W* 523-99-0* BORING LOGS.GPJ

Figure A21,
Log of Boring 1, Page 1 of 1

SAMPLE S1MBOLS

- ... SAMPLING UNSU: : ESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... : HUN%SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTEQ THE LOG OF SUBSURFA: E : ONDITIONS SHOWN HEREON APPLIES ONL1 AT THE SPE: IFI: BORING OR TREN: H LO: ATION AND AT THE DATE INDI: ATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFA: E : ONDITIONS AT OTHER LO: ATIONS AND TIMES.

GEOCON

PROJE: T NO. W* 523-99-0*

BORING 2

ELEV. (MSL.) - - DATE : OMPLETED **02/18/2021**

EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	MATERIAL DES: RIPTION	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C.)
0	BULK 0-5'				**ALLUVIUM** Sand, well-graded, medium dense, dry, light brown, fine- to coarse-grained, trace gravel.			
2	B2@2'			SW		26	109.0	4.7
4								
	B2@5'					40	107.2	10.9
6					**OLDER ALLUVIUM** Sand, well-graded, medium dense, dry, light brown, fine- to coarse-grained, trace gravel.			
8				SW				
*0	B2@10'				- brown	50 (5")	114.9	3.3
*2								
*4	B2@14'				Gravel with Sand, poorly graded, very dense, dry, gray, fine- to coarse-grained, fine gravel.	50 (4")		
*6				GP				
*8								
	B2@19'				- no recovery			

Refusal at 19.5 feet.
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W* 523-99-0* BORING LOGS.GPJ

Figure A22,
Log of Boring 2, Page 1 of 1

SAMPLE S1MBOLS

- ... SAMPLING UNSU: : ESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... : HUN%SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTEQ THE LOG OF SUBSURFA: E : ONDITIONS SHOWN HEREON APPLIES ONL1 AT THE SPE: IFI: BORING OR TREN: H LO: ATION AND AT THE DATE INDI: ATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFA: E : ONDITIONS AT OTHER LO: ATIONS AND TIMES.

GEOCON

PROJE: T NO. W* 523-99-0*

BORING 3

ELEV. (MSL.) -- DATE : OMPLETED **02/18/2021**

EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	MATERIAL DES: RIPTION	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C.)
0					**OLDER ALLUVIUM**			
2	B3@2'			SM	Silty Sand, poorly graded, very dense, dry, dark reddish brown, fine- to medium-grained, well-cemented.	50 (3")	116.4	8.5
4	B3@4'				- light brown, fine-grained	50 (6")	92.3	13.0
6					Sand, poorly graded, very dense, dry, light brown, fine- to medium-grained.			
8				SP				
*0	B3@9.5'					50 (2")	109.2	7.1
*2								
*4					Sand, well-graded, very dense, dry, light brown, fine- to coarse-grained, some gravel.			
*6	B3@15'			SW		50 (5")	126.9	1.8
*8					Sand, poorly graded, very dense, dry, light brown, fine- to medium-grained.			
	B3@19'			SP		50 (5")	100.0	8.1

Total depth of boring: 19.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W* 523-99-0* BORING LOGS.GPJ

Figure A23,
Log of Boring 3, Page 1 of 1

SAMPLE S1MBOLS

- ... SAMPLING UNSU: : ESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... : HUN%SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTEQ THE LOG OF SUBSURFA: E : ONDITIONS SHOWN HEREON APPLIES ONL1 AT THE SPE: IFI: BORING OR TREN: H LO: ATION AND AT THE DATE INDI: ATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFA: E : ONDITIONS AT OTHER LO: ATIONS AND TIMES.

GEOCON

PROJE: T NO. W* 523-99-0*

BORING 4

ELEV. (MSL.) - - DATE : OMPLETED **02/18/2021**

EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	MATERIAL DES: RIPTION	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C.)
0					**OLDER ALLUVIUM**			
2	B4@1.5'				Sand, poorly graded, very dense, dry, light reddish brown, fine- to medium-grained, well-cemented.	50 (6")	108.8	5.0
4	B4@4'				- light brown	50 (6")	105.1	5.2
6				SP				
8								
*0	B4@9'					50 (2")	107.4	2.8
*2								
*4								
*6	B4@14.5'			SW	Sand, well-graded, very dense, dry, light brown, fine- to coarse-grained.	50 (6")		
*8								
	B4@19'					50 (2")	76.8	6.0
					Total depth of boring: 19.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W* 523-99-0* BORING LOGS.GPJ

Figure A24,
Log of Boring 4, Page 1 of 1

SAMPLE S1MBOLS

- ☐ ... SAMPLING UNSU: : ESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... : HUN%SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTEQ THE LOG OF SUBSURFA: E : ONDITIONS SHOWN HEREON APPLIES ONL1 AT THE SPE: IFI: BORING OR TREN: H LO: ATION AND AT THE DATE INDI: ATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFA: E : ONDITIONS AT OTHER LO: ATIONS AND TIMES.

GEOCON

PROJE: T NO. W* 523-99-0*

BORING 5

ELEV. (MSL.) - - DATE : OMPLETED **02/18/2021**

EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	MATERIAL DES: RIPTION	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C.)
0					**OLDER ALLUVIUM**			
2	B5@1.5'				Sand, poorly graded, very dense, dry, light grayish brown, fine-grained, some medium-grained, well-cemented.	50 (6")	92.9	5.2
4								
	B5@4.5'				- white	50 (6")	84.7	6.9
6								
8								
*0	B5@9.5'				- light brown	50 (3")	119.8	2.4
*2				SP				
*4	B5@14'				- some fine gravel	50 (5")	108.3	4.4
*6								
*8								
20	B5@19'					50 (6")	92.4	15.5
22								
24	B5@24'					50 (2")	111.9	2.5
					Total depth of boring: 24.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W* 523-99-0* BORING LOGS.GPJ

Figure A25,
Log of Boring 5, Page 1 of 1

SAMPLE S1MBOLS

- ... SAMPLING UNSU: : ESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... : HUN%SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTEQ THE LOG OF SUBSURFA: E : ONDITIONS SHOWN HEREON APPLIES ONL1 AT THE SPE: IFI: BORING OR TREN: H LO: ATION AND AT THE DATE INDI: ATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFA: E : ONDITIONS AT OTHER LO: ATIONS AND TIMES.

GEOCON

PROJE: T NO. W* 523-99-0*

BORING 6

ELEV. (MSL.) - - DATE : OMPLETED **02/18/2021**

EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	MATERIAL DES: RIPTION	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C.)
0	BULK 0-5'				**OLDER ALLUVIUM** Sand, poorly graded, very dense, dry, light brown, fine- to medium-grained, well-cemented.			
2	B6@2'					50 (6")	110.1	4.3
4	B6@4'					50 (6")	146.4	3.7
6	B6@6'				- no recovery	50 (2")		
8				SP				
*0	B6@9.5'				- trace coarse-grained	50 (5")	126.4	1.9
*2								
*4	B6@14'					50 (5")	94.5	4.2
*6								
*8								
	B6@19'				- no recovery	50 (2")	121.5	2.0

Total depth of boring: 19.5 feet
No fill.
No groundwater encountered.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W* 523-99-0* BORING LOGS.GPJ

Figure A26,
Log of Boring 6, Page 1 of 1

SAMPLE S1MBOLS

- ... SAMPLING UNSU: : ESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... : HUN%SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTEQ THE LOG OF SUBSURFA: E : ONDITIONS SHOWN HEREON APPLIES ONL1 AT THE SPE: IFI: BORING OR TREN: H LO: ATION AND AT THE DATE INDI: ATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFA: E : ONDITIONS AT OTHER LO: ATIONS AND TIMES.

GEOCON

PROJE: T NO. W* 523-99-0*

BORING 7

ELEV. (MSL.) -- DATE : OMPLETED **02/18/2021**

EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	MATERIAL DES: RIPTION	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C.)
0					**OLDER ALLUVIUM**			
	B7@1'				Sand, poorly graded, very dense, dry, brown, fine-grained, trace medium-grained, some silt.	50 (6")	121.5	2.0
2								
4	B7@4'				- light brown, fine- to medium-grained	50 (6")	101.6	4.5
6				SP				
8								
*0	B7@9.5'				- some coarse-grained	50 (3")	117.3	4.6
*2								
*4								
	B7@14.5'				Sand, well-graded, very dense, dry, light brown, fine- to coarse-grained, trace silt.	50 (6")	115.8	3.6
*6				SW				
*8					- some fine gravel			
20	B7@19.5'					50 (6")	115.6	3.7
					Refusal at 20 feet. No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W* 523-99-0* BORING LOGS.GPJ

Figure A27,
Log of Boring 7, Page 1 of 1

SAMPLE S1MBOLS

- ☐ ... SAMPLING UNSU: : ESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... : HUN%SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTEQ THE LOG OF SUBSURFA: E : ONDITIONS SHOWN HEREON APPLIES ONL1 AT THE SPE: IFI: BORING OR TREN: H LO: ATION AND AT THE DATE INDI: ATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFA: E : ONDITIONS AT OTHER LO: ATIONS AND TIMES.

GEOCON

PROJE: T NO. W* 523-99-0*

BORING 8

ELEV. (MSL.) - - DATE : OMPLETED **02/18/2021**

EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	MATERIAL DES: RIPTION	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C.)
0	BULK 0-5'			SM	**ALLUVIUM** Silty Sand, poorly graded, very dense, dry, light brown, fine-grained, trace medium-grained.			
2	B8@1.5'					50 (2")	96.7	9.1
4	B8@4'				**OLDER ALLUVIUM** Sand, poorly graded, very dense, dry, light brown, fine- to medium-grained, well cemented.	50 (6")	101.1	6.0
6								
8								
*0	B8@9'			SP	- no cementation	50 (5")	120.0	3.4
*2								
*4	B8@14'				- fine-grained, trace medium-grained	50 (3")	109.1	5.3
*6								
*8								
20	B8@19'				Sand, well-graded, very dense, dry, light brown, fine- to coarse-grained, some fine gravel.	50 (5")	114.5	6.1
22				SW				
24	B8@24'				- no recovery	50 (1")		
					Total depth of boring: 24.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate			

W* 523-99-0* BORING LOGS.GPJ

Figure A28,
Log of Boring 8, Page 1 of 2

SAMPLE S1MBOLS

- ... SAMPLING UNSU: : ESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... : HUN%SAMPLE
- ... WATER TABLE OR SEEPAGE

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DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	**BORING 8** ELEV. (MSL.) - - DATE : OMPLETED **02/18/2021** EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C)
					MATERIAL DES: RIPTION			
					boundary between earth types; the transitions may be gradual.			

Figure A28,
Log of Boring 8, Page 2 of 2

W* 523-99-0* BORING LOGS.GPJ

SAMPLE S1MBOLS

- ☐ ... SAMPLING UNSU: : ESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◹ ... : HUN%SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTEQ THE LOG OF SUBSURFA: E : ONDITIONS SHOWN HEREON APPLIES ONL1 AT THE SPE: IFI: BORING OR TREN: H LO: ATION AND AT THE DATE INDI: ATED.
IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFA: E : ONDITIONS AT OTHER LO: ATIONS AND TIMES.

GEOCON

PROJE: T NO. W* 523-99-0*

BORING 9

ELEV. (MSL.) - - DATE : OMPLETED **02/18/2021**

EY UIPMENT **HOLLOW STEM AUGER** B1 Q **JMH**

DEPTH IN FEET	SAMPLE NO.	LITHOLOG1	GROUNDWATER	SOIL : LASS (US: S)	MATERIAL DES: RIPTION	PENETRATION RESISTAN: E (BLOWSFT/)	DR1 DENSIT1 (P:. .F.)	MOISTURE : ONTENT (C.)
0	BULK 0-5'				**OLDER ALLUVIUM** Sand, poorly grded, medium dense, dry, light reddish brown, fine- to medium-grained.			
2	B9@2'					28	102.1	12.0
4								
6	B9@5'				- very dense, trace silt, slightly moist	50 (5")	116.6	3.7
8								
*0	B9@9'			SP		50 (6")	117.2	2.7
*2								
*4	B9@14'					50 (6")	109.2	4.9
*6								
*8								
20	B9@19'					50 (5")	128.4	2.5
22				SM	Silty Sand, poorly graded, very dense, slightly moist, light brown, fine- to medium-grained, calcium stringers throughout.			
24	B9@24'						116.8	4.1
					Total depth of boring: 24.5 feet No fill. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W* 523-99-0* BORING LOGS.GPJ

Figure A29,
Log of Boring 9, Page 1 of 1

SAMPLE S1MBOLS

- ... SAMPLING UNSU: : ESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... : HUN%SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTEQ THE LOG OF SUBSURFA: E : ONDITIONS SHOWN HEREON APPLIES ONL1 AT THE SPE: IFI: BORING OR TREN: H LO: ATION AND AT THE DATE INDI: ATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFA: E : ONDITIONS AT OTHER LO: ATIONS AND TIMES.

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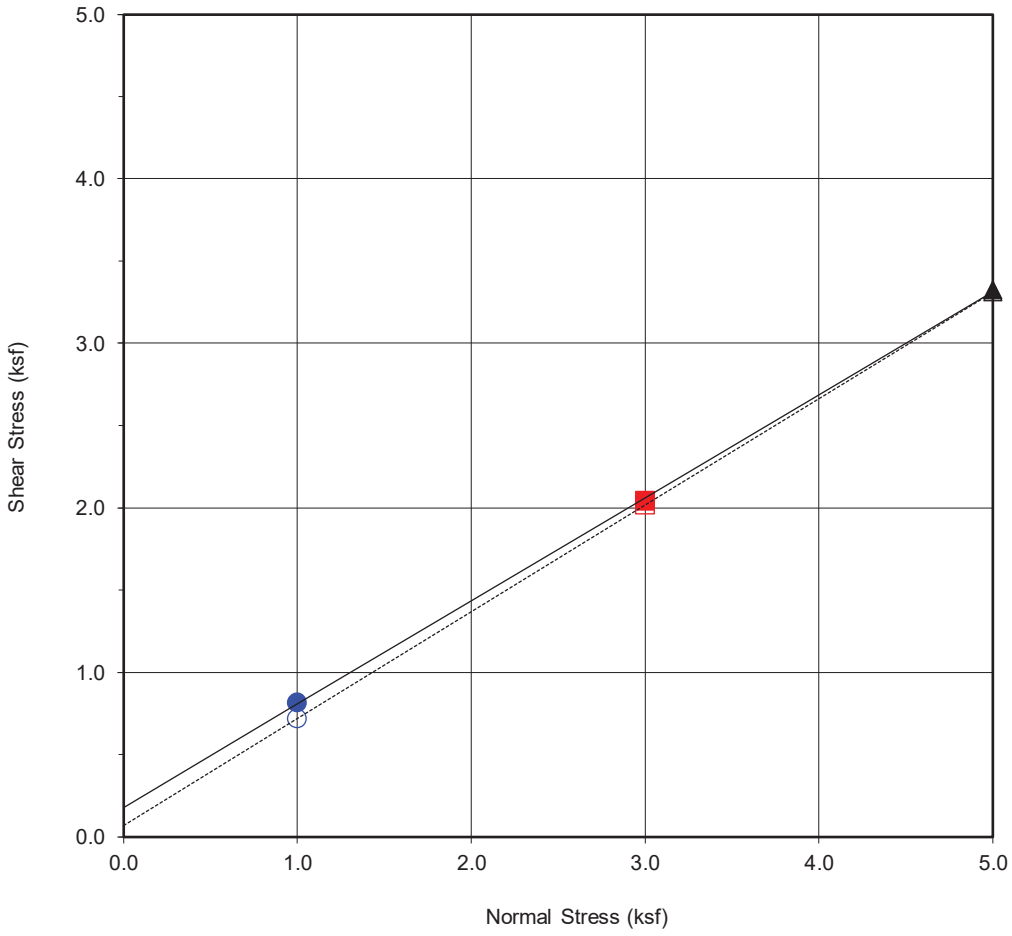
APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the "American Society of Testing and Materials (ASTM)", or other suggested procedures. Selected samples were tested for direct shear strength, consolidation characteristics, maximum dry density, corrosivity, in-place dry density and moisture content. The results of the laboratory tests are summarized in Figures B1 through B30. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.



Boring No.	**B1**
Sample No.	**B1@0-5'**
Depth (ft)	**0-5'**
Sample Type:	Bulk

Soil Identification:		
Silty Sand with Gravel (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	179	32.1
Ultimate	72	32.9

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.82	■ 2.04	▲ 3.32
Shear Stress @ End of Test (ksf)	○ 0.72	□ 2.02	△ 3.31
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	8.0	7.9	7.9
Initial Dry Density (pcf)	117.0	117.0	117.0
Initial Degree of Saturation (%)	48.9	48.5	48.3
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	16.4	15.2	15.3

GEOCON

DIRECT SHEAR TEST RESULTS

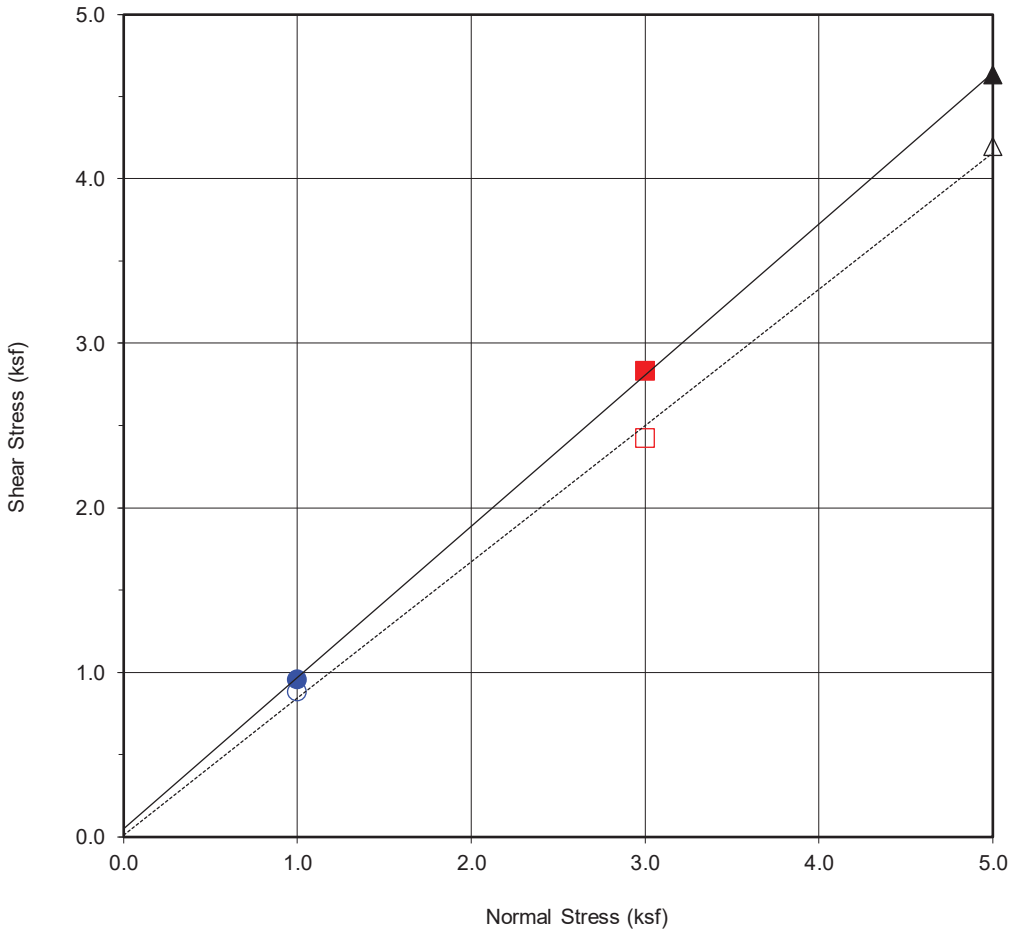
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B1



Boring No.	B2
Sample No.	B2@0-5'
Depth (ft)	0-5'
Sample Type:	Bulk

Soil Identification:
Well Graded Sand (SW)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	49	42.6
Ultimate	14	39.7

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.96	■ 2.83	▲ 4.63
Shear Stress @ End of Test (ksf)	○ 0.88	□ 2.42	△ 4.20
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	7.6	7.6	7.6
Initial Dry Density (pcf)	118.0	118.0	118.0
Initial Degree of Saturation (%)	48.2	48.1	47.9
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	12.7	12.7	12.3

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DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

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Project No.: W1523-99-01

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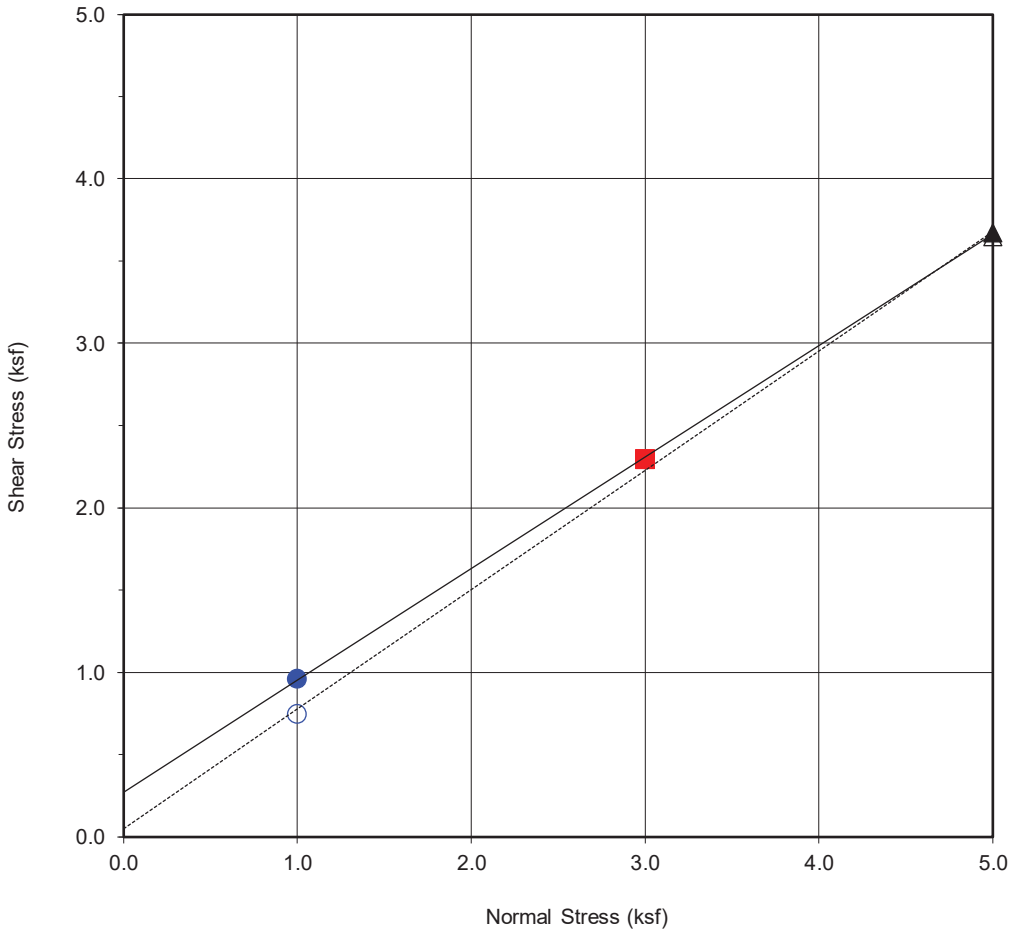
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B2



Boring No.	B8
Sample No.	B8@0-5'
Depth (ft)	0-5'
Sample Type:	Bulk

Soil Identification:
Silty Sand (SM)

Strength Parameters

	C (psf)	ϕ (^{o})
Peak	274	34.1
Ultimate	50	36.0

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.96	■ 2.29	▲ 3.67
Shear Stress @ End of Test (ksf)	○ 0.74	□ 2.29	△ 3.65
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	8.1	8.2	8.2
Initial Dry Density (pcf)	118.0	118.0	118.0
Initial Degree of Saturation (%)	51.3	51.8	51.6
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	15.1	14.7	14.1

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DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

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Project No.: W1523-99-01

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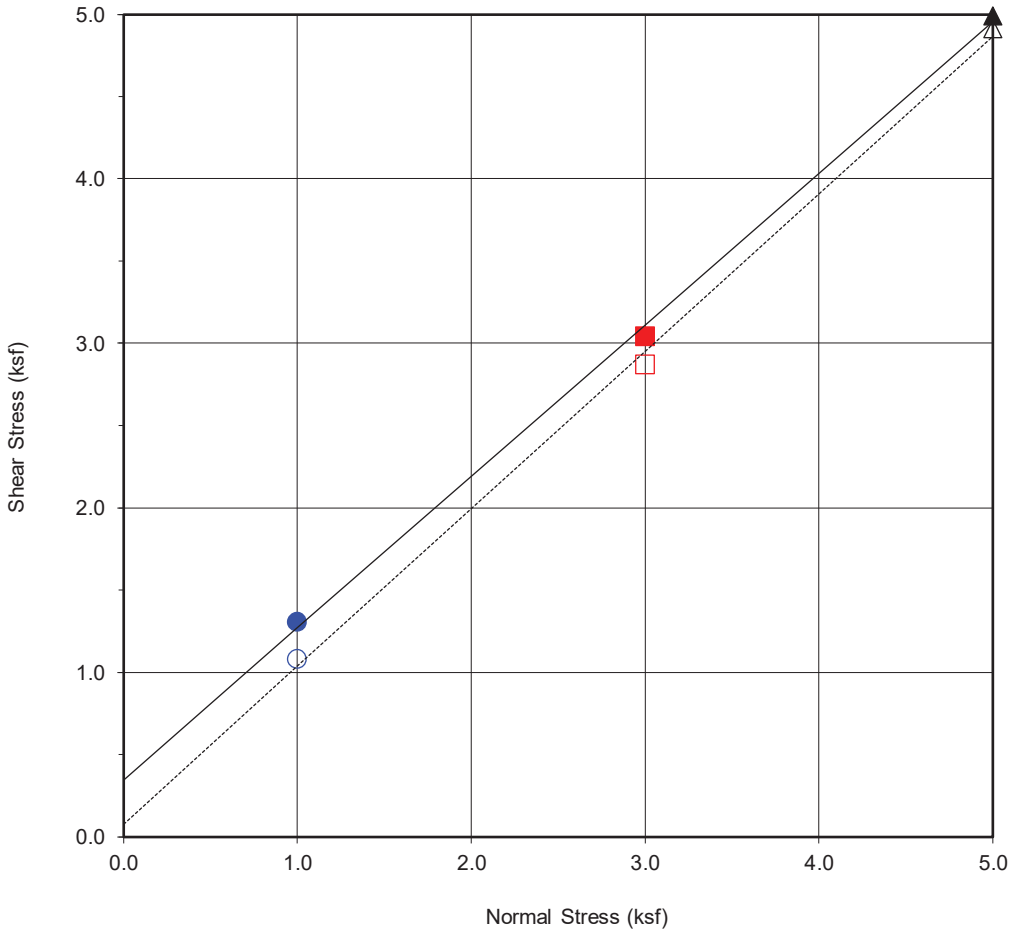
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B3



Boring No.	B2
Sample No.	B2@2'
Depth (ft)	2
Sample Type:	Ring

Soil Identification:
Well Graded Sand (SW)

Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	348	42.7
Ultimate	80	43.8

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.30	■ 3.04	▲ 4.99
Shear Stress @ End of Test (ksf)	○ 1.08	□ 2.87	△ 4.91
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	4.7	4.7	5.6
Initial Dry Density (pcf)	108.7	109.7	108.3
Initial Degree of Saturation (%)	23.2	23.4	27.1
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	15.4	15.5	13.8

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DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

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Project No.: W1523-99-01

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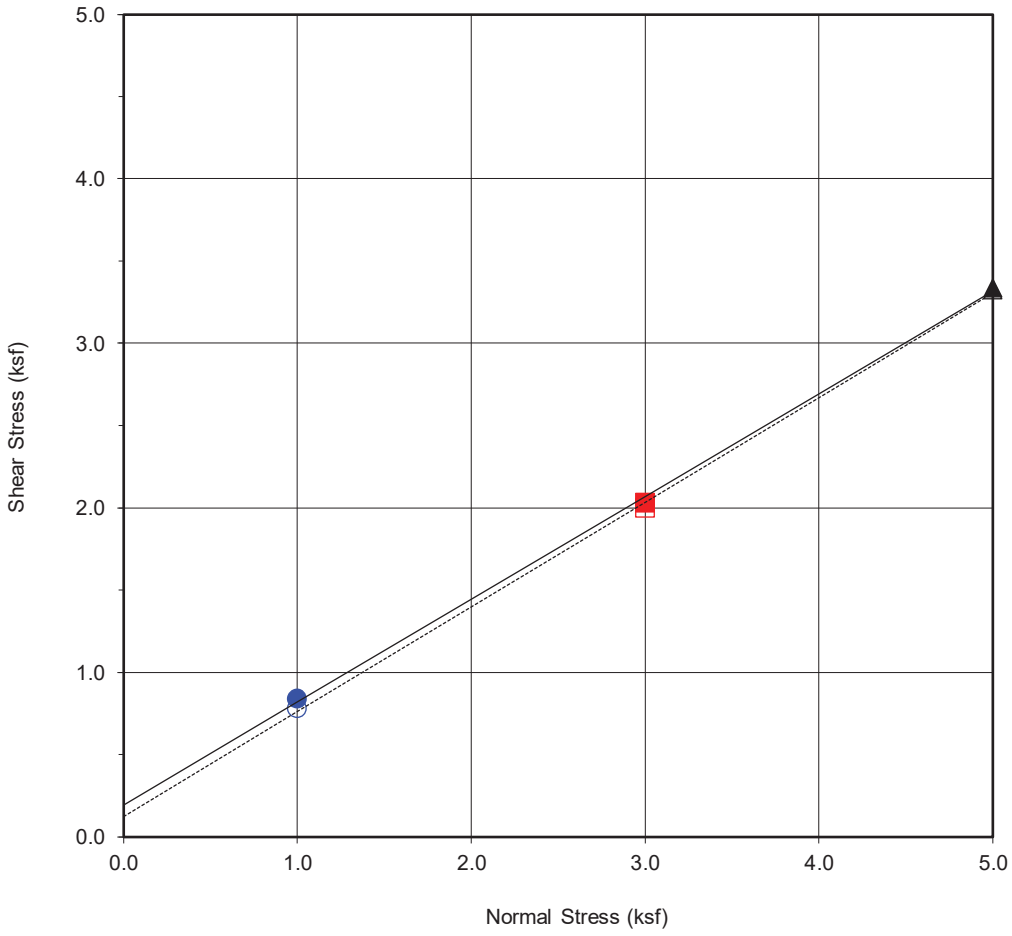
MARCH 2022 Figure B4



Boring No.	**B3**
Sample No.	**B3@4'**
Depth (ft)	**4**
Sample Type:	Ring

Soil Identification:		
Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	197	32.0
Ultimate	127	32.5

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.84	■ 2.03	▲ 3.34
Shear Stress @ End of Test (ksf)	○ 0.78	□ 2.00	△ 3.32
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	13.0	10.6	12.0
Initial Dry Density (pcf)	92.4	93.1	90.9
Initial Degree of Saturation (%)	42.5	35.3	38.0
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	25.0	20.5	20.1

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DIRECT SHEAR TEST RESULTS

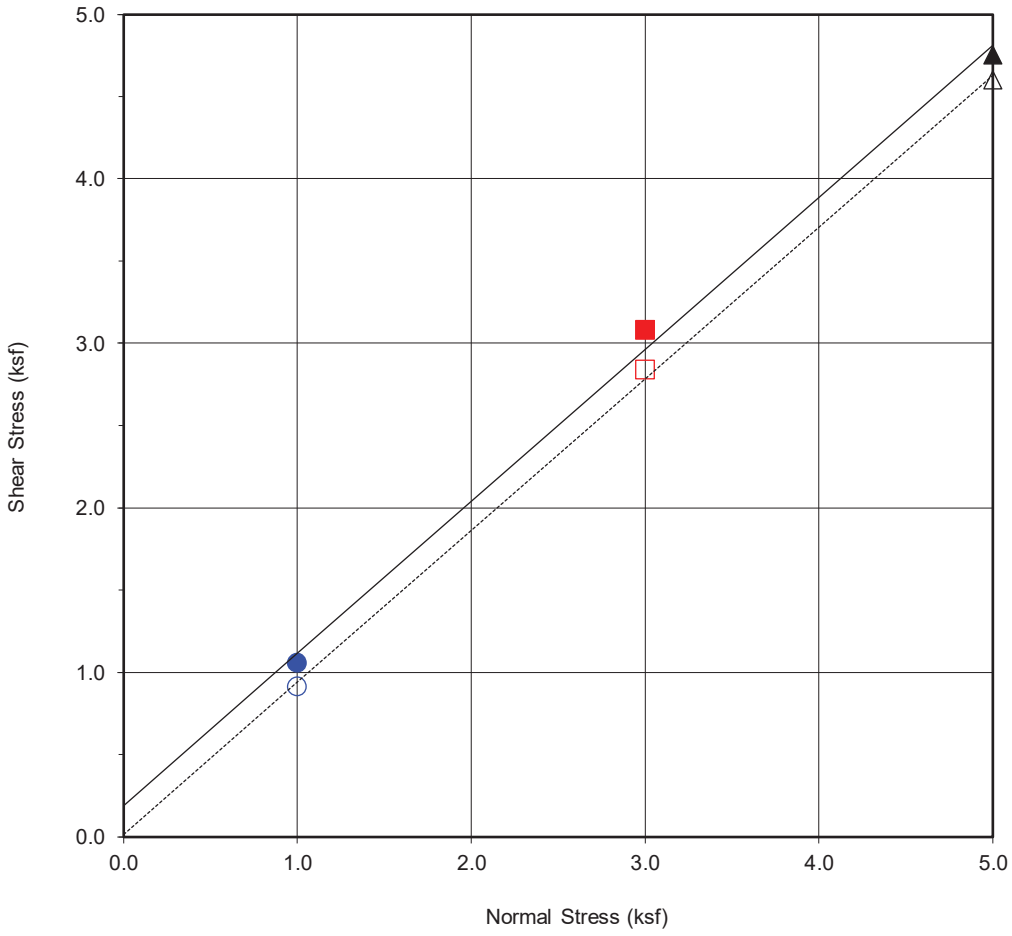
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B5



Boring No.	**B4**
Sample No.	**B4@1.5'**
Depth (ft)	**1.5**
Sample Type:	Ring

Soil Identification:		
Poorly Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	191	42.7
Ultimate	18	42.7

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.06	■ 3.08	▲ 4.75
Shear Stress @ End of Test (ksf)	○ 0.91	□ 2.84	△ 4.60
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	5.6	4.1	5.0
Initial Dry Density (pcf)	105.5	107.0	108.1
Initial Degree of Saturation (%)	25.1	19.3	23.9
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	16.4	13.9	13.6

GEOCON

DIRECT SHEAR TEST RESULTS

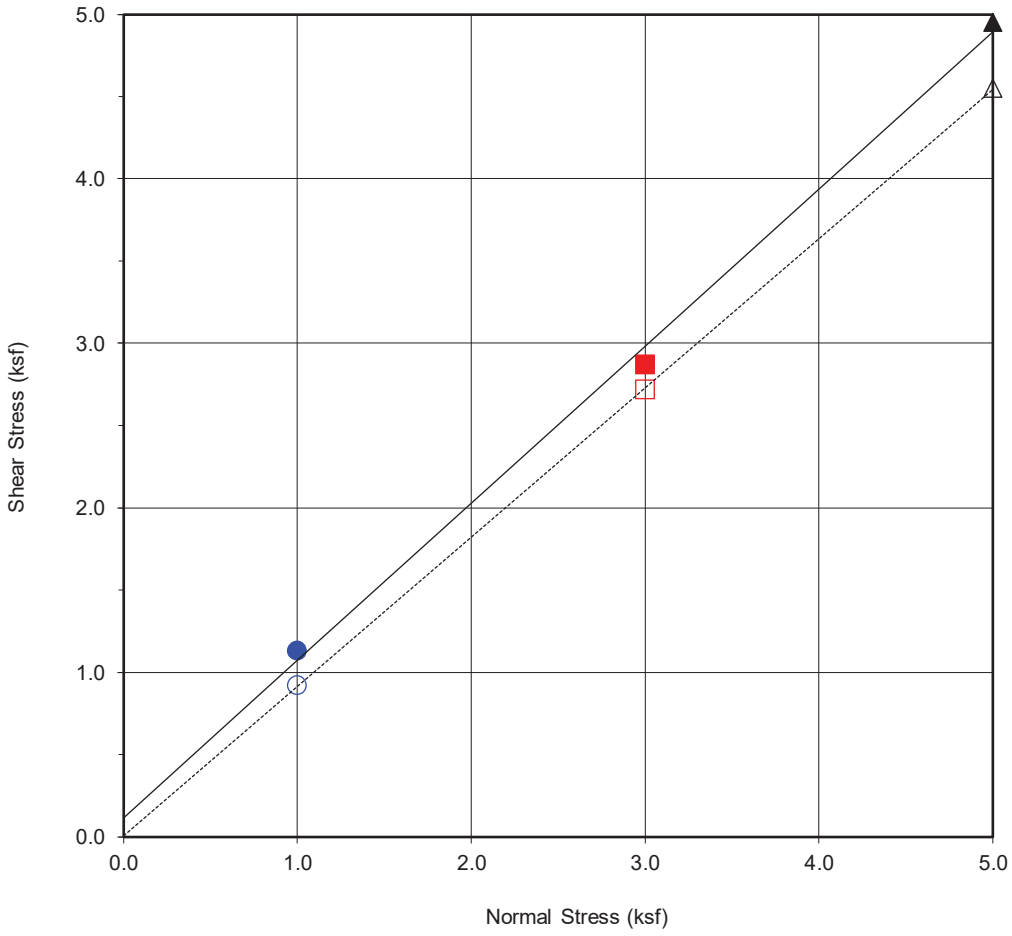
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B6



Boring No.	**B5**
Sample No.	**B5@4.5'**
Depth (ft)	**4.5**
Sample Type:	Ring

Soil Identification:		
Poorly Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	118	43.7
Ultimate	7	42.2

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 1.13	■ 2.87	▲ 4.95
Shear Stress @ End of Test (ksf)	○ 0.92	□ 2.72	△ 4.55
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	-0.4	2.3	6.9
Initial Dry Density (pcf)	87.9	82.9	88.2
Initial Degree of Saturation (%)	-1.3	6.1	20.4
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	28.3	29.1	25.0

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DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

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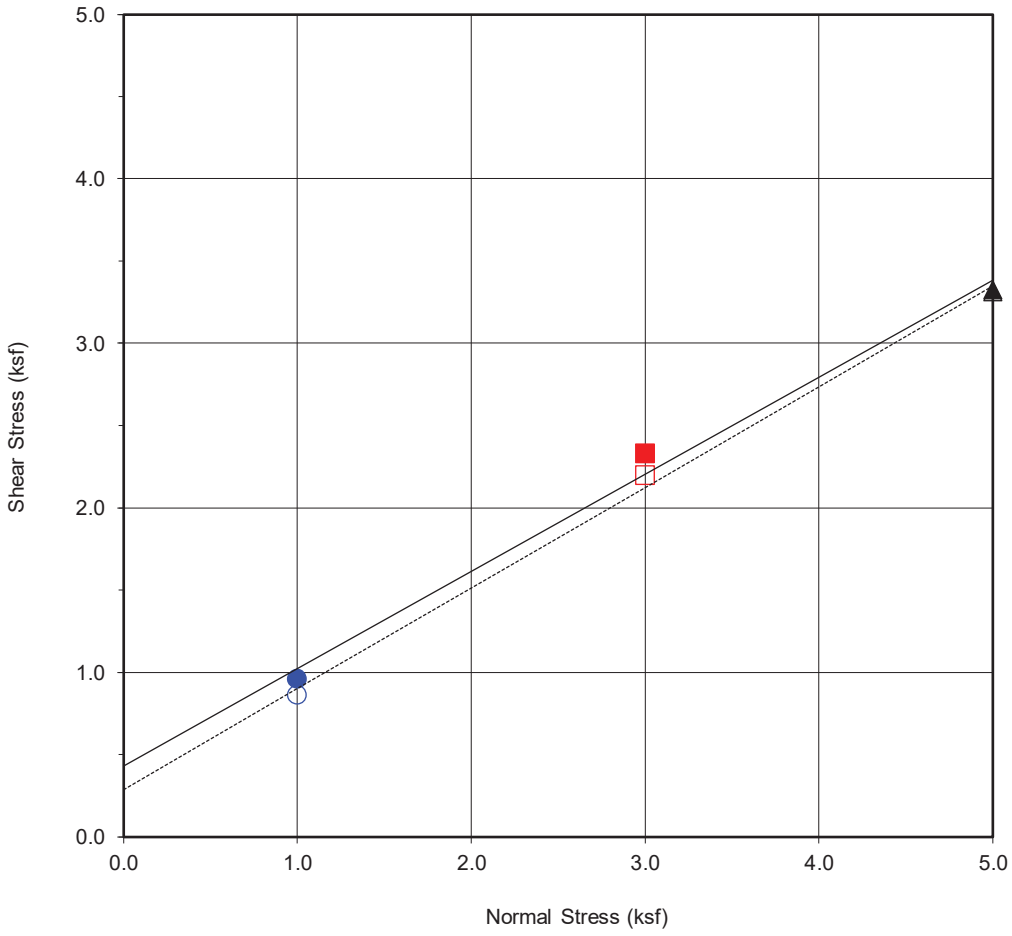
Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B7



Boring No.	B6
Sample No.	B6@2'
Depth (ft)	2
Sample Type:	Ring

Soil Identification:		
Well Cemented Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	431	30.6
Ultimate	288	31.5

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.96	■ 2.33	▲ 3.32
Shear Stress @ End of Test (ksf)	○ 0.86	□ 2.20	△ 3.31
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	5.3	4.3	7.4
Initial Dry Density (pcf)	106.9	109.4	103.6
Initial Degree of Saturation (%)	25.0	21.6	31.6
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	14.1	13.2	16.6

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DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

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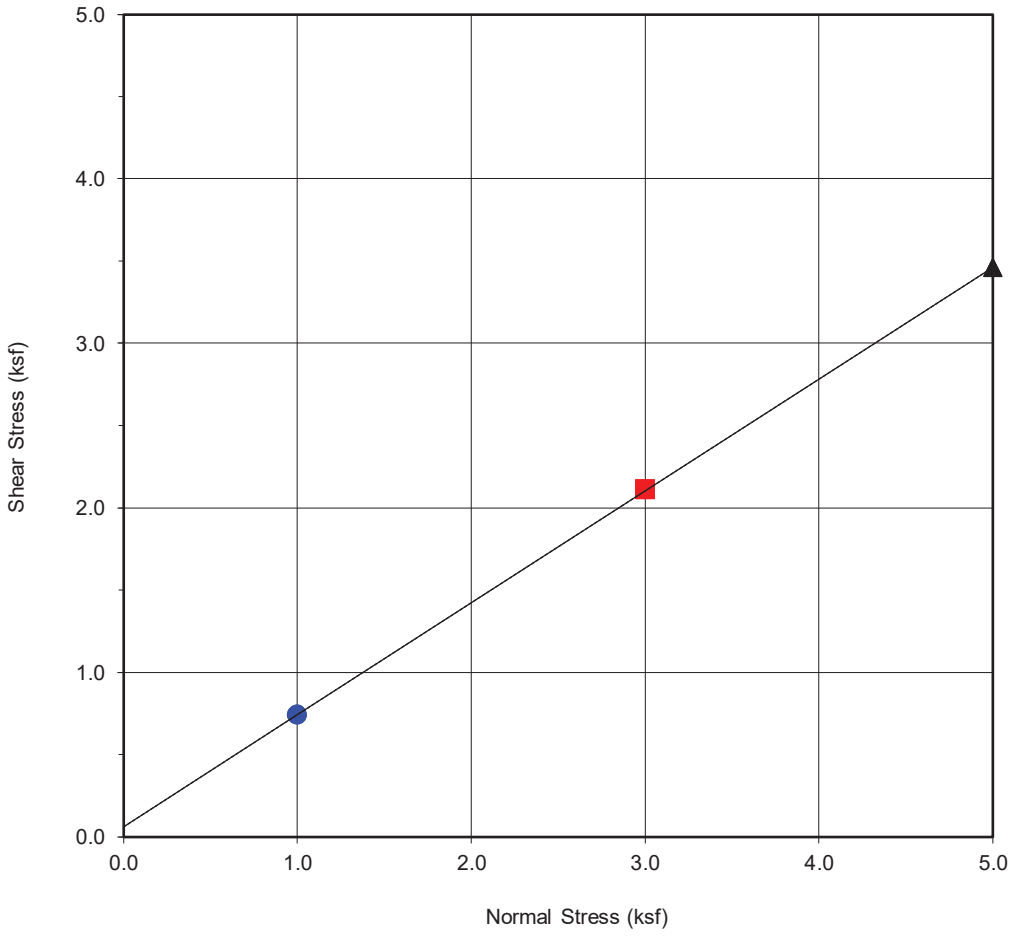
Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B8



Boring No.	**B8**
Sample No.	**B8@1.5'**
Depth (ft)	**1.5**
Sample Type:	Ring

Soil Identification:		
Silty Sand (SM)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	63	34.2
Ultimate	63	34.2

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.74	■ 2.11	▲ 3.46
Shear Stress @ End of Test (ksf)	○ 0.74	□ 2.11	△ 3.46
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	9.1	13.9	8.1
Initial Dry Density (pcf)	97.0	90.1	96.2
Initial Degree of Saturation (%)	33.4	43.0	29.1
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	16.9	18.8	15.9

GEOCON

DIRECT SHEAR TEST RESULTS

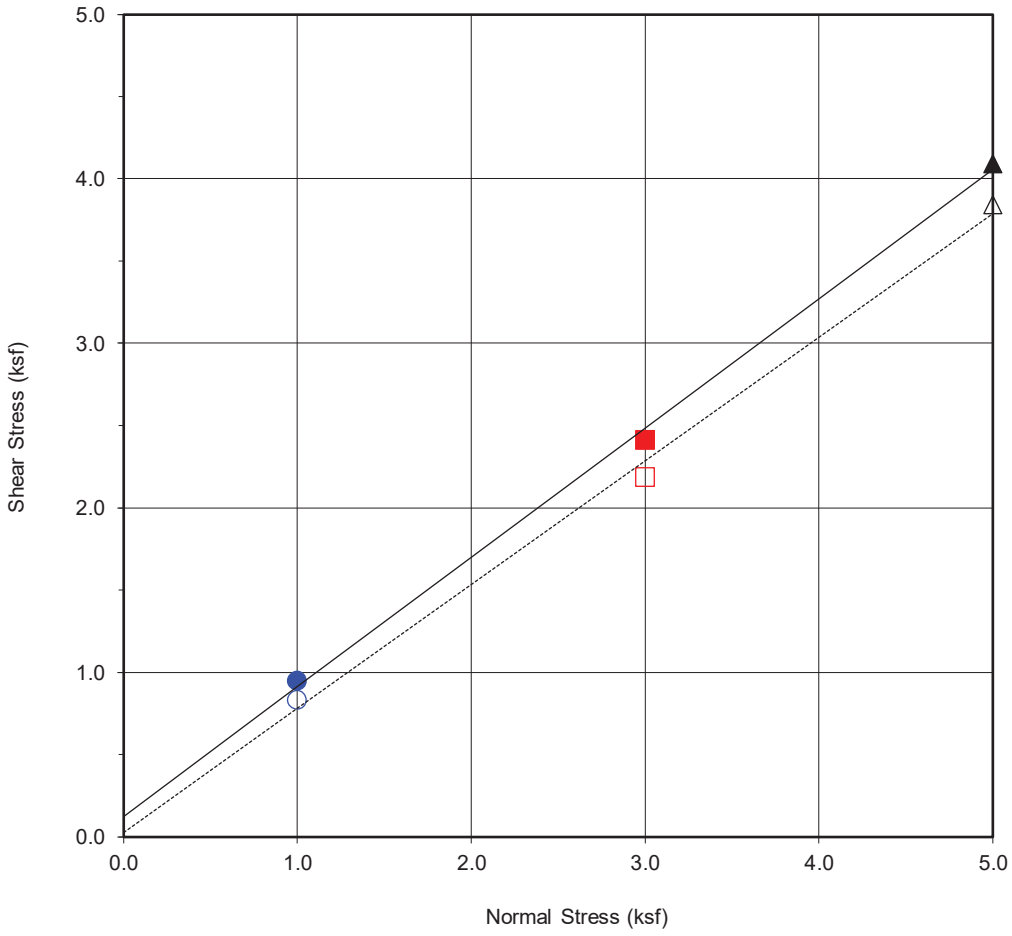
Consolidated Drained ASTM D-3080

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B9



Boring No.	B9
Sample No.	B9@2'
Depth (ft)	2
Sample Type:	Ring

Soil Identification:		
Poorly Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	126	38.2
Ultimate	27	37.0

Normal Strest (kip/ft2)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.95	■ 2.41	▲ 4.09
Shear Stress @ End of Test (ksf)	○ 0.83	□ 2.18	△ 3.84
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	6.4	7.1	7.1
Initial Dry Density (pcf)	105.9	107.7	105.3
Initial Degree of Saturation (%)	29.3	33.8	31.8
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	12.9	12.0	12.2

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

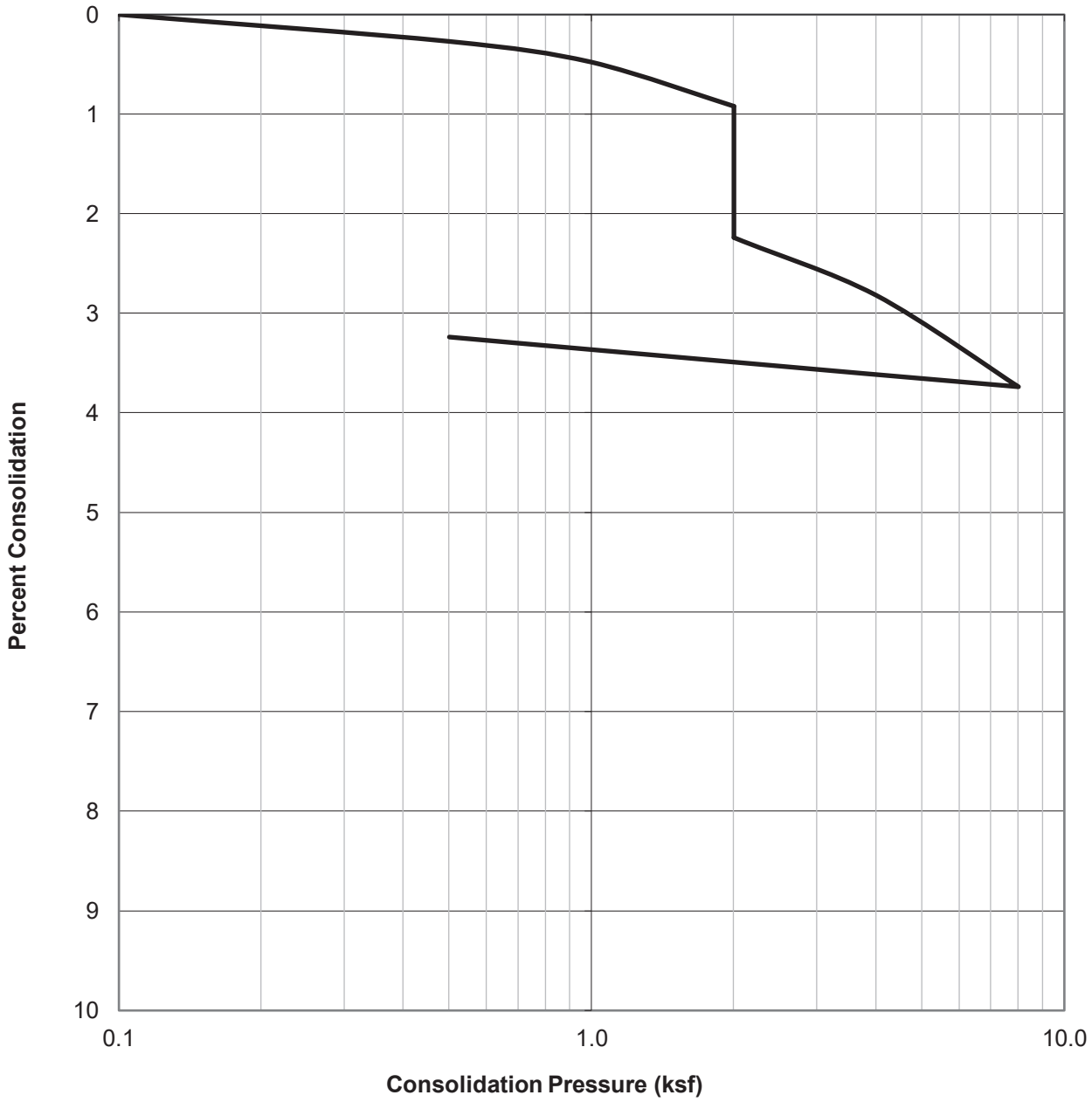
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B10

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B2@5	Well Graded Sand (SW)	105.7	10.9	24.9

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

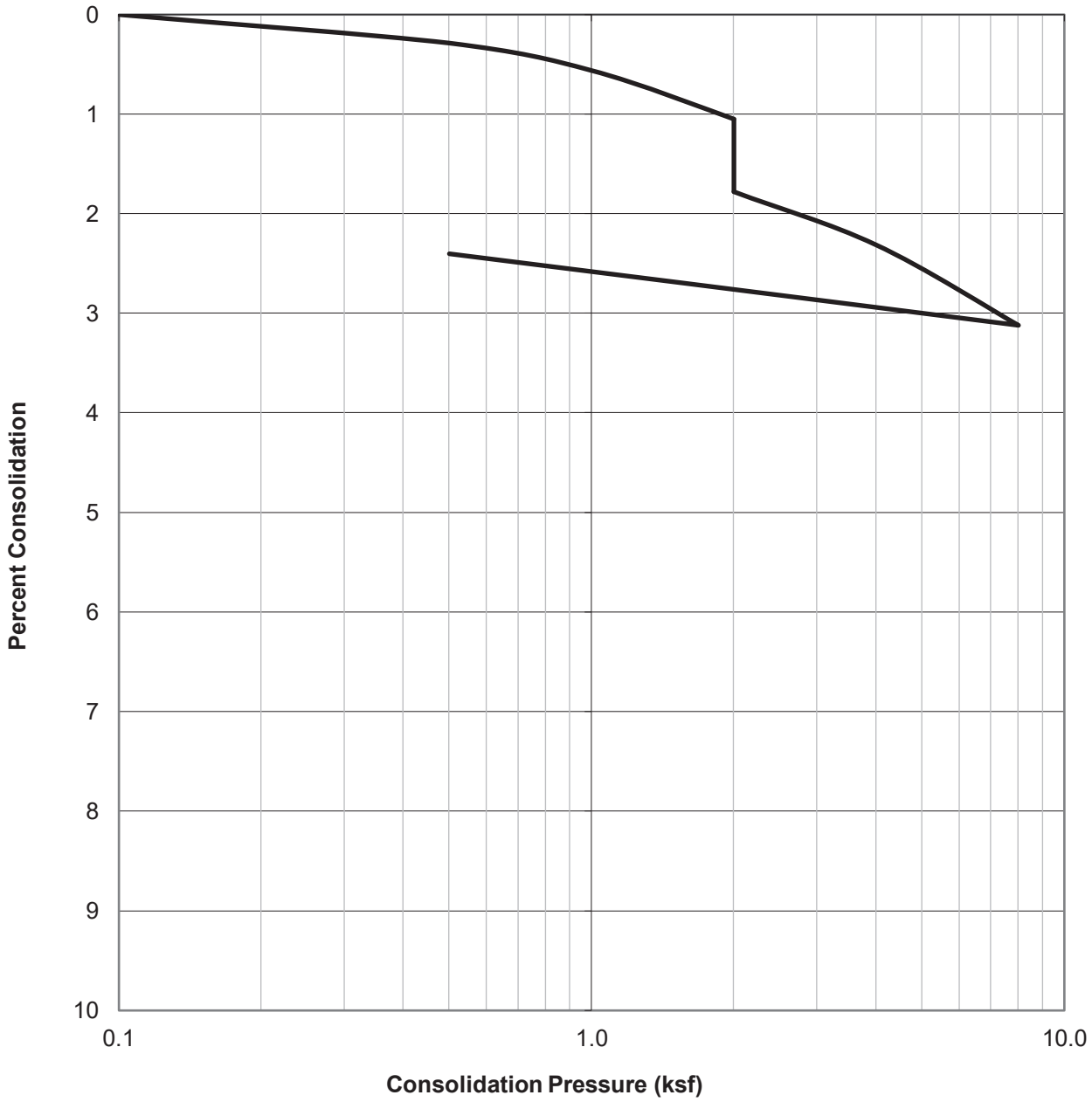
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B11

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B2@10	Well Graded Sand (SW)	113.1	3.3	15.8

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

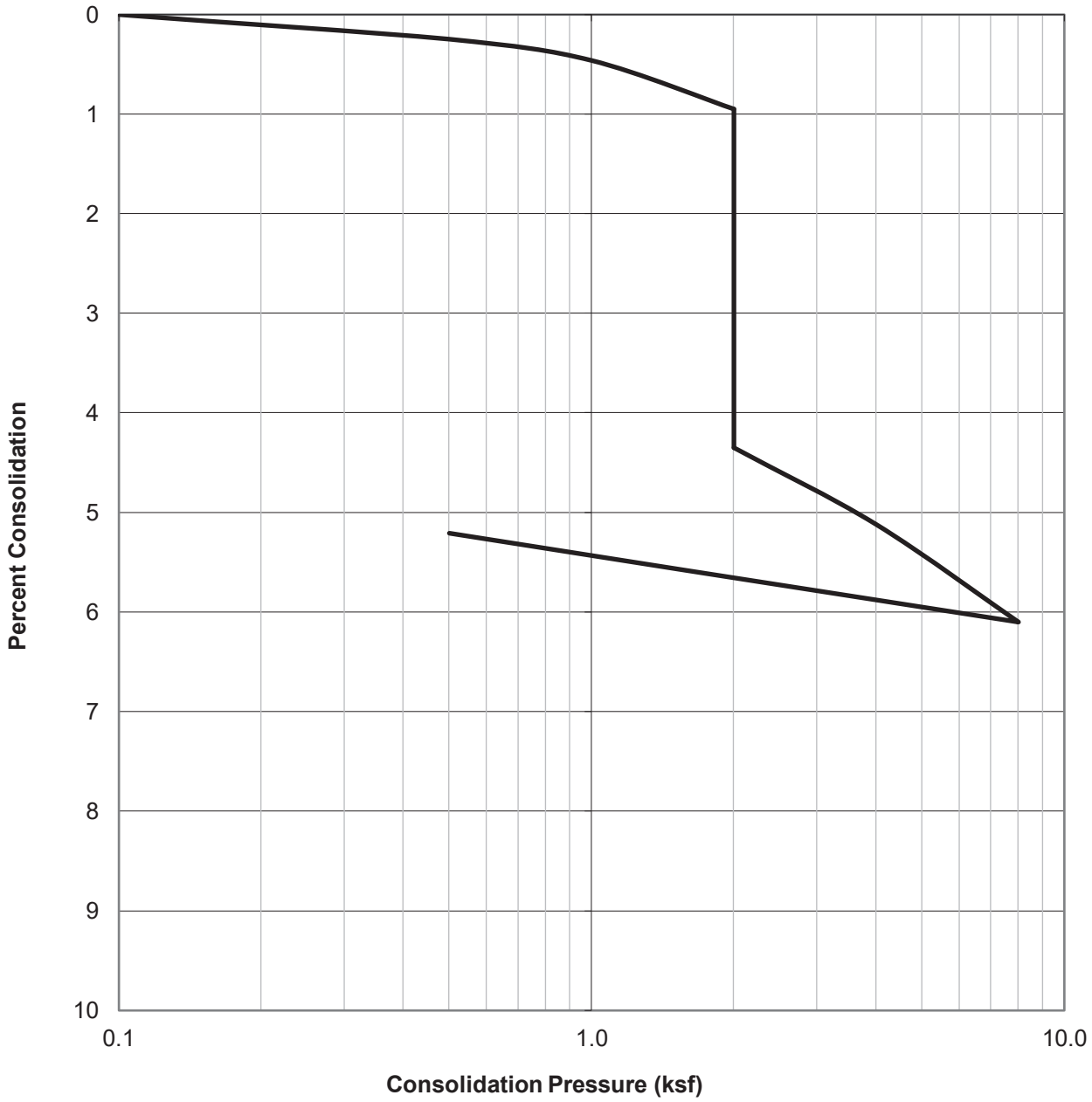
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B12

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@2	Silty Sand (SM)	108.8	8.5	16.5

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

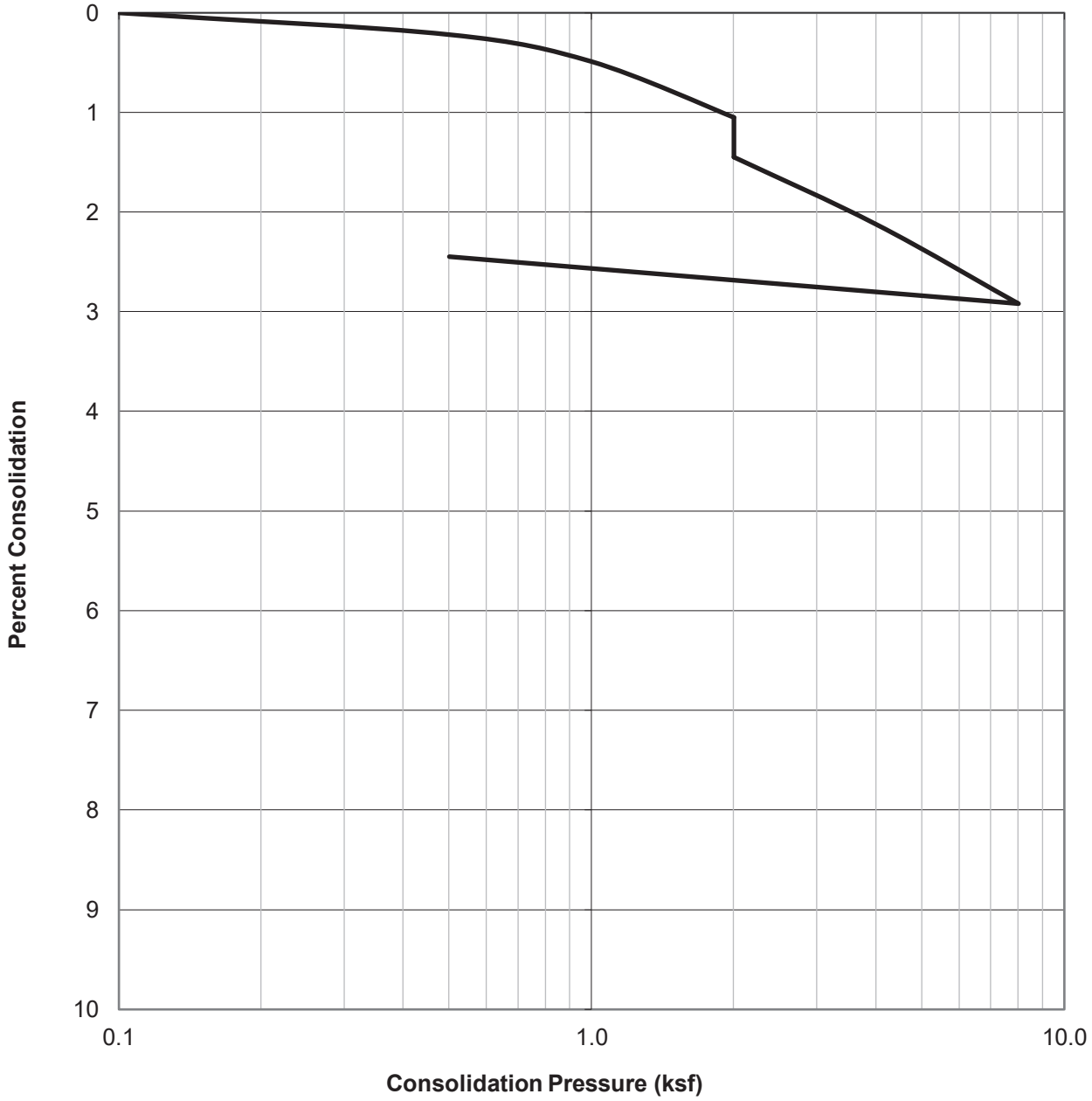
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B13

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@9.5	Brown Silty Sand (SM)	98.4	7.1	17.1

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

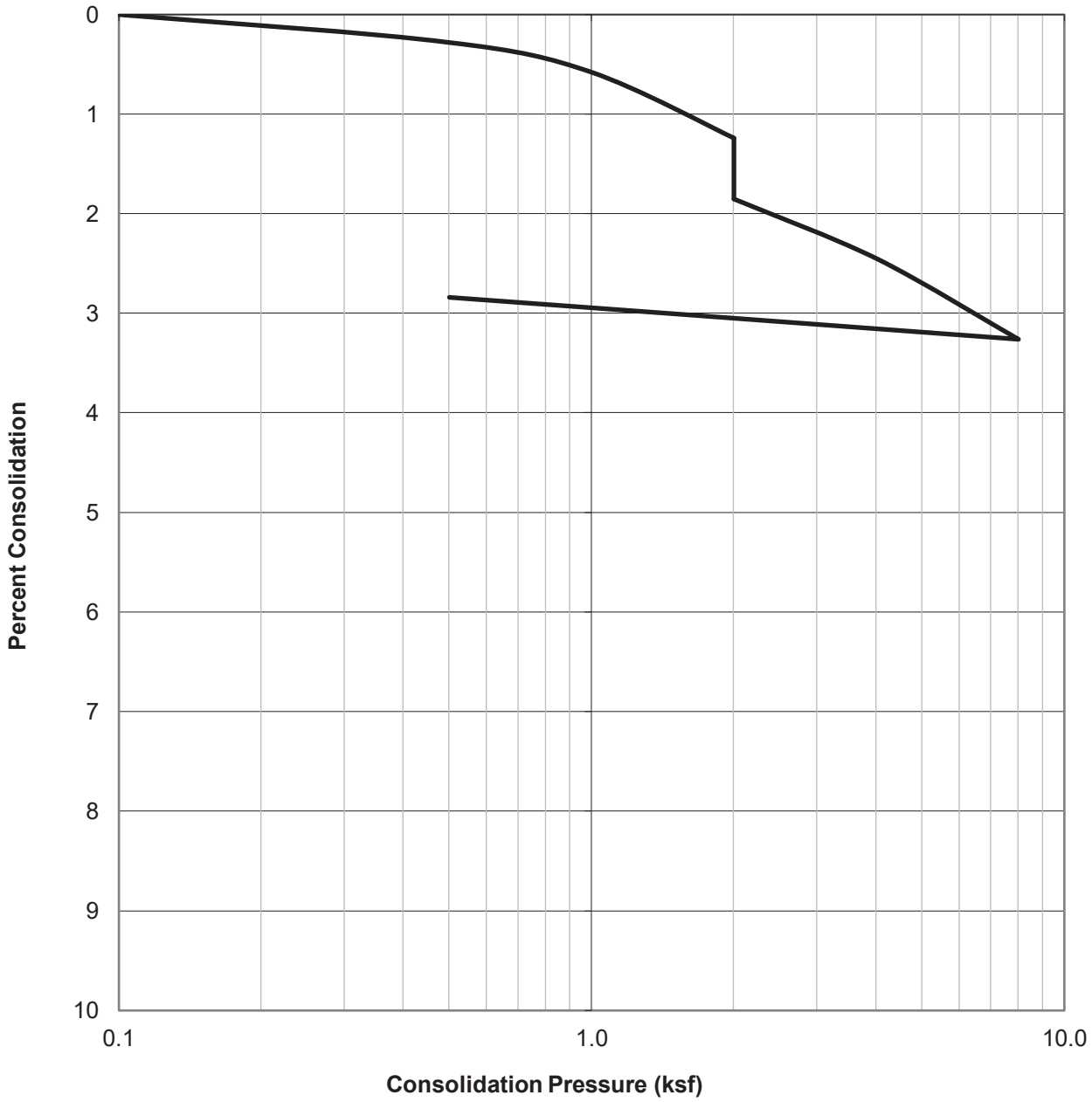
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B14

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@19	Poorly Graded Sand (SP)	92.0	8.1	22.1

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

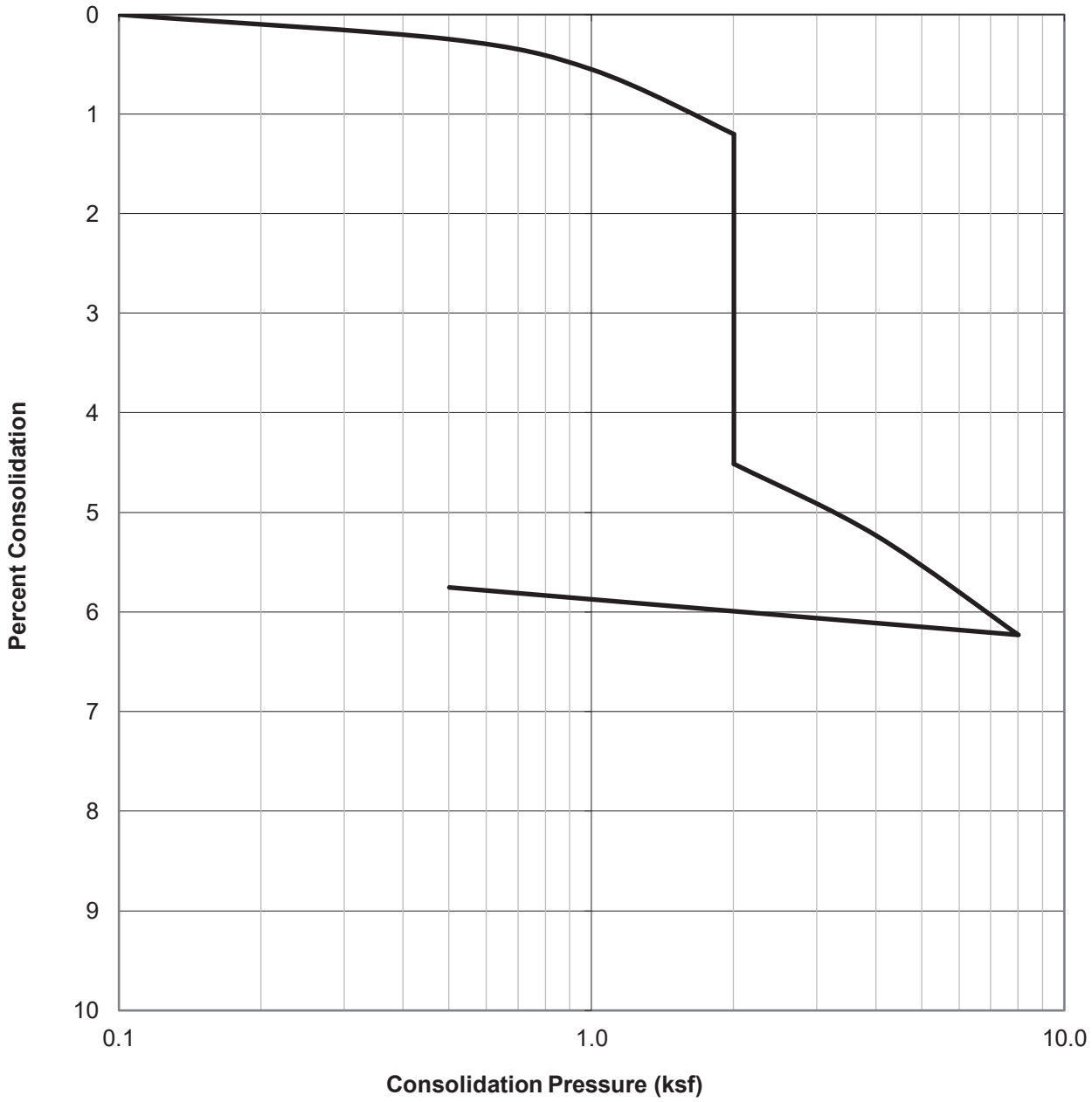
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B15

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@1.5	Poorly Graded Sand (SP)	96.5	5.2	18.0

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

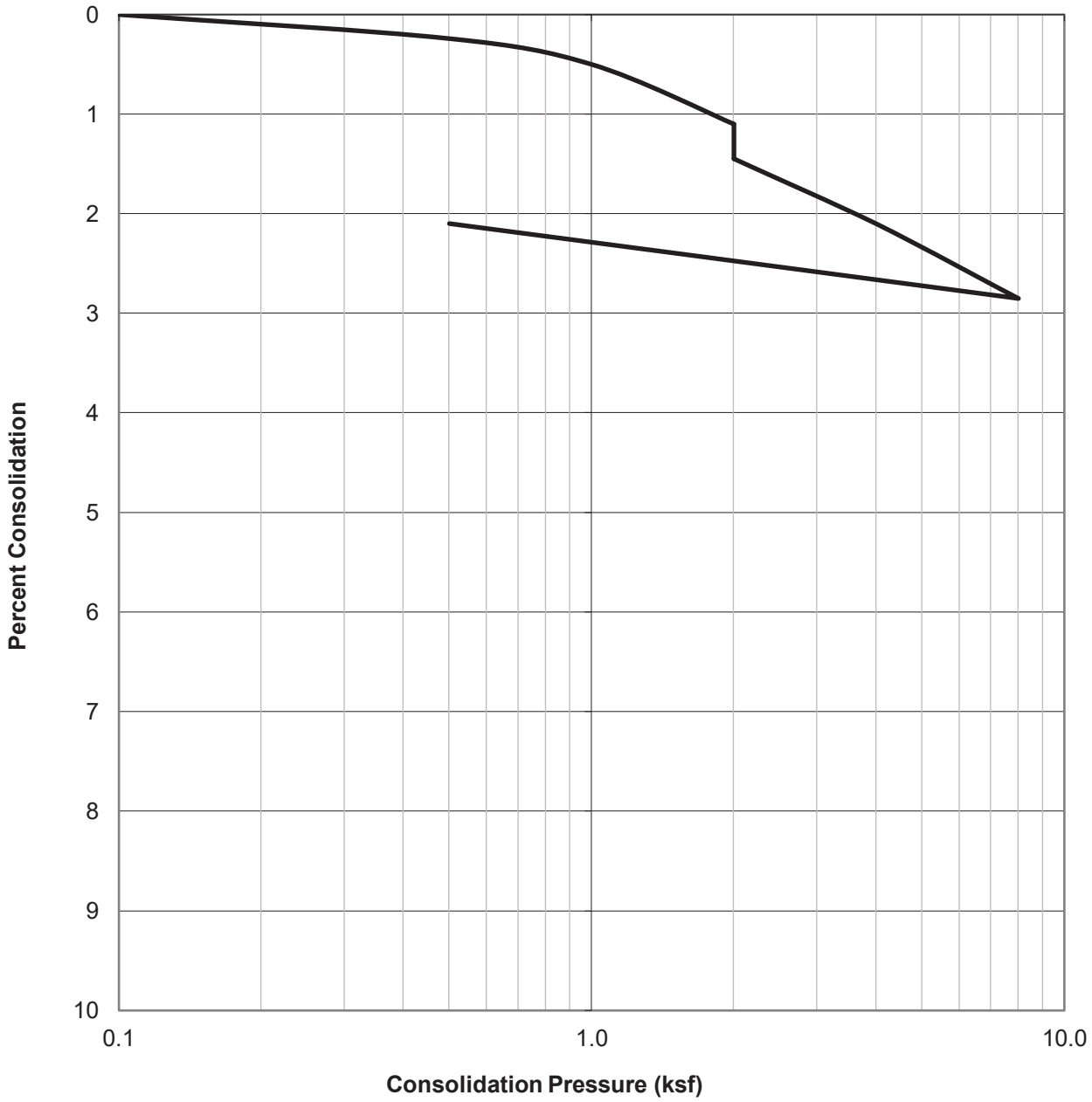
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B16

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@14	Poorly Graded Sand (SP)	92.8	8.8	19.5

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

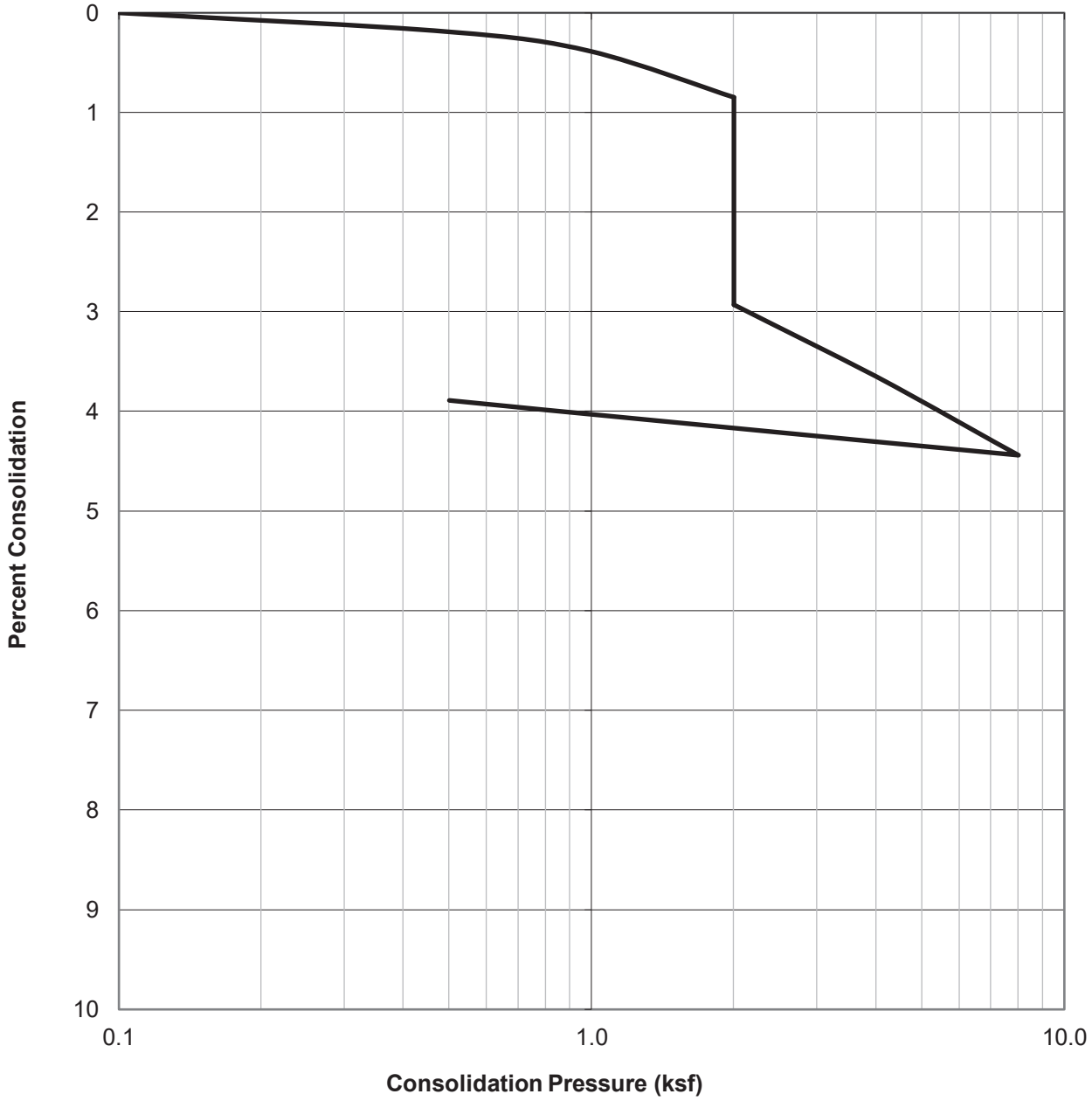
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B17

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B6@4	Light Brown Silty Sand (SM)	103.1	3.7	16.4

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

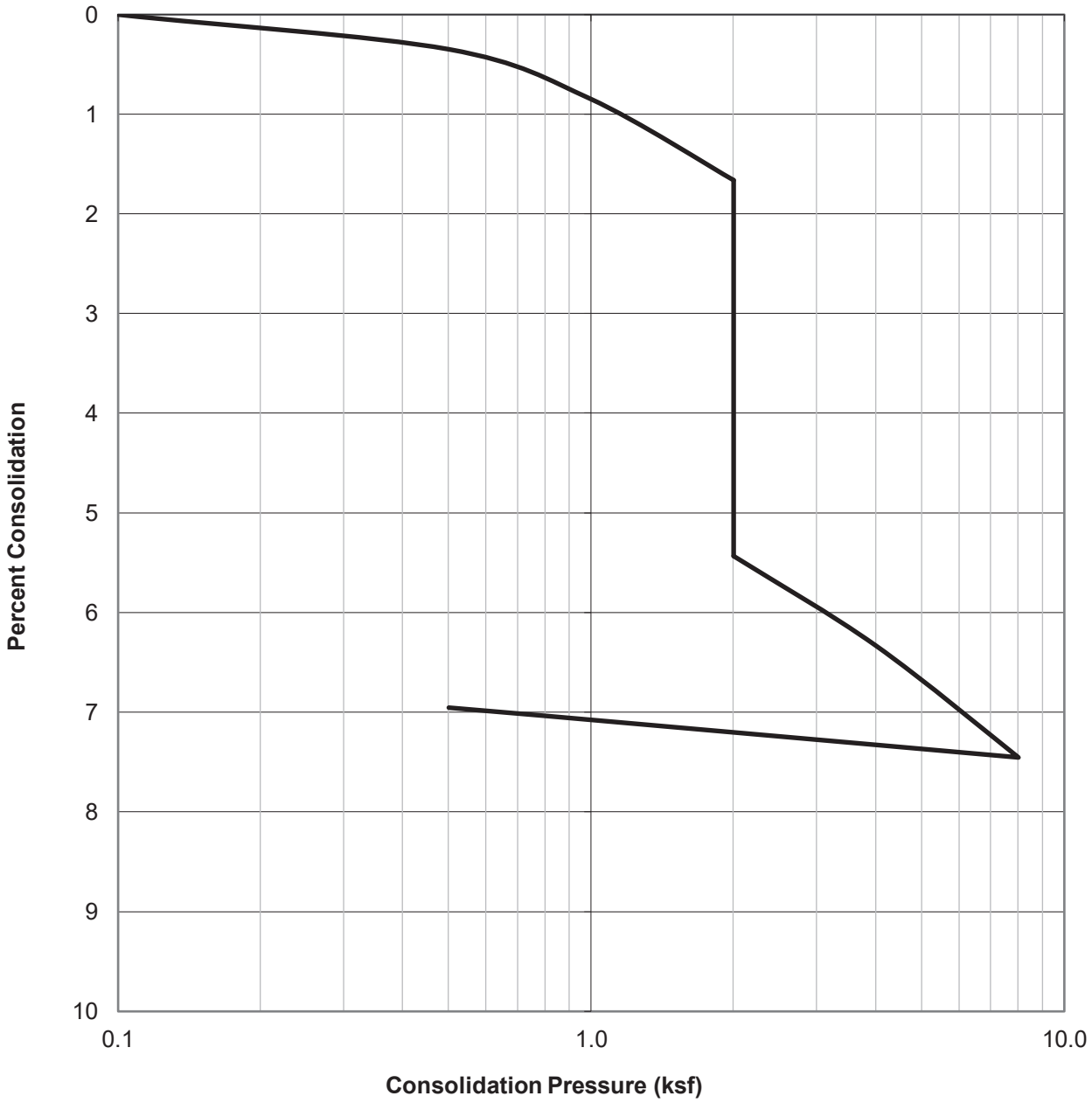
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B18

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B7@4	Brown Silty Sand (SM)	99.1	4.5	14.8

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

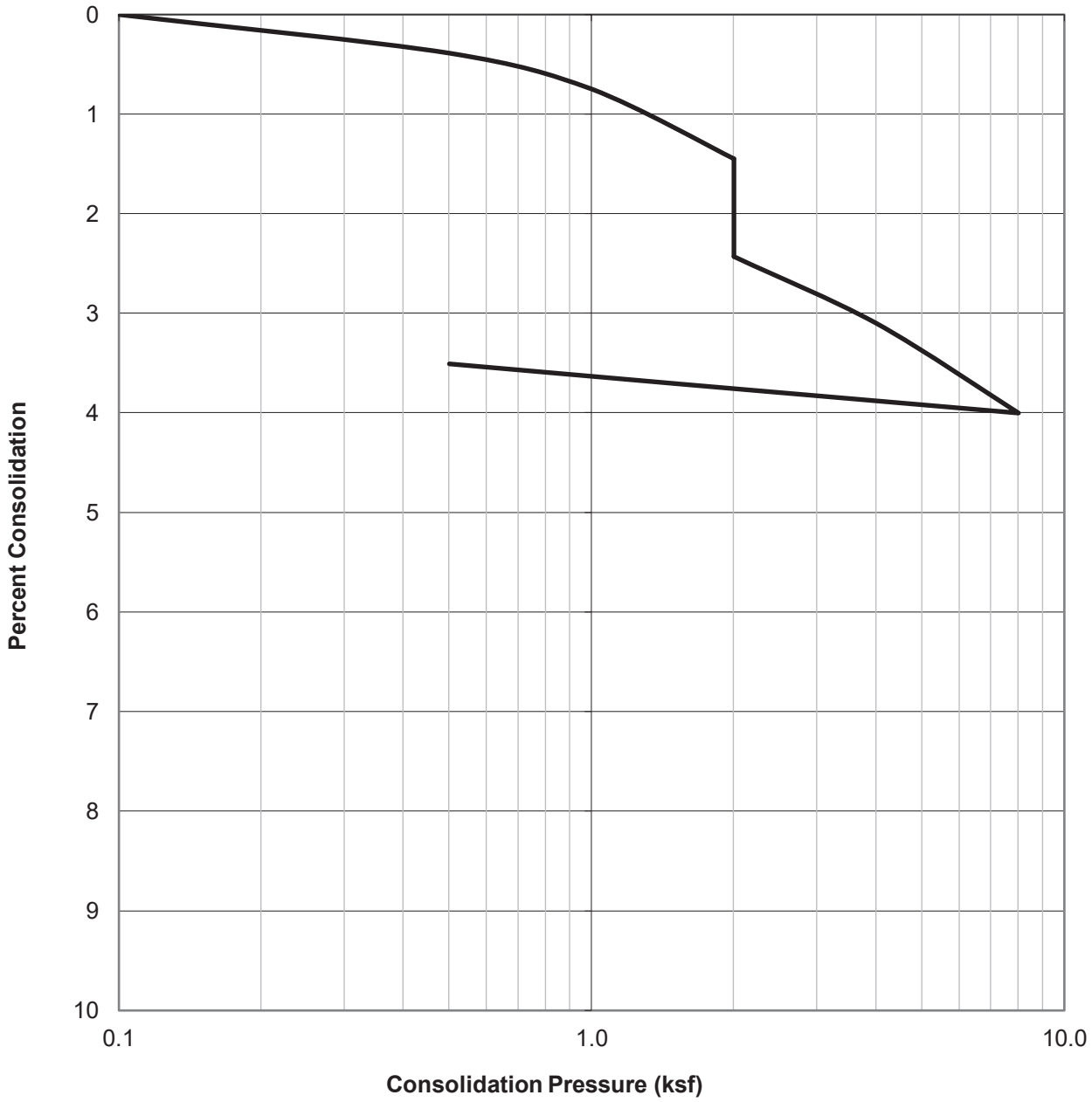
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B19

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B7@14.5	Well Graded Sand (SW)	111.8	3.6	13.9

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

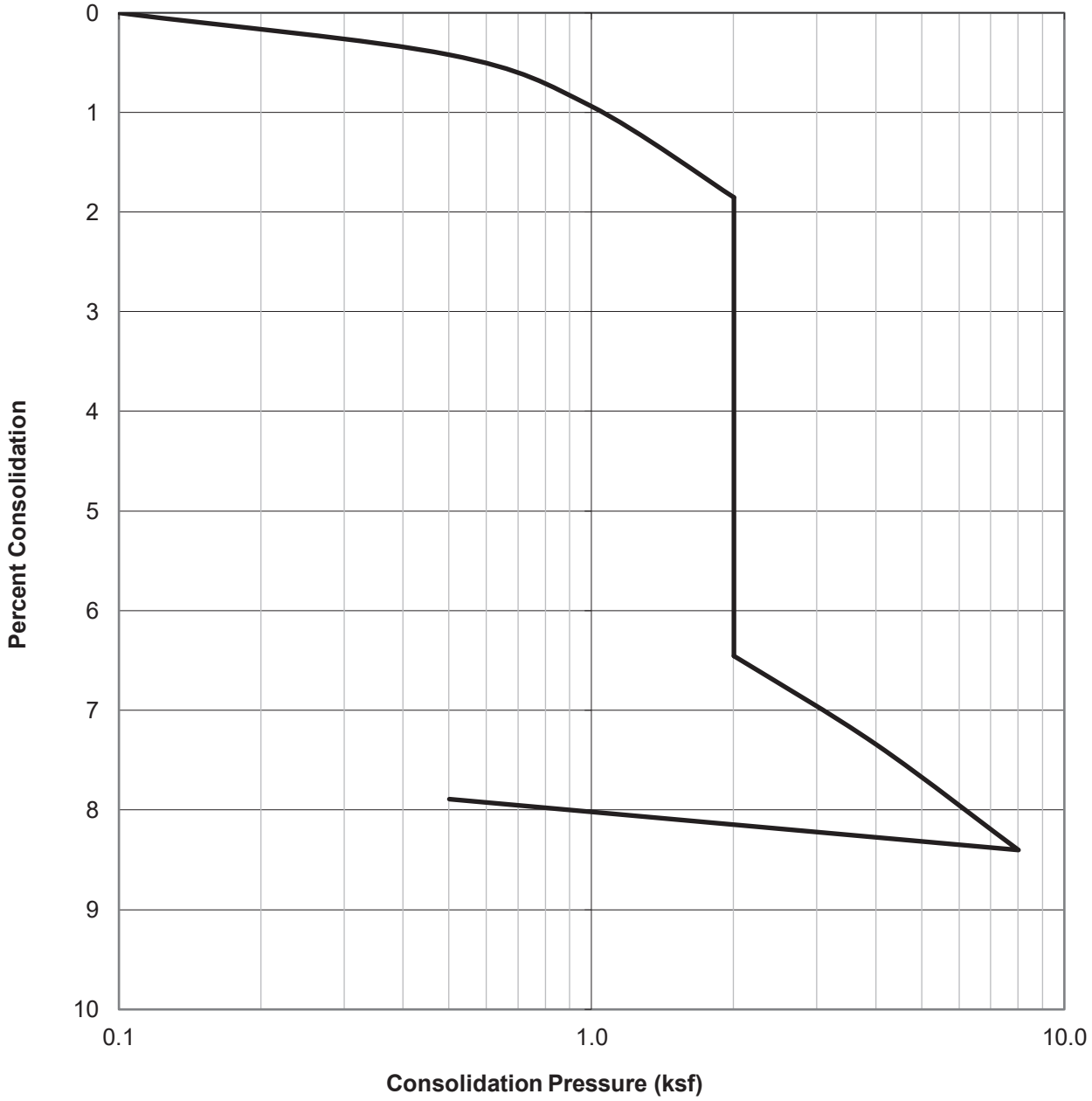
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B20

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B8@4	Poorly Graded Sand (SP)	92.7	6.0	15.9

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

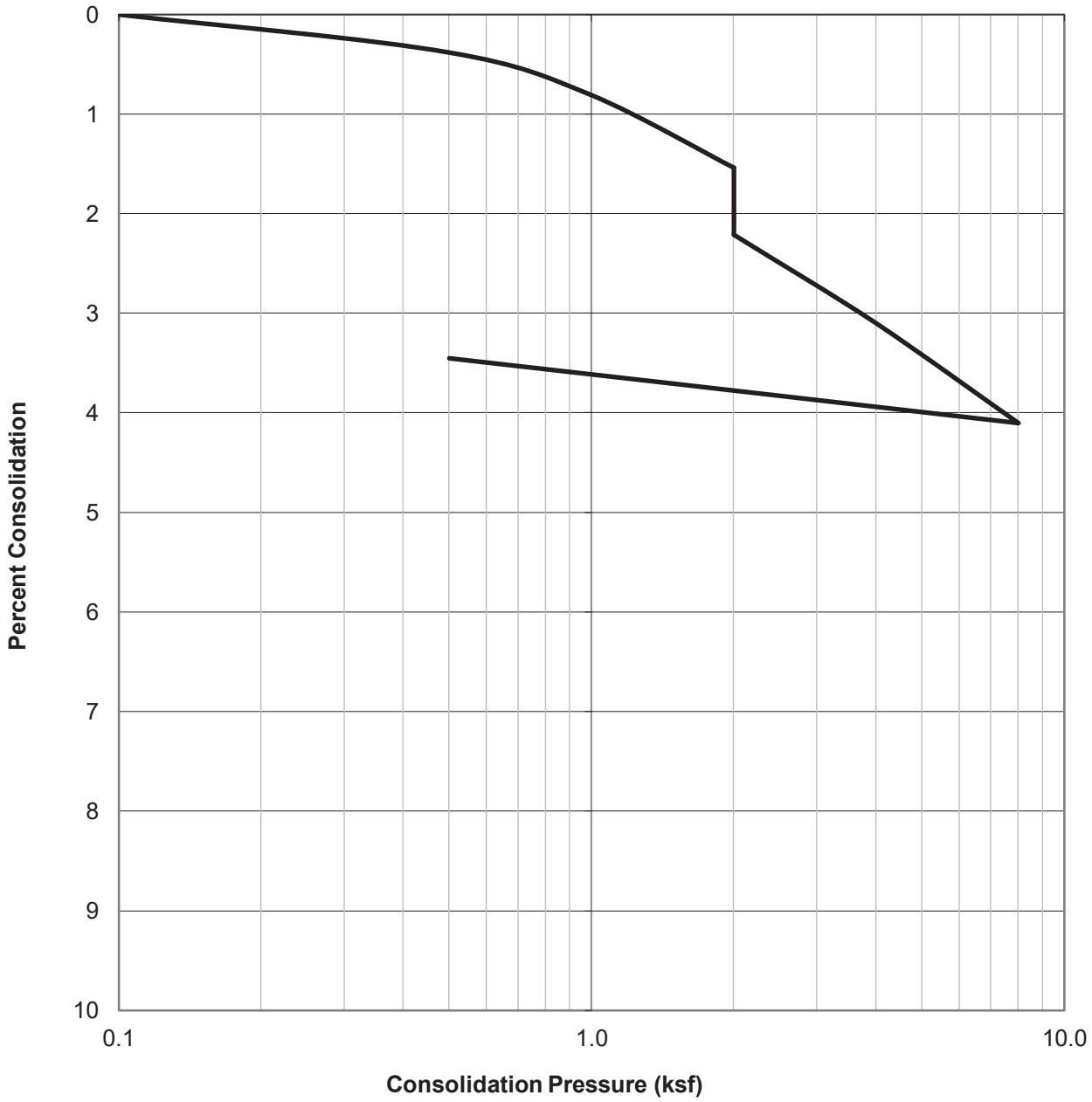
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B21

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B8@14	Poorly Graded Sand (SP)	106.7	5.3	14.6

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

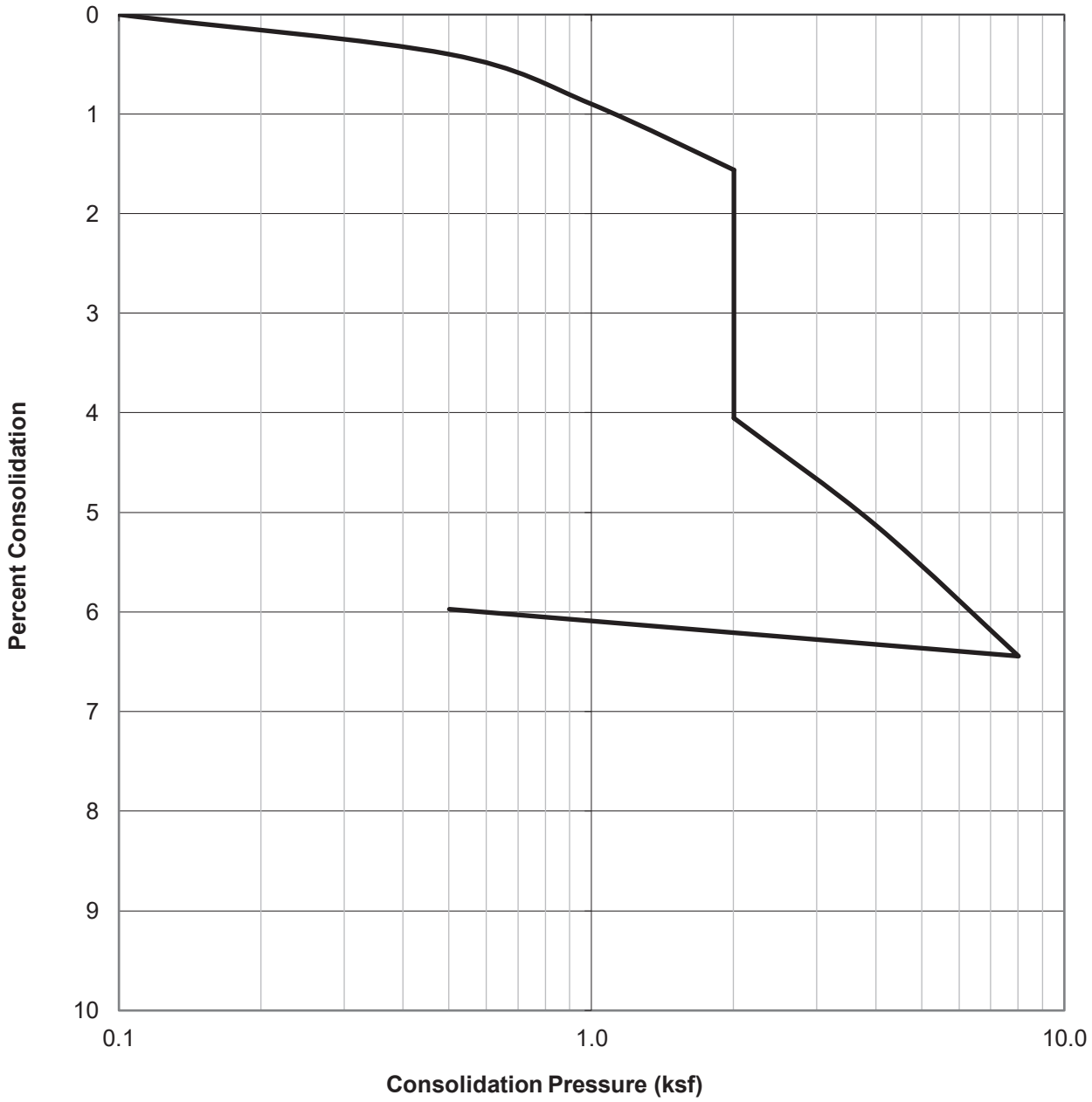
Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B22

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B9@5	Poorly Graded Sand (SP)	112.2	3.7	13.9

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B23

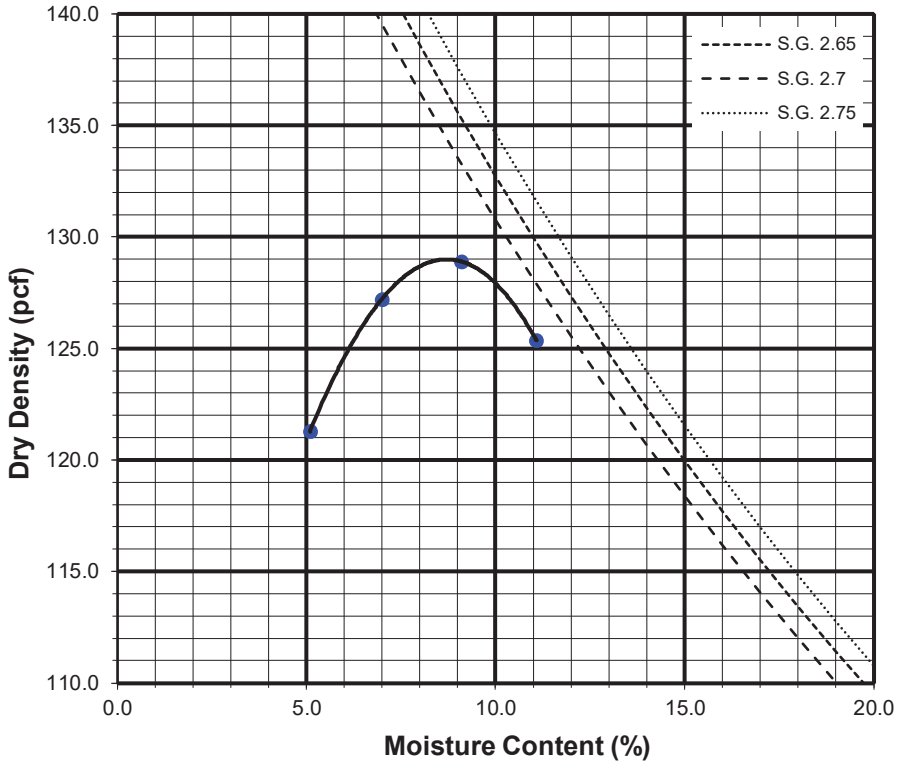
Sample No:

B1@0-5'	Light Reddish Brown Poorly Graded Sand with Gravel (SP)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6027	6157	6225	6204		
Weight of Mold	(g)	4107	4107	4107	4107		
Net Weight of Soil	(g)	1919	2050	2118	2097		
Wet Weight of Soil + Cont.	(g)	608.4	712.1	688.0	702.7		
Dry Weight of Soil + Cont.	(g)	586.1	674.5	642.0	645.1		
Weight of Container	(g)	148.4	136.7	136.2	125.3		
Moisture Content	(%)	5.1	7.0	9.1	11.1		
Wet Density	(pcf)	127.5	136.1	140.6	139.2		
Dry Density	(pcf)	121.3	127.2	128.9	125.4		

Maximum Dry Density (pcf)	**129.5**
Bulk Specific Gravity (dry)	**2.65**
Corrected Maximum Dry Density (pcf)	**133.0**

Optimum Moisture Content (%)	**8.5**
Oversized Fraction (%)	**12.0**
Corrected Moisture Content (%)	**7.5**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B24

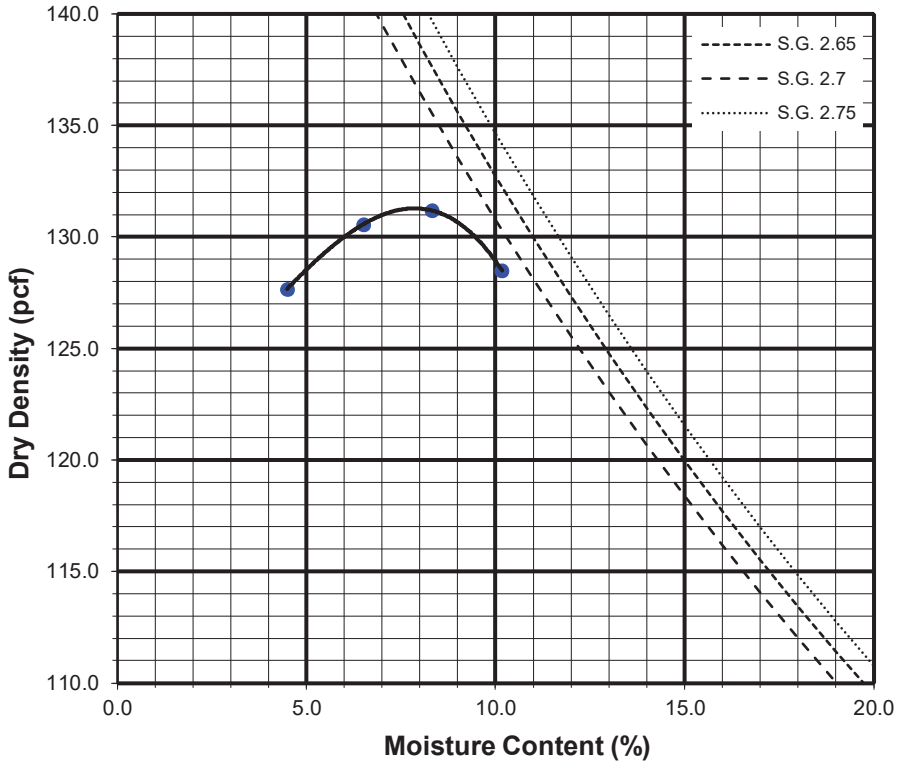
Sample No:

B2@0-5'	Light Brown Poorly Graded Sand with Gravel (SP)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6116	6201	6247	6239		
Weight of Mold	(g)	4107	4107	4107	4107		
Net Weight of Soil	(g)	2009	2094	2140	2132		
Wet Weight of Soil + Cont.	(g)	656.8	753.0	652.7	638.7		
Dry Weight of Soil + Cont.	(g)	634.3	716.0	613.0	591.5		
Weight of Container	(g)	133.1	146.8	135.3	127.3		
Moisture Content	(%)	4.5	6.5	8.3	10.2		
Wet Density	(pcf)	133.4	139.0	142.1	141.6		
Dry Density	(pcf)	127.7	130.6	131.2	128.5		

Maximum Dry Density (pcf)	**131.5**
Bulk Specific Gravity (dry)	**2.65**
Corrected Maximum Dry Density (pcf)	**136.0**

Optimum Moisture Content (%)	**7.5**
Oversized Fraction (%)	**17.0**
Corrected Moisture Content (%)	**6.0**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B25

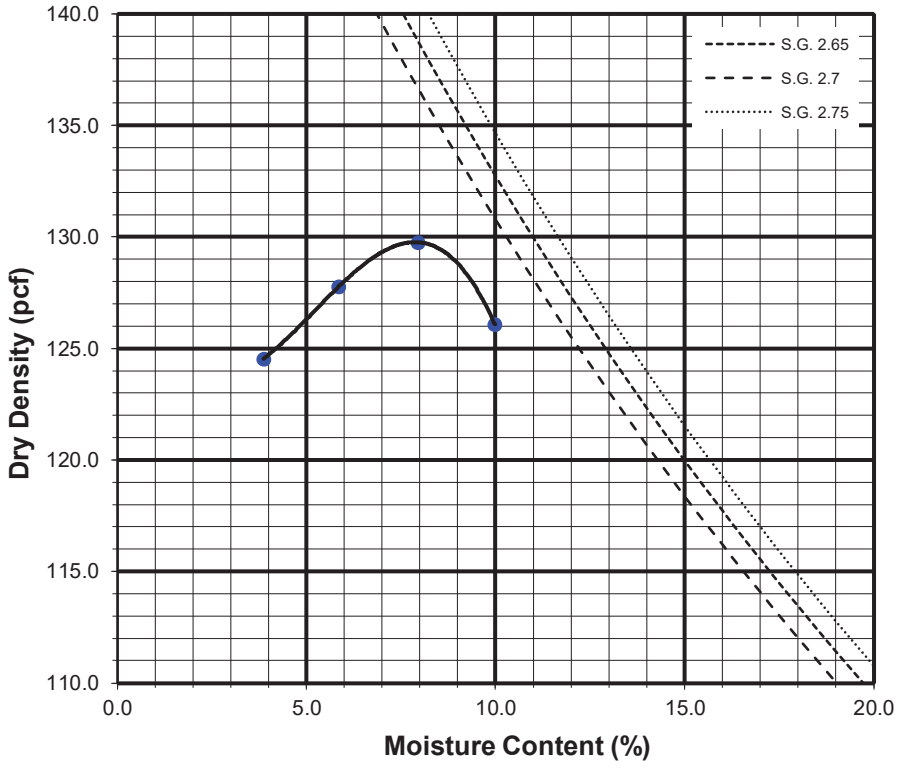
Sample No:

B6@0-5'	Light Brown Poorly Graded Sand (SP)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6061	6150	6223	6202		
Weight of Mold	(g)	4107	4107	4107	4107		
Net Weight of Soil	(g)	1954	2043	2116	2095		
Wet Weight of Soil + Cont.	(g)	733.2	738.2	661.4	720.7		
Dry Weight of Soil + Cont.	(g)	711.3	705.5	623.6	668.5		
Weight of Container	(g)	144.6	146.7	147.3	145.4		
Moisture Content	(%)	3.9	5.9	7.9	10.0		
Wet Density	(pcf)	129.3	135.2	140.1	138.7		
Dry Density	(pcf)	124.5	127.8	129.8	126.1		

Maximum Dry Density (pcf)	**130.0**

Optimum Moisture Content (%)	**8.0**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

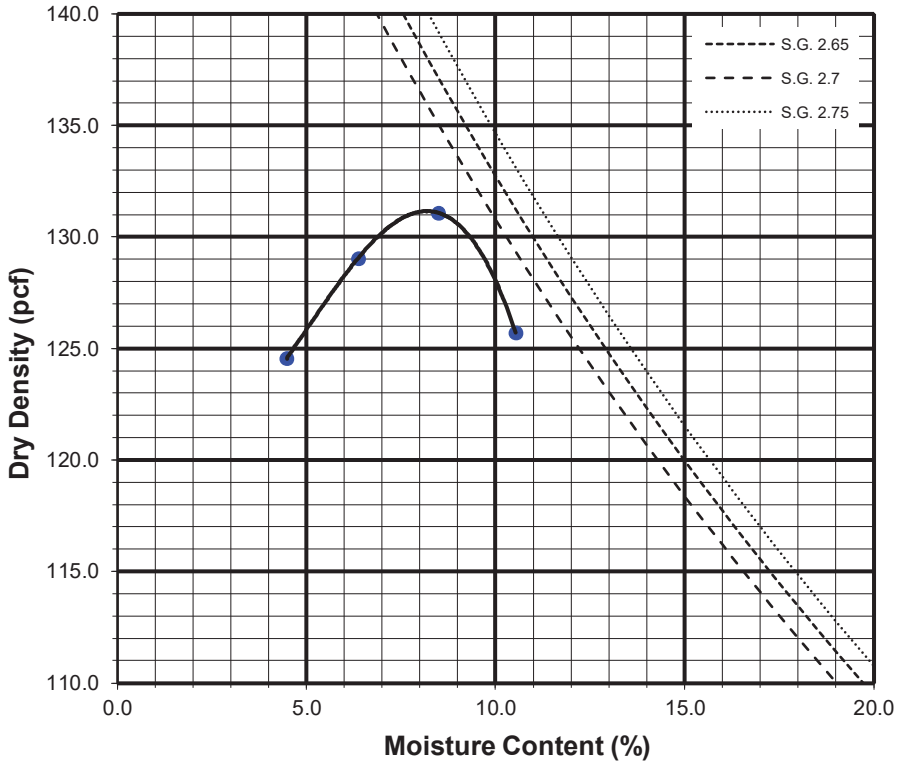
MARCH 2022 Figure B26

Sample No:

B8@0-5'	Light Brown Silty Sand (SM)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6073	6181	6255	6206		
Weight of Mold	(g)	4107	4107	4107	4107		
Net Weight of Soil	(g)	1966	2074	2148	2099		
Wet Weight of Soil + Cont.	(g)	721.4	734.6	741.8	727.6		
Dry Weight of Soil + Cont.	(g)	696.8	698.6	693.6	672.3		
Weight of Container	(g)	147.6	133.6	126.0	147.3		
Moisture Content	(%)	4.5	6.4	8.5	10.5		
Wet Density	(pcf)	130.1	137.3	142.2	138.9		
Dry Density	(pcf)	124.6	129.1	131.1	125.7		

Maximum Dry Density (pcf)	**131.5**	**Optimum Moisture Content (%)**	**8.0**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B27

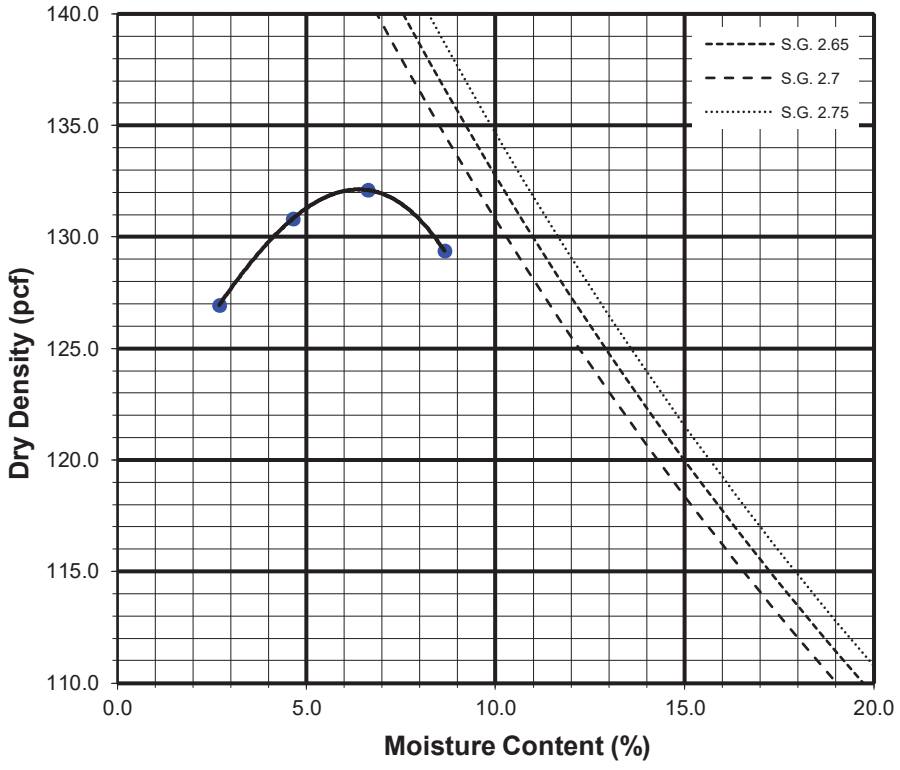
Sample No:

B9@0-5'	Light Reddish Brown Poorly Graded Sand (SP)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6077	6175	6235	6230		
Weight of Mold	(g)	4107	4107	4107	4107		
Net Weight of Soil	(g)	1969	2068	2128	2123		
Wet Weight of Soil + Cont.	(g)	649.1	716.0	683.5	726.3		
Dry Weight of Soil + Cont.	(g)	635.9	690.8	649.5	678.5		
Weight of Container	(g)	146.8	147.9	136.5	125.9		
Moisture Content	(%)	2.7	4.6	6.6	8.7		
Wet Density	(pcf)	130.4	136.9	140.9	140.6		
Dry Density	(pcf)	126.9	130.8	132.1	129.4		

Maximum Dry Density (pcf)	**132.0**

Optimum Moisture Content (%)	**6.0**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B28

SUMMARY OF LABORATORY POTENTIAL
OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST NO. 643

Sample No.	pH	Resistivity (ohm centimeters)
B1 @ 0-5'	8.5	150 (Severely Corrosive)
B2 @ 0-5'	7.9	9200 (Moderately Corrosive)
B6 @ 0-5'	9.3	5000 (Moderately Corrosive)

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
EPA NO. 325.3

Sample No.	Chloride Ion Content (%)
B1@0-5'	0.411
B2@0-5'	0.009
B6@0-5'	0.011

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Water Soluble Sulfate (% SO_4)	Sulfate Exposure*
B1@0-5'	0.046	S0
B2@0-5'	0.000	S0
B6@0-5'	0.000	S0

GEOCON

CORROSIVITY TEST RESULTS

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B29

SUMMARY OF LABORATORY POTENTIAL
OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
CALIFORNIA TEST NO. 643

Sample No.	pH	Resistivity (ohm centimeters)
B8 @ 0-5'	8.2	3000 (Moderately Corrosive)
B9 @ 0-5'	8.3	9700 (Moderately Corrosive)

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
EPA NO. 325.3

Sample No.	Chloride Ion Content (%)
B8@0-5'	0.006
B9@0-5'	0.011

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
CALIFORNIA TEST NO. 417

Sample No.	Water Soluble Sulfate (% SO_4)	Sulfate Exposure*
B8@0-5'	0.000	S0
B9@0-5'	0.000	S0

GEOCON

CORROSIVITY TEST RESULTS

Checked by: JMH

Project No.: W1523-99-01

565 ACRES
APPLE VALLEY, CALIFORNIA

MARCH 2022 Figure B30

Project No. W1523-99-01A
August 9, 2023

Mr. Opher Benrimon
Uncommon Developers
9220 Winnetka Avenue
Los Angeles, California 91311

Subject: PERCOLATION TEST RESULTS
PROPOSED WAREHOUSE BUILDING
NORTHEAST CORNER OF CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA
APN: 0463-241-03

Reference: *Geotechnical Investigation,* prepared by Geocon West, Inc., Project No. W1523-99-01A, dated December 5, 2022.

Dear Mr. Benrimon:

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Boring	Soil Type	Infiltration Depth (ft)	Average Infiltration Rate (in / hour)
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B2	SM	20-60½	0.39

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It is our opinion that the introduction of stormwater at the depths and locations indicated on the site plan will not create a perched groundwater condition, will not affect soil structure interaction of existing or proposed foundations due to expansive soils, will not saturate soils supported by existing or proposed retaining walls, and will not increase the potential for liquefaction. Resulting settlements are anticipated to be less than ¼ inch, if any.

Subsequent to the placement of the infiltration system, it is acceptable to backfill the resulting void space between the excavation sidewalls and the infiltration system with minimum two-sack slurry provided the slurry is not placed in the infiltration zone. It is recommended that pea gravel be utilized adjacent to the infiltration zone so communication of water to the soil is not hindered.

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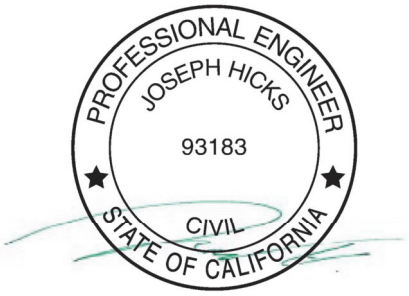
Should you have any questions regarding this letter, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

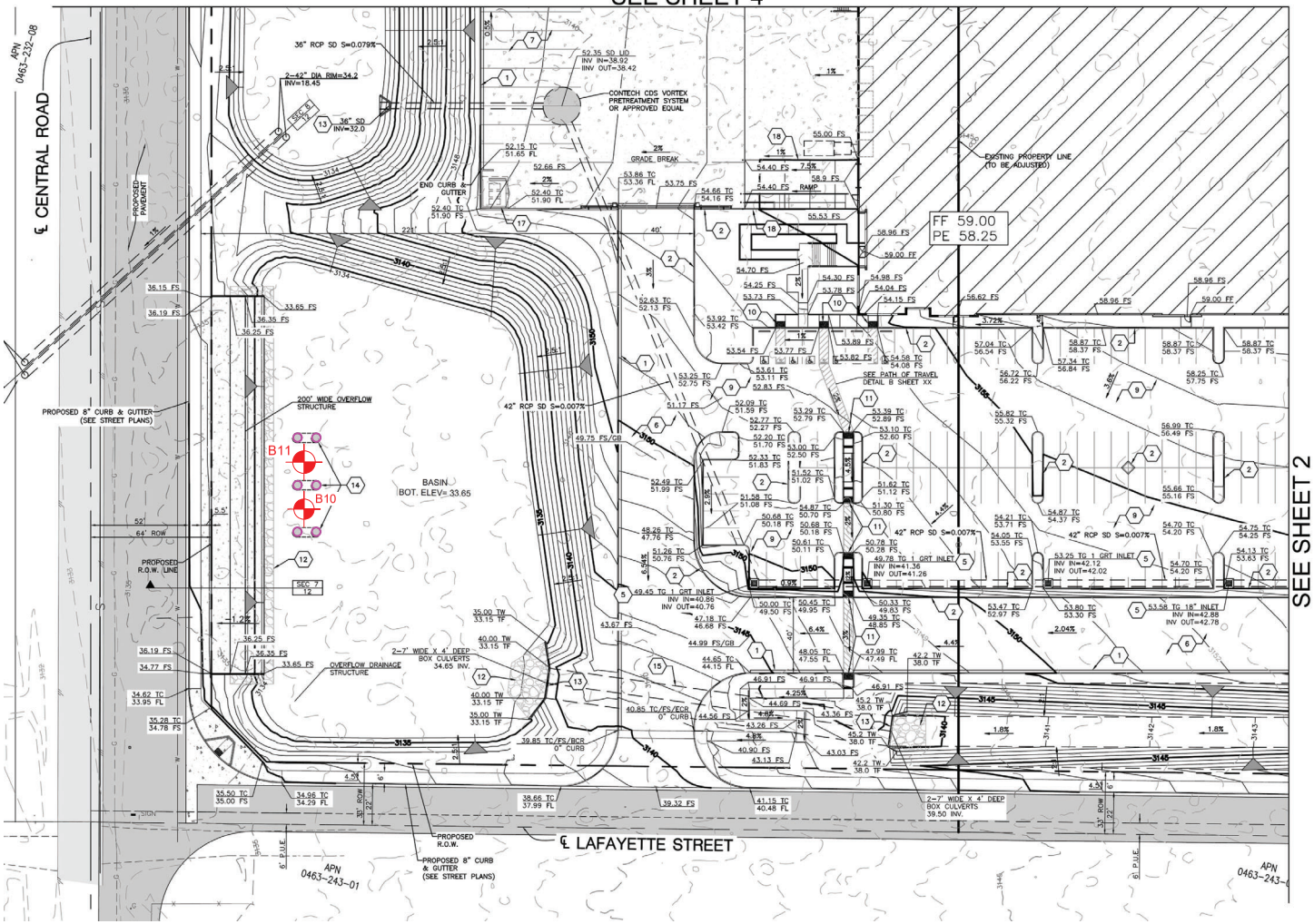
GEOCON WEST, INC.



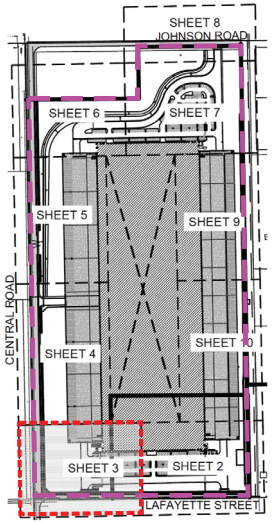
Joe Hicks, M.S.
PE 93183

Harry Derkalousdian
PE 79694

Attachments: Figure 1, Site Plan
Figures 2 and 3, Percolation Rate Calculations



OVERALL SITE



NORTH

0 60' 120

LEGEND

B1 Approximate Boring Location and ID

O Proposed Dry Well Location

GEOCON WEST, INC.
ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 N. VICTORY BOULEVARD, BURBANK, CA 91502
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: JMH | CHECKED BY: NDB

SITE PLAN

NORTHEAST CORNER OF CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

AUGUST 2023 | PROJECT NO. W1523-99-01A | FIG. 1

PERCOLATION TEST DATA SHEET

Project:	Central & Lafayette	Project No:	W1523-99-01A	Date:	7/18/2023
Test Hole No:	B10	Tested By:	CB		
Depth of Test Hole, D_T:	60.5	USCS Soil Classification:	SM		
Test Hole Dimensions (inches)			Length	Width	
Diameter (if round) =	8	Sides (if rectangular) =	---	---	

Sandy Soil Criteria Test*

Trial No.	Start Time	Stop Time	Δt Time Interval (min)	D_0 Initial Depth to Water (in)	D_f Final Depth to Water (in)	ΔD Change in Water Level (in)	Greater than or Equal to 6"? (y/n)
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3	13:10	13:40	30	240.0	321.6	81.6	529
4	13:45	14:15	30	240.0	295.2	55.2	783
5	14:20	14:50	30	240.0	295.2	55.2	783
6	14:55	15:25	30	240.0	295.2	55.2	783
7							
8							

Infiltration Rate Calculation:

Time Interval, Δt =	30	minutes	Ho =	486.0	inches
Final Depth to Water, Df =	295.2	inches	Hf =	430.8	inches
Test Hole Radius, r =	4	inches	ΔH =	55.2	inches
Initial Depth to Water, Do =	240.0	inches	Havg =	458.4	inches
Total Depth of Test Hole, DT =	726.0	inches			

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

Infiltration Rate, It = **0.48** inches/hour

Figure 2

PERCOLATION TEST DATA SHEET

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3	13:10	13:40	30	240.0	424.8	184.8	234
4	13:45	14:15	30	240.0	288.0	48.0	900
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Infiltration Rate, It = **0.39** inches/hour

Figure 3

Project No. W1523-99-01A
August 9, 2023

Mr. Opher Benrimon
Uncommon Developers
9220 Winnetka Avenue
Los Angeles, California 91311

Subject: PERCOLATION TEST RESULTS
PROPOSED WAREHOUSE BUILDING
NORTHEAST CORNER OF CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA
APN: 0463-241-03

Reference: *Geotechnical Investigation,* prepared by Geocon West, Inc., Project No. W1523-99-01A, dated December 5, 2022.

Dear Mr. Benrimon:

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Based on information provided by the civil engineer, it is our understanding that the stormwater infiltration system will consist of deep drywells located in the detention basin at the southwest corner of the site (see Site Plan, Figure 1).

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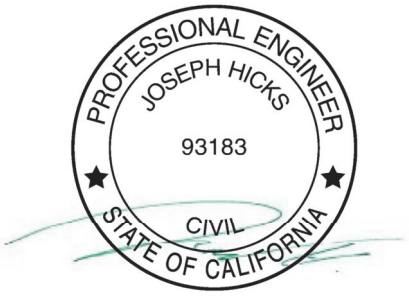

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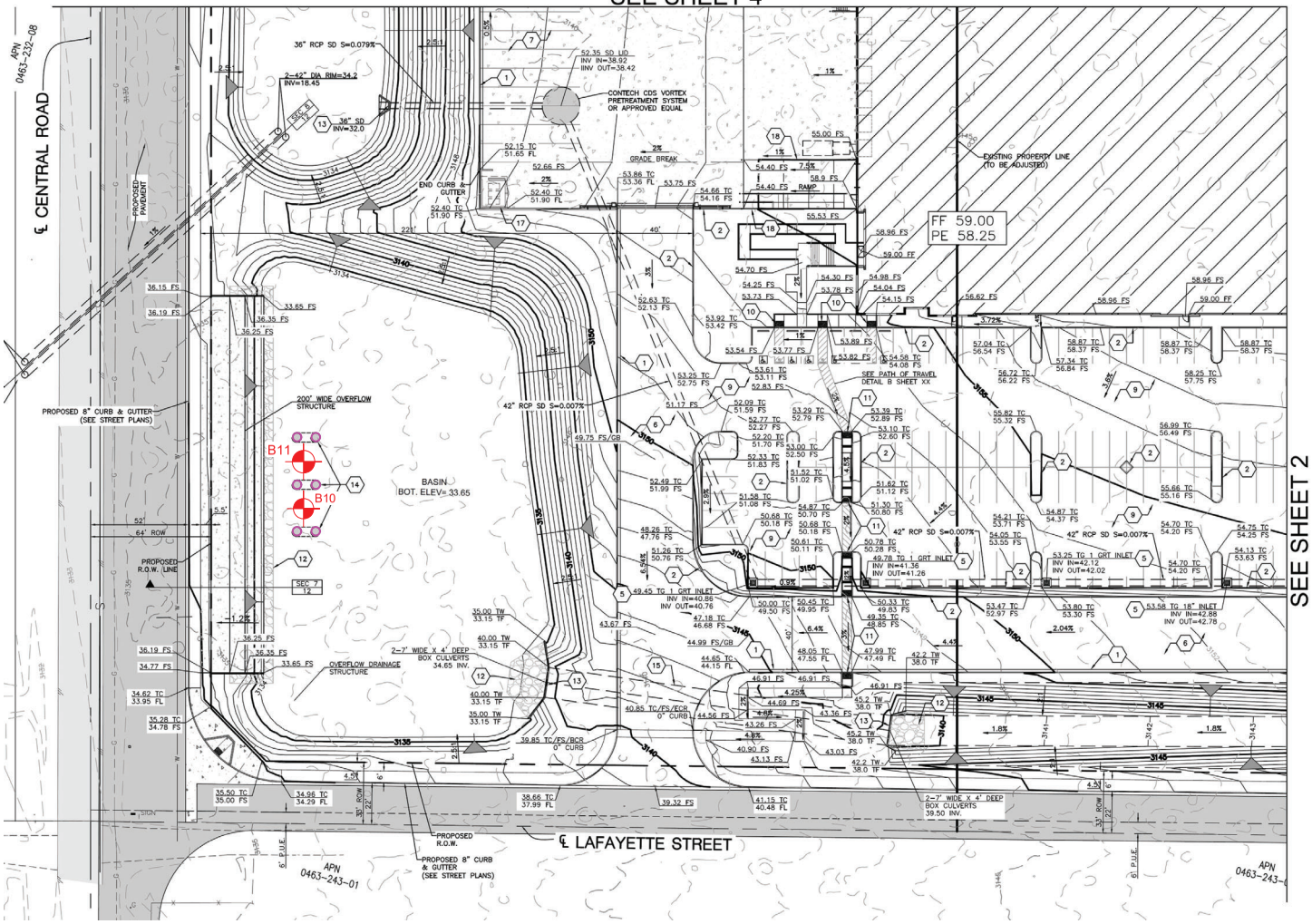

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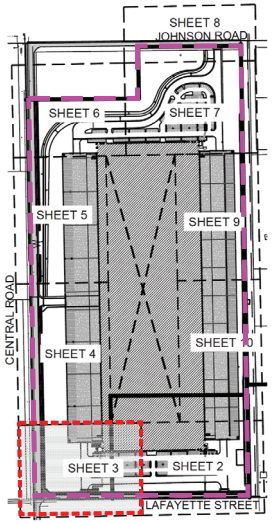

NORTH

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LEGEND

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500 N. VICTORY BOULEVARD, BURBANK, CA 91502
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: JMH | CHECKED BY: NDB

SITE PLAN

NORTHEAST CORNER OF CENTRAL ROAD AND LAFAYETTE STREET
APPLE VALLEY, CALIFORNIA

AUGUST 2023 | PROJECT NO. W1523-99-01A | FIG. 1

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Figure 3

Appendix G: Hydrology Study

ON-SITE HYDROLOGY STUDY

For

AP Investors Group LLC
APN 0463-241-02 & 03
Apple Valley, CA

May 30, 2023

Prepared by:

Merrell-Johnson Companies

22221 US Highway 18
Apple Valley, CA 92307
(760) 240-8000

Job No. 3675.007

E. Cary Packer, PE
Associate Engineer
R.C.E. 51752 Exp. 06/30/24

Mark D. Rowan
Project Manager

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- Unit Hydrograph Calculations
- On-site Hydrology Calculations
- Antecedent Moisture Condition (AMC) Maps

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- Soils Mapping and Information
- NOAA Atlas 14 Point Rainfall Information

Off-Site Hydrology Study

SECTION 1

DISCUSSION

INTRODUCTION

The purpose of this study was to determine the impact, if any, of the 100-year on-site storm runoff flow on the project site as delineated on the map contained in this study. The project site encompasses approximately 72 acres of property located on the east side of Central Road, between Johnson Road to the north and Lafayette Street on the south in the northeastern area of the Town of Apple Valley, San Bernardino County, California. Development of the site will be a proposed distribution warehouse facility.

METHODOLOGY

The method in determining these peak on-site runoff flows was the unit hydrograph method as specified in the 1986 San Bernardino County Hydrology Manual and the 2010 San Bernardino County Hydrology Manual Addendum for Arid Regions. The existing on-site flow was examined and delineated from U.S.G.S. Map: Apple Valley North and an examination of the project site.

Point rainfalls for the 100-year storm were obtained from the NOAA Atlas 14 per the 2010 Addendum to the County Hydrology Manual. The 100-year 1-hour point rainfall for the site is 1.07". Per the aforementioned addendum, AMC II was used for the project site and the soil types were determined to be Soil Type A in the eastern tributary area and Soil Type C southeastern tributary area per the Natural Resources Conservation Service's "Web Soil Survey". Rainfall and maps are included as exhibits in Section 3 of this report.

The on-site flow areas examined in this study is shown in Table A.

Table A

Sub-area	Elevation Difference (ft.)	Length (ft)	Area (Ac)	Avg. Slope (ft/ft)
On-site Undeveloped	38	2,668	72.5	0.0142
On-site Developed	39	3,482	72.5	0.0112

EXISTING CONDITIONS

The site is located along the east side of Central Road between Johnson Road to the north and Lafayette Street to the south in the Town of Apple Valley, California. The property is currently vacant, undeveloped land. Central Road is a paved road with dirt shoulders. Johnson Road and Lafayette Street area both graded, unimproved roads.

The results of the offsite flow analysis are summarized in Table B.

Table B

Sub-Area	Q_{100} (cfs)
On-site Undeveloped	207.7
On-site Developed	249.4
On-site 90% of Undeveloped	186.9

CONCLUSIONS AND RECOMMENDATIONS

During our field investigation of the site, we observed the existing conditions as stated previously. Future development of the project is being performed in conjunction with engineered improvement plans. Off-site flows were examined and delineated in the off-site hydrology study for this project which is attached to this report. Off-site flows from the east and southeast will be intercepted along the easterly property boundary, conveyed through the project, around the proposed building and outlet along the westerly and southerly boundaries following their historical flow locations. The Apple Valley MPD flow will be intercepted as it enters the property along the northern boundary, conveyed around the proposed development and released within its historical flow location along Central Road. The off-site flows will not comingle with on-site storm runoff.

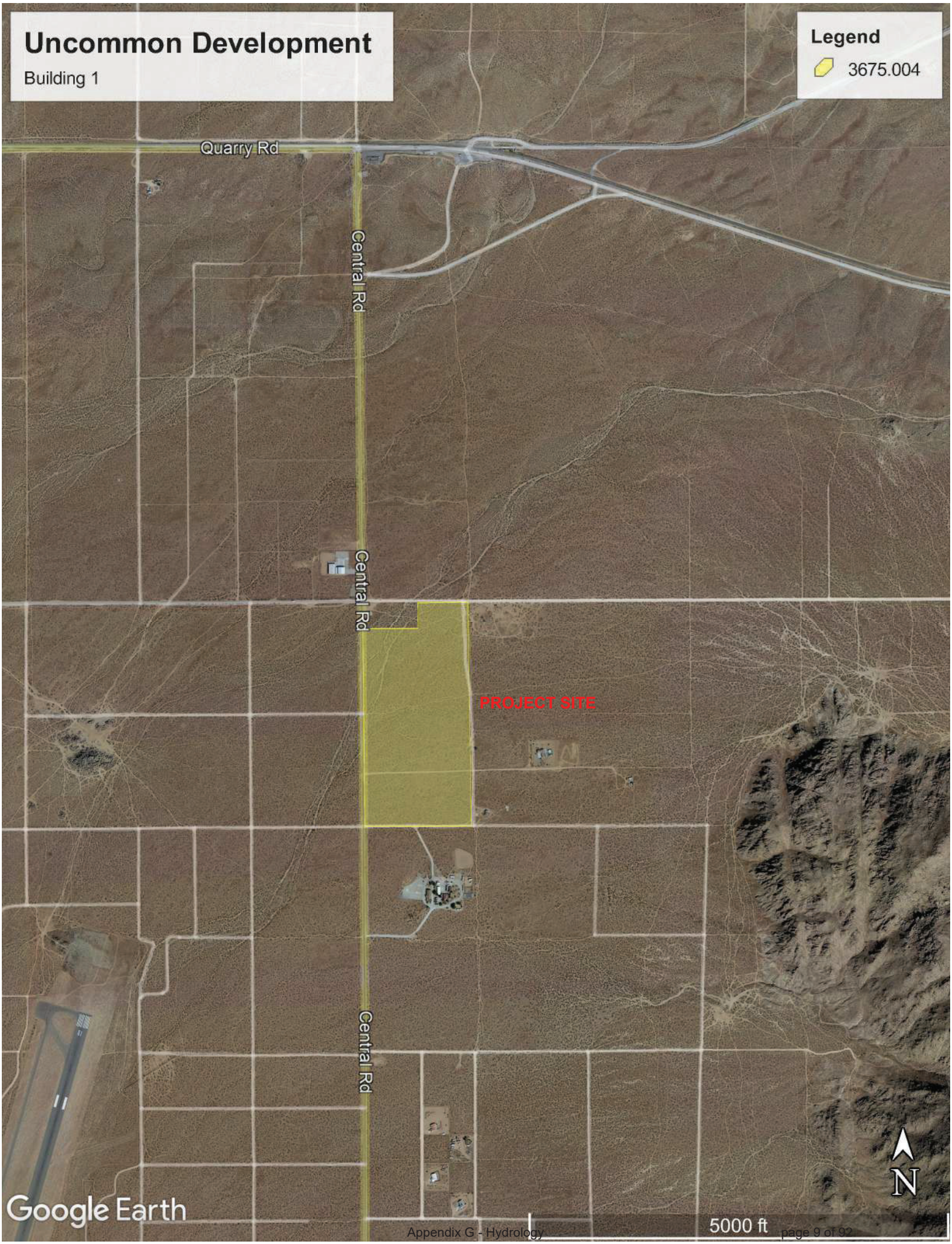
On-site runoff flows will be routed through the site and intercepted in an on-site storm drain system and routed to two pre-treatment hydrodynamic separators on site. Flows from the hydrodynamic pre-treatment will be conveyed to an on-site retention/detention basin and allowed to infiltrate. This basin is to be equipped with three infiltration dry wells to aid in the infiltration of runoff. The basin is sized to retain the design capture volume (DCV) from the water quality management plan (WQMP) prepared for the project.

On-site runoff in excess of the DCV will be detained within the basin and outlet through two, 42” RCP storm drains across Central Road. The basin outlet pipes are sized to convey the 90% storm runoff flow from the pre-development site which is approximately 187 cubic feet per second. Runoff flows will follow their historical flow paths from the project.

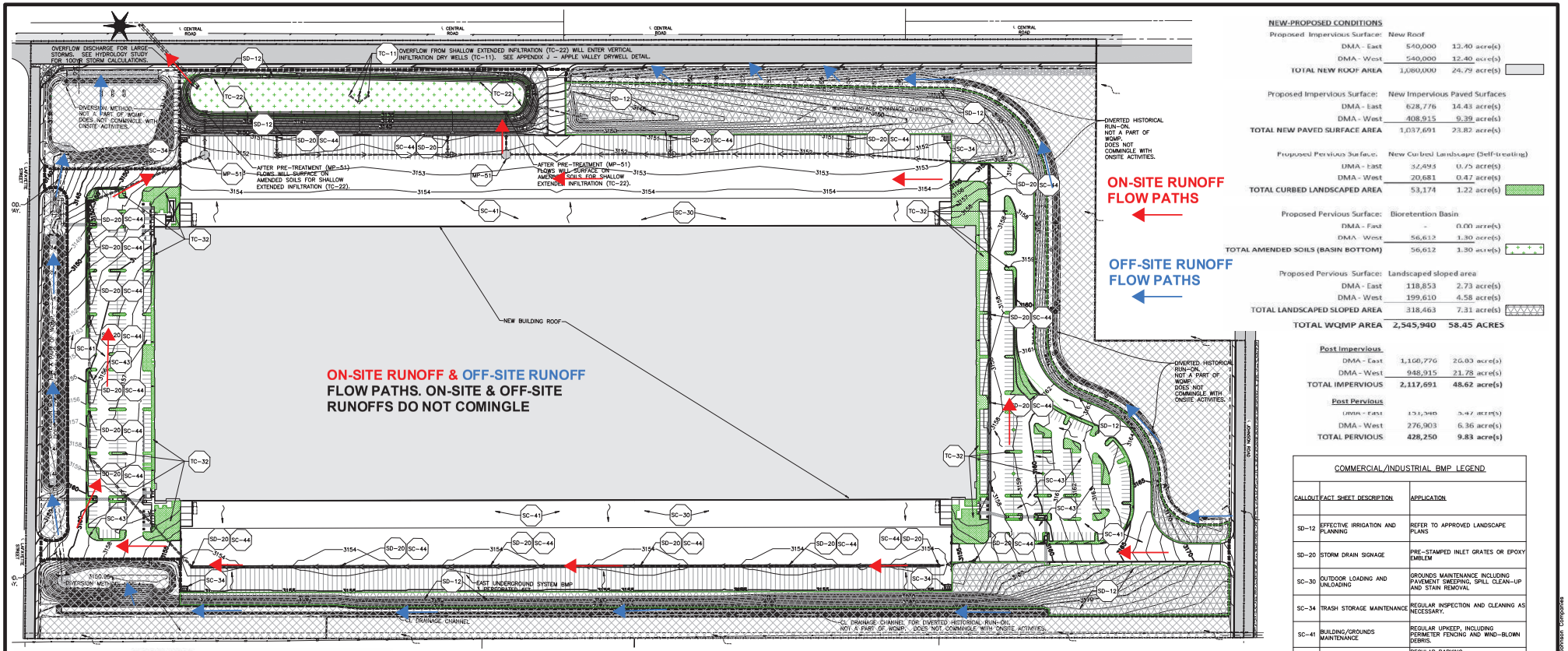
SECTION 2

EXHIBITS

VICINITY MAP


Uncommon Development
Building 1
Legend
3675.004
Quarry Rd
Central Rd
Central Rd
Central Rd
PROJECT SITE
N
Google Earth
5000 ft

PROPOSED DEVELOPMENT PLAN



NEW-PROPOSED CONDITIONS

Proposed Impervious Surface:	New Roof		
DMA - East	540,000	12.40	acre(s)
DMA - West	540,000	12.40	acre(s)
TOTAL NEW ROOF AREA	1,080,000	24.79	acre(s)
Proposed Impervious Surface:	New Impervious Paved Surfaces		
DMA - East	628,776	14.43	acre(s)
DMA - West	408,915	9.39	acre(s)
TOTAL NEW PAVED SURFACE AREA	1,037,691	23.82	acre(s)
Proposed Pervious Surface:	New Curbed Landscape (Self-treating)		
DMA - East	32,493	0.75	acre(s)
DMA - West	20,681	0.47	acre(s)
TOTAL CURBED LANDSCAPED AREA	53,174	1.22	acre(s)
Proposed Pervious Surface:	Bioretention Basin		
DMA - East	-	0.00	acre(s)
DMA - West	56,612	1.30	acre(s)
TOTAL AMENDED SOILS (BASIN BOTTOM)	56,612	1.30	acre(s)
Proposed Pervious Surface:	Landscaped sloped area		
DMA - East	118,853	2.73	acre(s)
DMA - West	199,610	4.58	acre(s)
TOTAL LANDSCAPED SLOPED AREA	318,463	7.31	acre(s)
TOTAL WQMP AREA	2,545,940	58.45	ACRES

ON-SITE RUNOFF FLOW PATHS

OFF-SITE RUNOFF FLOW PATHS

Post Impervious			
DMA - East	1,160,776	26.65	acre(s)
DMA - West	948,915	21.78	acre(s)
TOTAL IMPERVIOUS	2,117,691	48.62	acre(s)
Post Pervious			
DMA - East	151,348	3.47	acre(s)
DMA - West	276,903	6.36	acre(s)
TOTAL PERVIOUS	428,250	9.83	acre(s)

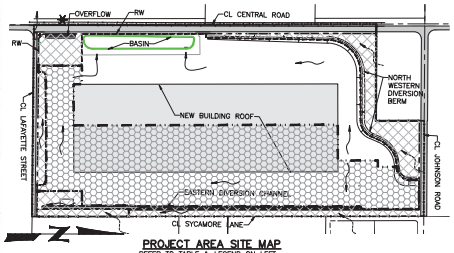
PROJECT AREAS

4. Site property perimeter CL to CL (sq.ft)	3,271,838	75.11	acre(s)
5. Exterior Road Improvements (sq.ft)	187,051	4.29	acre(s)
6. Portions Used to Divert Run-on (sq.ft)	513,754	11.79	acre(s)
7. Existing Paved Road (not disturbed) (sq.ft)	25,093	0.58	acre(s)
8. Facility Operations Area (On-site going to BMP)	2,545,940	58.45	acre(s)
9. Disturbance Total (sq.ft.) (Sum of Items 5 + 6 + 8) (sq.ft)	3,246,745	74.54	acre(s)
WQMP Project Area (sq.ft) (On-site going to BMP)	2,545,940	58.45	acre(s)

1 DRAINAGE AREA:

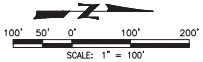
DMAs are to determine size of pre-treatment in Forms 4.2

DMA - East	1,320,122	30.31	acre(s)
DMA - West	1,225,818	28.14	acre(s)
DA 1 Entire Site	2,545,940	58.45	acre(s)



PROJECT AREA SITE MAP

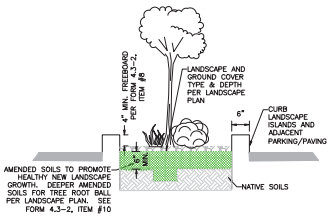
REFER TO TABLE & LEGEND ON LEFT, FORM 1-1, & FORMS 4.2-3 THRU 4.2-5



WQMP EXHIBIT LEGEND:

- INDICATES EXISTING CONTOUR
- INDICATES PROPOSED CONTOUR
- INDICATES ROAD CENTERLINE
- INDICATES PROPOSED UG STORM PIPE DIRECTION
- INDICATES EXISTING SURFACE FLOW DIRECTION
- INDICATES PROPOSED SURFACE FLOW DIRECTION
- R/W INDICATES RIGHT-OF-WAY
- SD-20 INDICATES BMPS CALLOUT (SEE BMP LEGEND TABLE)
- INDICATES BMP OVERFLOW

SIC CODE:4225: WAREHOUSE & STORAGE



TC-32: LANDSCAPED ISLAND DETAIL

NOT TO SCALE

SEE FORM 4.3-2

LANDSCAPED ISLANDS SURROUNDED BY CURB WITH 4" FREEBOARD WILL NOT COMMINGLE WITH SURFACE FLOWS DURING THE 2YR-1HR STORM.

COMMERCIAL/INDUSTRIAL BMP LEGEND

CALLOUT	FACT SHEET DESCRIPTION	APPLICATION
SD-12	EFFECTIVE IRRIGATION AND PLANNING	REFER TO APPROVED LANDSCAPE PLANS
SD-20	STORM DRAIN SIGNAGE	PRE-STAMPED INLET GRATES OR EPOXY EMBLEM
SC-30	OUTDOOR LOADING AND UNLOADING	GROUNDS MAINTENANCE INCLUDING PAVEMENT SWEEPING, SPILL CLEAN-UP AND STAIN REMOVAL
SC-34	TRASH STORAGE MAINTENANCE	REGULAR INSPECTION AND CLEANING AS NECESSARY.
SC-41	BUILDING/GROUNDS MAINTENANCE	REGULAR UPKEEP, INCLUDING PERIMETER FENCING AND WIND-BLOWN DEBRIS.
SC-43	PARKING AREA MAINTENANCE	REGULAR PARKING SWEEPING/VACUUMING. REMOVE OIL/GREASES STAINS/LEAKS PRIOR TO ENTERING ANY INLETS
SC-44	DRAINAGE AREA MAINTENANCE	ENSURE INLETS ARE PROTECTED FROM POLLUTANTS ENTERING AND REMAIN FREE OF BLOCKAGE
TC-11	INFILTRATION BASIN (UNDERGROUND DRYWELLS). SEE APPENDIX J – APPLE VALLEY DRYWELL DETAIL	REFER TO MANUFACTURE'S SPECIFICATIONS. PROFESSIONAL CONTRACTED INSPECTIONS, MAINTENANCE WITH VACUUM TRUCK & HAULER
TC-22	EXTENDED DETENTION BASIN (SURFACE LANDSCAPED BASIN)	PART OF GROUND MAINTENANCE. ENSURE AMENDED SOILS AND HEALTHY VEGETATION WILL PROPERLY INFILTRATE FLOWS FROM PRETREATMENT DEVICES. REMOVE WEEDS, OVERGROWTH, TRASH/DEBRIS. NO STANDING WATER LONGER THAN 48 HOURS AFTER RAIN FALL. POOR INFILTRATION WILL REQUIRE REMOVE OF CLAY LAYER AND REPLACEMENT OF AMENDED SOILS. MAINTAIN DEPTH FROM SURFACE BOTTOM TO INLETS AS SHOWN ON PLANS.
TC-32	BIORETENTION (CURBED LANDSCAPED ISLANDS)	PART OF GROUND MAINTENANCE. ENSURE AMENDED SOILS AND HEALTHY VEGETATION WILL PROPERLY INFILTRATE. NO STANDING WATER LONGER THAN 48 HOURS AFTER RAIN FALL. MAINTAIN DEPTHS AS SHOWN ON PLANS.
MP-51	PRE-TREATMENT HYDRODYNAMIC SEPARATOR, OR APPROVED EQUIVALENT THRU DIFFERED SUBMITTAL	REFER TO MANUFACTURE'S SPECIFICATIONS. PROFESSIONAL CONTRACTED MAINTENANCE VACUUM TRUCK & HAULER

THE CONTRACTOR IS REQUIRED BY GOVERNMENT CODE 4216 "CALIFORNIA ONE CALL LAW" TO CALL DIG ALERT AT LEAST TWO (2) WORKING DAYS BEFORE DIGGING. CONTRACTOR IS REQUIRED BY SAME CODE TO HAND-EXPOSE TO THE POINT OF NO CONFLICT 24" ON EITHER SIDE OF THE UNDERGROUND FACILITY SO YOU CAN DETERMINE ITS EXACT LOCATION BEFORE USING POWER EQUIPMENT.

811 Know what's below. Call before you dig.

BENCHMARK AND BASIS OF BEARING

OPUS STATIC GPS OBSERVATION
BASE POINT COORDINATES:
NORTHING: 2047019.0300'
EASTING: 6811199.3300 - CALIFORNIA STATE PLANE COORDINATE SYSTEM ZONE V NAD 83

ELEVATION: 3234.10' - NAVD 88

NO.	REVISION	DATE	BY

NOTE:

IF THIS PLAN IS NOT SIGNED AND DATED BY THE ENGINEER OF RECORD AND ALSO BY THE CITY ENGINEER OR UTILITY COMPANY OFFICIAL IN THE APPROVAL BLOCKS OF THIS PLAN THEN THIS PLAN IS PRELIMINARY AND NOT FOR CONSTRUCTION.

REGISTERED PROFESSIONAL ENGINEER E. CARY PACKER No. C-51752 CIVIL STATE OF CALIFORNIA

MERRELL JOHNSON

MERRELL JOHNSON ENGINEERING, INC.
22051 US HIGHWAY 18, APPLE VALLEY, CA 92307
760.240.8000 | MERRELLJOHNSON.COM

DRAWN BY:	EKJ/JNC
DATE:	05/26/23
DESIGNED BY:	ECP/EKJ
DATE:	05/26/23
APPROVED BY:	ECP
DATE:	05/26/23

TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:

NORMAN B. MILLER, TOWN ENGINEER DATE

RCE 59809, EXP. DATE:

THESE PLANS ARE SIGNED BY THE TOWN OF APPLE VALLEY FOR CONCEPT ADHERENCE TO TOWN STANDARDS AND REQUIREMENTS ONLY. THE TOWN OF APPLE VALLEY IS NOT RESPONSIBLE FOR DESIGN, ASSUMPTIONS AND ACCURACY.

Town of Apple Valley

TOWN OF APPLE VALLEY WQMP EXHIBIT PLAN WAREHOUSE FACILITY

FOR

AP INVESTORS GROUP, LLC
18929 CENTRAL ROAD

SCALE:	AS SHOWN
JOB NO.	3675.007
SHEET	1 OF 2

P:\3675.007\Drawings\WQMP Exhibit 3675.007 (1).dwg - WQMP Exhibit (1) - Merrell Johnson Companies
30 May 2023 - 10:43am

SECTION 3

HYDROLOGY CALCULATIONS

UNIT HYDROGRAPH CALCULATIONS

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

Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

Study date 02/23/23

++

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

Program License Serial Number 5006

APPLE MGA - JOB 3675.007
ON-SITE UNDEVELOPED STORM RUNOFF
100-YEAR STORM EVENT - AMC II

Storm Event Year = 100

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
72.50	1	0.60
Rainfall data for year 2		
72.50	6	0.72
Rainfall data for year 2		
72.50	24	1.29
Rainfall data for year 100		

```
            72.50            1           1.07
------------------------------------------------------------------------
Rainfall data for year 100
            72.50            6           1.98
------------------------------------------------------------------------
Rainfall data for year 100
            72.50           24           3.38
------------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 2)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 67.0      67.0         72.50      1.000     0.578    1.000    0.578

Area-averaged adjusted loss rate Fm (In/Hr) =  0.578

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

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC2)           Yield Fr
    72.50   1.000         67.0      67.0       4.93     0.232

Area-averaged catchment yield fraction, Y =  0.232
Area-averaged low loss fraction, Yb =  0.768
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watercourse length =    2668.00(Ft.)
Length from concentration point to centroid =    1477.00(Ft.)
Elevation difference along watercourse =      38.00(Ft.)
Mannings friction factor along watercourse =  0.020
Watershed area =      72.50(Ac.)
Catchment Lag time =   0.100 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 82.9752
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.578(In/Hr)
Average low loss rate fraction (Yb) = 0.768 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.508(In)
Computed peak 30-minute rainfall =  0.869(In)
Specified peak 1-hour rainfall =  1.070(In)
Computed peak 3-hour rainfall =  1.561(In)
Specified peak 6-hour rainfall =  1.980(In)
Specified peak 24-hour rainfall =  3.380(In)


Rainfall depth area reduction factors:
Using a total area of      72.50(Ac.) (Ref: fig. E-4)
```

```
5-minute factor = 0.997     Adjusted rainfall =  0.506(In)
30-minute factor = 0.997    Adjusted rainfall =  0.866(In)
1-hour factor = 0.997       Adjusted rainfall =  1.066(In)
3-hour factor = 1.000       Adjusted rainfall =  1.560(In)
6-hour factor = 1.000       Adjusted rainfall =  1.980(In)
24-hour factor = 1.000      Adjusted rainfall =  3.380(In)
--------------------------------------------------------------------------

                        U n i t  H y d r o g r a p h
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph          Unit Hydrograph
Number            Mean values             ((CFS))
--------------------------------------------------------------------------
                (K =       876.80 (CFS))

  1               11.660                 102.232
  2               59.142                 416.320
  3               78.913                 173.356
  4               87.744                  77.424
  5               92.655                  43.064
  6               95.706                  26.749
  7               97.562                  16.274
  8               98.572                   8.857
  9               99.488                   8.027
 10              100.000                   4.492
--------------------------------------------------------------------------
--------------------------------------------------------------------------
--------------------------------------------------------------------------
Total soil rain loss =      2.20(In)
Total effective rainfall =      1.18(In)
Peak flow rate in flood hydrograph =    207.69(CFS)
--------------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                     24 - H O U R    S T O R M
                R u n o f f      H y d r o g r a p h
--------------------------------------------------------------------------
             Hydrograph in   5   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0       75.0     150.0     225.0     300.0
-----------------------------------------------------------------------
  0+ 5       0.0007      0.11  Q         |         |         |         |
  0+10       0.0045      0.55  Q         |         |         |         |
  0+15       0.0095      0.73  Q         |         |         |         |
  0+20       0.0151      0.81  Q         |         |         |         |
  0+25       0.0210      0.86  Q         |         |         |         |
  0+30       0.0272      0.89  Q         |         |         |         |
  0+35       0.0334      0.91  Q         |         |         |         |
  0+40       0.0398      0.92  Q         |         |         |         |
```

0+45	0.0462	0.93	Q	|	|	|	|
0+50	0.0527	0.94	Q	|	|	|	|
0+55	0.0593	0.95	Q	|	|	|	|
1+ 0	0.0658	0.95	Q	|	|	|	|
1+ 5	0.0723	0.95	Q	|	|	|	|
1+10	0.0789	0.96	Q	|	|	|	|
1+15	0.0855	0.96	Q	|	|	|	|
1+20	0.0922	0.96	Q	|	|	|	|
1+25	0.0988	0.97	Q	|	|	|	|
1+30	0.1055	0.97	Q	|	|	|	|
1+35	0.1122	0.97	Q	|	|	|	|
1+40	0.1189	0.98	Q	|	|	|	|
1+45	0.1256	0.98	Q	|	|	|	|
1+50	0.1324	0.98	Q	|	|	|	|
1+55	0.1392	0.99	Q	|	|	|	|
2+ 0	0.1460	0.99	Q	|	|	|	|
2+ 5	0.1529	0.99	Q	|	|	|	|
2+10	0.1597	1.00	Q	|	|	|	|
2+15	0.1666	1.00	Q	|	|	|	|
2+20	0.1735	1.00	Q	|	|	|	|
2+25	0.1805	1.01	QV	|	|	|	|
2+30	0.1874	1.01	QV	|	|	|	|
2+35	0.1944	1.02	QV	|	|	|	|
2+40	0.2014	1.02	QV	|	|	|	|
2+45	0.2085	1.02	QV	|	|	|	|
2+50	0.2156	1.03	QV	|	|	|	|
2+55	0.2227	1.03	QV	|	|	|	|
3+ 0	0.2298	1.04	QV	|	|	|	|
3+ 5	0.2369	1.04	QV	|	|	|	|
3+10	0.2441	1.04	QV	|	|	|	|
3+15	0.2513	1.05	QV	|	|	|	|
3+20	0.2586	1.05	QV	|	|	|	|
3+25	0.2659	1.06	QV	|	|	|	|
3+30	0.2732	1.06	QV	|	|	|	|
3+35	0.2805	1.06	QV	|	|	|	|
3+40	0.2878	1.07	QV	|	|	|	|
3+45	0.2952	1.07	QV	|	|	|	|
3+50	0.3026	1.08	QV	|	|	|	|
3+55	0.3101	1.08	QV	|	|	|	|
4+ 0	0.3176	1.09	QV	|	|	|	|
4+ 5	0.3251	1.09	QV	|	|	|	|
4+10	0.3326	1.10	QV	|	|	|	|
4+15	0.3402	1.10	QV	|	|	|	|
4+20	0.3478	1.10	QV	|	|	|	|
4+25	0.3555	1.11	QV	|	|	|	|
4+30	0.3631	1.11	Q V	|	|	|	|
4+35	0.3708	1.12	Q V	|	|	|	|
4+40	0.3786	1.12	Q V	|	|	|	|
4+45	0.3864	1.13	Q V	|	|	|	|
4+50	0.3942	1.13	Q V	|	|	|	|

```
4+55       0.4020      1.14  Q V       |          |          |          |
5+ 0       0.4099      1.14  Q V       |          |          |          |
5+ 5       0.4178      1.15  Q V       |          |          |          |
5+10       0.4258      1.16  Q V       |          |          |          |
5+15       0.4338      1.16  Q V       |          |          |          |
5+20       0.4418      1.17  Q V       |          |          |          |
5+25       0.4499      1.17  Q V       |          |          |          |
5+30       0.4580      1.18  Q V       |          |          |          |
5+35       0.4661      1.18  Q V       |          |          |          |
5+40       0.4743      1.19  Q V       |          |          |          |
5+45       0.4825      1.19  Q V       |          |          |          |
5+50       0.4908      1.20  Q V       |          |          |          |
5+55       0.4991      1.21  Q V       |          |          |          |
6+ 0       0.5075      1.21  Q V       |          |          |          |
6+ 5       0.5158      1.22  Q V       |          |          |          |
6+10       0.5243      1.22  Q V       |          |          |          |
6+15       0.5328      1.23  Q V       |          |          |          |
6+20       0.5413      1.24  Q  V      |          |          |          |
6+25       0.5498      1.24  Q  V      |          |          |          |
6+30       0.5585      1.25  Q  V      |          |          |          |
6+35       0.5671      1.26  Q  V      |          |          |          |
6+40       0.5758      1.26  Q  V      |          |          |          |
6+45       0.5846      1.27  Q  V      |          |          |          |
6+50       0.5934      1.28  Q  V      |          |          |          |
6+55       0.6022      1.28  Q  V      |          |          |          |
7+ 0       0.6111      1.29  Q  V      |          |          |          |
7+ 5       0.6200      1.30  Q  V      |          |          |          |
7+10       0.6290      1.31  Q  V      |          |          |          |
7+15       0.6381      1.31  Q  V      |          |          |          |
7+20       0.6472      1.32  Q  V      |          |          |          |
7+25       0.6563      1.33  Q  V      |          |          |          |
7+30       0.6655      1.34  Q  V      |          |          |          |
7+35       0.6748      1.34  Q  V      |          |          |          |
7+40       0.6841      1.35  Q  V      |          |          |          |
7+45       0.6935      1.36  Q  V      |          |          |          |
7+50       0.7029      1.37  Q  V      |          |          |          |
7+55       0.7124      1.38  Q  V      |          |          |          |
8+ 0       0.7219      1.39  Q   V     |          |          |          |
8+ 5       0.7315      1.39  Q   V     |          |          |          |
8+10       0.7412      1.40  Q   V     |          |          |          |
8+15       0.7509      1.41  Q   V     |          |          |          |
8+20       0.7607      1.42  Q   V     |          |          |          |
8+25       0.7706      1.43  Q   V     |          |          |          |
8+30       0.7805      1.44  Q   V     |          |          |          |
8+35       0.7905      1.45  Q   V     |          |          |          |
8+40       0.8005      1.46  Q   V     |          |          |          |
8+45       0.8107      1.47  Q   V     |          |          |          |
8+50       0.8208      1.48  Q   V     |          |          |          |
8+55       0.8311      1.49  Q   V     |          |          |          |
9+ 0       0.8414      1.50  Q   V     |          |          |          |
```

```
 9+ 5       0.8519      1.51  Q   V     |          |          |          |
 9+10       0.8623      1.52  Q   V     |          |          |          |
 9+15       0.8729      1.53  Q   V     |          |          |          |
 9+20       0.8835      1.55  Q   V     |          |          |          |
 9+25       0.8943      1.56  Q    V    |          |          |          |
 9+30       0.9051      1.57  Q    V    |          |          |          |
 9+35       0.9160      1.58  Q    V    |          |          |          |
 9+40       0.9269      1.59  Q    V    |          |          |          |
 9+45       0.9380      1.61  Q    V    |          |          |          |
 9+50       0.9491      1.62  Q    V    |          |          |          |
 9+55       0.9604      1.63  Q    V    |          |          |          |
10+ 0       0.9717      1.65  Q    V    |          |          |          |
10+ 5       0.9831      1.66  Q    V    |          |          |          |
10+10       0.9946      1.67  Q    V    |          |          |          |
10+15       1.0062      1.69  Q    V    |          |          |          |
10+20       1.0180      1.70  Q    V    |          |          |          |
10+25       1.0298      1.72  Q    V    |          |          |          |
10+30       1.0417      1.73  Q    V    |          |          |          |
10+35       1.0537      1.75  Q    V    |          |          |          |
10+40       1.0659      1.76  Q    V    |          |          |          |
10+45       1.0782      1.78  Q     V   |          |          |          |
10+50       1.0905      1.80  Q     V   |          |          |          |
10+55       1.1030      1.81  Q     V   |          |          |          |
11+ 0       1.1156      1.83  Q     V   |          |          |          |
11+ 5       1.1284      1.85  Q     V   |          |          |          |
11+10       1.1413      1.87  Q     V   |          |          |          |
11+15       1.1543      1.89  Q     V   |          |          |          |
11+20       1.1674      1.91  Q     V   |          |          |          |
11+25       1.1807      1.93  Q     V   |          |          |          |
11+30       1.1941      1.95  Q     V   |          |          |          |
11+35       1.2077      1.97  Q     V   |          |          |          |
11+40       1.2214      1.99  Q     V   |          |          |          |
11+45       1.2353      2.01  Q     V   |          |          |          |
11+50       1.2493      2.04  Q      V  |          |          |          |
11+55       1.2635      2.06  Q      V  |          |          |          |
12+ 0       1.2779      2.09  Q      V  |          |          |          |
12+ 5       1.2923      2.09  Q      V  |          |          |          |
12+10       1.3061      2.00  Q      V  |          |          |          |
12+15       1.3197      1.98  Q      V  |          |          |          |
12+20       1.3334      1.99  Q      V  |          |          |          |
12+25       1.3472      2.00  Q      V  |          |          |          |
12+30       1.3612      2.03  Q      V  |          |          |          |
12+35       1.3753      2.05  Q      V  |          |          |          |
12+40       1.3896      2.08  Q      V  |          |          |          |
12+45       1.4042      2.11  Q      V  |          |          |          |
12+50       1.4190      2.15  Q      V  |          |          |          |
12+55       1.4340      2.18  Q       V |          |          |          |
13+ 0       1.4493      2.22  Q       V |          |          |          |
13+ 5       1.4648      2.25  Q       V |          |          |          |
13+10       1.4806      2.30  Q       V |          |          |          |
```

```
13+15       1.4967      2.34  Q       V |         |         |         |
13+20       1.5131      2.38  Q       V |         |         |         |
13+25       1.5299      2.43  Q       V |         |         |         |
13+30       1.5469      2.48  Q       V |         |         |         |
13+35       1.5644      2.53  Q       V |         |         |         |
13+40       1.5822      2.59  Q       V |         |         |         |
13+45       1.6003      2.64  Q       V |         |         |         |
13+50       1.6190      2.70  Q        V|         |         |         |
13+55       1.6380      2.76  Q        V|         |         |         |
14+ 0       1.6575      2.84  Q        V|         |         |         |
14+ 5       1.6775      2.91  Q        V|         |         |         |
14+10       1.6982      3.00  Q        V|         |         |         |
14+15       1.7194      3.08  Q        V|         |         |         |
14+20       1.7413      3.18  Q        V|         |         |         |
14+25       1.7638      3.27  Q        V|         |         |         |
14+30       1.7871      3.38  Q         V         |         |         |
14+35       1.8111      3.48  Q         V         |         |         |
14+40       1.8360      3.62  Q         V         |         |         |
14+45       1.8618      3.74  Q         V         |         |         |
14+50       1.8886      3.90  Q         V         |         |         |
14+55       1.9165      4.05  Q         V         |         |         |
15+ 0       1.9458      4.25  Q         V         |         |         |
15+ 5       1.9764      4.44  Q         |V        |         |         |
15+10       2.0086      4.69  Q         |V        |         |         |
15+15       2.0426      4.93  Q         |V        |         |         |
15+20       2.0789      5.26  Q         |V        |         |         |
15+25       2.1167      5.50  Q         |V        |         |         |
15+30       2.1551      5.56  Q         | V       |         |         |
15+35       2.1955      5.87  Q         | V       |         |         |
15+40       2.2402      6.49  Q         | V       |         |         |
15+45       2.2900      7.23  Q         | V       |         |         |
15+50       2.3486      8.50  |Q        |  V      |         |         |
15+55       2.4292     11.71  |Q        |  V      |         |         |
16+ 0       2.5966     24.30  |  Q      |   V     |         |         |
16+ 5       3.1680     82.96  |         |Q     V  |         |         |
16+10       4.5983    207.69  |         |         |     V Q |         |
16+15       5.2461     94.06  |         | Q       |        V|         |
16+20       5.5699     47.01  |     Q   |         |         |V        |
16+25       5.7688     28.88  |  Q      |         |         | V       |
16+30       5.9063     19.96  | Q       |         |         |  V      |
16+35       6.0029     14.02  |Q        |         |         |  V      |
16+40       6.0709      9.89  |Q        |         |         |   V     |
16+45       6.1305      8.65  |Q        |         |         |   V     |
16+50       6.1744      6.37  Q         |         |         |   V     |
16+55       6.2019      3.99  Q         |         |         |   V     |
17+ 0       6.2271      3.67  Q         |         |         |   V     |
17+ 5       6.2506      3.41  Q         |         |         |    V    |
17+10       6.2726      3.19  Q         |         |         |    V    |
17+15       6.2934      3.01  Q         |         |         |    V    |
17+20       6.3130      2.85  Q         |         |         |    V    |
```

```
17+25       6.3317      2.71  Q         |          |          |    V     |
17+30       6.3495      2.59  Q         |          |          |    V     |
17+35       6.3667      2.48  Q         |          |          |    V     |
17+40       6.3831      2.39  Q         |          |          |    V     |
17+45       6.3989      2.30  Q         |          |          |    V     |
17+50       6.4142      2.22  Q         |          |          |     V    |
17+55       6.4290      2.15  Q         |          |          |     V    |
18+ 0       6.4433      2.08  Q         |          |          |     V    |
18+ 5       6.4574      2.05  Q         |          |          |     V    |
18+10       6.4719      2.10  Q         |          |          |     V    |
18+15       6.4863      2.09  Q         |          |          |     V    |
18+20       6.5005      2.06  Q         |          |          |     V    |
18+25       6.5144      2.02  Q         |          |          |     V    |
18+30       6.5280      1.98  Q         |          |          |     V    |
18+35       6.5414      1.94  Q         |          |          |     V    |
18+40       6.5545      1.90  Q         |          |          |     V    |
18+45       6.5674      1.87  Q         |          |          |     V    |
18+50       6.5800      1.83  Q         |          |          |     V    |
18+55       6.5924      1.80  Q         |          |          |      V   |
19+ 0       6.6045      1.76  Q         |          |          |      V   |
19+ 5       6.6164      1.73  Q         |          |          |      V   |
19+10       6.6281      1.70  Q         |          |          |      V   |
19+15       6.6397      1.67  Q         |          |          |      V   |
19+20       6.6510      1.64  Q         |          |          |      V   |
19+25       6.6621      1.62  Q         |          |          |      V   |
19+30       6.6731      1.59  Q         |          |          |      V   |
19+35       6.6839      1.57  Q         |          |          |      V   |
19+40       6.6945      1.54  Q         |          |          |      V   |
19+45       6.7050      1.52  Q         |          |          |      V   |
19+50       6.7153      1.50  Q         |          |          |      V   |
19+55       6.7255      1.48  Q         |          |          |      V   |
20+ 0       6.7356      1.46  Q         |          |          |      V   |
20+ 5       6.7455      1.44  Q         |          |          |      V   |
20+10       6.7553      1.42  Q         |          |          |      V   |
20+15       6.7649      1.40  Q         |          |          |      V   |
20+20       6.7745      1.39  Q         |          |          |       V  |
20+25       6.7839      1.37  Q         |          |          |       V  |
20+30       6.7932      1.35  Q         |          |          |       V  |
20+35       6.8024      1.34  Q         |          |          |       V  |
20+40       6.8115      1.32  Q         |          |          |       V  |
20+45       6.8205      1.31  Q         |          |          |       V  |
20+50       6.8294      1.29  Q         |          |          |       V  |
20+55       6.8382      1.28  Q         |          |          |       V  |
21+ 0       6.8469      1.26  Q         |          |          |       V  |
21+ 5       6.8555      1.25  Q         |          |          |       V  |
21+10       6.8640      1.24  Q         |          |          |       V  |
21+15       6.8724      1.22  Q         |          |          |       V  |
21+20       6.8808      1.21  Q         |          |          |       V  |
21+25       6.8890      1.20  Q         |          |          |       V  |
21+30       6.8972      1.19  Q         |          |          |       V  |
```

```
   21+35       6.9053      1.18  Q          |          |          |        V |
   21+40       6.9133      1.17  Q          |          |          |        V |
   21+45       6.9213      1.15  Q          |          |          |        V |
   21+50       6.9292      1.14  Q          |          |          |        V |
   21+55       6.9370      1.13  Q          |          |          |        V |
   22+ 0       6.9447      1.12  Q          |          |          |        V |
   22+ 5       6.9524      1.11  Q          |          |          |         V|
   22+10       6.9600      1.10  Q          |          |          |         V|
   22+15       6.9675      1.09  Q          |          |          |         V|
   22+20       6.9750      1.09  Q          |          |          |         V|
   22+25       6.9824      1.08  Q          |          |          |         V|
   22+30       6.9898      1.07  Q          |          |          |         V|
   22+35       6.9971      1.06  Q          |          |          |         V|
   22+40       7.0043      1.05  Q          |          |          |         V|
   22+45       7.0115      1.04  Q          |          |          |         V|
   22+50       7.0186      1.03  Q          |          |          |         V|
   22+55       7.0257      1.03  Q          |          |          |         V|
   23+ 0       7.0327      1.02  Q          |          |          |         V|
   23+ 5       7.0397      1.01  Q          |          |          |         V|
   23+10       7.0466      1.00  Q          |          |          |         V|
   23+15       7.0535      1.00  Q          |          |          |         V|
   23+20       7.0603      0.99  Q          |          |          |         V|
   23+25       7.0670      0.98  Q          |          |          |         V|
   23+30       7.0737      0.98  Q          |          |          |         V|
   23+35       7.0804      0.97  Q          |          |          |         V|
   23+40       7.0870      0.96  Q          |          |          |         V|
   23+45       7.0936      0.96  Q          |          |          |         V|
   23+50       7.1002      0.95  Q          |          |          |         V|
   23+55       7.1066      0.94  Q          |          |          |         V|
   24+ 0       7.1131      0.94  Q          |          |          |         V|
   24+ 5       7.1188      0.82  Q          |          |          |         V|
   24+10       7.1214      0.38  Q          |          |          |         V|
   24+15       7.1227      0.20  Q          |          |          |         V|
   24+20       7.1235      0.11  Q          |          |          |         V|
   24+25       7.1240      0.07  Q          |          |          |         V|
   24+30       7.1243      0.04  Q          |          |          |         V|
   24+35       7.1244      0.02  Q          |          |          |         V|
   24+40       7.1245      0.01  Q          |          |          |         V|
   24+45       7.1246      0.00  Q          |          |          |          V
-------------------------------------------------------------------------
```

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

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Study date 02/23/23

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

Program License Serial Number 5006

APPLE MGA - JOB 3675.007
ON-SITE DEVELOPED STORM RUNOFF
100-YEAR STORM EVENT - AMC II

Storm Event Year = 100

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
72.50	1	0.60
Rainfall data for year 2		
72.50	6	0.75
Rainfall data for year 2		
72.50	24	1.29

Rainfall data for year 100

```
            72.50            1           1.07
------------------------------------------------------------------------
Rainfall data for year 100
            72.50            6           1.98
------------------------------------------------------------------------
Rainfall data for year 100
            72.50           24           3.38
------------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 2)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      32.0         72.50      1.000     0.978    0.100    0.098

Area-averaged adjusted loss rate Fm (In/Hr) =  0.098

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

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC2)           Yield Fr
     7.25   0.100         32.0      32.0      16.90     0.000
    65.25   0.900         98.0      98.0       0.20     0.931

Area-averaged catchment yield fraction, Y =  0.838
Area-averaged low loss fraction, Yb =  0.162
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watercourse length =    3482.00(Ft.)
Length from concentration point to centroid =    1400.00(Ft.)
Elevation difference along watercourse =      39.00(Ft.)
Mannings friction factor along watercourse =  0.015
Watershed area =      72.50(Ac.)
Catchment Lag time =   0.085 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 97.4877
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.098(In/Hr)
Average low loss rate fraction (Yb) = 0.162 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall =  0.508(In)
Computed peak 30-minute rainfall =  0.869(In)
Specified peak 1-hour rainfall =  1.070(In)
Computed peak 3-hour rainfall =  1.561(In)
Specified peak 6-hour rainfall =  1.980(In)
Specified peak 24-hour rainfall =  3.380(In)


Rainfall depth area reduction factors:
```

```
Using a total area of      72.50(Ac.) (Ref: fig. E-4)

5-minute factor = 0.997     Adjusted rainfall =  0.506(In)
30-minute factor = 0.997    Adjusted rainfall =  0.866(In)
1-hour factor = 0.997       Adjusted rainfall =  1.066(In)
3-hour factor = 1.000       Adjusted rainfall =  1.560(In)
6-hour factor = 1.000       Adjusted rainfall =  1.980(In)
24-hour factor = 1.000      Adjusted rainfall =  3.380(In)
-------------------------------------------------------------------------

                        U n i t  H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph          Unit Hydrograph
Number            Mean values             ((CFS))
-------------------------------------------------------------------------
                (K =       876.80 (CFS))

  1                16.414                143.917
  2                66.154                436.116
  3                83.370                150.953
  4                91.010                 66.987
  5                95.153                 36.325
  6                97.495                 20.533
  7                98.706                 10.623
  8                99.686                  8.586
  9               100.000                  2.757
-------------------------------------------------------------------------
-------------------------------------------------------------------------
-------------------------------------------------------------------------
Total soil rain loss =      0.46(In)
Total effective rainfall =      2.92(In)
Peak flow rate in flood hydrograph =    249.42(CFS)
-------------------------------------------------------------------------
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                     24 - H O U R    S T O R M
                  R u n o f f      H y d r o g r a p h
-------------------------------------------------------------------------
              Hydrograph in   5   Minute intervals ((CFS))

     -------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0       75.0     150.0     225.0     300.0
-------------------------------------------------------------------------
  0+ 5       0.0038      0.55  Q         |         |         |         |
  0+10       0.0189      2.20  Q         |         |         |         |
  0+15       0.0381      2.78  Q         |         |         |         |
  0+20       0.0591      3.05  Q         |         |         |         |
  0+25       0.0811      3.19  Q         |         |         |         |
  0+30       0.1037      3.28  Q         |         |         |         |
  0+35       0.1267      3.33  Q         |         |         |         |
  0+40       0.1499      3.38  Q         |         |         |         |
```

0+45	0.1734	3.40	Q				
0+50	0.1969	3.41	Q				
0+55	0.2204	3.42	Q				
1+ 0	0.2441	3.43	Q				
1+ 5	0.2678	3.45	Q				
1+10	0.2916	3.46	Q				
1+15	0.3155	3.47	Q				
1+20	0.3395	3.48	Q				
1+25	0.3635	3.49	Q				
1+30	0.3877	3.51	Q				
1+35	0.4119	3.52	Q				
1+40	0.4362	3.53	Q				
1+45	0.4606	3.54	QV				
1+50	0.4851	3.56	QV				
1+55	0.5096	3.57	QV				
2+ 0	0.5343	3.58	QV				
2+ 5	0.5591	3.59	QV				
2+10	0.5839	3.61	QV				
2+15	0.6088	3.62	QV				
2+20	0.6338	3.63	QV				
2+25	0.6590	3.65	QV				
2+30	0.6842	3.66	QV				
2+35	0.7095	3.67	QV				
2+40	0.7349	3.69	QV				
2+45	0.7604	3.70	QV				
2+50	0.7860	3.72	QV				
2+55	0.8116	3.73	QV				
3+ 0	0.8374	3.75	QV				
3+ 5	0.8633	3.76	QV				
3+10	0.8893	3.77	Q V				
3+15	0.9154	3.79	Q V				
3+20	0.9416	3.80	Q V				
3+25	0.9679	3.82	Q V				
3+30	0.9943	3.84	Q V				
3+35	1.0208	3.85	Q V				
3+40	1.0475	3.87	Q V				
3+45	1.0742	3.88	Q V				
3+50	1.1010	3.90	Q V				
3+55	1.1280	3.91	Q V				
4+ 0	1.1551	3.93	Q V				
4+ 5	1.1822	3.95	Q V				
4+10	1.2096	3.96	Q V				
4+15	1.2370	3.98	Q V				
4+20	1.2645	4.00	Q V				
4+25	1.2922	4.01	Q V				
4+30	1.3199	4.03	Q V				
4+35	1.3478	4.05	Q V				
4+40	1.3758	4.07	Q V				
4+45	1.4040	4.09	Q V				
4+50	1.4323	4.11	Q V				

```
4+55       1.4607      4.12  Q  V      |          |          |          |
5+ 0       1.4892      4.14  Q  V      |          |          |          |
5+ 5       1.5178      4.16  Q  V      |          |          |          |
5+10       1.5466      4.18  Q  V      |          |          |          |
5+15       1.5756      4.20  Q  V      |          |          |          |
5+20       1.6046      4.22  Q  V      |          |          |          |
5+25       1.6338      4.24  Q  V      |          |          |          |
5+30       1.6632      4.26  Q  V      |          |          |          |
5+35       1.6927      4.28  Q  V      |          |          |          |
5+40       1.7223      4.30  Q  V      |          |          |          |
5+45       1.7521      4.32  Q  V      |          |          |          |
5+50       1.7820      4.34  Q   V     |          |          |          |
5+55       1.8120      4.36  Q   V     |          |          |          |
6+ 0       1.8423      4.39  Q   V     |          |          |          |
6+ 5       1.8726      4.41  Q   V     |          |          |          |
6+10       1.9032      4.43  Q   V     |          |          |          |
6+15       1.9338      4.45  Q   V     |          |          |          |
6+20       1.9647      4.48  Q   V     |          |          |          |
6+25       1.9957      4.50  Q   V     |          |          |          |
6+30       2.0269      4.53  Q   V     |          |          |          |
6+35       2.0582      4.55  Q   V     |          |          |          |
6+40       2.0897      4.57  Q   V     |          |          |          |
6+45       2.1213      4.60  Q   V     |          |          |          |
6+50       2.1532      4.62  Q   V     |          |          |          |
6+55       2.1852      4.65  Q   V     |          |          |          |
7+ 0       2.2174      4.68  Q    V    |          |          |          |
7+ 5       2.2498      4.70  Q    V    |          |          |          |
7+10       2.2823      4.73  Q    V    |          |          |          |
7+15       2.3151      4.75  Q    V    |          |          |          |
7+20       2.3480      4.78  Q    V    |          |          |          |
7+25       2.3811      4.81  Q    V    |          |          |          |
7+30       2.4145      4.84  Q    V    |          |          |          |
7+35       2.4480      4.87  Q    V    |          |          |          |
7+40       2.4817      4.90  Q    V    |          |          |          |
7+45       2.5156      4.92  Q    V    |          |          |          |
7+50       2.5498      4.96  Q    V    |          |          |          |
7+55       2.5841      4.99  Q    V    |          |          |          |
8+ 0       2.6187      5.02  Q    V    |          |          |          |
8+ 5       2.6534      5.05  Q     V   |          |          |          |
8+10       2.6884      5.08  Q     V   |          |          |          |
8+15       2.7236      5.11  Q     V   |          |          |          |
8+20       2.7591      5.15  Q     V   |          |          |          |
8+25       2.7948      5.18  Q     V   |          |          |          |
8+30       2.8307      5.22  Q     V   |          |          |          |
8+35       2.8668      5.25  Q     V   |          |          |          |
8+40       2.9032      5.29  Q     V   |          |          |          |
8+45       2.9399      5.32  Q     V   |          |          |          |
8+50       2.9768      5.36  Q     V   |          |          |          |
8+55       3.0140      5.40  Q     V   |          |          |          |
9+ 0       3.0514      5.44  Q     V   |          |          |          |
```

```
 9+ 5       3.0891      5.47  Q     V   |          |          |          |
 9+10       3.1271      5.52  Q      V  |          |          |          |
 9+15       3.1653      5.55  Q      V  |          |          |          |
 9+20       3.2039      5.60  Q      V  |          |          |          |
 9+25       3.2427      5.64  Q      V  |          |          |          |
 9+30       3.2818      5.68  Q      V  |          |          |          |
 9+35       3.3212      5.72  Q      V  |          |          |          |
 9+40       3.3610      5.77  Q      V  |          |          |          |
 9+45       3.4010      5.81  Q      V  |          |          |          |
 9+50       3.4414      5.86  Q      V  |          |          |          |
 9+55       3.4821      5.91  Q      V  |          |          |          |
10+ 0       3.5231      5.96  Q      V  |          |          |          |
10+ 5       3.5645      6.01  Q       V |          |          |          |
10+10       3.6062      6.06  Q       V |          |          |          |
10+15       3.6483      6.11  Q       V |          |          |          |
10+20       3.6908      6.17  Q       V |          |          |          |
10+25       3.7336      6.22  Q       V |          |          |          |
10+30       3.7768      6.28  Q       V |          |          |          |
10+35       3.8204      6.33  Q       V |          |          |          |
10+40       3.8644      6.39  Q       V |          |          |          |
10+45       3.9088      6.45  Q       V |          |          |          |
10+50       3.9537      6.51  Q       V |          |          |          |
10+55       3.9990      6.57  Q        V|          |          |          |
11+ 0       4.0447      6.64  Q        V|          |          |          |
11+ 5       4.0909      6.70  Q        V|          |          |          |
11+10       4.1375      6.78  Q        V|          |          |          |
11+15       4.1846      6.84  Q        V|          |          |          |
11+20       4.2323      6.92  Q        V|          |          |          |
11+25       4.2804      6.99  Q        V|          |          |          |
11+30       4.3291      7.07  Q        V|          |          |          |
11+35       4.3782      7.14  Q        V|          |          |          |
11+40       4.4280      7.23  Q         V          |          |          |
11+45       4.4783      7.30  Q         V          |          |          |
11+50       4.5292      7.40  Q         V          |          |          |
11+55       4.5807      7.48  Q         V          |          |          |
12+ 0       4.6329      7.57  |Q        V          |          |          |
12+ 5       4.6847      7.52  |Q        V          |          |          |
12+10       4.7343      7.20  Q         V          |          |          |
12+15       4.7835      7.15  Q         V          |          |          |
12+20       4.8330      7.19  Q         V          |          |          |
12+25       4.8829      7.25  Q         |V         |          |          |
12+30       4.9335      7.34  Q         |V         |          |          |
12+35       4.9847      7.43  Q         |V         |          |          |
12+40       5.0367      7.55  |Q        |V         |          |          |
12+45       5.0894      7.66  |Q        |V         |          |          |
12+50       5.1431      7.79  |Q        |V         |          |          |
12+55       5.1976      7.91  |Q        |V         |          |          |
13+ 0       5.2531      8.06  |Q        |V         |          |          |
13+ 5       5.3094      8.19  |Q        | V        |          |          |
13+10       5.3669      8.35  |Q        | V        |          |          |
```

13+15	5.4254	8.49	Q	V			
13+20	5.4850	8.66	Q	V			
13+25	5.5458	8.82	Q	V			
13+30	5.6078	9.01	Q	V			
13+35	5.6711	9.19	Q	V			
13+40	5.7358	9.40	Q	V			
13+45	5.8019	9.59	Q	V			
13+50	5.8696	9.83	Q	V			
13+55	5.9388	10.05	Q	V			
14+ 0	6.0098	10.32	Q	V			
14+ 5	6.0827	10.58	Q	V			
14+10	6.1579	10.92	Q	V			
14+15	6.2351	11.22	Q	V			
14+20	6.3148	11.57	Q	V			
14+25	6.3968	11.90	Q	V			
14+30	6.4816	12.32	Q	V			
14+35	6.5691	12.70	Q	V			
14+40	6.6599	13.19	Q	V			
14+45	6.7539	13.65	Q	V			
14+50	6.8520	14.23	Q	V			
14+55	6.9539	14.80	Q	V			
15+ 0	7.0607	15.52	Q	V			
15+ 5	7.1725	16.23	Q	V			
15+10	7.2906	17.15	Q	V			
15+15	7.4151	18.07	Q	V			
15+20	7.5480	19.30	Q	V			
15+25	7.6862	20.07	Q	V			
15+30	7.8259	20.28	Q	V			
15+35	7.9743	21.55	Q	V			
15+40	8.1390	23.91	Q	V			
15+45	8.3239	26.85	Q	V			
15+50	8.5428	31.78	Q	V			
15+55	8.8182	39.99	Q	V			
16+ 0	9.2236	58.86	Q	V			
16+ 5	10.1579	135.67	Q	V			
16+10	11.8757	249.42	Q	V			
16+15	12.6732	115.80	Q	V			
16+20	13.1332	66.80	Q	V			
16+25	13.4470	45.56	Q	V			
16+30	13.6846	34.49	Q	V			
16+35	13.8682	26.67	Q	V			
16+40	14.0253	22.80	Q	V			
16+45	14.1497	18.06	Q	V			
16+50	14.2544	15.20	Q	V			
16+55	14.3502	13.91	Q	V			
17+ 0	14.4391	12.91	Q	V			
17+ 5	14.5221	12.06	Q	V			
17+10	14.6000	11.30	Q	V			
17+15	14.6735	10.68	Q	V			
17+20	14.7433	10.14	Q	V			

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17+25      14.8099      9.66  |Q        |         |         |  V      |
17+30      14.8735      9.24  |Q        |         |         |  V      |
17+35      14.9346      8.87  |Q        |         |         |  V      |
17+40      14.9934      8.53  |Q        |         |         |  V      |
17+45      15.0500      8.22  |Q        |         |         |   V     |
17+50      15.1047      7.94  |Q        |         |         |   V     |
17+55      15.1576      7.69  |Q        |         |         |   V     |
18+ 0      15.2089      7.45  Q         |         |         |   V     |
18+ 5      15.2597      7.37  Q         |         |         |   V     |
18+10      15.3120      7.59  |Q        |         |         |   V     |
18+15      15.3639      7.54  |Q        |         |         |   V     |
18+20      15.4149      7.42  Q         |         |         |   V     |
18+25      15.4651      7.28  Q         |         |         |    V    |
18+30      15.5142      7.13  Q         |         |         |    V    |
18+35      15.5623      6.99  Q         |         |         |    V    |
18+40      15.6095      6.85  Q         |         |         |    V    |
18+45      15.6558      6.71  Q         |         |         |    V    |
18+50      15.7011      6.58  Q         |         |         |    V    |
18+55      15.7456      6.46  Q         |         |         |    V    |
19+ 0      15.7892      6.34  Q         |         |         |    V    |
19+ 5      15.8321      6.23  Q         |         |         |    V    |
19+10      15.8742      6.12  Q         |         |         |    V    |
19+15      15.9157      6.01  Q         |         |         |     V   |
19+20      15.9564      5.92  Q         |         |         |     V   |
19+25      15.9965      5.82  Q         |         |         |     V   |
19+30      16.0360      5.73  Q         |         |         |     V   |
19+35      16.0748      5.64  Q         |         |         |     V   |
19+40      16.1131      5.56  Q         |         |         |     V   |
19+45      16.1508      5.48  Q         |         |         |     V   |
19+50      16.1880      5.40  Q         |         |         |     V   |
19+55      16.2247      5.33  Q         |         |         |     V   |
20+ 0      16.2609      5.25  Q         |         |         |     V   |
20+ 5      16.2966      5.18  Q         |         |         |     V   |
20+10      16.3319      5.12  Q         |         |         |     V   |
20+15      16.3667      5.05  Q         |         |         |      V  |
20+20      16.4010      4.99  Q         |         |         |      V  |
20+25      16.4350      4.93  Q         |         |         |      V  |
20+30      16.4685      4.87  Q         |         |         |      V  |
20+35      16.5017      4.81  Q         |         |         |      V  |
20+40      16.5344      4.76  Q         |         |         |      V  |
20+45      16.5668      4.70  Q         |         |         |      V  |
20+50      16.5989      4.65  Q         |         |         |      V  |
20+55      16.6305      4.60  Q         |         |         |      V  |
21+ 0      16.6619      4.55  Q         |         |         |      V  |
21+ 5      16.6929      4.50  Q         |         |         |      V  |
21+10      16.7236      4.46  Q         |         |         |      V  |
21+15      16.7540      4.41  Q         |         |         |      V  |
21+20      16.7841      4.37  Q         |         |         |       V |
21+25      16.8139      4.32  Q         |         |         |       V |
21+30      16.8434      4.28  Q         |         |         |       V |
```

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   21+35      16.8726      4.24  Q          |          |          |        V |
   21+40      16.9015      4.20  Q          |          |          |        V |
   21+45      16.9302      4.16  Q          |          |          |        V |
   21+50      16.9586      4.13  Q          |          |          |        V |
   21+55      16.9868      4.09  Q          |          |          |        V |
   22+ 0      17.0147      4.05  Q          |          |          |        V |
   22+ 5      17.0423      4.02  Q          |          |          |        V |
   22+10      17.0698      3.98  Q          |          |          |        V |
   22+15      17.0969      3.95  Q          |          |          |        V |
   22+20      17.1239      3.92  Q          |          |          |        V |
   22+25      17.1507      3.88  Q          |          |          |        V |
   22+30      17.1772      3.85  Q          |          |          |        V |
   22+35      17.2035      3.82  Q          |          |          |        V |
   22+40      17.2296      3.79  Q          |          |          |         V|
   22+45      17.2555      3.76  Q          |          |          |         V|
   22+50      17.2812      3.73  Q          |          |          |         V|
   22+55      17.3067      3.70  Q          |          |          |         V|
   23+ 0      17.3320      3.68  Q          |          |          |         V|
   23+ 5      17.3571      3.65  Q          |          |          |         V|
   23+10      17.3821      3.62  Q          |          |          |         V|
   23+15      17.4068      3.59  Q          |          |          |         V|
   23+20      17.4314      3.57  Q          |          |          |         V|
   23+25      17.4558      3.54  Q          |          |          |         V|
   23+30      17.4800      3.52  Q          |          |          |         V|
   23+35      17.5041      3.49  Q          |          |          |         V|
   23+40      17.5280      3.47  Q          |          |          |         V|
   23+45      17.5517      3.45  Q          |          |          |         V|
   23+50      17.5753      3.42  Q          |          |          |         V|
   23+55      17.5987      3.40  Q          |          |          |         V|
   24+ 0      17.6220      3.38  Q          |          |          |         V|
   24+ 5      17.6414      2.81  Q          |          |          |         V|
   24+10      17.6492      1.14  Q          |          |          |         V|
   24+15      17.6531      0.56  Q          |          |          |         V|
   24+20      17.6552      0.30  Q          |          |          |         V|
   24+25      17.6563      0.16  Q          |          |          |         V|
   24+30      17.6569      0.08  Q          |          |          |         V|
   24+35      17.6572      0.04  Q          |          |          |         V|
   24+40      17.6572      0.01  Q          |          |          |         V|
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AP Investors Warehouse

Pressure Flow Calculations for Detention Basin Metered Flow Rate

project #3675.007

6/2/2023

Node No.	Flow (gpm)	Flow (cfs)	Dia. (in)	Dia. (ft)	Area of Pipe (sq ft)	Velocity (fps)	Fitting	k value	(v^2)/2g	Pipe Length	C value	Headloss feet	Headloss psi	Total psi
													Measured Pressure in Mainline	0.574
19	40,392	90.00	42	3.50	9.62	9.35			1.36	250.00	130	1.32	0.57	0.00
18	40,392	90.00	42	3.50	9.62	9.35			1.36			0.00	0.00	0.00
17	40,392	90.00	42	3.50	9.62	9.35			1.36			0.00	0.00	0.00
16	40,392	90.00	42	3.50	9.62	9.35			1.36			0.00	0.00	0.00

Velocity	V = Q/A
Area	A = (pi * D^2)/4
	pi = 3.141592654
Pipe loss	h = (4.727 L Q^1.85)/D^4.87 C^1.85
Fitting loss	hf = k * v^2/2g

Minimum Pressure = 0.00 psi

Total Flow rate 2pipe x 90 cfs = 180 cfs

Elevation Differencer from inlet to outlet requires 0.574 psi x 2.31 = 1.32 feet.

2010 ANTECEDENT MOISTURE CONDITION (AMC) MAP

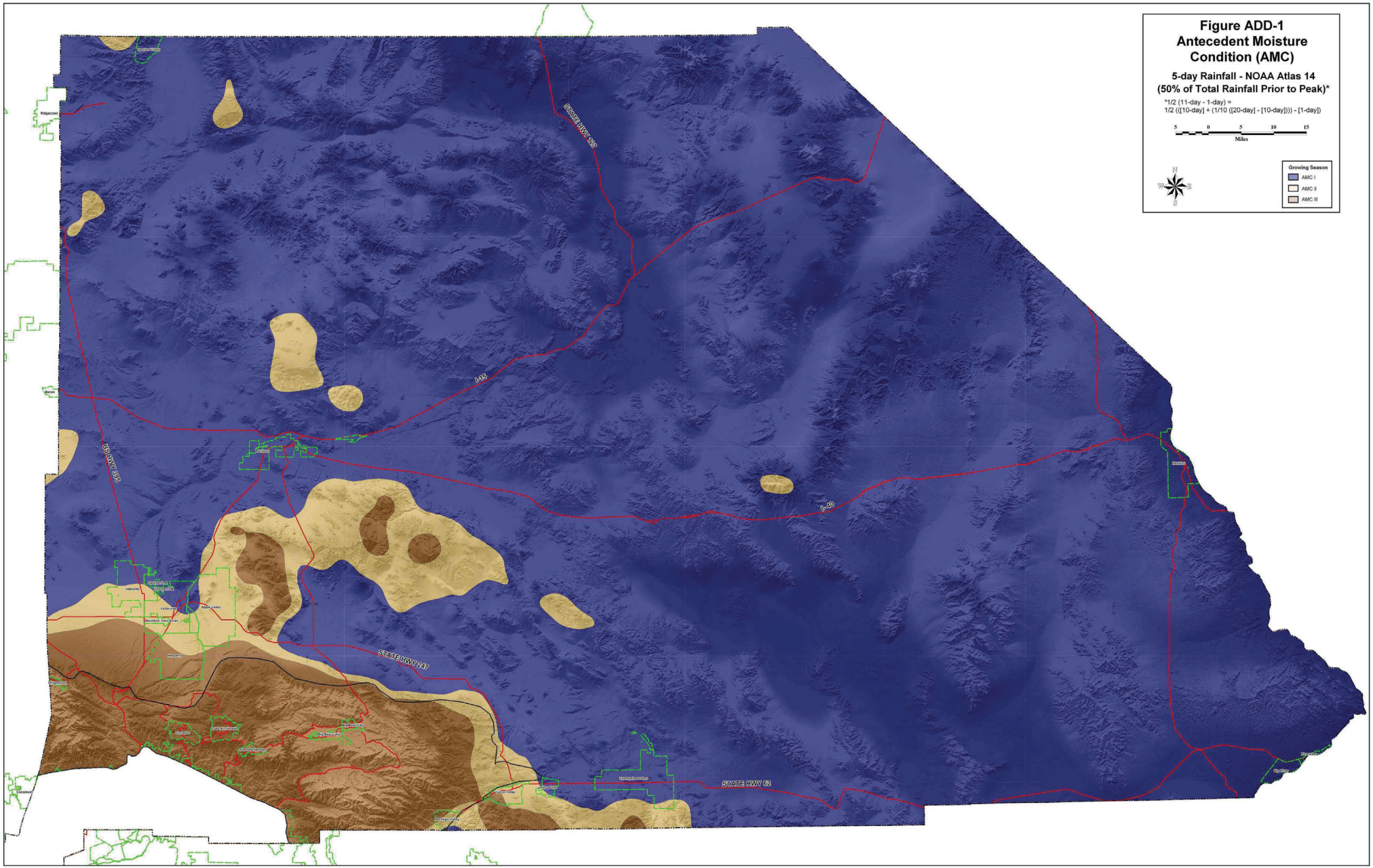


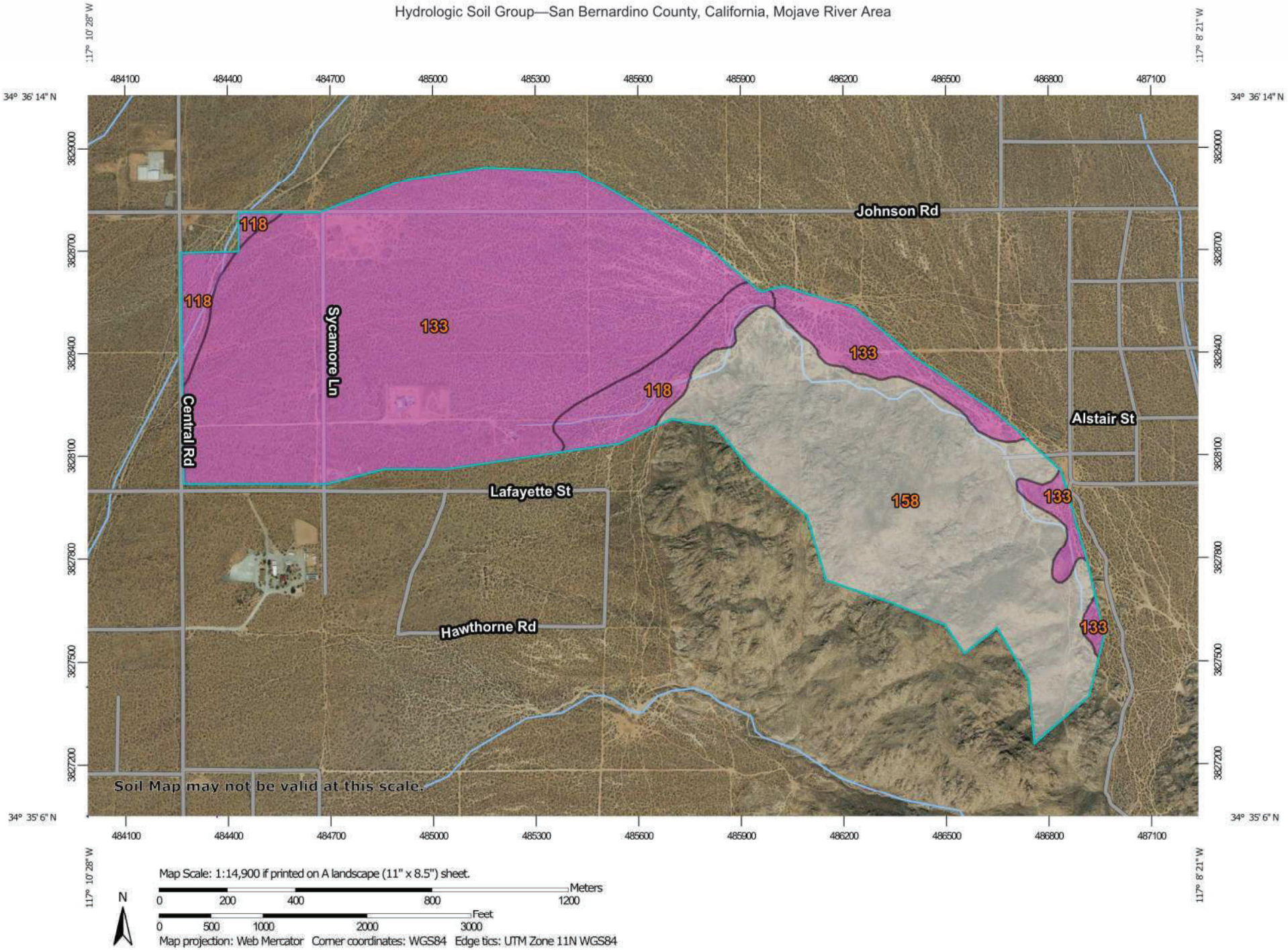
Figure ADD-1
Antecedent Moisture Condition (AMC)
5-day Rainfall - NOAA Atlas 14
(50% of Total Rainfall Prior to Peak)*
*1/2 (11-day - 1-day) =
1/2 (([10-day] + (1/10 ([20-day] - [10-day]))) - [1-day])
5 0 5 10 15
Miles
Growing Season
AMC I
AMC II
AMC III
STATE HWY 297
I-35
US HWY 385
I-40
STATE HWY 247
STATE HWY 62

Uncommon Development
Antecedent Moisture Condition II
Legend
3675.004
Quarry Rd
Central Rd
PROJECT SITE
Central Rd
N
Google Earth
1 mi

EXHIBITS

SOILS MAP

Hydrologic Soil Group—San Bernardino County, California, Mojave River Area



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 13, Sep 13, 2021

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

Date(s) aerial images were photographed: Mar 27, 2021—May 24, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
118	CAJON-ARIZO COMPLEX, 2 TO 15 PERCENT SLOPES*	A	31.5	6.5%
133	HELENDALE-BRYMAN LOAMY SANDS, 2 TO 5 PERCENT SLOPES*	A	293.0	60.3%
158	ROCK OUTCROP-LITHIC TORRIORTHENTS COMPLEX, 15 TO 50 PERCENT SLOPES*		161.4	33.2%
Totals for Area of Interest			**485.9**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOAA ATLAS 14 POINT RAINFALLS

NOAA Atlas 14, Volume 6, Version 2
Location name: Apple Valley, California, USA*
Latitude: 34.5984°, Longitude: -117.1618°
Elevation: 3215.65 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.082 (0.067-0.100)	0.115 (0.094-0.141)	0.161 (0.132-0.198)	0.200 (0.163-0.249)	0.258 (0.203-0.330)	0.305 (0.235-0.399)	0.355 (0.267-0.475)	0.409 (0.300-0.564)	0.487 (0.343-0.699)	0.552 (0.376-0.819)
10-min	0.117 (0.096-0.144)	0.165 (0.135-0.202)	0.230 (0.189-0.284)	0.287 (0.234-0.357)	0.369 (0.291-0.474)	0.436 (0.337-0.571)	0.508 (0.383-0.681)	0.586 (0.430-0.808)	0.698 (0.492-1.00)	0.791 (0.538-1.17)
15-min	0.142 (0.117-0.174)	0.199 (0.164-0.244)	0.279 (0.229-0.343)	0.347 (0.283-0.431)	0.447 (0.352-0.573)	0.528 (0.407-0.691)	0.615 (0.463-0.824)	0.709 (0.520-0.977)	0.845 (0.595-1.21)	0.957 (0.651-1.42)
30-min	0.195 (0.160-0.239)	0.273 (0.225-0.336)	0.383 (0.314-0.471)	0.477 (0.388-0.592)	0.613 (0.483-0.787)	0.725 (0.560-0.949)	0.844 (0.636-1.13)	0.974 (0.714-1.34)	1.16 (0.817-1.67)	1.31 (0.894-1.95)
60-min	0.248 (0.204-0.304)	0.348 (0.286-0.427)	0.487 (0.399-0.599)	0.607 (0.494-0.753)	0.780 (0.615-1.00)	0.922 (0.712-1.21)	1.07 (0.809-1.44)	1.24 (0.908-1.71)	1.48 (1.04-2.12)	1.67 (1.14-2.48)
2-hr	0.350 (0.288-0.429)	0.473 (0.389-0.580)	0.642 (0.527-0.791)	0.787 (0.640-0.977)	0.994 (0.783-1.27)	1.16 (0.897-1.52)	1.34 (1.01-1.80)	1.53 (1.12-2.11)	1.81 (1.27-2.59)	2.03 (1.38-3.01)
3-hr	0.425 (0.350-0.521)	0.566 (0.466-0.695)	0.760 (0.624-0.936)	0.925 (0.753-1.15)	1.16 (0.914-1.49)	1.35 (1.04-1.77)	1.55 (1.17-2.08)	1.77 (1.29-2.43)	2.07 (1.46-2.97)	2.32 (1.58-3.44)
6-hr	0.577 (0.475-0.707)	0.760 (0.625-0.933)	1.01 (0.828-1.24)	1.22 (0.992-1.51)	1.52 (1.20-1.95)	1.75 (1.35-2.30)	2.00 (1.51-2.68)	2.27 (1.66-3.12)	2.64 (1.86-3.79)	2.94 (2.00-4.36)
12-hr	0.738 (0.608-0.905)	0.977 (0.804-1.20)	1.30 (1.07-1.60)	1.57 (1.28-1.95)	1.95 (1.53-2.50)	2.24 (1.73-2.94)	2.55 (1.92-3.42)	2.88 (2.11-3.96)	3.33 (2.34-4.78)	3.69 (2.51-5.47)
24-hr	0.967 (0.858-1.11)	1.30 (1.15-1.50)	1.74 (1.54-2.01)	2.11 (1.85-2.46)	2.61 (2.22-3.15)	3.01 (2.50-3.70)	3.42 (2.77-4.30)	3.84 (3.03-4.98)	4.43 (3.35-5.98)	4.89 (3.57-6.84)
2-day	1.15 (1.02-1.32)	1.57 (1.39-1.80)	2.12 (1.87-2.45)	2.58 (2.26-3.00)	3.21 (2.72-3.86)	3.69 (3.07-4.54)	4.19 (3.40-5.28)	4.71 (3.71-6.10)	5.42 (4.10-7.32)	5.98 (4.37-8.35)
3-day	1.25 (1.10-1.43)	1.72 (1.52-1.98)	2.34 (2.07-2.71)	2.86 (2.50-3.33)	3.56 (3.01-4.28)	4.10 (3.40-5.04)	4.65 (3.77-5.86)	5.23 (4.12-6.78)	6.02 (4.55-8.13)	6.64 (4.85-9.28)
4-day	1.32 (1.17-1.52)	1.83 (1.62-2.10)	2.50 (2.21-2.88)	3.05 (2.67-3.55)	3.80 (3.22-4.57)	4.37 (3.63-5.38)	4.97 (4.03-6.26)	5.58 (4.40-7.23)	6.43 (4.86-8.67)	7.09 (5.18-9.90)
7-day	1.44 (1.27-1.65)	1.98 (1.75-2.28)	2.69 (2.38-3.11)	3.29 (2.88-3.83)	4.10 (3.47-4.93)	4.73 (3.92-5.81)	5.37 (4.35-6.77)	6.04 (4.76-7.83)	6.96 (5.26-9.40)	7.68 (5.61-10.7)
10-day	1.52 (1.35-1.75)	2.08 (1.84-2.40)	2.84 (2.50-3.27)	3.46 (3.03-4.03)	4.32 (3.66-5.20)	4.99 (4.14-6.13)	5.68 (4.60-7.15)	6.39 (5.04-8.28)	7.38 (5.58-9.96)	8.15 (5.96-11.4)
20-day	1.74 (1.54-2.00)	2.39 (2.12-2.76)	3.28 (2.90-3.79)	4.02 (3.52-4.68)	5.05 (4.28-6.08)	5.86 (4.86-7.20)	6.69 (5.42-8.43)	7.57 (5.97-9.81)	8.78 (6.64-11.8)	9.73 (7.11-13.6)
30-day	1.97 (1.74-2.26)	2.71 (2.40-3.13)	3.73 (3.30-4.31)	4.59 (4.02-5.35)	5.80 (4.92-6.98)	6.75 (5.61-8.30)	7.74 (6.27-9.75)	8.78 (6.92-11.4)	10.2 (7.72-13.8)	11.3 (8.29-15.9)
45-day	2.31 (2.05-2.66)	3.20 (2.83-3.69)	4.42 (3.91-5.11)	5.46 (4.79-6.36)	6.94 (5.88-8.35)	8.12 (6.74-9.98)	9.35 (7.57-11.8)	10.6 (8.39-13.8)	12.4 (9.41-16.8)	13.9 (10.1-19.4)
60-day	2.53 (2.25-2.92)	3.50 (3.10-4.03)	4.84 (4.28-5.59)	5.99 (5.25-6.97)	7.63 (6.47-9.18)	8.95 (7.43-11.0)	10.3 (8.38-13.0)	11.8 (9.31-15.3)	13.9 (10.5-18.7)	15.5 (11.4-21.7)

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

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

Please refer to NOAA Atlas 14 document for more information.

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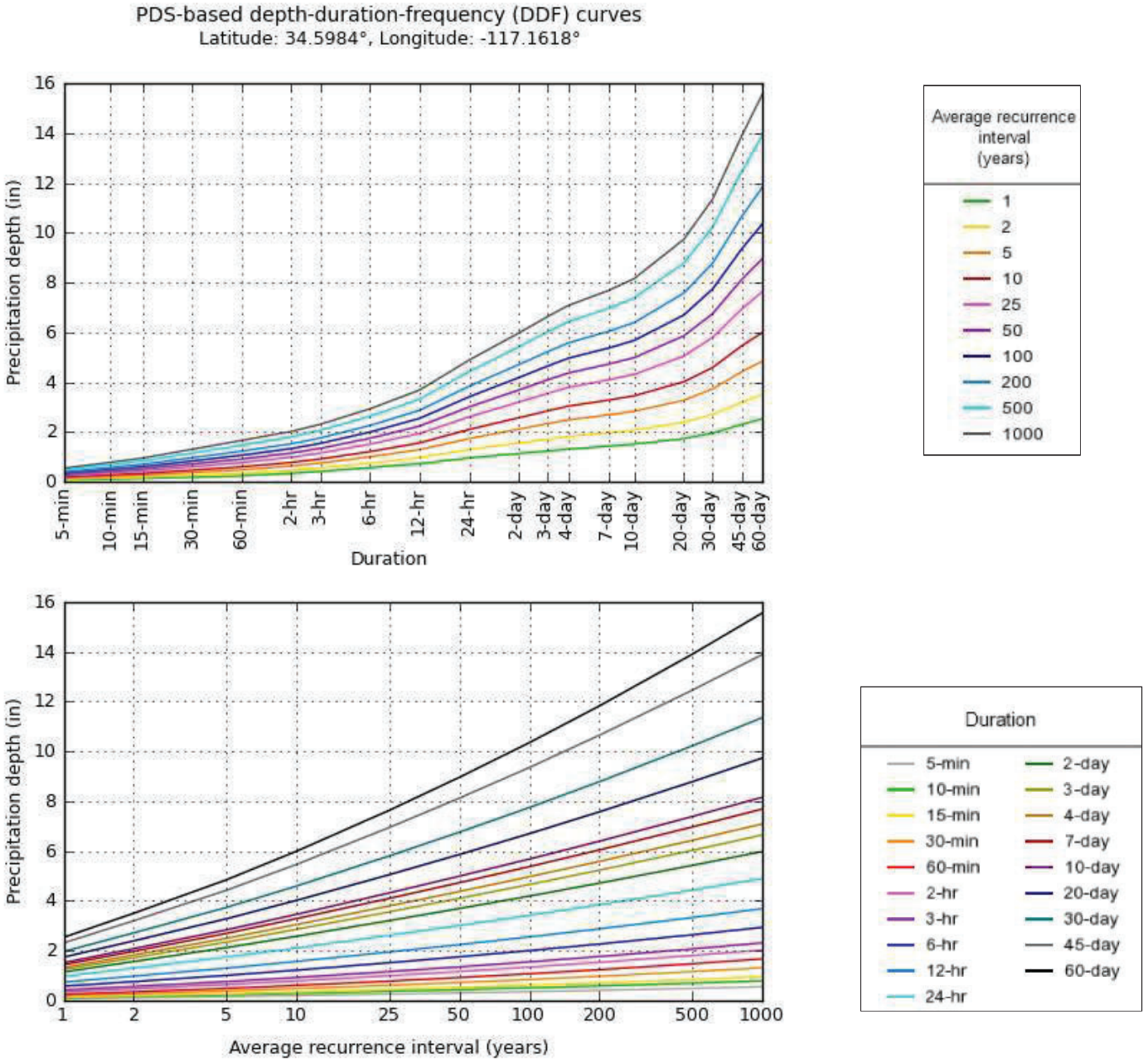
PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Jul 28 21:47:44 2022

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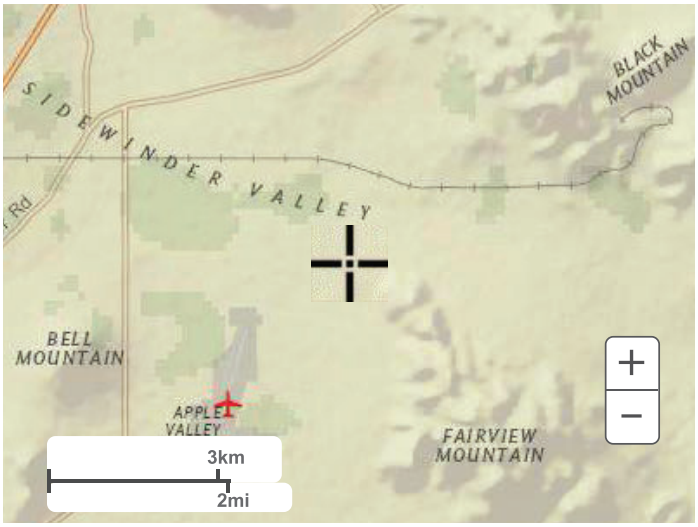
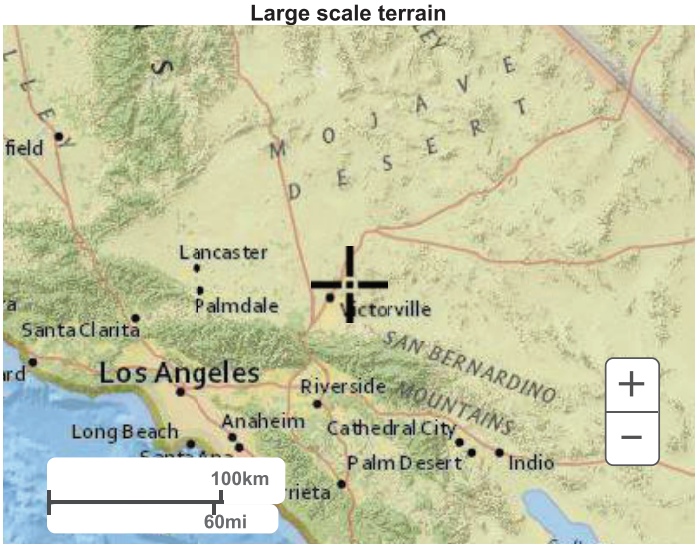
Maps & aerials

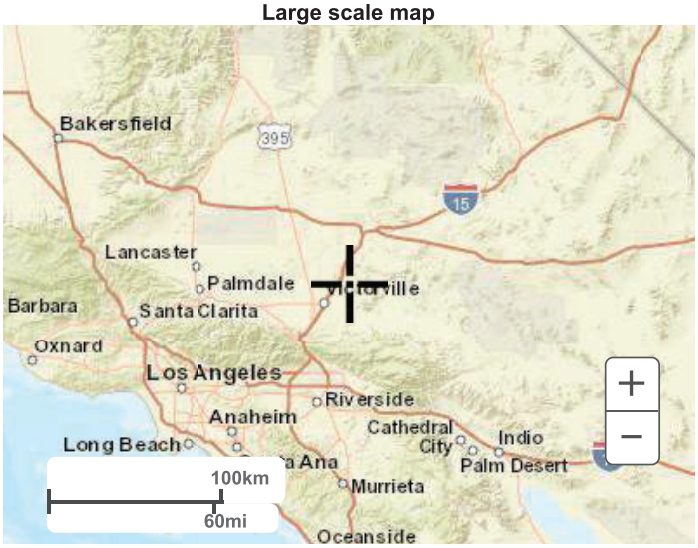
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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

Disclaimer

HYDROLOGY STUDY

For

AP Investors Group LLC
APN 0463-241-02 & 03
Apple Valley, CA

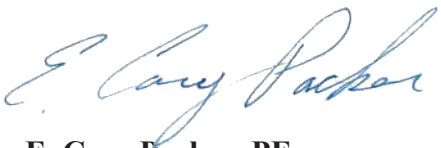
July 29, 2022

Prepared by:

Merrell-Johnson Companies

22221 US Highway 18
Apple Valley, CA 92307
(760) 240-8000

Job No. 3675.007



9/15/2022

E. Cary Packer, PE
Associate Engineer
R.C.E. 51752 Exp. 06/30/24

Mark D. Rowan
Project Manager

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Town of Apple Valley Master Plan of Drainage
San Bernardino County Flood Control District Design Criteria

SECTION 1

DISCUSSION

INTRODUCTION

The purpose of this study was to determine the impact, if any, of the 100-year storm runoff flow tributary to the project site as delineated on the map contained in this study. The project site encompasses approximately 72 acres of property located on the east side of Central Road, between Johnson Road to the north and Lafayette Street on the south in the northeastern area of the Town of Apple Valley, San Bernardino County, California. Development of the site will be a proposed distribution warehouse facility.

METHODOLOGY

The method in determining these peak runoff flows was the rational method as specified in the 1986 San Bernardino County Hydrology Manual and the 2010 San Bernardino County Hydrology Manual Addendum for Arid Regions. The existing offsite flow was examined and delineated from U.S.G.S. Map: Apple Valley North, review of the Apple Valley Master Plan of Drainage (MPD) and an examination of the project site.

The tributary watershed areas examined extend easterly and southeasterly from the eastern property boundary. The eastern and southeastern tributary areas encompass approximately 173.5 and 215.2 acres respectively. The blue line stream entering the property crossing Johnson Road was examined from the Apple Valley Master Plan of Drainage. Per the Apple Valley MPD, this drainage channel has a calculated 100-year runoff flow of 3,818 cfs at the northern property boundary.

Point rainfalls for the 100-year storm were obtained from the NOAA Atlas 14 per the 2010 Addendum to the County Hydrology Manual. The 100-year 1-hour point rainfall for the site is 1.07”. Per the aforementioned addendum, AMC II was used for the project site and the soil types were determined to be Soil Type A in the eastern tributary area and Soil Type C southeastern tributary area per the Natural Resources Conservation Service’s “Web Soil Survey”. Rainfall and maps are included as exhibits in Section 3 of this report.

The offsite tributary area examined in this study is shown in Table A.

Table A

Sub-area	Elevation Difference (ft.)	Length (ft)	Area (Ac)	Avg. Slope (ft/ft)
Node 11 – 15 (Eastern)	138	4,138	173.5	0.0333
Node 21 – 26 (Southeastern)	700	11,005	215.2	0.0671
Node 31 – Apple Valley MPD	738	20,961	2,944	0.0352

EXISTING CONDITIONS

The site is located along the east side of Central Road between Johnson Road to the north and Lafayette Street to the south in the Town of Apple Valley, California. The property is currently vacant, undeveloped land. Central Road is a paved road with dirt shoulders. Johnson Road and Lafayette Street area both graded, unimproved roads.

Tributary off-site flows come from the east as sheet flows entering along the eastern property boundary. Flows from the southeast tributary area follow a blueline stream that becomes undefined prior to crossing the eastern property boundary near the southeast property corner. The Apple Valley MDP crosses Johnson Road and flows southwesterly across the northwesterly property boundary.

The results of the offsite flow analysis are summarized in Table B.

Table B

Sub-Area	Q_{100} (cfs)
Node 11 – 15 (Eastern)	194.3
Node 21 – 26 (Southeastern)	218.3
Node 31 – Apple Valley MPD	3,818

CONCLUSIONS AND RECOMMENDATIONS

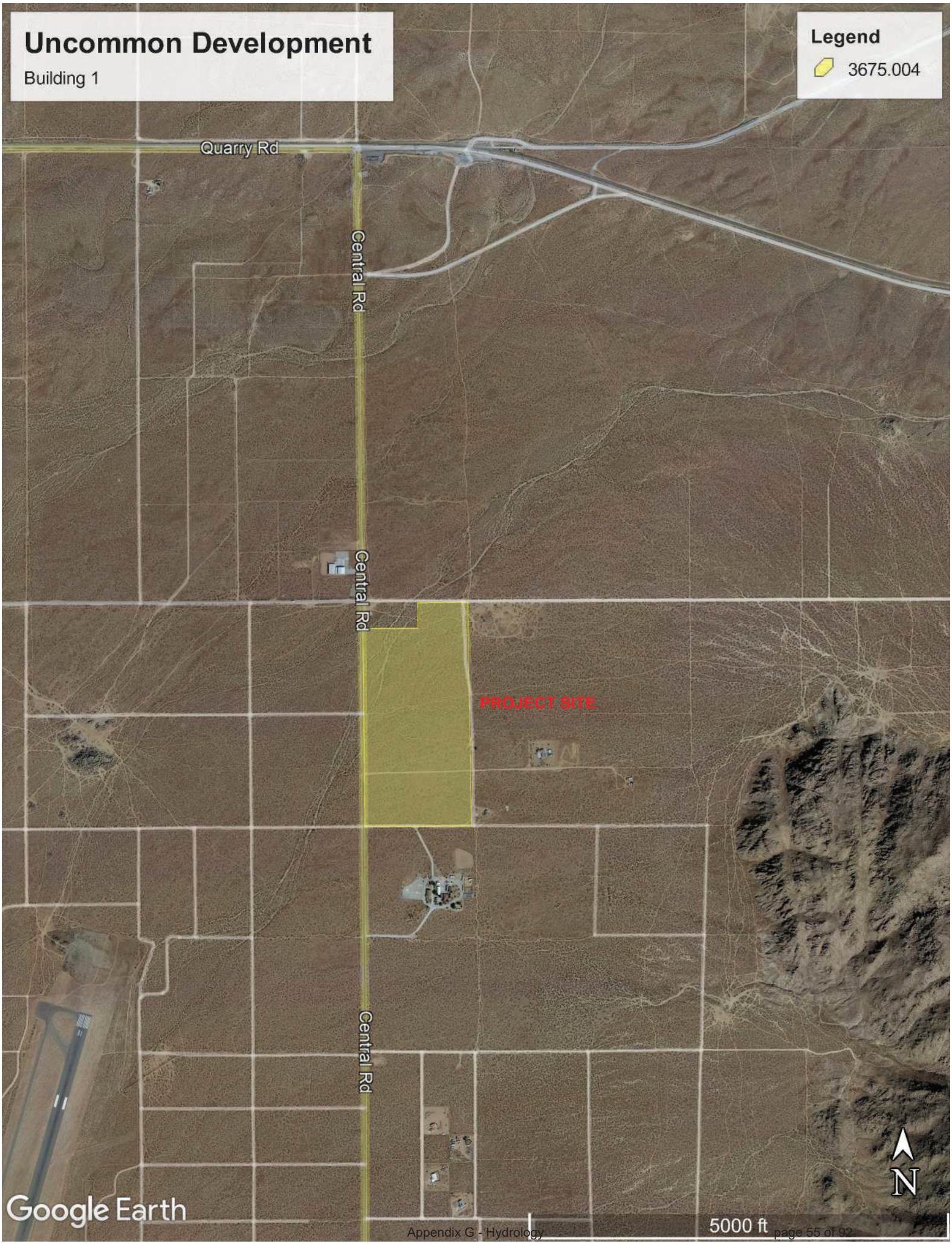
During our field investigation of the site, we observed the existing conditions as stated previously. Future development of the project is being performed in conjunction with engineered improvement plans. Off-site flows from the east and southeast will be intercepted along the easterly property boundary, conveyed through the project, around the proposed building and outlet along the westerly and southerly boundaries following their historical flow locations. The Apple Valley MPD flow will be conveyed in an improved

drainage channel per the San Bernardino County Flood Control District drainage channel design criteria. The increased on-site runoff flow due to development of the site will flow to retention basins along the western and southern frontage of the project and allowed to infiltrate. Excess runoff from larger storm events will outlet as weir flow across Central Road following the historical drainage patterns

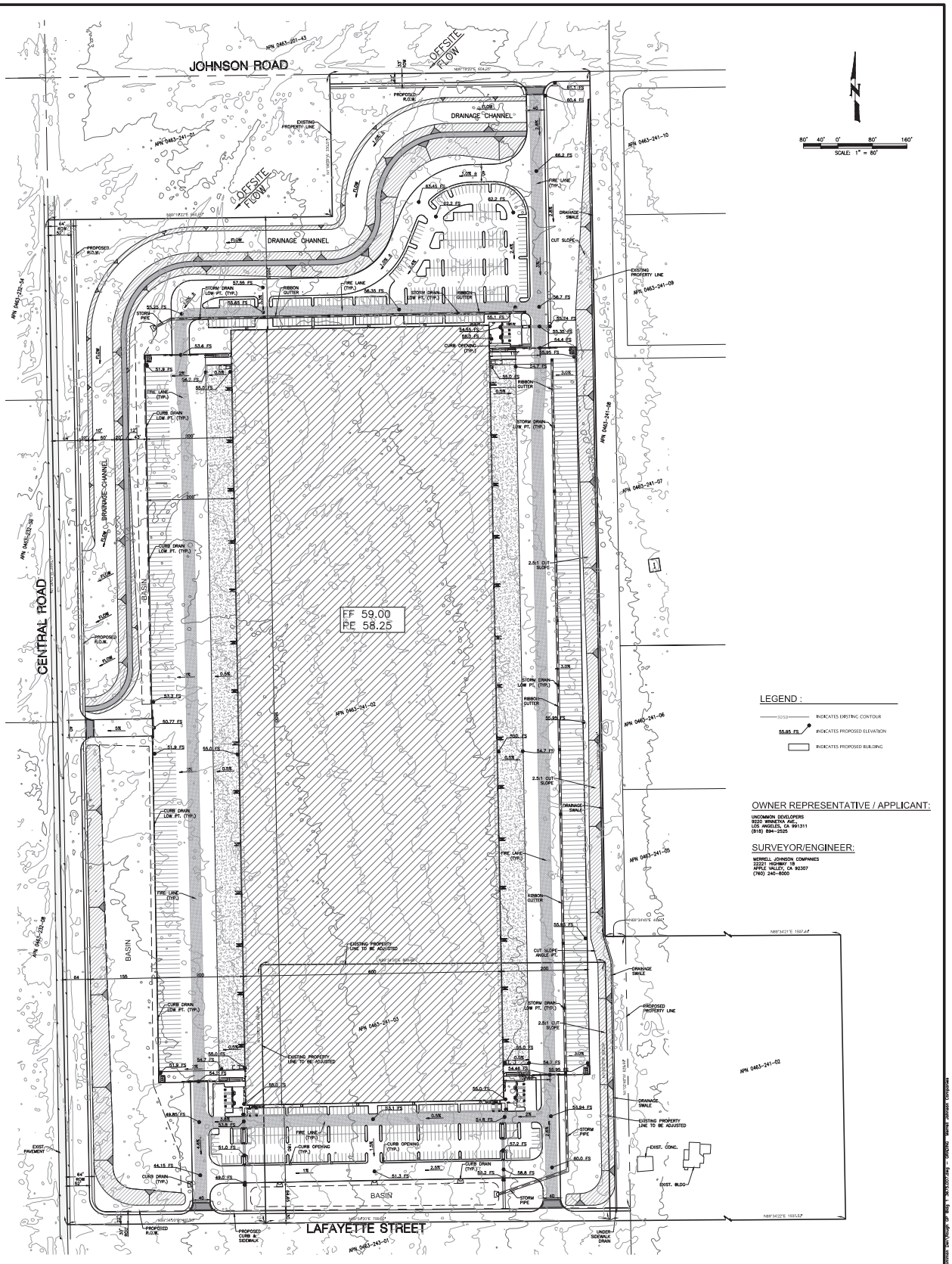
SECTION 2

EXHIBITS

VICINITY MAP


Uncommon Development
Building 1
Legend
3675.004
Quarry Rd
Central Rd
Central Rd
Central Rd
PROJECT SITE
Google Earth
5000 ft
N

PROPOSED DEVELOPMENT PLAN



OWNER REPRESENTATIVE / APPLICANT:

UNCOMMON DEVELOPERS
9220 N. MINNETKA AV.
LOS ANGELES, CA 91311
(818) 894-2525

SURVEYOR/ENGINEER:

MERRELL JOHNSON COMPANIES
22287 MOMENTUM
APPLE VALLEY, CA 92307
(760) 240-6000

IN PROGRESS

OWNER REPRESENTATIVE:
UNCOMMON
9220 MINNETKA AVENUE
LOS ANGELES, CA 91311

DATE	DELTA	REVISION DESCRIPTION	APPROVAL DATE	APPROVAL BY

MERRELL JOHNSON

CONCEPTUAL GRADING PLAN
AP INVESTORS GROUP LLC
CENTRAL RD & LAFAYETTE
STREET 68.2 ACRES

FOR:
UNCOMMON DEVELOPERS

DRAWN BY: EKJ
DATE: 09/14/22
JOB NO. 3675.007
SHEET 1 OF 1

SECTION 3

HYDROLOGY CALCULATIONS

RATIONAL CALCULATIONS – Q_{100}

OFF-SITE HYDROLOGY CALCULATIONS

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2004 Version 7.0
Rational Hydrology Study Date: 07/29/22

APPLE MGA - JOB 3675.004
OFF-SITE TRIBUTARY RUNOFF
NODE 11 - NODE 15
100-YEAR STORM EVENT - AMC II

MERRELL JOHNSON COMPANIES
22221 HIGHWAY 18
APPLE VALLEY, CA 92307
(760) 240-8000 * FAX (760) 240-1400

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.070 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 11.000 to Point/Station 12.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 67.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.578(In/Hr)
Initial subarea data:
Initial area flow distance = 964.000(Ft.)
Top (of initial area) elevation = 3300.000(Ft.)
Bottom (of initial area) elevation = 3263.000(Ft.)
Difference in elevation = 37.000(Ft.)
Slope = 0.03838 s(%)= 3.84
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 15.739 min.
Rainfall intensity = 2.730(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.709
Subarea runoff = 18.787(CFS)
Total initial stream area = 9.700(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.578(In/Hr)

++
Process from Point/Station 12.000 to Point/Station 13.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow = 0.384(Ft.), Average velocity = 3.541(Ft/s)
******* Irregular Channel Data **********

Information entered for subchannel number 1 :

```
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             10.00              0.00
      3             20.00              0.00
      4             30.00              1.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     18.787(CFS)
  '     '    flow top width =     17.670(Ft.)
  '     '    velocity=    3.541(Ft/s)
  '     '    area =      5.306(Sq.Ft)
  '     '    Froude number =     1.139

Upstream point elevation =  3263.000(Ft.)
Downstream point elevation =  3240.000(Ft.)
Flow length =   663.000(Ft.)
Travel time  =    3.12 min.
Time of concentration =   18.86 min.
Depth of flow =   0.384(Ft.)
Average velocity =   3.541(Ft/s)
Total irregular channel flow =    18.787(CFS)
Irregular channel normal depth above invert elev. =   0.384(Ft.)
Average velocity of channel(s) =   3.541(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       12.000 to Point/Station       13.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    18.86 min.
Rainfall intensity =      2.406(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.684
Subarea runoff =     32.852(CFS) for   21.700(Ac.)
Total runoff =     51.639(CFS)
Effective area this stream =       31.40(Ac.)
Total Study Area (Main Stream No. 1) =       31.40(Ac.)
Area averaged Fm value =    0.578(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Depth of flow =   0.483(Ft.), Average velocity =   4.303(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2             10.00              0.00
      3             30.00              0.00
      4             40.00              1.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
```

```
Sub-Channel flow  =     51.639(CFS)
  '     '    flow top width =     29.665(Ft.)
  '     '    velocity=    4.303(Ft/s)
  '     '    area =     12.000(Sq.Ft)
  '     '    Froude number =     1.192

Upstream point elevation =  3240.000(Ft.)
Downstream point elevation =  3205.000(Ft.)
Flow length =  1017.000(Ft.)
Travel time  =    3.94 min.
Time of concentration =   22.80 min.
Depth of flow =   0.483(Ft.)
Average velocity =   4.303(Ft/s)
Total irregular channel flow =    51.639(CFS)
Irregular channel normal depth above invert elev. =   0.483(Ft.)
Average velocity of channel(s) =   4.303(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       13.000 to Point/Station       14.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    22.80 min.
Rainfall intensity =      2.106(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.653
Subarea runoff =     57.427(CFS) for   47.900(Ac.)
Total runoff =    109.066(CFS)
Effective area this stream =       79.30(Ac.)
Total Study Area (Main Stream No. 1) =       79.30(Ac.)
Area averaged Fm value =    0.578(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       15.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Depth of flow =   0.631(Ft.), Average velocity =   4.758(Ft/s)
      ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1             0.00             1.00
      2            10.00             0.00
      3            40.00             0.00
      4            50.00             1.00
Manning's 'N' friction factor =   0.035
------------------------------------------------------------------
Sub-Channel flow  =    109.065(CFS)
  '     '    flow top width =     42.624(Ft.)
  '     '    velocity=    4.758(Ft/s)
  '     '    area =     22.921(Sq.Ft)
  '     '    Froude number =     1.144

Upstream point elevation =  3205.000(Ft.)
```

```
Downstream point elevation =  3162.000(Ft.)
Flow length =  1494.000(Ft.)
Travel time  =    5.23 min.
Time of concentration =   28.03 min.
Depth of flow =   0.631(Ft.)
Average velocity =   4.758(Ft/s)
Total irregular channel flow =   109.066(CFS)
Irregular channel normal depth above invert elev. =   0.631(Ft.)
Average velocity of channel(s) =   4.758(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       14.000 to Point/Station       15.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 67.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.578(In/Hr)
Time of concentration =    28.03 min.Tc
Rainfall intensity =      1.823(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.614
Subarea runoff =     85.262(CFS) for   94.200(Ac.)
Total runoff =    194.328(CFS) Q100
Effective area this stream =      173.50(Ac.)
Total Study Area (Main Stream No. 1) =      173.50(Ac.)
Area averaged Fm value =    0.578(In/Hr)
End of computations, Total Study Area =          173.50 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  67.0
```

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2004 Version 7.0
Rational Hydrology Study Date: 07/29/22

APPLE MGA - JOB 3675.004SE
OFF-SITE TRIBUTARY FLOW
NODE 21 - NODE 26
100-YEAR STORM EVENT - AMC II

MERRELL JOHNSON COMPANIES
22221 HIGHWAY 18
APPLE VALLEY, CA 92307
(760) 240-8000 * FAX (760) 240-1400

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

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.070 (In.)
Slope used for rainfall intensity curve b = 0.7000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 21.000 to Point/Station 22.000
**** INITIAL AREA EVALUATION ****

UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 86.00
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.265(In/Hr)
Initial subarea data:
Initial area flow distance = 985.000(Ft.)
Top (of initial area) elevation = 3860.000(Ft.)
Bottom (of initial area) elevation = 3555.000(Ft.)
Difference in elevation = 305.000(Ft.)
Slope = 0.30964 s(%)= 30.96
TC = k(0.525)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 10.456 min.
Rainfall intensity = 3.635(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.834
Subarea runoff = 18.806(CFS)
Total initial stream area = 6.200(Ac.)
Pervious area fraction = 1.000
Initial area Fm value = 0.265(In/Hr)

++
Process from Point/Station 22.000 to Point/Station 23.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****

Depth of flow = 0.449(Ft.), Average velocity = 5.788(Ft/s)
******* Irregular Channel Data ***********

Information entered for subchannel number 1 :

```
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              5.00              0.00
      3             10.00              0.00
      4             15.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
Sub-Channel flow  =     18.806(CFS)
  '     '    flow top width =      9.486(Ft.)
  '     '    velocity=    5.788(Ft/s)
  '     '    area =      3.249(Sq.Ft)
  '     '    Froude number =     1.743

Upstream point elevation =  3555.000(Ft.)
Downstream point elevation =  3467.000(Ft.)
Flow length =   858.000(Ft.)
Travel time  =    2.47 min.
Time of concentration =   12.93 min.
Depth of flow =   0.449(Ft.)
Average velocity =   5.788(Ft/s)
Total irregular channel flow =    18.806(CFS)
Irregular channel normal depth above invert elev. =   0.449(Ft.)
Average velocity of channel(s) =   5.788(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       22.000 to Point/Station       23.000
**** SUBAREA FLOW ADDITION ****
_____________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Time of concentration =    12.93 min.
Rainfall intensity =      3.134(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.824
Subarea runoff =     34.894(CFS) for   14.600(Ac.)
Total runoff =     53.700(CFS)
Effective area this stream =       20.80(Ac.)
Total Study Area (Main Stream No. 1) =       20.80(Ac.)
Area averaged Fm value =    0.265(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.000 to Point/Station       24.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
_____________________________________________________________________
Depth of flow =   0.644(Ft.), Average velocity =   6.306(Ft/s)
      ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              1.00
      2              5.00              0.00
      3             15.00              0.00
      4             20.00              1.00
Manning's 'N' friction factor =   0.040
-----------------------------------------------------------------
```

```
Sub-Channel flow  =     53.700(CFS)
  '     '    flow top width =     16.441(Ft.)
  '     '    velocity=    6.306(Ft/s)
  '     '    area =      8.516(Sq.Ft)
  '     '    Froude number =     1.544

Upstream point elevation =  3467.000(Ft.)
Downstream point elevation =  3415.000(Ft.)
Flow length =   743.000(Ft.)
Travel time  =    1.96 min.
Time of concentration =   14.89 min.
Depth of flow =   0.644(Ft.)
Average velocity =   6.306(Ft/s)
Total irregular channel flow =    53.700(CFS)
Irregular channel normal depth above invert elev. =   0.644(Ft.)
Average velocity of channel(s) =   6.306(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       23.000 to Point/Station       24.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Time of concentration =    14.89 min.
Rainfall intensity =      2.838(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.816
Subarea runoff =     69.969(CFS) for   32.600(Ac.)
Total runoff =    123.668(CFS)
Effective area this stream =       53.40(Ac.)
Total Study Area (Main Stream No. 1) =       53.40(Ac.)
Area averaged Fm value =    0.265(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       24.000 to Point/Station       25.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Depth of flow =   0.866(Ft.), Average velocity =   5.871(Ft/s)
      ******* Irregular Channel Data ***********
----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1             0.00             2.00
      2            10.00             0.00
      3            30.00             0.00
      4            40.00             2.00
Manning's 'N' friction factor =   0.040
----------------------------------------------------------------
Sub-Channel flow  =    123.669(CFS)
  '     '    flow top width =     28.658(Ft.)
  '     '    velocity=    5.871(Ft/s)
  '     '    area =     21.064(Sq.Ft)
  '     '    Froude number =     1.207

Upstream point elevation =  3415.000(Ft.)
```

```
Downstream point elevation =  3346.000(Ft.)
Flow length =  1818.000(Ft.)
Travel time  =    5.16 min.
Time of concentration =   20.05 min.
Depth of flow =   0.866(Ft.)
Average velocity =   5.871(Ft/s)
Total irregular channel flow =   123.668(CFS)
Irregular channel normal depth above invert elev. =   0.866(Ft.)
Average velocity of channel(s) =   5.871(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       24.000 to Point/Station       25.000
**** SUBAREA FLOW ADDITION ****
________________________________________________________________________
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 86.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.265(In/Hr)
Time of concentration =    20.05 min.
Rainfall intensity =      2.305(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.796
Subarea runoff =     71.450(CFS) for   52.900(Ac.)
Total runoff =    195.118(CFS)
Effective area this stream =      106.30(Ac.)
Total Study Area (Main Stream No. 1) =      106.30(Ac.)
Area averaged Fm value =    0.265(In/Hr)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station       26.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
________________________________________________________________________
Depth of flow =   1.217(Ft.), Average velocity =   6.149(Ft/s)
      ******* Irregular Channel Data ***********
------------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
      1              0.00              2.00
      2             10.00              0.00
      3             30.00              0.00
      4             40.00              2.00
Manning's 'N' friction factor =   0.040
------------------------------------------------------------------
Sub-Channel flow  =    195.118(CFS)
  '     '    flow top width =     32.166(Ft.)
  '     '    velocity=    6.149(Ft/s)
  '     '    area =     31.731(Sq.Ft)
  '     '    Froude number =     1.091

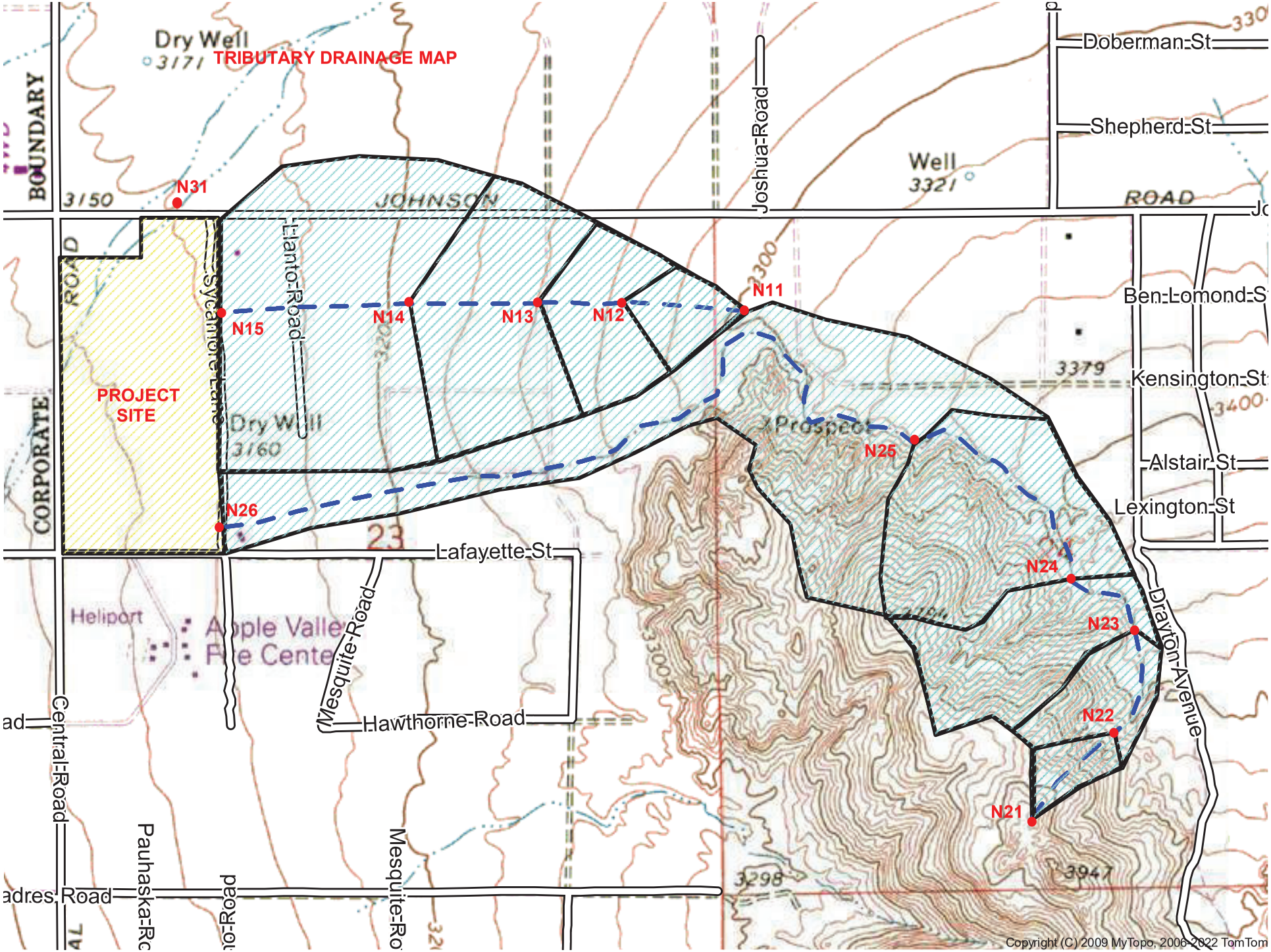
Upstream point elevation =  3346.000(Ft.)
Downstream point elevation =  3160.000(Ft.)
Flow length =  6601.000(Ft.)
Travel time  =   17.89 min.
Time of concentration =   37.94 min.
Depth of flow =   1.217(Ft.)
Average velocity =   6.149(Ft/s)
Total irregular channel flow =   195.118(CFS)
```

```
Irregular channel normal depth above invert elev. =   1.217(Ft.)
Average velocity of channel(s) =   6.149(Ft/s)

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station       25.000 to Point/Station       26.000
**** SUBAREA FLOW ADDITION ****
----------------------------------------------------------------------
UNDEVELOPED (poor cover) subarea
Decimal fraction soil group A = 0.500
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.500
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 76.50
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.428(In/Hr)
Time of concentration =    37.94 min.
Rainfall intensity =      1.475(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.688
Subarea runoff =     23.149(CFS) for  108.900(Ac.)
Total runoff =    218.267(CFS)
Effective area this stream =      215.20(Ac.)
Total Study Area (Main Stream No. 1) =      215.20(Ac.)
Area averaged Fm value =    0.348(In/Hr)
End of computations, Total Study Area =          215.20 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  81.2
```

TRIBUTARY DRAINAGE MAP


TRIBUTARY DRAINAGE MAP
PROJECT SITE
N31
N15
N14
N13
N12
N11
N26
N25
N24
N23
N22
N21
Dry Well
3171
Dry Well
3160
Well
3321
3150
3379
3298
3947
BOUNDARY
CORPORATE
ROAD
JOHNSON
Sycamore Lane
Llano Road
Joshua Road
Doberman St
Shepherd St
Ben Lomond St
Kensington St
Alstair St
Lexington St
Prospect
Lafayette St
Mesquite Road
Hawthorne Road
Central Road
Pauhaska Rd
Heliport
Drayton Avenue
Copyright (C) 2009 MyTopo, 2006-2022 TomTom

2010 ANTECEDENT MOISTURE CONDITION (AMC) MAP

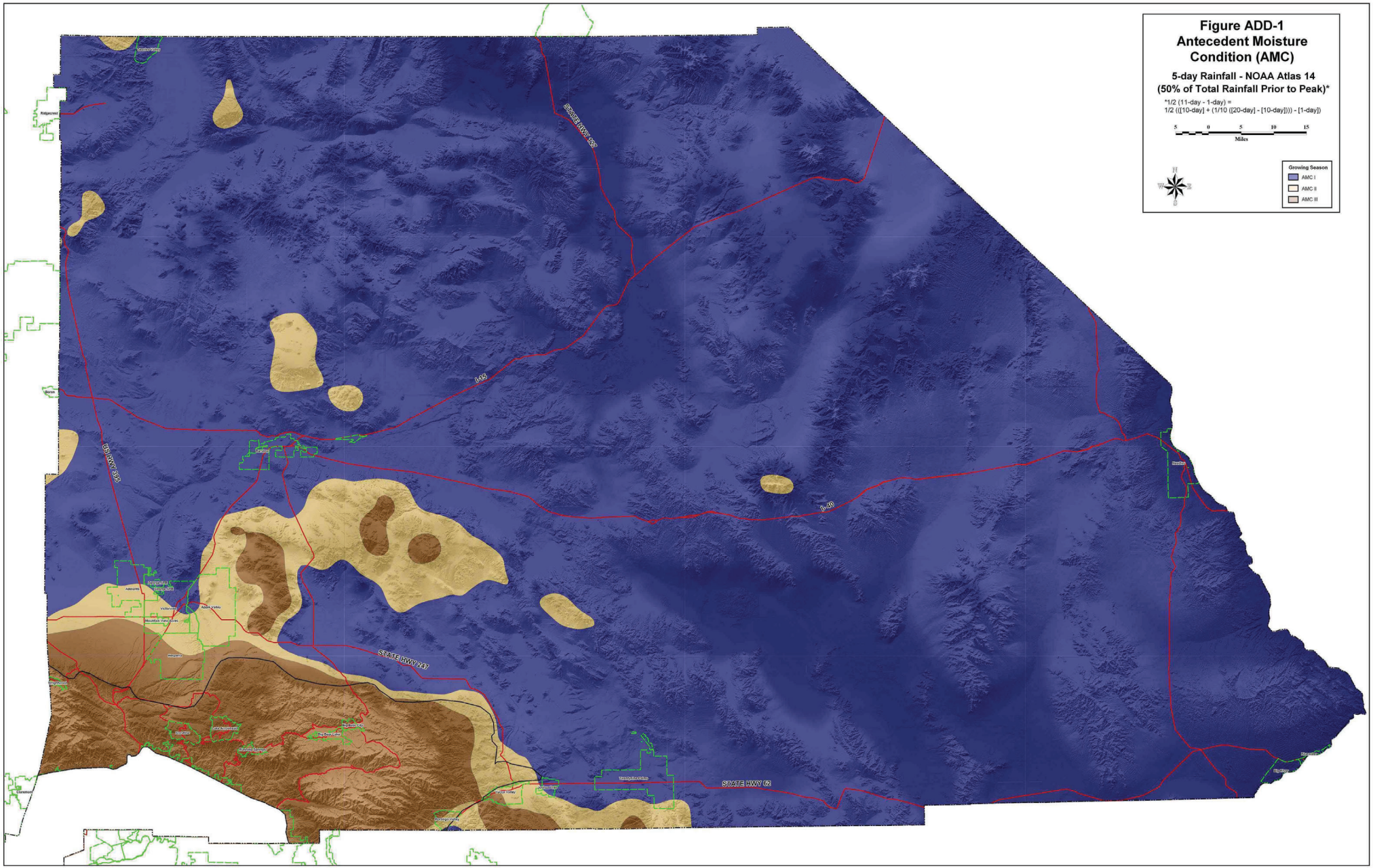


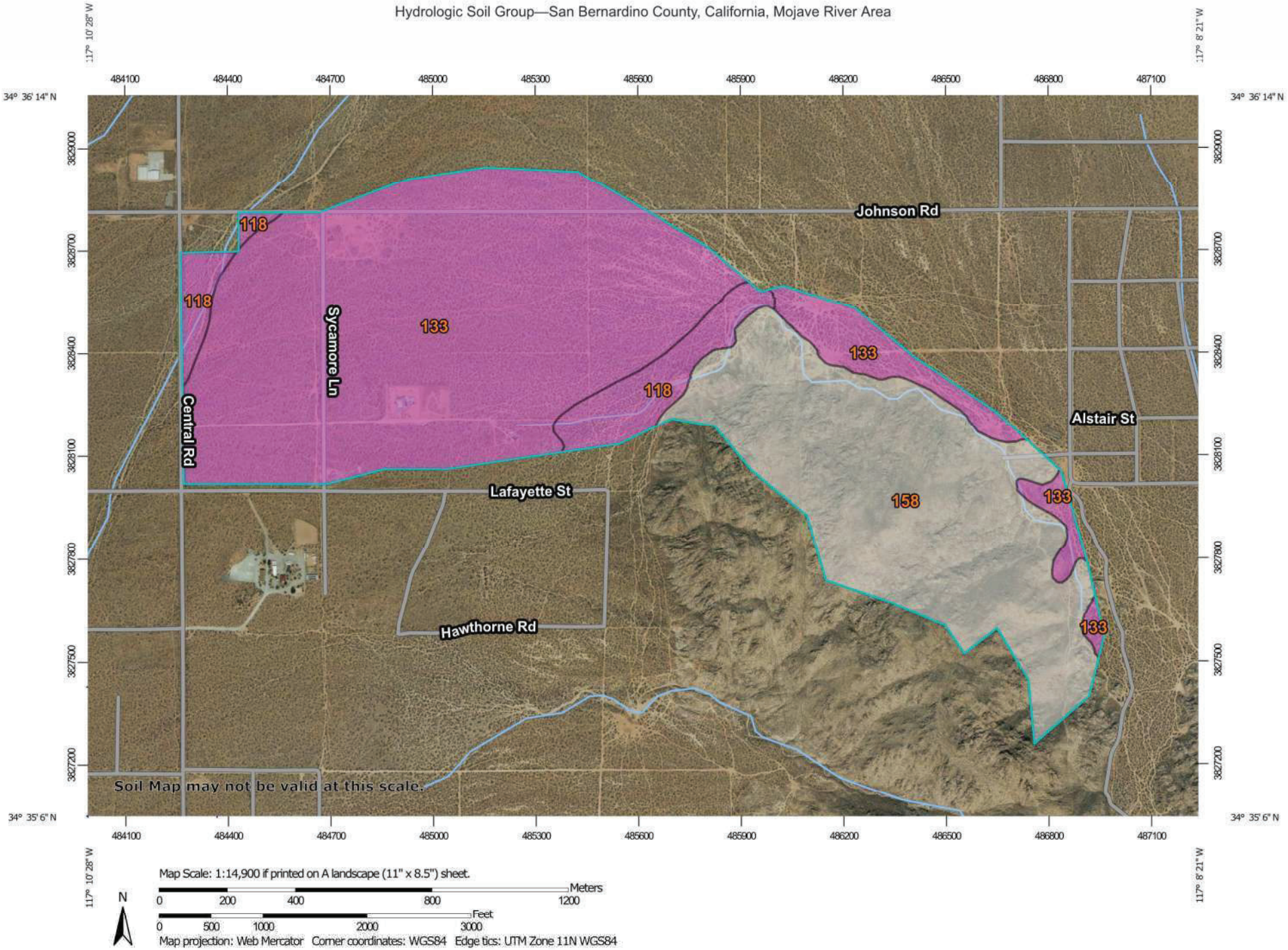
Figure ADD-1
Antecedent Moisture Condition (AMC)
5-day Rainfall - NOAA Atlas 14
(50% of Total Rainfall Prior to Peak)*
*1/2 (11-day - 1-day) =
1/2 (([10-day] + (1/10 ([20-day] - [10-day]))) - [1-day])
5 0 5 10 15
Miles
Growing Season
AMC I
AMC II
AMC III
STATE HWY 297
I-35
US HWY 385
I-40
STATE HWY 247
STATE HWY 62

Uncommon Development
Antecedent Moisture Condition II
Legend
3675.004
Quarry Rd
Central Rd
PROJECT SITE
Central Rd
Google Earth
1 mi
N

EXHIBITS

SOILS MAP

Hydrologic Soil Group—San Bernardino County, California, Mojave River Area



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 13, Sep 13, 2021

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

Date(s) aerial images were photographed: Mar 27, 2021—May 24, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
118	CAJON-ARIZO COMPLEX, 2 TO 15 PERCENT SLOPES*	A	31.5	6.5%
133	HELENDALE-BRYMAN LOAMY SANDS, 2 TO 5 PERCENT SLOPES*	A	293.0	60.3%
158	ROCK OUTCROP-LITHIC TORRIORTHENTS COMPLEX, 15 TO 50 PERCENT SLOPES*		161.4	33.2%
Totals for Area of Interest			**485.9**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOAA ATLAS 14 POINT RAINFALLS

NOAA Atlas 14, Volume 6, Version 2
Location name: Apple Valley, California, USA*
Latitude: 34.5984°, Longitude: -117.1618°
Elevation: 3215.65 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.082 (0.067-0.100)	0.115 (0.094-0.141)	0.161 (0.132-0.198)	0.200 (0.163-0.249)	0.258 (0.203-0.330)	0.305 (0.235-0.399)	0.355 (0.267-0.475)	0.409 (0.300-0.564)	0.487 (0.343-0.699)	0.552 (0.376-0.819)
10-min	0.117 (0.096-0.144)	0.165 (0.135-0.202)	0.230 (0.189-0.284)	0.287 (0.234-0.357)	0.369 (0.291-0.474)	0.436 (0.337-0.571)	0.508 (0.383-0.681)	0.586 (0.430-0.808)	0.698 (0.492-1.00)	0.791 (0.538-1.17)
15-min	0.142 (0.117-0.174)	0.199 (0.164-0.244)	0.279 (0.229-0.343)	0.347 (0.283-0.431)	0.447 (0.352-0.573)	0.528 (0.407-0.691)	0.615 (0.463-0.824)	0.709 (0.520-0.977)	0.845 (0.595-1.21)	0.957 (0.651-1.42)
30-min	0.195 (0.160-0.239)	0.273 (0.225-0.336)	0.383 (0.314-0.471)	0.477 (0.388-0.592)	0.613 (0.483-0.787)	0.725 (0.560-0.949)	0.844 (0.636-1.13)	0.974 (0.714-1.34)	1.16 (0.817-1.67)	1.31 (0.894-1.95)
60-min	0.248 (0.204-0.304)	0.348 (0.286-0.427)	0.487 (0.399-0.599)	0.607 (0.494-0.753)	0.780 (0.615-1.00)	0.922 (0.712-1.21)	1.07 (0.809-1.44)	1.24 (0.908-1.71)	1.48 (1.04-2.12)	1.67 (1.14-2.48)
2-hr	0.350 (0.288-0.429)	0.473 (0.389-0.580)	0.642 (0.527-0.791)	0.787 (0.640-0.977)	0.994 (0.783-1.27)	1.16 (0.897-1.52)	1.34 (1.01-1.80)	1.53 (1.12-2.11)	1.81 (1.27-2.59)	2.03 (1.38-3.01)
3-hr	0.425 (0.350-0.521)	0.566 (0.466-0.695)	0.760 (0.624-0.936)	0.925 (0.753-1.15)	1.16 (0.914-1.49)	1.35 (1.04-1.77)	1.55 (1.17-2.08)	1.77 (1.29-2.43)	2.07 (1.46-2.97)	2.32 (1.58-3.44)
6-hr	0.577 (0.475-0.707)	0.760 (0.625-0.933)	1.01 (0.828-1.24)	1.22 (0.992-1.51)	1.52 (1.20-1.95)	1.75 (1.35-2.30)	2.00 (1.51-2.68)	2.27 (1.66-3.12)	2.64 (1.86-3.79)	2.94 (2.00-4.36)
12-hr	0.738 (0.608-0.905)	0.977 (0.804-1.20)	1.30 (1.07-1.60)	1.57 (1.28-1.95)	1.95 (1.53-2.50)	2.24 (1.73-2.94)	2.55 (1.92-3.42)	2.88 (2.11-3.96)	3.33 (2.34-4.78)	3.69 (2.51-5.47)
24-hr	0.967 (0.858-1.11)	1.30 (1.15-1.50)	1.74 (1.54-2.01)	2.11 (1.85-2.46)	2.61 (2.22-3.15)	3.01 (2.50-3.70)	3.42 (2.77-4.30)	3.84 (3.03-4.98)	4.43 (3.35-5.98)	4.89 (3.57-6.84)
2-day	1.15 (1.02-1.32)	1.57 (1.39-1.80)	2.12 (1.87-2.45)	2.58 (2.26-3.00)	3.21 (2.72-3.86)	3.69 (3.07-4.54)	4.19 (3.40-5.28)	4.71 (3.71-6.10)	5.42 (4.10-7.32)	5.98 (4.37-8.35)
3-day	1.25 (1.10-1.43)	1.72 (1.52-1.98)	2.34 (2.07-2.71)	2.86 (2.50-3.33)	3.56 (3.01-4.28)	4.10 (3.40-5.04)	4.65 (3.77-5.86)	5.23 (4.12-6.78)	6.02 (4.55-8.13)	6.64 (4.85-9.28)
4-day	1.32 (1.17-1.52)	1.83 (1.62-2.10)	2.50 (2.21-2.88)	3.05 (2.67-3.55)	3.80 (3.22-4.57)	4.37 (3.63-5.38)	4.97 (4.03-6.26)	5.58 (4.40-7.23)	6.43 (4.86-8.67)	7.09 (5.18-9.90)
7-day	1.44 (1.27-1.65)	1.98 (1.75-2.28)	2.69 (2.38-3.11)	3.29 (2.88-3.83)	4.10 (3.47-4.93)	4.73 (3.92-5.81)	5.37 (4.35-6.77)	6.04 (4.76-7.83)	6.96 (5.26-9.40)	7.68 (5.61-10.7)
10-day	1.52 (1.35-1.75)	2.08 (1.84-2.40)	2.84 (2.50-3.27)	3.46 (3.03-4.03)	4.32 (3.66-5.20)	4.99 (4.14-6.13)	5.68 (4.60-7.15)	6.39 (5.04-8.28)	7.38 (5.58-9.96)	8.15 (5.96-11.4)
20-day	1.74 (1.54-2.00)	2.39 (2.12-2.76)	3.28 (2.90-3.79)	4.02 (3.52-4.68)	5.05 (4.28-6.08)	5.86 (4.86-7.20)	6.69 (5.42-8.43)	7.57 (5.97-9.81)	8.78 (6.64-11.8)	9.73 (7.11-13.6)
30-day	1.97 (1.74-2.26)	2.71 (2.40-3.13)	3.73 (3.30-4.31)	4.59 (4.02-5.35)	5.80 (4.92-6.98)	6.75 (5.61-8.30)	7.74 (6.27-9.75)	8.78 (6.92-11.4)	10.2 (7.72-13.8)	11.3 (8.29-15.9)
45-day	2.31 (2.05-2.66)	3.20 (2.83-3.69)	4.42 (3.91-5.11)	5.46 (4.79-6.36)	6.94 (5.88-8.35)	8.12 (6.74-9.98)	9.35 (7.57-11.8)	10.6 (8.39-13.8)	12.4 (9.41-16.8)	13.9 (10.1-19.4)
60-day	2.53 (2.25-2.92)	3.50 (3.10-4.03)	4.84 (4.28-5.59)	5.99 (5.25-6.97)	7.63 (6.47-9.18)	8.95 (7.43-11.0)	10.3 (8.38-13.0)	11.8 (9.31-15.3)	13.9 (10.5-18.7)	15.5 (11.4-21.7)

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

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

Please refer to NOAA Atlas 14 document for more information.

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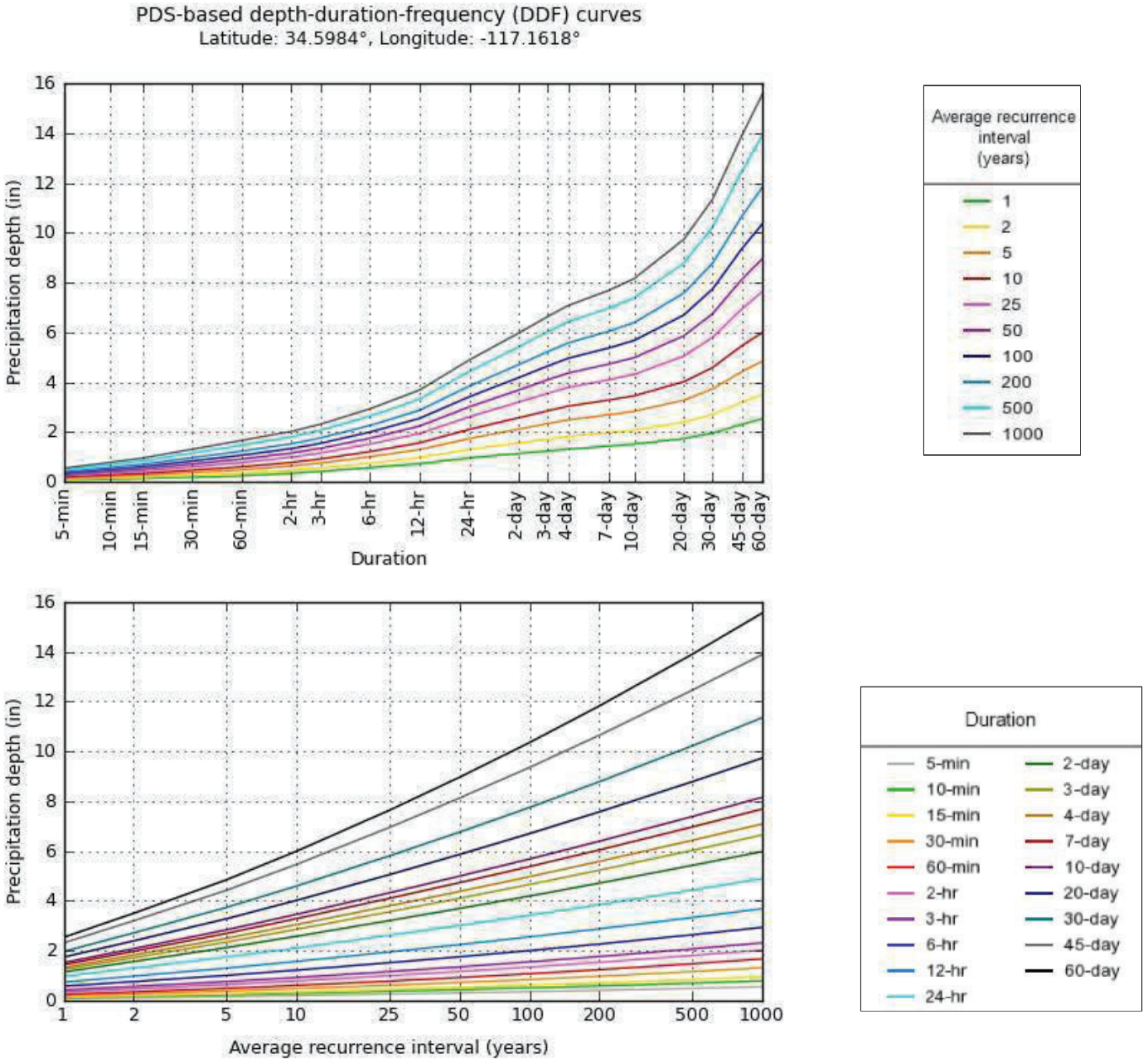
PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Thu Jul 28 21:47:44 2022

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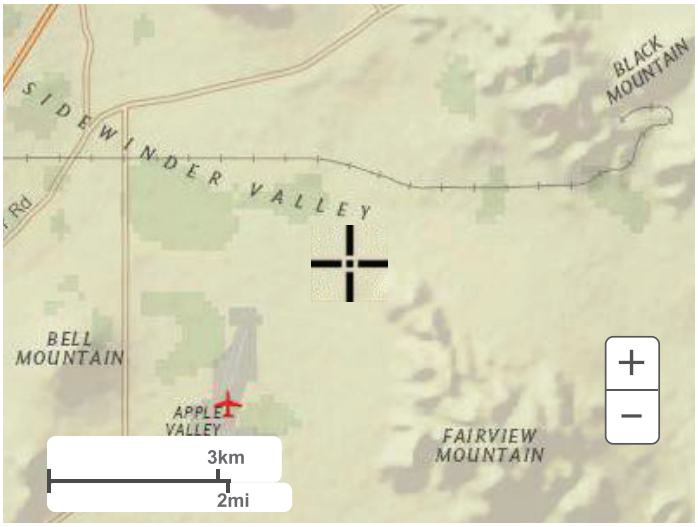
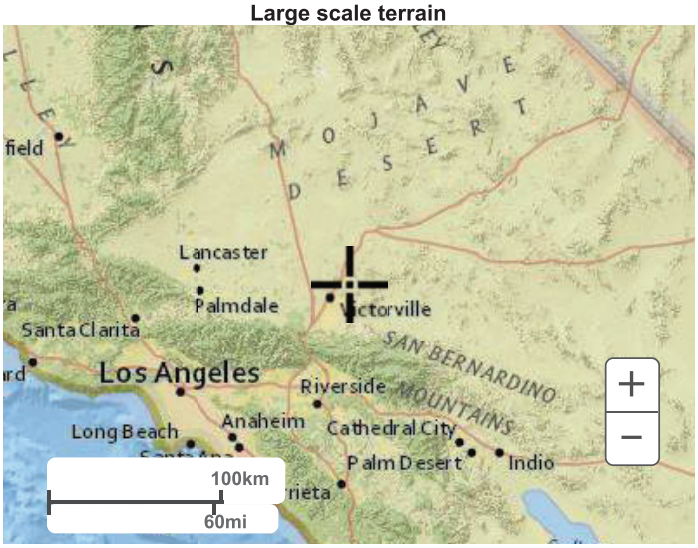
Maps & aerials

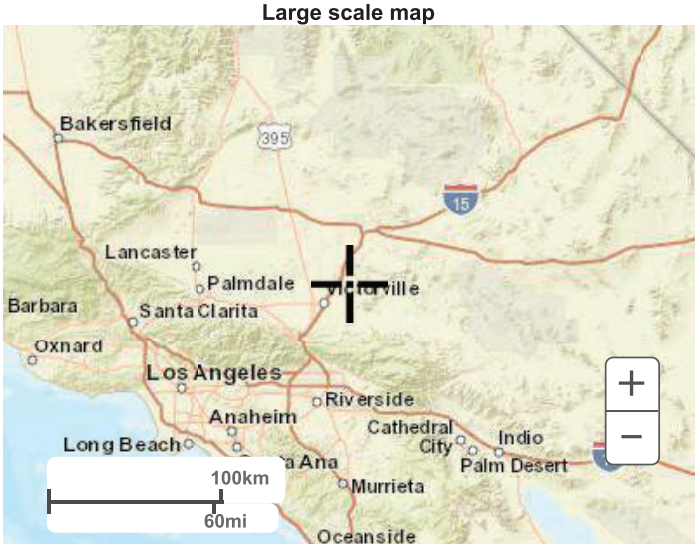
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

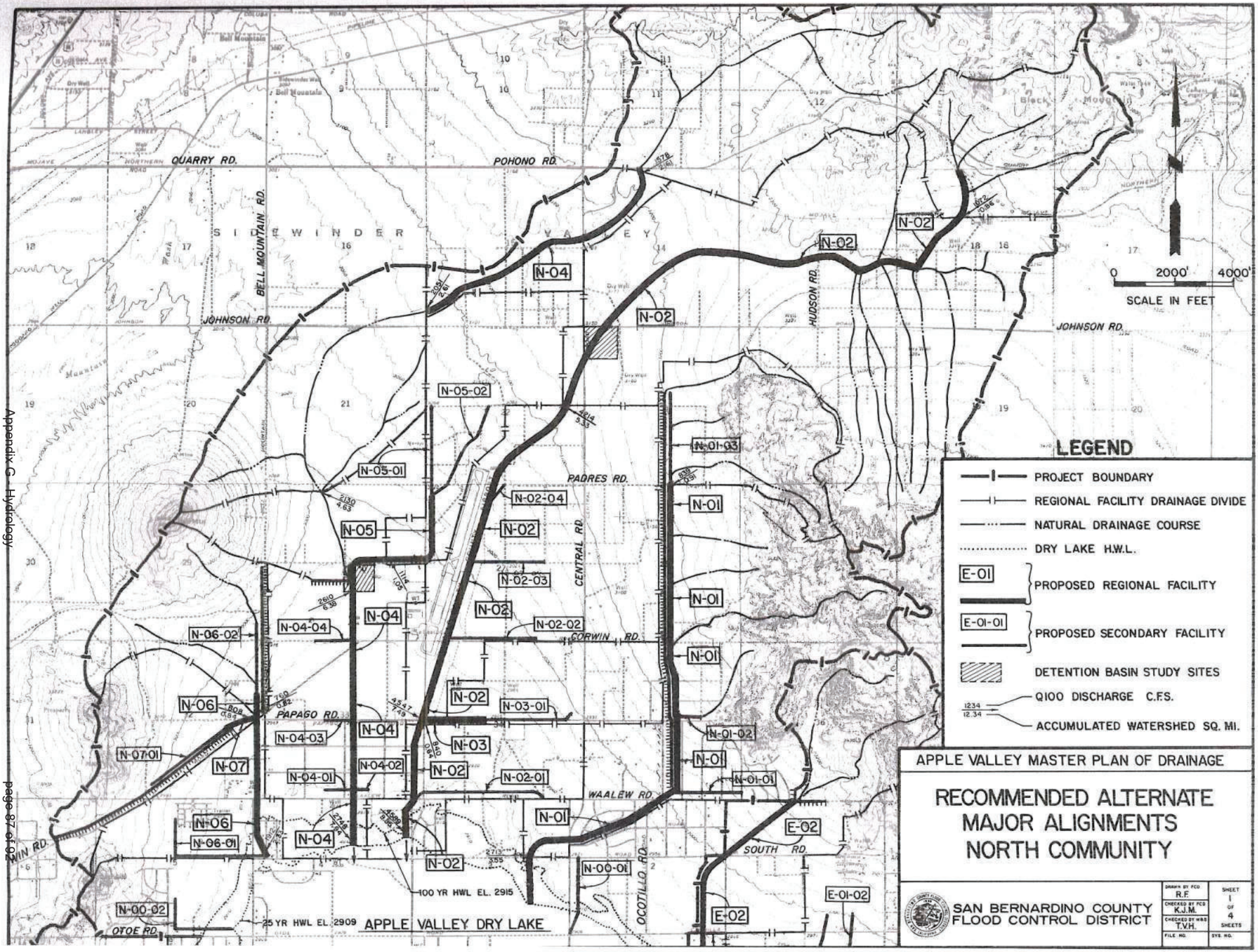
Back to Top

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

Disclaimer

TOWN OF APPLE VALLEY

MASTER PLAN OF DRAINAGE MAP



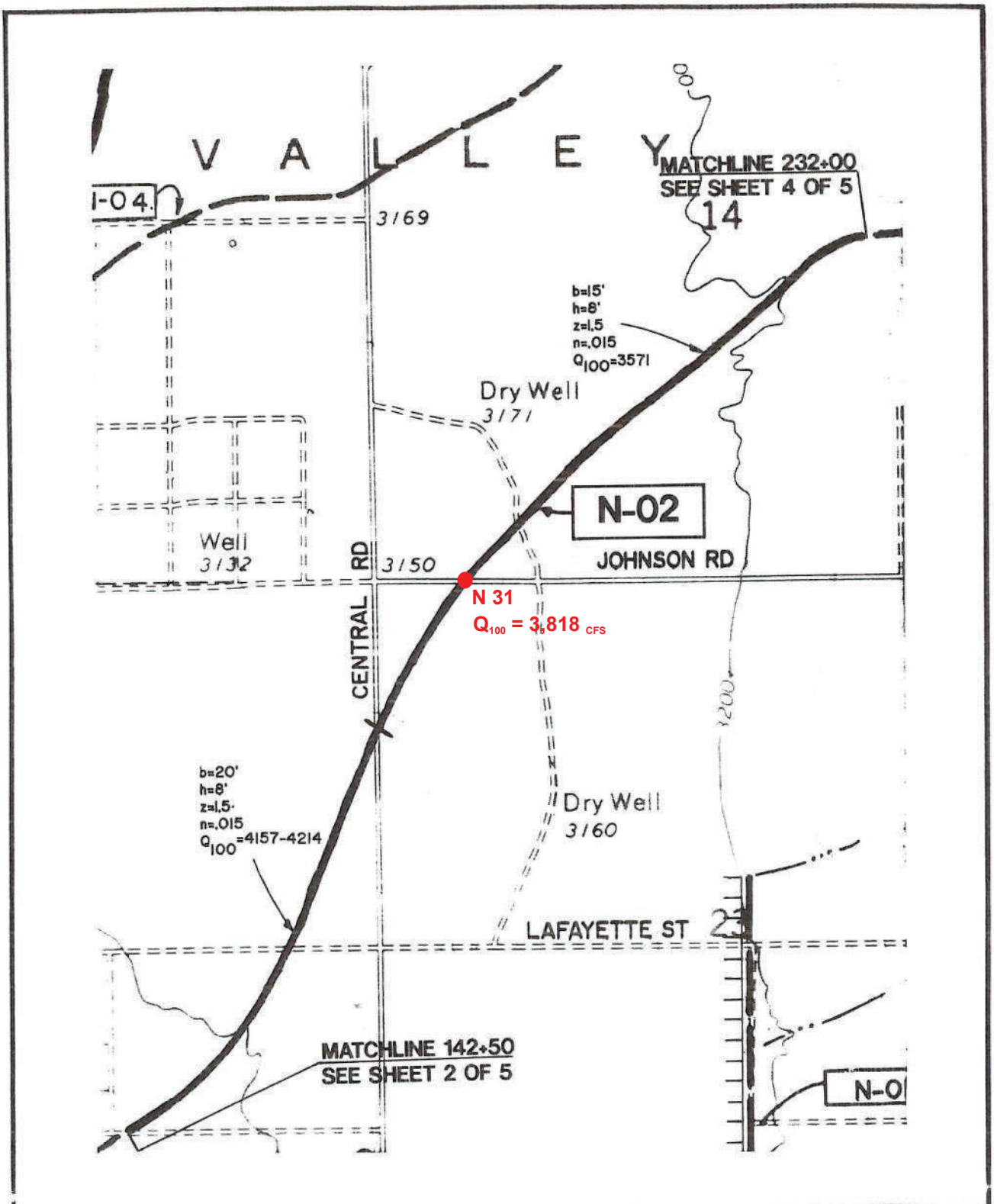
APPLE VALLEY MASTER PLAN OF DRAINAGE

RECOMMENDED ALTERNATE MAJOR ALIGNMENTS NORTH COMMUNITY

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT

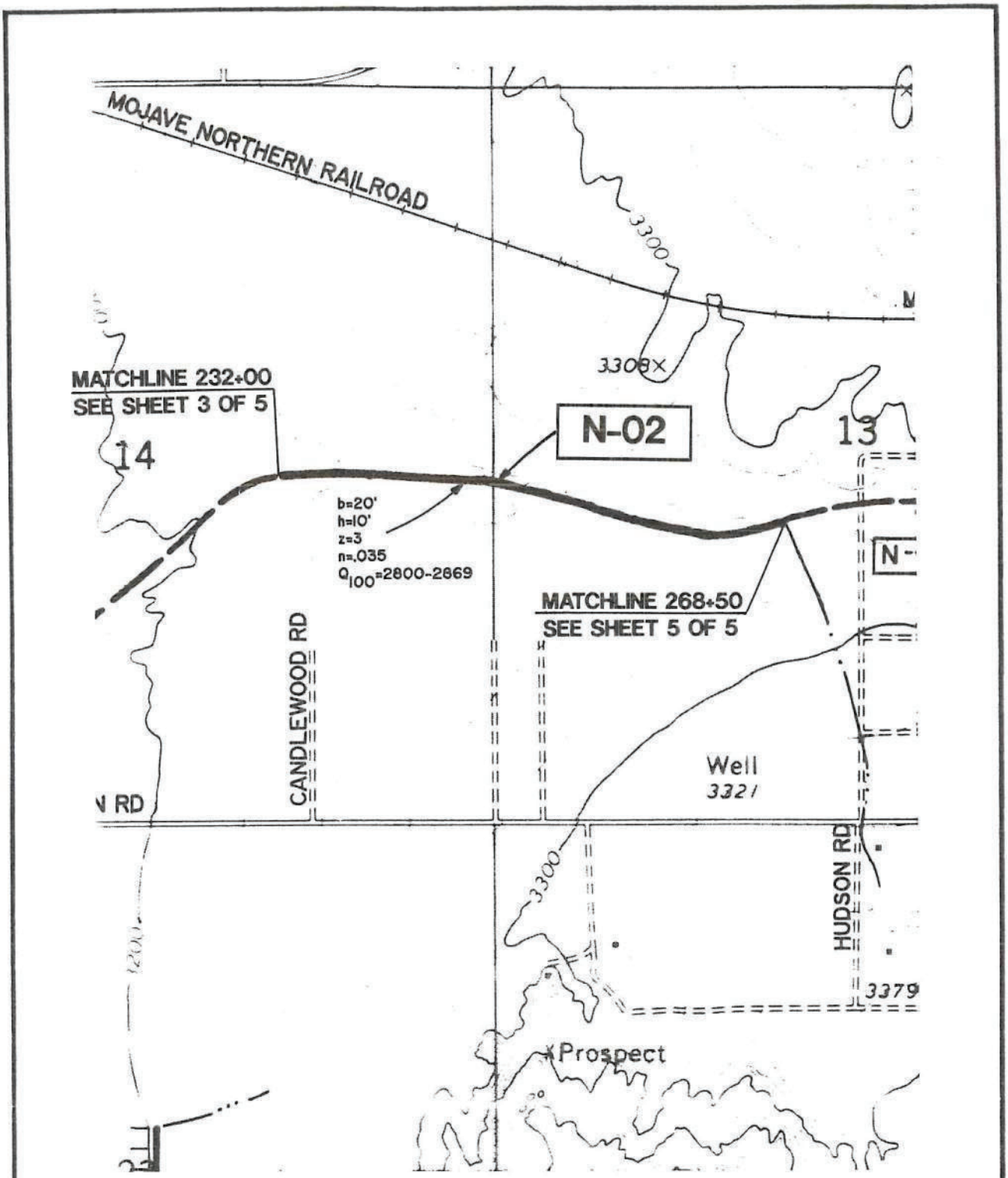
DRAWN BY FCD	CHECKED BY FCD	CHECKED BY WRS	FILE NO.
R.F.	K.J.M.	T.V.H.	

SHEET 1 OF 4 SHEETS — SYS. NO.



LEGEND	WATERSHED BOUNDARY	.....	DRY LAKE H.W.L.
	PROPOSED FACILITY	TTTTTT	LEVEE
	FACILITY SHOWN ELSEWHERE	— ··· —	N.D.C.

APPLE VALLEY MASTER PLAN OF DRAINAGE	COMPREHENSIVE STORM DRAIN PLAN LINE N-02 SHEET 3 OF 5	SCALE 1"=1000' WILLIAMSON & SCHMID



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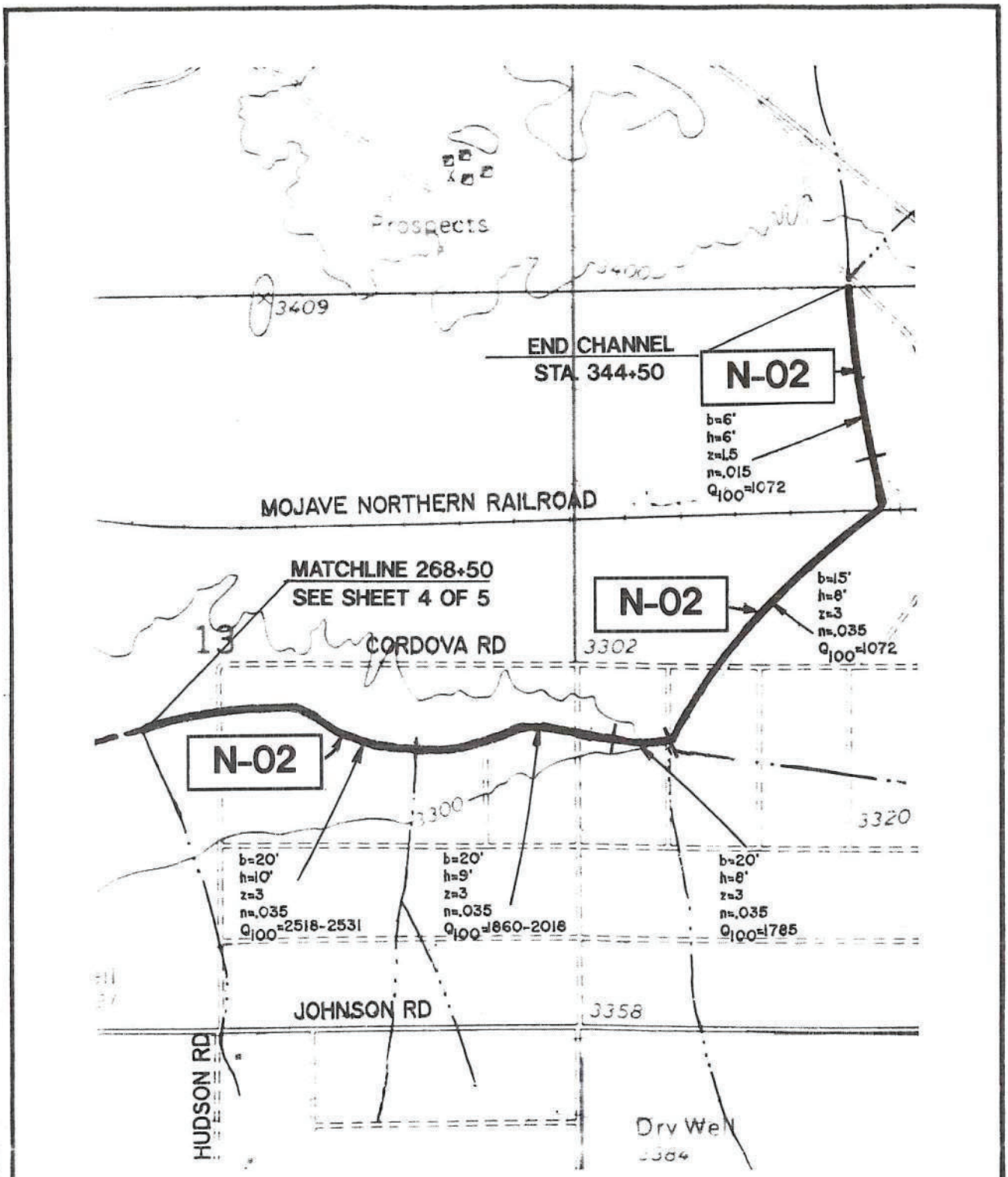
	PROPOSED FACILITY	TTTTTT	LEVEE
	FACILITY SHOWN ELSEWHERE	—···—	N.D.C.

APPLE VALLEY MASTER PLAN OF DRAINAGE	COMPREHENSIVE STORM DRAIN PLAN LINE N-02 SHEET 4 OF 5	SCALE 1"=1000' WILLIAMSON & SCHMID



LEGEND	WATERSHED BOUNDARY	DRY LAKE H.W.L.	
	PROPOSED FACILITY	LEVEE	
	FACILITY SHOWN ELSEWHERE	N.D.C.	

APPLE VALLEY MASTER PLAN OF DRAINAGE	COMPREHENSIVE STORM DRAIN PLAN LINE N-02 SHEET 5 OF 5	SCALE 1"=1000' WILLIAMSON & SCHMID

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT
DESIGN CRITERIA

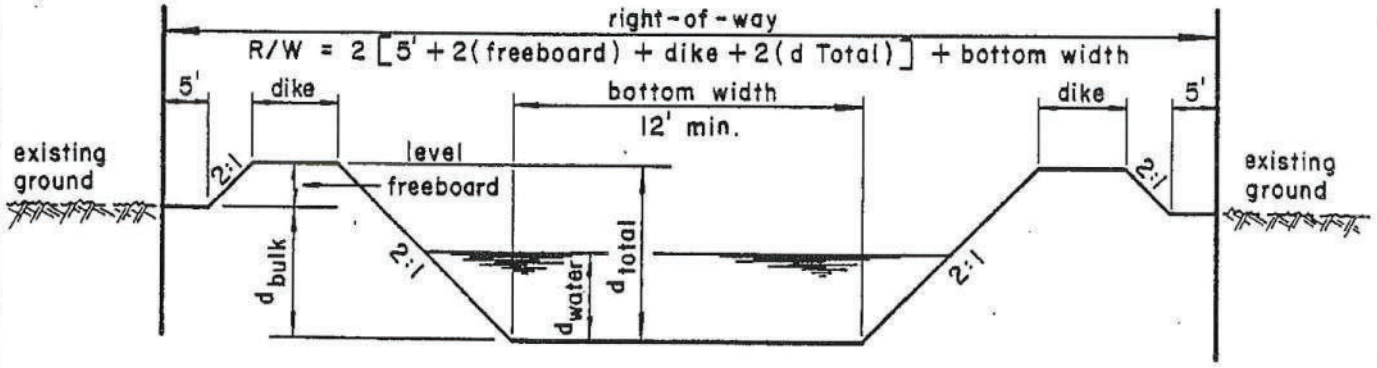
1) Hydrology calculations shall adhere to the San Bernardino County Hydrology Manual.

2) Structural calculations shall adhere to the Los Angeles County Flood Control District Structural Design Manual and to the State of California Department of Transportation Bridge Planning and Design Manuals and the Standard Plans.

3) Basin structural design shall adhere to the Los Angeles County Flood Control District Design Manual for Debris Dams and Basins.

4) Hydraulic design shall adhere to the Los Angeles County Flood Control District Hydraulic Design Manual and to the State of California Department of Transportation Highway Design Manual. Lined drainage facilities shall be designed with a bulking factor of 50% increase in water depth when there are no facilities to remove debris. Closed conduit systems shall be designed with a surface backup system to handle a Q_{100} frequency storm, a bulking factor of 50% increase in Q_{100} and a debris basin system to remove debris. Culverts under roadways, except when connected to lined open channels, shall be designed in accordance with Caltrans Highway Design Manual.

5) Earth channel design shall adhere to the following:
   a) Bulk depth
      i) For graded earth channels, use $d_{bulk} = 1.5 d_{water}$
      ii) For natural drainage courses, compute d_{bulk} based upon $Q_{bulk} = 2\ Q_{100}$
   b) For total depth use $*d_{total} = d_{bulk}$ + freeboard
      * When "V" < 6 f.p.s. - use d_{water} + 2' freeboard
        8 f.p.s. > "V" ≥ 6 f.p.s. use d_{bulk} + 2' freeboard "V" = velocity
        "V" ≥ 8 f.p.s. use d_{bulk} + 3' freeboard
   c) Dike width
      When bottom width = 12' to 40' use dike width + 15'
      bottom width = 40' or more use dike width = 18'



EARTH CHANNEL SECTION

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT		
REVISIONS	DWN. BY	DATE
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Appendix H: CASQA BMP Fact Sheets

Site Design BMPs

SD-10 Site Design & Landscape Planning
SD-12 Efficient Irrigation and Planting
SD-20 Storm Drain Signage
SD-32 Trash Storage Areas

Source Control BMPs

SC-10 Non-Stormwater Discharges
SC-11 Spill Prevention Control and Cleanup
SC-30 Outdoor Loading and Unloading
SC-34 Waste Handling and Disposal
SC-41 Building and Grounds Maintenance
SC-43 Parking Area Maintenance
SC-44 Drainage Area Maintenance

Treatment Control BMPs

TC-11 Infiltration Basin (UG Gravel & Pipes)
TC-22 Extended Detention Basin (Surface)
TC-32 Bioretention (Amended Soils Infiltration Basins)

Manufactured BMPs **(refer to Appendix G for manufacture's specifications**
MP-51 Hydrodynamic Seperator

Apple Valley **Trash Enclosure Standard**

SC-10 Non-Stormwater Discharges

Description

Non-Stormwater discharges (NSWDs) are flows that do not consist entirely of stormwater. Some NSWDs do not include pollutants and may be discharged to the storm drain if local regulations allow. These include uncontaminated groundwater and natural springs. There are also some NSWDs that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include potable water sources, fire hydrant flushing, air conditioner condensate, landscape irrigation drainage and landscape watering, and emergency firefighting, as discussed in section 2 of the Handbook.

However, there are certain NSWDs that pose environmental concerns. These discharges may originate from illegal dumping of industrial material or wastes or from internal floor drains, appliances, industrial processes, sinks, and toilets that are illegally connected to the nearby storm drainage system through on-site drainage and piping. These unauthorized discharges (e.g., process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals, and other pollutants into storm drains.

NSWDs must be addressed through a combination of detection and elimination. The ultimate goal is to effectively eliminate unauthorized NSWDs to the stormwater drainage system by implementing measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants onto streets and into the storm drain system and downstream water bodies.

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*
■ *Substitute Products*

Targeted Constituents	
Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance and Record Keeping	✓

Approach

Initially a discharger must make an assessment of NSWDs to determine which types must be eliminated or addressed through best management practices (BMPs). The focus of the following approach is eliminating unauthorized NSWDs. See

other BMP fact sheets in this series for activity-specific pollution prevention procedures.

General Pollution Prevention Protocols

- Implement waste management controls described in SC-34 Waste Handling and Disposal.
- Develop clear protocols and lines of communication for effectively prohibiting NSWDs, especially those that are not classified as hazardous. These are often not responded to as effectively as they should be.
- Clearly identify storm drains by stenciling or otherwise demarcating them, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste - Drains to Stream" or similar wording on or next to them to warn against ignorant or unintentional dumping of pollutants into the storm drainage system.
- Manage and control sources of water such as hose bibs, faucets, wash racks, and irrigation heads. Identify hoses and faucets in the stormwater pollution prevention plan (SWPPP), and post signage for appropriate use.

NSWD Investigation Protocols

Identifying the sources of NSWDs requires the discharger to conduct an investigation of the facility at regular intervals. There are several categories of NSWDs, including the following:

- Visible, easily identifiable discharges typically generated as surface runoff such as uncontained surface runoff from vehicle or equipment washing.
- Nonvisible (e.g., subsurface) discharges into the site drainage system through a variety of pathways that are not obvious.

The approach to detecting and eliminating NSWDs will vary considerably, as discussed below:

Visible and Identifiable Discharges

- Conduct routine inspections of the facilities and of each major activity area, and identify visible evidence of unauthorized NSWDs. This may include the following:
  - ✓ Visual observations of actual discharges occurring
  - ✓ Evidence of surface staining or discoloring, which indicates that discharges have occurred
  - ✓ Pools of water in low-lying areas when a rain event has not occurred
  - ✓ Discussions with operations personnel to understand practices that might lead to unauthorized discharges
- If evidence of NSWDs is discovered:

- ✓ Document the location and circumstances using worksheets 5 and 6 (in section 2 of the Handbook), including digital photos.
- ✓ Identify and implement any quick remedy or corrective action (e.g., moving uncovered containers inside or to a proper location).
- ✓ Develop a plan to eliminate the discharge. Consult the appropriate activity-specific BMP fact sheet for alternative approaches to manage and eliminate the discharge.

- ☐ Make sure the facility SWPPP is up-to-date and includes applicable BMPs to address the NSWD.

Other Illegal Discharges (Nonvisible)

Illicit Connections

- ☐ Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of as-built piping schematics.
- ☐ Isolate problem areas and plug illicit discharge points.
- ☐ Locate and evaluate discharges to the storm drain system.
- ☐ Perform a visual inspection and inventory:
  - ✓ Inventory and inspect each discharge point during dry weather.
  - ✓ Keep in mind that drainage from a storm event can continue for 1 or 2 days following the end of a storm and groundwater might infiltrate the underground stormwater collection system.
  - ✓ NSWDs are often intermittent and might require periodic inspections.

Infield Piping

- ☐ A review of the as-built piping schematics is a way to determine if there are any connections to the stormwater collection system.
- ☐ Inspect the path of loading/unloading area drain inlets and floor drains in older buildings.
- ☐ Never assume that storm drains are connected to the sanitary sewer system.

Monitor Investigation/Detection of Illegal Discharges

- ☐ If a suspected illegal or unknown discharge is detected, monitoring the discharge might help identify the content and/or the source. This may be done with a field screening analysis or flow meter measurements, or by collecting a sample for laboratory analysis. Section 5 and appendix D in the Handbook describe the necessary field equipment and procedures for field investigations.

- Investigative monitoring can be conducted over time. For example, if a discharge is intermittent, monitoring might be conducted to determine the timing of the discharge to determine the source.

- Investigative monitoring may be conducted over a spatial area. For example, if a discharge is observed in a pipe, monitoring might be conducted at accessible upstream locations to pinpoint the source of the discharge.

- Generally, investigative monitoring requiring collection of samples and submittal for laboratory analysis requires proper planning and specially trained staff.

Smoke Testing

Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two piping systems. Smoke testing is generally performed at a downstream location, and the smoke is forced upstream using blowers to create positive pressure. The advantage to smoke testing is that it can potentially identify multiple potential discharge sources at once.

- Smoke testing uses a harmless, nontoxic smoke cartridges developed specifically for this purpose.

- Smoke testing requires specialized equipment (e.g., cartridges, blowers) and generally should be conducted only by specially trained staff.

- A standard operating procedure (SOP) for smoke testing is highly desirable. The SOP should address the following elements:

  - ✓ Proper planning and notification of nearby residents and emergency services since introducing smoke into the system could result in false alarms.

  - ✓ During dry weather, filling the stormwater collection system with smoke and then tracing the smoke back to sources.

  - ✓ Temporary isolation of segments of pipe using sand bags to force the smoke into leaking pipes.

  - ✓ The appearance of smoke in a waste vent pipe, at a sewer manhole, or even the base of a toilet, indicating that there might be a connection between the sanitary and storm water systems.

- Most municipal wastewater agencies having necessary staff and equipment to conduct smoke testing that should be contacted if cross-connections with the sanitary sewer are suspected. See SC-44 Drainage System Maintenance for more information.

Dye Testing

- Dye testing is typically performed when there is a suspected specific pollutant source and location (i.e., leaking sanitary sewer) and evidence of dry weather flows in the stormwater collection system.

- Dye is released at a probable upstream source location, either the facility's sanitary or process wastewater system. The dye must be released with a sufficient volume of water to flush the system.

- Operators then visually examine the downstream discharge points from the stormwater collection system for the presence of the dye.

- Dye testing can be performed informally using commercially available products to conduct an initial investigation for fairly obvious cross-connections.

- More detailed dye testing should be performed by properly trained staff following SOPs. Specialized equipment such as fluorometers might be necessary to detect low concentrations of dye.

- Most municipal wastewater agencies will have necessary staff and equipment to conduct dye testing, and they should be contacted if cross-connections with the sanitary sewer are suspected.

TV Inspection of Drainage System

- Closed circuit television (CCTV) can be employed to visually identify illicit connections to the industrial storm drainage system. Two types of CCTV systems are available: (1) a small specially designed camera that can be manually pushed on a stiff cable through storm drains to observe the interior of the piping, and (2) a larger remotely operated video camera on treads or wheels that can be guided through storm drains to view the interior of the pipe.

- CCTV systems often include a high-pressure water jet and camera on a flexible cable. The water jet cleans debris and biofilm off the inside of the pipes so the camera can take video images of the pipes' condition.

- CCTV units can detect large cracks and other defects such as offsets in pipe ends caused by root intrusions or shifting substrate.

- CCTV can also be used to detect dye introduced into the sanitary sewer.

- CCTV inspections require specialized equipment and properly trained staff and are generally best left to specialized contractors or municipal public works staff.

Illegal Dumping

- Substances illegally dumped on streets and into the storm drain systems and creeks may include paints, used oil and other automotive fluids, construction debris, chemicals, fresh

concrete, leaves, grass clippings, and pet wastes. These substances can cause quality problems in stormwater and receiving waters as well as clog the storm drain system itself.

- Establish a system for tracking incidents. The system should be designed to identify the following:
  - ✓ Illegal dumping hot spots
  - ✓ Types and quantities (in some cases) of wastes
  - ✓ Patterns in time of occurrence (time of day/night, month, or year)
  - ✓ Mode of dumping (e.g., abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, and accidents/spills)
  - ✓ An anonymous tip/reporting mechanism
  - ✓ Evidence of responsible parties (e.g., tagging or encampments)
- One of the keys to successful reduction or elimination of illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Add some landscaping and beautification to hot spots to discourage future dumping as well as to provide open space and increase property values.
- Lighting or barriers might also be needed to discourage future dumping.
- See fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of NSWDs.
- Proactively conduct investigations of high-priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for proactive investigations.

Spill and Leak Prevention and Response

- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or hazmat team may be necessary.
- See SC-11 Spill Prevention, Control, and Cleanup.

Employee Training Program

- Training of technical staff in identifying and documenting illegal dumping incidents is required. The frequency of training must be specified in the SWPPP and depends on site-specific industrial materials and activities.
- Consider posting a quick reference table near storm drains to reinforce training.
- Train employees to identify NSWDs and report discharges to the appropriate department.
- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur. Employees should be familiar with the spill prevention control and countermeasure plan. Employees should be able to identify work/jobs with high potential for spills and suggest methods to reduce the potential.
- Determine and implement appropriate outreach efforts to reduce non-permissible NSWDs.
- Conduct spill response drills annually (if no events occurred) to evaluate the effectiveness of the plan.
- When a responsible party is identified, educate the party on the impacts of his or her actions.
- Document training activities.

Quality Assurance and Record Keeping

Performance Evaluation

- Annually review internal investigation results; assess whether goals were met and what changes or improvements are necessary.

- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.
- Develop document and data management procedures.
- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited NSWDs observed during the course of normal daily activities so they can be investigated, contained, and cleaned up or eliminated.
- Document that NSWDs have been eliminated by recording tests performed, methods used, dates of testing, and any on-site drainage points observed.
- Annually document and report the results of the program.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.
- Document training activities.

Potential Limitations and Work-Arounds

Some facilities may have space constraints, limited staffing, and time limitations that can preclude implementation of BMPs. Following are some typical limitations and recommended "work-arounds:"

- Many facilities do not have accurate, up-to-date as-built plans or drawings that might be necessary to conduct NSWD assessments.
  - ✓ Online tools such as Google Earth can provide an aerial view of the facility and may be useful in understanding drainage patterns and potential sources of NSWDs.
  - ✓ Local municipal jurisdictions may have useful drainage systems maps.
- Video surveillance cameras are commonly used to secure the perimeter of industrial facilities against break-ins and theft. These surveillance systems may also be useful for capturing illegal dumping activities. Minor, temporary adjustments to the field of view of existing surveillance camera systems to target known or suspected problem areas may be a cost-effective way of capturing illegal dumping activities and identifying the perpetrators.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Capital facility cost requirements may be minimal unless cross-connections to storm drains are detected.

- Indoor floor drains may require replumbing if cross-connections are detected.
- Leaky sanitary sewers will require repair or replacement, which can have significant costs depending on the size and industrial activity at the facility.

Maintenance (including administrative and staffing)

- The primary effort is for staff time and depends on how aggressively a program is implemented.
- Costs for containment and disposal of any leak or discharge is borne by the discharger.
- Illicit connections can be difficult to locate, especially if there is groundwater infiltration.
- Illegal dumping and illicit connection violations require technical staff to detect and investigate them.

Supplemental Information

Permit Requirements

The IGP authorizes certain NSWDs, provided BMPs are included in the SWPPP and implemented to:

- Reduce or prevent the contact of authorized NSWDs with materials or equipment that are potential sources of pollutants;
- Reduce, to the extent practicable, the flow or volume of authorized NSWDs;
- Ensure that authorized NSWDs do not contain quantities of pollutants that cause or contribute to an exceedance of a water quality standards; and
- Reduce or prevent discharges of pollutants in authorized NSWDs in a manner that reflects best industry practice considering technological availability and economic practicability and achievability.

References and Resources

Center for Watershed Protection. 2004. *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*. EPA Cooperative Agreement X-82907801-0. Available online at https://www3.epa.gov/npdes/pubs/idde_manualwithappendices.pdf.

Orange County Stormwater Program. n.d. Best Management Practices for Industrial/Commercial Business Activities. Available online at http://ocwatersheds.com/documents/bmp/industrialcommercialbusinessesactivities.

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https://waterresources.saccounty.net/stormwater/Pages/best-management-practices.aspx.

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Southern California Coastal Water Research Project. 2013. *The California Microbial Source Identification Manual: A Tiered Approach to Identifying Fecal Pollution Sources to Beaches*. Technical Report 804. Available online at http://swrcb.ca.gov/water_issues/programs/beaches/cbi_projects/docs/sipp_manual.pdf.

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U.S. Environmental Protection Agency. 2017. National Pollutant Discharge Elimination System. Available online at https://www.epa.gov/npdes.

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Efficient Irrigation & Planting SD-12

Photo: SFPUC Urban Watershed Management Program

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage

Description

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

Approach

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

Applicability

This fact sheet is applicable to planting and irrigation systems of residential, commercial, and industrial areas in new development and redevelopment projects as defined by various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.). These plans define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land distributing activities with structural or impervious surfaces.

Design Considerations

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

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.

- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.
- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species).
- Consider design features such as:
  - Using mulches (such as wood chips or bark) in planter areas without ground cover to minimize sediment in runoff;
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect;
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible; and
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth.
- Employ other comparable, equally effective methods to reduce irrigation water runoff.
- Note that Assembly Bill 1881, the Model Water Efficiency Landscape Ordinance, requires the use of efficient irrigation and compatible plantings for any project over 2055 square feet.

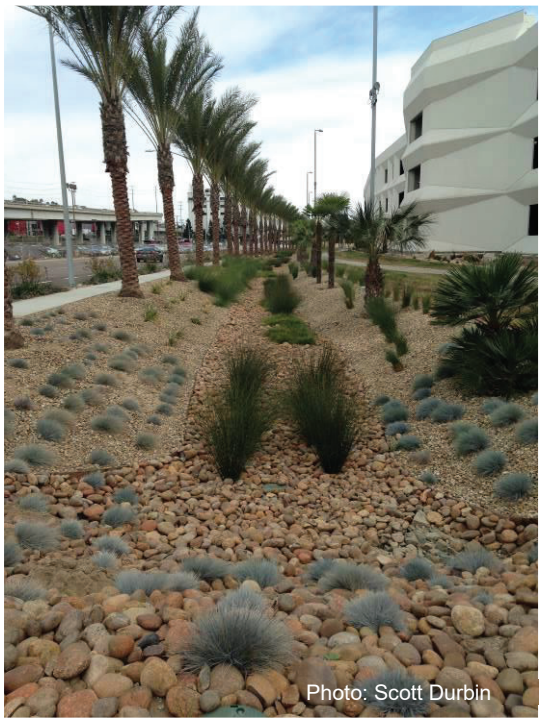


Figure 1. Swale at San Diego Airport with rock mulch, low-water plantings, and irrigation controls.

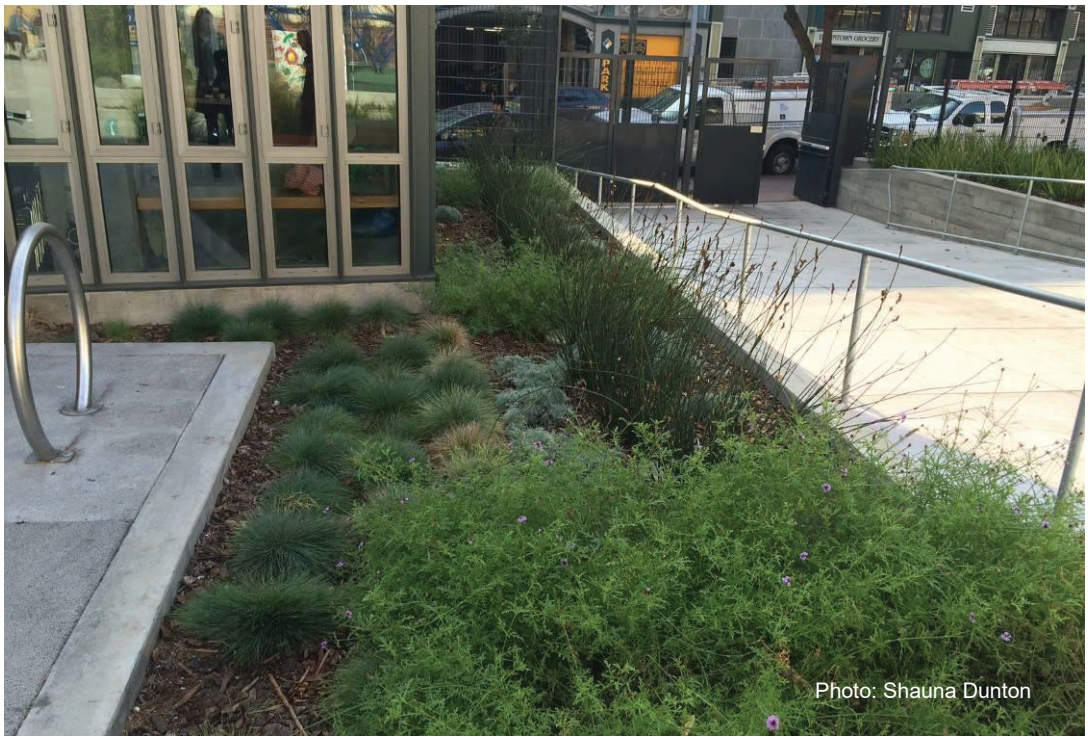


Figure 2. Mulched landscape area adjacent to permeable concrete at a public park in San Francisco.

Figure 3. Downspout to mulched flow-through planter bed in project courtyard.

Other Resources

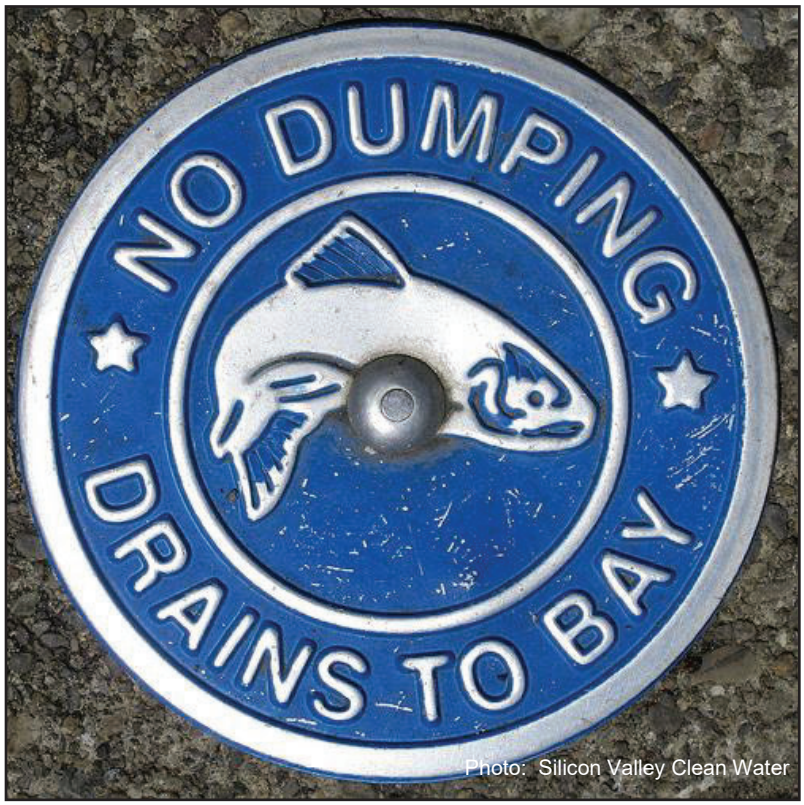
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

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

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

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

Storm Drain Signage SD-20



http://www.svcw.org/facilities/sitePages/discharge to sf bay.aspx

Design Objectives

- Cover
- Contain
- Reduce/Minimize
- ☑ Prohibit Dumping
- Collect & Convey

Targeted Constituents

- ☑ Sediment
- ☑ Nutrients
- ☑ Trash
- ☑ Metals
- ☑ Bacteria
- ☑ Oil & Grease
- ☑ Synthetic Organics
- ☑ Pesticides

Description

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

Approach

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

Applicability

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

Design considerations provided are applicable to new development and redevelopment as defined by various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.). These plans define “redevelopment” in terms of amounts of additional impervious

area, increases in gross floor area and/or exterior construction, and land distributing activities with structural or impervious surfaces.

Design Considerations

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

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

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING – DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.
- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

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

Additional Information

Maintenance Considerations

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

Examples

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

Other Resources

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

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

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

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

Trash Storage Areas SD-32

Photo Credit: GSM Landscape Architects

Design Objectives

- ☑ Cover
- ☑ Contain
- Reduce/Minimize
- ☑ Prohibit Dumping
- ☑ Collect & Convey

Targeted Constituents

- Sediment
- ☑ Nutrients
- ☑ Trash
- Metals
- ☑ Bacteria
- ☑ Oil & Grease
- ☑ Synthetic Organics
- ☑ Pesticides

Description

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

Approach

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

Suitable Applications

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

Design considerations provided are applicable to new development and redevelopment as defined by various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.). These plans define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land distributing activities with structural or impervious surfaces.

Design Considerations

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

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

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

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash and minimize pest entry options.
- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Additional Information

Maintenance Considerations

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

Other Resources

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

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

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

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

SC-10 Non-Stormwater Discharges

Description

Non-Stormwater discharges (NSWDs) are flows that do not consist entirely of stormwater. Some NSWDs do not include pollutants and may be discharged to the storm drain if local regulations allow. These include uncontaminated groundwater and natural springs. There are also some NSWDs that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include potable water sources, fire hydrant flushing, air conditioner condensate, landscape irrigation drainage and landscape watering, and emergency firefighting, as discussed in section 2 of the Handbook.

However, there are certain NSWDs that pose environmental concerns. These discharges may originate from illegal dumping of industrial material or wastes or from internal floor drains, appliances, industrial processes, sinks, and toilets that are illegally connected to the nearby storm drainage system through on-site drainage and piping. These unauthorized discharges (e.g., process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals, and other pollutants into storm drains.

NSWDs must be addressed through a combination of detection and elimination. The ultimate goal is to effectively eliminate unauthorized NSWDs to the stormwater drainage system by implementing measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants onto streets and into the storm drain system and downstream water bodies.

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*
■ *Substitute Products*

Targeted Constituents	
Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance and Record Keeping	✓

Approach

Initially a discharger must make an assessment of NSWDs to determine which types must be eliminated or addressed through best management practices (BMPs). The focus of the following approach is eliminating unauthorized NSWDs. See

other BMP fact sheets in this series for activity-specific pollution prevention procedures.

General Pollution Prevention Protocols

- Implement waste management controls described in SC-34 Waste Handling and Disposal.
- Develop clear protocols and lines of communication for effectively prohibiting NSWDs, especially those that are not classified as hazardous. These are often not responded to as effectively as they should be.
- Clearly identify storm drains by stenciling or otherwise demarcating them, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste - Drains to Stream" or similar wording on or next to them to warn against ignorant or unintentional dumping of pollutants into the storm drainage system.
- Manage and control sources of water such as hose bibs, faucets, wash racks, and irrigation heads. Identify hoses and faucets in the stormwater pollution prevention plan (SWPPP), and post signage for appropriate use.

NSWD Investigation Protocols

Identifying the sources of NSWDs requires the discharger to conduct an investigation of the facility at regular intervals. There are several categories of NSWDs, including the following:

- Visible, easily identifiable discharges typically generated as surface runoff such as uncontained surface runoff from vehicle or equipment washing.
- Nonvisible (e.g., subsurface) discharges into the site drainage system through a variety of pathways that are not obvious.

The approach to detecting and eliminating NSWDs will vary considerably, as discussed below:

Visible and Identifiable Discharges

- Conduct routine inspections of the facilities and of each major activity area, and identify visible evidence of unauthorized NSWDs. This may include the following:
  - ✓ Visual observations of actual discharges occurring
  - ✓ Evidence of surface staining or discoloring, which indicates that discharges have occurred
  - ✓ Pools of water in low-lying areas when a rain event has not occurred
  - ✓ Discussions with operations personnel to understand practices that might lead to unauthorized discharges
- If evidence of NSWDs is discovered:

- ✓ Document the location and circumstances using worksheets 5 and 6 (in section 2 of the Handbook), including digital photos.
- ✓ Identify and implement any quick remedy or corrective action (e.g., moving uncovered containers inside or to a proper location).
- ✓ Develop a plan to eliminate the discharge. Consult the appropriate activity-specific BMP fact sheet for alternative approaches to manage and eliminate the discharge.

- ☐ Make sure the facility SWPPP is up-to-date and includes applicable BMPs to address the NSWD.

Other Illegal Discharges (Nonvisible)

Illicit Connections

- ☐ Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of as-built piping schematics.
- ☐ Isolate problem areas and plug illicit discharge points.
- ☐ Locate and evaluate discharges to the storm drain system.
- ☐ Perform a visual inspection and inventory:
  - ✓ Inventory and inspect each discharge point during dry weather.
  - ✓ Keep in mind that drainage from a storm event can continue for 1 or 2 days following the end of a storm and groundwater might infiltrate the underground stormwater collection system.
  - ✓ NSWDs are often intermittent and might require periodic inspections.

Infield Piping

- ☐ A review of the as-built piping schematics is a way to determine if there are any connections to the stormwater collection system.
- ☐ Inspect the path of loading/unloading area drain inlets and floor drains in older buildings.
- ☐ Never assume that storm drains are connected to the sanitary sewer system.

Monitor Investigation/Detection of Illegal Discharges

- ☐ If a suspected illegal or unknown discharge is detected, monitoring the discharge might help identify the content and/or the source. This may be done with a field screening analysis or flow meter measurements, or by collecting a sample for laboratory analysis. Section 5 and appendix D in the Handbook describe the necessary field equipment and procedures for field investigations.

- Investigative monitoring can be conducted over time. For example, if a discharge is intermittent, monitoring might be conducted to determine the timing of the discharge to determine the source.

- Investigative monitoring may be conducted over a spatial area. For example, if a discharge is observed in a pipe, monitoring might be conducted at accessible upstream locations to pinpoint the source of the discharge.

- Generally, investigative monitoring requiring collection of samples and submittal for laboratory analysis requires proper planning and specially trained staff.

Smoke Testing

Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two piping systems. Smoke testing is generally performed at a downstream location, and the smoke is forced upstream using blowers to create positive pressure. The advantage to smoke testing is that it can potentially identify multiple potential discharge sources at once.

- Smoke testing uses a harmless, nontoxic smoke cartridges developed specifically for this purpose.

- Smoke testing requires specialized equipment (e.g., cartridges, blowers) and generally should be conducted only by specially trained staff.

- A standard operating procedure (SOP) for smoke testing is highly desirable. The SOP should address the following elements:

  - ✓ Proper planning and notification of nearby residents and emergency services since introducing smoke into the system could result in false alarms.

  - ✓ During dry weather, filling the stormwater collection system with smoke and then tracing the smoke back to sources.

  - ✓ Temporary isolation of segments of pipe using sand bags to force the smoke into leaking pipes.

  - ✓ The appearance of smoke in a waste vent pipe, at a sewer manhole, or even the base of a toilet, indicating that there might be a connection between the sanitary and storm water systems.

- Most municipal wastewater agencies having necessary staff and equipment to conduct smoke testing that should be contacted if cross-connections with the sanitary sewer are suspected. See SC-44 Drainage System Maintenance for more information.

Dye Testing

- Dye testing is typically performed when there is a suspected specific pollutant source and location (i.e., leaking sanitary sewer) and evidence of dry weather flows in the stormwater collection system.

- Dye is released at a probable upstream source location, either the facility's sanitary or process wastewater system. The dye must be released with a sufficient volume of water to flush the system.

- Operators then visually examine the downstream discharge points from the stormwater collection system for the presence of the dye.

- Dye testing can be performed informally using commercially available products to conduct an initial investigation for fairly obvious cross-connections.

- More detailed dye testing should be performed by properly trained staff following SOPs. Specialized equipment such as fluorometers might be necessary to detect low concentrations of dye.

- Most municipal wastewater agencies will have necessary staff and equipment to conduct dye testing, and they should be contacted if cross-connections with the sanitary sewer are suspected.

TV Inspection of Drainage System

- Closed circuit television (CCTV) can be employed to visually identify illicit connections to the industrial storm drainage system. Two types of CCTV systems are available: (1) a small specially designed camera that can be manually pushed on a stiff cable through storm drains to observe the interior of the piping, and (2) a larger remotely operated video camera on treads or wheels that can be guided through storm drains to view the interior of the pipe.

- CCTV systems often include a high-pressure water jet and camera on a flexible cable. The water jet cleans debris and biofilm off the inside of the pipes so the camera can take video images of the pipes' condition.

- CCTV units can detect large cracks and other defects such as offsets in pipe ends caused by root intrusions or shifting substrate.

- CCTV can also be used to detect dye introduced into the sanitary sewer.

- CCTV inspections require specialized equipment and properly trained staff and are generally best left to specialized contractors or municipal public works staff.

Illegal Dumping

- Substances illegally dumped on streets and into the storm drain systems and creeks may include paints, used oil and other automotive fluids, construction debris, chemicals, fresh

concrete, leaves, grass clippings, and pet wastes. These substances can cause quality problems in stormwater and receiving waters as well as clog the storm drain system itself.

- Establish a system for tracking incidents. The system should be designed to identify the following:
  - ✓ Illegal dumping hot spots
  - ✓ Types and quantities (in some cases) of wastes
  - ✓ Patterns in time of occurrence (time of day/night, month, or year)
  - ✓ Mode of dumping (e.g., abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, and accidents/spills)
  - ✓ An anonymous tip/reporting mechanism
  - ✓ Evidence of responsible parties (e.g., tagging or encampments)
- One of the keys to successful reduction or elimination of illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Add some landscaping and beautification to hot spots to discourage future dumping as well as to provide open space and increase property values.
- Lighting or barriers might also be needed to discourage future dumping.
- See fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of NSWDs.
- Proactively conduct investigations of high-priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for proactive investigations.

Spill and Leak Prevention and Response

- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or hazmat team may be necessary.
- See SC-11 Spill Prevention, Control, and Cleanup.

Employee Training Program

- Training of technical staff in identifying and documenting illegal dumping incidents is required. The frequency of training must be specified in the SWPPP and depends on site-specific industrial materials and activities.
- Consider posting a quick reference table near storm drains to reinforce training.
- Train employees to identify NSWDs and report discharges to the appropriate department.
- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur. Employees should be familiar with the spill prevention control and countermeasure plan. Employees should be able to identify work/jobs with high potential for spills and suggest methods to reduce the potential.
- Determine and implement appropriate outreach efforts to reduce non-permissible NSWDs.
- Conduct spill response drills annually (if no events occurred) to evaluate the effectiveness of the plan.
- When a responsible party is identified, educate the party on the impacts of his or her actions.
- Document training activities.

Quality Assurance and Record Keeping

Performance Evaluation

- Annually review internal investigation results; assess whether goals were met and what changes or improvements are necessary.

- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.
- Develop document and data management procedures.
- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited NSWDs observed during the course of normal daily activities so they can be investigated, contained, and cleaned up or eliminated.
- Document that NSWDs have been eliminated by recording tests performed, methods used, dates of testing, and any on-site drainage points observed.
- Annually document and report the results of the program.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.
- Document training activities.

Potential Limitations and Work-Arounds

Some facilities may have space constraints, limited staffing, and time limitations that can preclude implementation of BMPs. Following are some typical limitations and recommended "work-arounds:"

- Many facilities do not have accurate, up-to-date as-built plans or drawings that might be necessary to conduct NSWD assessments.
  - ✓ Online tools such as Google Earth can provide an aerial view of the facility and may be useful in understanding drainage patterns and potential sources of NSWDs.
  - ✓ Local municipal jurisdictions may have useful drainage systems maps.
- Video surveillance cameras are commonly used to secure the perimeter of industrial facilities against break-ins and theft. These surveillance systems may also be useful for capturing illegal dumping activities. Minor, temporary adjustments to the field of view of existing surveillance camera systems to target known or suspected problem areas may be a cost-effective way of capturing illegal dumping activities and identifying the perpetrators.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Capital facility cost requirements may be minimal unless cross-connections to storm drains are detected.

- Indoor floor drains may require replumbing if cross-connections are detected.
- Leaky sanitary sewers will require repair or replacement, which can have significant costs depending on the size and industrial activity at the facility.

Maintenance (including administrative and staffing)

- The primary effort is for staff time and depends on how aggressively a program is implemented.
- Costs for containment and disposal of any leak or discharge is borne by the discharger.
- Illicit connections can be difficult to locate, especially if there is groundwater infiltration.
- Illegal dumping and illicit connection violations require technical staff to detect and investigate them.

Supplemental Information

Permit Requirements

The IGP authorizes certain NSWDs, provided BMPs are included in the SWPPP and implemented to:

- Reduce or prevent the contact of authorized NSWDs with materials or equipment that are potential sources of pollutants;
- Reduce, to the extent practicable, the flow or volume of authorized NSWDs;
- Ensure that authorized NSWDs do not contain quantities of pollutants that cause or contribute to an exceedance of a water quality standards; and
- Reduce or prevent discharges of pollutants in authorized NSWDs in a manner that reflects best industry practice considering technological availability and economic practicability and achievability.

References and Resources

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SC-11 Spill Prevention, Control, and Cleanup

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental spills. Preparation for these spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify hazardous material storage areas, specify material handling procedures, describe spill response procedures, and provide locations of spill cleanup equipment and materials. The plan should include steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills. An adequate supply of spill cleanup materials must be maintained on-site.

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*
■ *Substitute Products*

Targeted Constituents	
Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered	
Good Housekeeping	
Preventative Maintenance	✓
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance and Record Keeping	✓

Approach

General Pollution Prevention Protocols

- ☐ Develop procedures to prevent/mitigate spills to storm drain systems.
- ☐ Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.
- ☐ Establish procedures and/or controls to minimize spills and leaks. The procedures should provide the following:
  - ✓ A description of the facility, owner and address, activities, chemicals, and quantities present

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- ✓ A facility map of the location(s) of industrial materials
- ✓ Notification and evacuation procedures
- ✓ Cleanup instructions
- ✓ Identification of responsible departments
- ✓ Identification of key spill response personnel

- ☐ Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials brought into the facility.

Spill and Leak Prevention and Response

Spill Prevention

- ☐ Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- ☐ If illegal dumping is observed at the facility:

  - ✓ Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - ✓ Add some landscaping and beautification to hot spots to discourage illegal dumping.
  - ✓ Bright lighting and/or entrance barriers might also be needed to discourage illegal dumping.

- ☐ Store and contain liquid materials so if the container ruptures, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

- ☐ If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

Preventative Maintenance

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

- Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.

- Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain*.

- Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).

- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).

- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).

- Identify key spill response personnel.

Spill Response

- Clean up leaks and spills immediately.

- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).

- On paved surfaces, clean up spills with as little water as possible.

  - ✓ Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills.

  - ✓ If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

  - ✓ If possible use physical methods for the cleanup of dry chemicals (e.g., brooms, shovels, sweepers, or vacuums).

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.

- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.

- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board or local authority as location regulations dictate.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center at 800-424-8802 (24 hours).
- Report spills to 911 for dispatch and cleanup assistance when needed. Do not contact fire agencies directly.
- Establish a system for tracking incidents. The system should be designed to identify the following incident-related information:
  - ✓ Types and quantities (in some cases) of wastes
  - ✓ Patterns in time of occurrence (time of day/night, month, or year)
  - ✓ Mode of dumping (e.g., abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, and accidents/spills)
  - ✓ Cleanup procedures
  - ✓ Responsible parties

Employee Training Program

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills:
  - ✓ Employees should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
  - ✓ Employees should be familiar with the spill prevention, control, and countermeasure (SPCC) plan.
- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the SPCC plan, and the plan should be readily available.
- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- State regulations require that facilities with a storage capacity of 10,000 gallons or more of petroleum prepare a SPCC plan (California Health & Safety Code Chapter 6.67).
- State regulations also exist for storage of hazardous materials, including the preparation of area and business plans for emergency response to releases or threatened releases (California Health & Safety Code Chapter 6.95).
- Consider requiring smaller secondary containment areas (less than 200 square feet) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including Capital and Operation & Maintenance)

- Costs will vary depending on the size of the facility and the necessary controls.
- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including Administrative and Staffing)

- Develop an SPCC plan, provide and document training, conduct inspections of material storage areas, and supply spill kits.
- Extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Quality Assurance and Record Keeping

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of best management practices (BMPs). A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. Set up a record keeping and reporting system for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge

- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

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

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

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

Supplemental Information

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from tanks can accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are the following:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from a truck or rail car to a storage tank or from a storage tank to a truck or rail car

SC-11 Spill Prevention, Control, and Cleanup

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Employ the following practices to enhance the code requirements:

- Place tanks in a designated area.
- Encapsulate tanks located in areas where firearms are discharged in concrete or the equivalent.
- Ensure that designated areas are impervious, paved with Portland cement concrete, and free of cracks and gaps to contain leaks and spills.
- Store liquid materials in double walled tanks approved by Underwriters Laboratories or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, install a dead-end sump in the drain.
- Drain all other liquids to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Pass accumulated stormwater in petroleum storage areas through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanges, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from a truck or rail car to a storage facility or from a storage facility to a truck or rail car.
- Visually inspect a new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, tank walls, and the piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that might weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.

- Have a qualified professional periodically conduct integrity testing.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained hazmat teams from local fire departments or environmental health departments. In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities and pertaining to leaks and smaller spills at vehicle maintenance shops.

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair any identified leaks immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment on-site.
- Always use secondary containment such as a drip pan or drop cloth to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use absorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Do not leave full drip pans or other open containers lying around.
- Oil filters disposed of in trash cans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.
- Store cracked batteries in a nonleaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- ☐ Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - ✓ Cover fueling area if possible.
  - ✓ Use a perimeter drain or slope pavement inward with drainage to a sump.
  - ✓ Pave fueling area with concrete rather than asphalt.
- ☐ If a dead-end sump is not used to collect spills, install an oil/water separator.
- ☐ Install vapor recovery nozzles to help control drips as well as air pollution.
- ☐ Discourage "topping-off" of fuel tanks.
- ☐ Use secondary containment when transferring fuel from a tank truck to a fuel tank.
- ☐ Use absorbent materials on small spills and general cleaning rather than hosing down the area. Remove the absorbent materials promptly.
- ☐ Carry out all federal and state requirements regarding underground storage tanks, or install aboveground tanks.
- ☐ Do not use mobile fueling of mobile industrial equipment around the facility; instead, transport the equipment to designated fueling areas.
- ☐ Keep your SPCC plan up to date.
- ☐ Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

In developing a spill prevention and response program to meet stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook for specific activities.

The program should:

- ☐ Integrate with existing emergency response/hazardous materials programs (e.g., the fire department);
- ☐ Contain procedures to prevent/mitigate spills to storm drain systems;
- ☐ Identify responsible departments;
- ☐ Contain standardized reporting procedures; containment, storage, and disposal activities; documentation; and follow-up procedures;

- Address spills at municipal facilities, as well as public areas; and
- Provide training concerning spill prevention, response, and cleanup for all appropriate personnel.

SC-11 Spill Prevention, Control, and Cleanup

References and Resources

California Environmental Protection Agency. 2017. *California's Nonpoint Source Program Plan*. Available online at http://www.waterboards.ca.gov/water_issues/programs/nps/.

Clark County Washington. 2015. *Clark County Storm Water Pollution Control Manual*. Available online at https://www.clark.wa.gov/public-works/stormwater-code-and-manual.

King County Washington. 2016. *King County Storm Water Pollution Control Manual*. Available online at https://kingcounty.gov/services/environment/water-and-land/stormwater/documents/pollution-prevention-manual.aspx.

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Santa Clara Valley Urban Runoff Pollution Prevention Program. Online at https://www.sccgov.org/sites/cwp/Pages/scvurppp.aspx.

The Stormwater Managers Resource Center. 2017. Online at http://www.stormwatercenter.net/.

SC-30 Outdoor Loading and Unloading

Description

The loading and unloading of materials usually occurs outdoors on docks or terminals. If materials are spilled, leak, or are lost during those activities, they may collect in the soil or on other surfaces and have the potential to be carried away by wind or stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move the materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading and unloading of materials.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and best management practice (BMP) implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- ☐ Limit exposure of material to rainfall whenever possible.
- ☐ Prevent stormwater run-on.
- ☐ Check equipment regularly for leaks.

Good Housekeeping

- ☐ Develop an operations plan that provides procedures for loading and unloading activities.
- ☐ Conduct loading and unloading activities in dry weather if possible.

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*
■ *Substitute Products*

Targeted Constituents	
Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	✓
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance and Record Keeping	✓

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SC-30 Outdoor Loading and Unloading

- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and a building to prevent exposure of the materials to rain.
- Design loading and unloading areas to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading and unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks when feasible.
- Load and unload only in designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip-collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains inlets in the area.
- Grade and/or berm the loading and unloading area with drainage to a sump; regularly remove materials accumulated in the sump.

Spill and Leak Response and Prevention

- Keep your spill prevention, control, and countermeasure (SPCC) plan up to date or have an emergency spill cleanup plan readily available, as applicable.
- Contain leaks during transfer of liquid materials.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all employees.
- Ensure that employees are familiar with the site's SPCC plan and proper spill cleanup procedures.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

Material Handling and Waste Management

- "Spot clean" leaks and drips routinely to prevent runoff of spillage.
- Do not pour liquid wastes into floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- Do not put used or leftover cleaning solutions, solvents, or automotive fluids in the storm drain or sanitary sewer.

SC-30 Outdoor Loading and Unloading

- Collect leaking or dripping fluids in drip pans or containers. Fluids are easier to recycle if kept separate.
- Promptly transfer used fluids to the proper waste or recycling drums. Do not leave drip pans or other open containers lying around.
- Minimize the possibility of stormwater pollution from outside waste receptacles by doing at least one of the following:
  - ✓ Use only watertight waste receptacles and keep the lids closed.
  - ✓ Grade and pave the waste receptacle area to prevent run-on of stormwater.
  - ✓ Install a roof over the waste receptacle area.
  - ✓ Install a low containment berm around the waste receptacle area.
  - ✓ Use and maintain drip pans under waste receptacles.
- Post "No littering" signs.
- Perform work area cleanup and dry sweep after daily operations.

Employee Training Program

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading and unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

Quality Assurance and Record Keeping

- Keep accurate maintenance logs that document activities performed, quantities of materials removed, and improvement actions taken.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and what method was used to dispose of it.
- Establish procedures to complete logs and file them in the central office.
- Keep accurate logs of daily cleanup operations.

SC-30 Outdoor Loading and Unloading

Potential Limitations and Work-Arounds

Some facilities may have space constraints, limited staffing, and time limitations that preclude implementation of BMPs. Provided below are typical limitations and recommended work-arounds.

- Space and time limitations might preclude all transfers from being performed indoors or under cover.
  - ✓ Designate specific areas for outdoor loading and unloading.
  - ✓ Require employees to understand and follow spill and leak prevention BMPs.
- It may not be possible to conduct transfers only during dry weather.
  - ✓ Limit exposure of materials and equipment to rainfall to the maximum extent practicable.
  - ✓ Require employees to understand and follow spill and leak prevention BMPs.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

Many facilities already have indoor or covered areas for loading and unloading activities and will require no additional capital expenditures.

If outdoor activities are required, construction of berms or other means to retain spills and leaks may require appropriate constructed systems for containment. These containment areas may require significant new capital investment.

Capital investments will likely be required at some sites if cover and containment facilities are inadequate and can vary significantly depending upon site conditions.

Maintenance

Most of the operations and maintenance (O&M) activities associated with implementing this BMP are integrally linked to routine operations as previously described. Therefore, additional O&M is not required.

- Conduct regular inspections and make repairs and improvements as necessary.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area. Do not wash with water.

Supplemental Information

Loading and Unloading of Liquids

- Loading and unloading of liquids should occur in a manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer

or treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to aboveground and underground storage tanks, the following procedures should be used:
  - ✓ The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - ✓ The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.
  - ✓ The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.
- For transfer from rail cars to storage tanks that must occur outdoors, use the following procedures:
  - ✓ Place drip pans at locations where spillage may occur such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - ✓ Drip pan systems should be installed between the rails to collect spillage from the tank cars.

References and Resources

Minnesota Pollution Control Agency.2015. *Industrial Stormwater Best Management Practices Guidebook BMP 26 Fueling and Liquid Loading/Unloading Operations*. Available online at http://www.pca.state.mn.us/index.php/view-document.html?gid=10557.

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SC-34 Waste Handling and Disposal

Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and best management practice (BMP) implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Accomplish reduction in the amount of waste generated using the following source controls:
  - ✓ Production planning and sequencing;
  - ✓ Process or equipment modification;
  - ✓ Raw material substitution or elimination;
  - ✓ Loss prevention and housekeeping;
  - ✓ Waste segregation and separation; and
  - ✓ Close loop recycling.
- ☐ Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- ☐ Recycle materials whenever possible.

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*
■ *Substitute Products*

Targeted Constituents	
Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	✓
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	✓
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance and Record Keeping	✓

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- Use the entire product before disposing of the container.
- To the maximum extent possible, store wastes under cover or indoors after ensuring that all safety concerns such as fire hazard and ventilation have been addressed.
- Provide containers for each waste stream at each work station. Allow time after each shift to clean area.

Good Housekeeping

- Cover storage containers with leakproof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater run-on and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Dispose of rinse water and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain. Clean the containers in a designated wash area that drains to a clarifier.
- Transfer waste from damaged containers into safe containers.
- Take special care to minimize losses when loading or unloading wastes. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- When cleaning around restaurant/food handling dumpster areas, use dry methods when possible (e.g., sweeping, use of absorbents). If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- Stencil or demarcate storm drains on the facility's property with a prohibitive message regarding waste disposal.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropylene, or hypalon.
- If possible, move the activity indoor after ensuring that all safety concerns such as fire hazard and ventilation have been addressed.

Preventative Maintenance

- Prevent stormwater run-on from entering the waste management area by enclosing the area or building a berm around the area.

- ☐ Prevent rain from directly contacting waste materials.
- ☐ Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropylene, or hypalon.
- ☐ Cover the area with a permanent roof if feasible.
- ☐ Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- ☐ Check waste containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- ☐ Sweep and clean the waste management area regularly. Use dry methods when possible (e.g., sweeping, vacuuming, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- ☐ Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- ☐ Repair leaking equipment such as valves, lines, seals, and pumps promptly.

Spill and Leak Prevention and Response

- ☐ Keep your spill prevention, control, and countermeasure (SPCC) plan up to date.
- ☐ Have an emergency plan, equipment, and trained personnel ready at all times to deal immediately with major spills.
- ☐ Collect all spilled liquids, and properly dispose of them.
- ☐ Store and maintain appropriate spill cleanup materials in a location known to all near the designated wash area.
- ☐ Ensure that vehicles transporting waste have spill prevention equipment that can minimize the possibility of spills during transport. Spill prevention equipment includes:
  - ✓ Baffles for liquid waste; and
  - ✓ Sealed gates and spill guards for solid waste.

Material Handling and Waste Management

Litter Control

- ☐ Post “No littering” signs, and enforce antilitter laws.
- ☐ Provide a sufficient number of litter receptacles for the facility.
- ☐ Clean out and cover litter receptacles frequently to prevent spillage.

SC-34 Waste Handling and Disposal

Waste Collection

- ☐ Keep waste collection areas clean.
- ☐ Inspect solid waste containers for structural damage regularly. Repair or replace damaged containers as necessary.
- ☐ Secure solid waste containers; containers must be closed tightly when not in use.
- ☐ Do not fill waste containers with washout water or any other liquid.
- ☐ Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, and pesticides may not be disposed of in solid waste containers (see the chemical/ hazardous wastes section below).
- ☐ Do not mix wastes; that can cause chemical reactions, make recycling impossible, and complicate disposal. Affix labels to all waste containers clearly identifying what they contain.

Chemical/Hazardous Wastes

- ☐ Select designated hazardous waste collection areas on-site.
- ☐ Store hazardous materials and wastes in covered containers and protect them from vandalism.
- ☐ Place hazardous waste containers in secondary containment.
- ☐ Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.
- ☐ Hazardous waste cannot be reused or recycled; it must be disposed of by a licensed hazardous waste hauler.

Employee Training Program

- ☐ Educate employees about pollution prevention measures and goals.
- ☐ Train employees how to properly handle and dispose of waste using the source control BMPs described above.
- ☐ Train employees and subcontractors in proper hazardous waste management.
- ☐ Use a training log or similar method to document training.
- ☐ Ensure that employees are familiar with the site's SPCC plan and/or proper spill cleanup procedures.

Quality Assurance and Record Keeping

- ☐ Keep accurate maintenance logs that document minimum BMP activities performed for waste handling and disposal, types and quantities of waste disposed of, and any improvement actions.

- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and the method used to dispose of the waste.
- Establish procedures to complete logs and file them in the central office.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Capital costs will vary substantially depending on the size of the facility and the types of waste handled. Significant capital costs might be associated with reducing wastes by modifying processes or implementing closed-loop recycling.
- Many facilities already have indoor covered areas where waste materials are stored and require no additional capital expenditures for providing cover.
- If outdoor storage of wastes is required, construction of berms or other means to prevent stormwater run-on and runoff might require appropriate constructed systems for containment.
- Capital investments will likely be required at some sites if cover and containment facilities are inadequate and can vary significantly depending upon site conditions.

Maintenance

- Check waste containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- When cleaning around restaurant/food handling dumpster areas, sweep and clean the waste management area regularly. Use dry methods when possible (e.g., sweeping, use of absorbents). If water must be used after sweeping/using absorbents, collect water and discharge through a grease interceptor to the sewer.
- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Repair leaking equipment such as valves, lines, seals, and pumps promptly.

References and Resources

Minnesota Pollution Control Agency. 2015. *Industrial Stormwater Best Management Practices Guidebook BMP 26 Fueling and Liquid Loading/Unloading Operations*. Available online at http://www.pca.state.mn.us/index.php/view-document.html?gid=10557.

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SC-41 Building and Grounds Maintenance

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers, and pesticides; suspended solids; heavy metals; abnormal pH; and oils and greases. Using the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and best management practice (BMP) implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Switch to nontoxic chemicals for maintenance to the maximum extent possible.
- ☐ Choose cleaning agents that can be recycled.
- ☐ Encourage proper lawn management and landscaping, including use of native vegetation.
- ☐ Encourage use of integrated pest management techniques for pest control.
- ☐ Encourage proper on-site recycling of yard trimmings.
- ☐ Recycle residual paints, solvents, lumber, and other material as much as possible.

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*
■ *Substitute Products*

Targeted Constituents	
Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	✓
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance and Record Keeping	✓

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- Clean work areas at the end of each work shift using dry cleaning methods such as sweeping and vacuuming.

Good Housekeeping

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations in which soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum, or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.

- If soaps or detergents are not used and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.

- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, and other collected vegetation as garbage or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.

- Use mulch or other erosion control measures on exposed soils. See also SC-40 Contaminated and Erodible Areas for more information.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement or ground, or toward a storm drain.

- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.

- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.

- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with nonwater-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner and turpentine) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is especially necessary on rainy days. The containment device(s)

must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to dewater an excavation site, you might need to filter the water before discharging to a catch basin or off-site. If discharging off-site, direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover can include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, and other collected vegetation as garbage, by composting, or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- When soils are exposed, use mulch or other erosion control measures.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: Do not put it in the storm drain; instead pour it over landscaped areas.
- Use hand weeding when practical.

Fertilizer and Pesticide Management

- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalks if fertilizer is spilled on these surfaces before applying irrigation water.

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Inspection

- ☐ Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Spill and Leak Prevention and Response

- ☐ Keep your spill prevention, control, and countermeasure (SPCC) plan up to date.
- ☐ Place a stockpile of spill cleanup materials such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where they are readily accessible.
- ☐ Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- ☐ Familiarize employees with the SPCC plan.
- ☐ Clean up spills immediately.

Material Handling and Waste Management

- ☐ Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- ☐ Do not over-apply fertilizers, herbicides, and other pesticides. Prepare only the amount needed. Follow the recommended usage instructions. Over-application is expensive and environmentally harmful. Unless on steep slopes, till fertilizers into the soil rather than hydraulic application. Apply surface dressings in several smaller applications, as opposed to one large application, to allow time for infiltration and to avoid excess material being carried offsite by runoff. Do not apply these chemicals before predicted rainfall.
- ☐ Dispose of empty pesticide containers according to the instructions on the container label.
- ☐ Rinse containers and use the rinse water as product. Dispose of unused pesticide as hazardous waste.
- ☐ Implement storage requirements for pesticide products with guidance from the local fire department and county agricultural commissioner. Provide secondary containment for pesticides.

- ☐ Refer to Fact Sheet BG-30 for additional pest control best practices.

Employee Training Program

- ☐ Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.

- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the needs of individual staff members.

Quality Assurance and Record Keeping

- Keep accurate logs that document maintenance activities performed and minimum BMP measures implemented.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and the method use to dispose of the waste.
- Establish procedures to complete logs and file them in the central office.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Additional capital costs are not anticipated for building and grounds maintenance. Implementation of the minimum BMPs described above should be conducted as part of regular site operations.

Maintenance

- Maintenance activities for the BMPs described above will be minimal, and no additional cost is anticipated.

Supplemental Information

Fire Sprinkler Line Flushing

Site fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, although in some areas it could be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; that coating will contaminate the water from the first flush but not from subsequent flushes. Nitrates, polyphosphates, and other corrosion inhibitors, as well as fire suppressants and antifreeze might be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and, between flushes, could accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This might result in a significant biochemical oxygen demand problem, and the water often smells. Consequently dispose of fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to enter the storm drain or infiltration because of the potentially high levels of pollutants in fire sprinkler line water.

SC-41 Building and Grounds Maintenance

References and Resources

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SC-43 Parking Area Maintenance

Description

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

BMPs for other outdoor areas on-site (loading/unloading, material storage, and equipment operations) are described in fact sheets SC-30 through SC-33.

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*
■ *Substitute Products*

Targeted Constituents	
Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	✓
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance and Record Keeping	✓

Approach

The goal of this program is to ensure that stormwater pollution prevention practices are considered when conducting activities on or around parking areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Encourage advanced designs and maintenance strategies for impervious parking lots. Refer to the treatment control BMP fact sheets in this Handbook for additional information.
- ☐ Keep accurate maintenance logs to evaluate BMP implementation.

Good Housekeeping

- ☐ Keep all parking areas clean and orderly. Remove debris, litter, and sediments in a timely fashion.
- ☐ Post "No littering" signs, and enforce antilitter laws.
- ☐ Provide an adequate number of litter receptacles.

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- Clean out litter receptacles frequently and cover them to prevent spillage.

Preventative Maintenance

Inspection

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

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below if water is used to clean surfaces:
  - ✓ Block the storm drain or contain runoff.
  - ✓ Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
- Follow the procedures below when cleaning heavy oily deposits:
  - ✓ Clean oily spots with absorbent materials.
  - ✓ Use a screen or filter fabric over inlet, then wash surfaces.
  - ✓ Do not allow discharges to the storm drain.
  - ✓ Vacuum/pump discharges to a tank or discharge to sanitary sewer.
  - ✓ Dispose of spilled materials and absorbents appropriately.

Surface Repair

- Check local ordinances for standard urban stormwater mitigation plan/low impact development (SUSMP/LID) ordinance.
- Preheat, transfer, or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, and so forth. Leave

covers in place until the job is completed and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

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

Spill and Leak Prevention and Response

- Keep your spill prevention, control, and countermeasure (SPCC) plan up to date.
- Place a stockpile of spill cleanup materials where they are readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Employee Training Program

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

Quality Assurance and Record Keeping

- Keep accurate maintenance logs that document minimum BMP activities performed for parking area maintenance, types and quantities of waste disposed of, and any improvement actions.
- Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and the method used to dispose of the waste.
- Establish procedures to complete logs and file them in the central office.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Capital investments may be required at some sites to purchase sweeping equipment, train sweeper operators, install oil/water/sand separators, or implement advanced BMPs. These costs can vary significantly depending upon site conditions and the number of BMPs required.

SC-43 Parking Area Maintenance

Maintenance

- Sweep and clean parking lots regularly to minimize pollutant transport into storm drains from stormwater runoff.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Maintain advanced BMPs such as vegetated swales, infiltration trenches, or detention basins as appropriate. Refer to the treatment control fact sheets for more information.

Supplemental Information

Advanced BMPs

Some parking areas may require advanced BMPs to further reduce pollutants in stormwater runoff, and a few examples are listed below. Refer to the treatment control fact sheets and the *Development BMP Handbook* for more information.

- When possible, direct sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Use sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lots to include semipermeable hardscape.

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SC-44 Drainage System Maintenance

Description

As a consequence of its function, the stormwater drainage facilities on site convey stormwater that may contain certain pollutants either to the off-site conveyance system that collects and transports urban runoff and stormwater, or directly to receiving waters. The protocols in this fact sheet are intended to reduce pollutants leaving the site to the offsite drainage infrastructure or to receiving waters through proper on-site conveyance system operation and maintenance. The targeted constituents will vary depending on site characteristics and operations.

Approach

Successful implementation depends on effective training of employees on applicable best management practices (BMPs) and general pollution prevention strategies and objectives.

General Pollution Prevention Protocols

- ☐ Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the proper hydraulic functioning of the system to avoid flooding.

- ☐ Develop and follow a site-specific drainage system maintenance plan that describes maintenance locations, methods, required equipment, water sources, sediment collection areas, disposal requirements, and any other pertinent information.

Good Housekeeping

Illicit Connections and Discharges

- ☐ Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:

Objectives
■ *Cover*
■ *Contain*
■ *Educate*
■ *Reduce/Minimize*

Targeted Constituents	
Sediment	✓
Nutrients	✓
Trash	✓
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Minimum BMPs Covered	
Good Housekeeping	✓
Preventative Maintenance	✓
Spill and Leak Prevention and Response	✓
Material Handling & Waste Management	
Erosion and Sediment Controls	
Employee Training Program	✓
Quality Assurance and Record Keeping	✓

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- ✓ Identify evidence of spills such as paints, discoloring, and odors.
- ✓ Record locations of apparent illegal discharges or illicit connections.
- ✓ Track flows back to potential discharges and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques that include zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, and television camera inspection.
- ✓ Eliminate the discharge once the origin of the flow is established.

- ☐ Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste—Drains to Stream" or similar wording stenciled on or next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- ☐ Refer to fact sheet SC-10 Non-stormwater Discharges for additional information.

Illegal Dumping

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

Preventative Maintenance

Catch Basins/Inlet Structures

- ☐ Staff should regularly inspect facilities to ensure compliance with the following:
  - ✓ Immediate repair of any deterioration threatening structural integrity.
  - ✓ Cleaning before the sump is 40 percent full. Catch basins should be cleaned as frequently as necessary to meet this standard.

- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Prioritize storm drain inlets; clean and repair them as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and disposed of properly. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

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

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removal, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification and improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural state of any river, stream, or lake in California must enter into a stream or lake alteration agreement with the Department of Fish and Wildlife. The developer-applicant should also contact local governments (city, county, or special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, or Department of Water Resources), and the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service.

SC-44 Drainage System Maintenance

Spill and Leak Prevention and Response

- ☐ Keep your spill prevention, control, and countermeasure (SPCC) plan up to date.
- ☐ Investigate promptly all reports of spills, leaks, and illegal dumping.
- ☐ Place a stockpile of spill cleanup materials where they are readily accessible or at a central location.
- ☐ Clean up all spills and leaks using dry methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.

Employee Training Program

- ☐ Educate employees about pollution prevention measures and goals.
- ☐ Train employees how to properly handle and dispose of waste using the source control BMPs described above.
- ☐ Train employees and subcontractors in proper hazardous waste management.
- ☐ Use a training log or similar method to document training.
- ☐ Ensure that employees are familiar with the site's SPCC plan and/or proper spill cleanup procedures.
- ☐ Have staff involved in detection and removal of illicit connections trained in the following:
  - ✓ OSHA-required health and safety training (Title 29 of the Code of Federal Regulations [CFR] 1910.120) plus annual refresher training (as needed).
  - ✓ OSHA confined space entry training (Cal/OSHA Confined Space, Title 8 and Federal/OSHA 29 CFR 1910.146).
  - ✓ Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Quality Assurance and Record Keeping

- ☐ Keep accurate maintenance logs that document minimum BMP activities performed for drainage system maintenance, types and quantities of waste disposed of, and any improvement actions.
- ☐ Keep accurate logs of spill response actions that document what was spilled, how it was cleaned up, and the method used to dispose of the waste.
- ☐ Keep accurate logs of illicit connections, illicit discharges, and illegal dumping into the storm drain system, including how wastes were cleaned up and disposed of.
- ☐ Establish procedures to complete logs and file them in the central office.

Potential Limitations and Work-Arounds

The following are typical limitations and recommended work-arounds for drainage system maintenance:

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

  - ✓ Perform all maintenance on-site and do not flush accumulated material downstream to private property or riparian habitats.

- Storm drain flushing is most effective in small-diameter pipes (i.e., a pipe 36 inches in diameter or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing include the availability of a water source, finding a downstream area to collect sediments, and liquid/sediment disposal.

  - ✓ Develop and follow a site-specific drainage system maintenance plan that describes maintenance locations, methods, required equipment, water sources, sediment collection areas, disposal requirements, and any other pertinent information.

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

  - ✓ Do not dump illegal materials anywhere on-site.

  - ✓ Identify illicit connections, illicit discharge, and illegal dumping.

  - ✓ Clean up spills immediately, and properly dispose of wastes.

- Local municipal codes might include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the sanitary sewer system.

  - ✓ Collect all materials and pollutants accumulated in the drainage system and dispose of them according to local regulations.

  - ✓ Install debris excluders in areas with a trash total maximum daily load.

Potential Capital Facility Costs and Operation & Maintenance Requirements

Facilities

- Capital costs will vary substantially depending on the size of the facility and characteristics of the drainage system. Significant capital costs may be associated with purchasing water trucks, vacuum trucks, and any other necessary cleaning equipment or improving the drainage infrastructure to reduce the potential.

- Developing and implementing a site-specific drainage system maintenance plan will require additional capital if a similar program is not already in place.

Maintenance

- Two-person teams might be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.
- Methods used for illicit connection detection (e.g., smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors such as the amount of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Supplemental Information

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants from storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents plug flow discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

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

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

Cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65–75 percent for organics and 55–65 percent for dry weather grit/inorganic

material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used if allowed or that fire hydrant line flushing coincide with storm sewer flushing.

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Infiltration Basin TC-11

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituent	Removal
Sediment	High
Nutrients	High
Trash	High
Metals	High
Bacteria	High
Oil and Grease	High
Organics	High
Flow Control	High

Description

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

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated. The Water Augmentatoin Study (LASGRWC 2010) perfomred in the Los Angeles region showed no negative impact to ground water from infiltrating stormwater through infiltration practices treating stormwater from sites ranging from 0.5 acres to 7.4 acres.

Infiltration basins have been shown to be effective at reducing many of the pollutants regulated by the State and Regional Water Boards. Additionally, the Water Boards have determined that

infiltration basins can qualify as a "Full Capture System (FCS)[1]" for trash. Accordingly, in addition to providing general specifications, this fact sheet includes trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. See the "**Full Trash Capture Compliance**" section and "***Trash FCS***" subsections in this fact sheet for more information.

Advantages

- Provides stormwater treatment and can be designed to meet hydromodification management requirements and the full capture system definition for trash control.
- 100% reduction in the load discharged to surface waters.
- Can achieve pre-development hydrology by infiltrating a significant portion of the average annual rainfall runoff.

Limitations

- Have a high failure rate if soil and subsurface conditions are not suitable.
- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C or D.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation (Table 1). Vegetation establishment may improve water quality performance and decrease residence time (i.e., increase water losses). If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

Table 1. Typical pollutant removal for constituents and removal processes

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Sediment	High (90%)	9.9 mg/l	Settling, filtration and sedimentation in top 2 to 8 inches of media.	1.5 feet	Geosyntec Consultants and Wright Water Engineering 2012; Hatt et al. 2008; Hunt et al. 2012; Li and Davis 2008; Stander and Borst 2010; Maniquiz, 2010; Scholes, 2007

[1] Full Capture System (FCS): A treatment control, or series of treatment controls, including but not limited to, a multi-benefit projector a low impact development control that traps all particles that are 5 mm or greater, and has a design treatment capacity that is either: a) of not less than the peak flow rate, Q, resulting from a one-year, one-hour, storm in the subdrainage area, or b) appropriately sized to, and designed to carry at least the same flows as, the corresponding storm drain.

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Metals	High	TCd: 0.07 µg/L, TCr: 0.35 µg/L, TCu: 5.33 µg/L, *TFe: 1027 µg/L,* TPb: 0.19 µg/L, *TNi: 4.53 µg/L,* TZn: 12.0 µg/L	Settling with sediment and sorption to organic matter and clay in media.	2 feet	Geosyntec Consultants and Wright Water Engineering 2012; Hsieh and Davis 2005; Hunt et al. 2012; Maniquiz, 2010
Hydro-carbons	High (90-97%)	N/A	Volatilization, sorption, and degradation in mulch layer.	1 foot	Hong et al. 2006; Hunt et al. 2012; Barraud et al 1999; Dierkes and Geiger, 1999; Mikkelsen et al. 1997; Hong et al. 2006. Hsieh and Davis 2005; Pitt et al. 1999
Total phosphorus	High (-240% to 99%)	*0.240 mg/l*	Settling with sediment, sorption to organic matter and clay in media, and plant uptake. Poor removal efficiency can result from media containing high organic matter or with high background concentrations of phosphorus.	2 feet	Clark and Pitt 2009; Davis 2007; Geosyntec Consultants and Wright Water Engineering 2012; Hsieh and Davis 2005; Hunt et al. 2006; Hunt and Lord 2006; Li et al. 2010; Maniquiz 2010
Total nitrogen	High (TKN: -5% to 64%, Nitrate: 1% to 80%)	TN: 0.92 mg/l, TKN: 1.34 mg/l, $NO_{2,3}$-N: 0.37 mg/l	Sorption and settling (TKN), denitrification in IWS (nitrate), and plant uptake. Poor removal efficiency can result from media containing high organic matter.	3 feet	Barrett et al. 2013; Clark and Pitt 2009; Geosyntec Consultants and Wright Water Engineering 2012; Hunt et al. 2006; Hunt et al. 2012; Kim et al. 2003; Li et al. 2010; Passeport et al. 2009; Maniquiz, 2010; Winiarski et al. 2006

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Bacteria	High	*Enterococcus*: 235 MPN/ 100 mL, *E.coli*: 101 MPN/100 mL	Sedimentation, filtration, sorption, desiccation, predation, and photolysis in mulch layer and media.	2 feet	Geosyntec Consultants and Wright Water Engineering 2012; Hathaway et al. 2009; Hathaway et al. 2011; Hunt and Lord 2006; Hunt et al. 2008; Hunt et al. 2012; Jones and Hunt 2010
Trash	High	*N/A*	Filtration	1.5 feet of media	Barrett et al. 2013

[1] Concentrations are based on bioretention performance data. Underlined effluent concentrations were (statistically) significantly lower than influent concentrations, as determined by statistical hypothesis testing on the available sampled data. Effluent concentrations displayed in *italics* were (statistically) significantly higher than influent concentrations.

Groundwater contamination concerns exists for infiltration basins (Lind and Karro, 1995; Datry et al., 2004; Pitt, 1999) but pollutant concentrations in the soil column have been shown to decrease rapidly with depth (within the first 6 to 18 inches) (Dechesne, M. et al., 2004; Dierkes and Geiger, 1999; Mikkelsen et al., 1997; Datry et al., 2004). However, pollutant concentrations can be of concern as deep as 10 feet, preferential flow pathways are suspected as the means of transport in some geologic settings (Winiarski et al. 2006). These observations warrant a 10 foot minimum between infiltration basin bottom and seasonal high water table.

Trash FCS

The Trash Amendments adopted by the State Water Board in April 2015 provide a performance standard for treatment of stormwater for trash in the form of the definition of FCS, which infiltration basin meets (see Section 5.6.1 for FCS details).

Suitability and Design

The use of infiltration basins may be limited by a number of factors, including type of native soils, climate, and location of groundwater table. Site characteristics, such as excessive slope of the drainage area, fine-grained soil types, and proximate location of the water table and bedrock, can also preclude the use of infiltration basins. The constraints of each site dictate the appropriate siting and footprint. Fundamental infiltration basin design components are as follows:

- Infiltration rate assessed on-site by a licensed geotechnical engineer or soil scientist.
- Unsuitable if known soil contamination is present, or if upstream drainage area uses or store chemicals or hazardous materials that could drain to the basin.
- 10 feet of separation between bottom of the basin and seasonal high water table.

- Drainage area that has been fully stabilized, plus use of a pretreatment BMP (e.g. grassed swales, gravity separator) at the entry point to ensure longevity.
- 10-ft setback from foundations, 100-ft from septic fields and water supply wells, and 50-ft from steep slopes.

Basin design is highly dependent on the constraints of the considered site. Costs will vary in accordance with the design. Table 2 details a number of core construction components and corresponding design considerations.

Table 2. Cost of design components and associated considerations

Component	Cost	Design Consideration
Excavation		Requires infiltration rate > 0.5 in/hr. When excavating ensure that subgrade compaction is minimized. Design for 6 to 18 inches average ponding depth. Basin should contain entire upstream WQV. After final grading, till the infiltration surface deeply
Without underdrains	$2.75–$5.00/ft^2	
With underdrains	$3.90–$6.15/ft^2	
Soil Media		1.5–4 feet (deeper for better pollutant removal, hydrologic benefits, and rooting depths) at minimum 5 in/hr infiltration. Total phosphorus < 15 ppm, pH 6–8, CEC > 5 meq/100 g soil. Organic Matter Content < 5% by weight. 65% sand, 20% sandy loam, and 15% compost (from vegetation-based feedstock) by volume.
Recommended mix	$2.90–$4.30/ft^2	
With engineered media	$3.60–$5.40/ft^2	
Soil Media Barrier		When incorporating an underdrain, separate media from native soil with a geotextile layer, 2 to 4 inches of washed sand (ASTM C-33), followed by 2 inches of choking stone (ASTM No. 8) over a 1.5 ft envelope of ASTM No. 57 stone.
Geotextile	$0.45/ft^2	
Washed sand (2-inch layer)	$0.20/ft^2	
No. 8 aggregate (min 2 inches thick)	$0.28/ft^2	
No. 57 stone (1.5 + feet)	$2.49/ft^2	
Hydraulic Restriction Layer		May use hydraulic restriction layer on vertical surfaces to restrict lateral flows to adjacent subgrades, foundations, or utilities.
Filter fabric	$0.45/ft^2	
Clay	$0.65/ft^2	
30-mil liner	$0.35/ft^2	
Concrete barrier	$12.00/ft^2	

Subsurface Option (Figure 1) Excavation, Installation, and Backfill Concrete Unit	 $9.20/ft^2 $59.93/ft^2	Constructing a subsurface facility includes excavating to depth, installing concrete unit, overdig, and backfill. Concrete unit height assumed here: 11' 4". *Requires* pretreatment BMP to capture trash and debris.
Landscape	$0.20–$3.50/ft^2	Armor surface with cobble or vegetation. If planted (optional), install native, deep rooting, and drought tolerant plants.

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

Basin invert area should be determined by the equation. Where:

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

A = Basin invert area (m^2)

WQV = water quality volume (m^3)

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

t = drawdown time (48 hr)

Design Variations

When traditional surface basins are infeasible because of land constraints, subsurface extended detention basin are ideal (Figure 1). Open space parks (e.g., baseball fields, etc.) are an example of where a subsurface infiltration basin is ideal because the park's purpose as a recreational area is not compromised. Additionally, recreational areas typical lack large structures, therefore the issue of overhead weight over the subsurface unit is not a concern.

Figure 1. Subsurface design of an infiltration basin, mid-construction.

Full Trash Capture Compliance

This section provides trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. In addition to developing and adopting the Trash Amendments, the State Water Board provides implementation information on its Trash Implementation web page: https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html.

The web page includes information on best management practices or Full Capture Systems, including lists of State-certified Multi-Benefit Trash Treatment Systems. So, when selecting BMPs for trash control, fact sheet users should refer to both this BMP fact sheet and the State Water Board's Trash Implementation web page.

Design Modifications to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

The infiltration basin must be configured to allow trash to enter the system and for trash to remain in the basin until it can be collected and removed. To meet the requirement, inlets must be designed to pass the peak flow produced by the one-year, one-hour design storm or the same flows as the capacity of the inlet storm drain and solids that would be retained by a 5 mm screen or mesh, must remain in the system.

Inlets

There are a multitude of inlet configurations that will allow trash to enter and be captured in an infiltration basin. An open inlet with a forebay is recommended.

Pretreatment

Pretreatment is beneficial to increase and consolidate trash capture while managing maintenance requirements. A forebay with mortared cobble is one example of incorporating pretreatment in the inlet (Figure 2). This configuration can slow flow and allow trash and gross solids to settle out while consolidating at the edge of the infiltration basin to make it easier for maintenance crews to collect and remove.

Figure 2. Example of a forebay as pretreatment for an infiltration basin.

Trash Containment

Once trash has been captured in an infiltration basin it must be contained so trash does not escape the infiltration basin. Containment may be provided by one or more of these features:

Figure 3. Example of an outlet with 5 mm screen.

- an external design feature or up-gradient structure designed to bypass flows exceeding the region-specific one-year, one-hour storm event; or
- the BMP having sufficient capacity to trap particles from flows exceeding those generated by the one-year, one-hour storm event; or
- the BMP having sufficient capacity to treat either the design flows or volumes through media filtration or infiltration into native or amended soils; or
- use of a maximum 5 mm mesh screen on all outlets.

Maintenance

A considerable cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time. To mitigate failure, ensure particulate loading of the stormwater is minimal, or is reduced with an adjacent pretreatment (i.e. vegetated buffer strip). Reducing the particulate loading enables the soils infiltrative capacity to stay high and functional.

Clogged infiltration basins reduced water quality performance but can also enable standing water to become a nuisance due to mosquito breeding. If the basin takes more than 48 hours to drain, then the rock fill should be removed and all dimensions of the basin should be increased by 2 inches to provide a fresh surface for infiltration. To mitigate failure, ensure particulate loading of the stormwater is minimal, or is reduced with an adjacent pretreatment (Figure 2). Reducing particulate loading enables the soil's infiltrative capacity to remain high and functional. Table 3 provides maintenance activity details, frequency, and costs.

Table 3. Typical maintenance activities and associated costs and frequency

Frequency	Cost	Activity
Routine Maintenance (required monthly to every 2 years)		
Routine (small)	$7.62/ft^2	Remove excess sediment, trash, and debris across the surface, inlet, and outlet. Check for and stabilize erosion. Pruning and mowing overgrown

Frequency	Cost	Activity
Routine (medium)	$1.91/ft^2	vegetation that interferes with access, or safety (if applicable).
Routine (large)	$1.91/ft^2	
End of Life Replacement (service life of 20 years)		Excavate to the depth of soil media. Test soil for excessive soil contamination of common stormwater pollutants (e.g. metals, nutrients). Continue to remove underlying soil if pollutants exceed standard for contaminated soil. Replace with clean soil.
Replacement (small)	$10.52/ft^2	
Replacement (medium)	$10.17/ft^2	
Replacement (large)	$10.11/ft^2	
Note: Small System = 500 ft^2; Medium System = 2000 ft^2; Large System = 4000 ft^2 Underlined statement indicates that the activity may be required more frequently than shown in the table to meet the State Water Board maintenance criteria for Multi-Benefit Treatment Systems to be qualified as Full Capture Systems.		

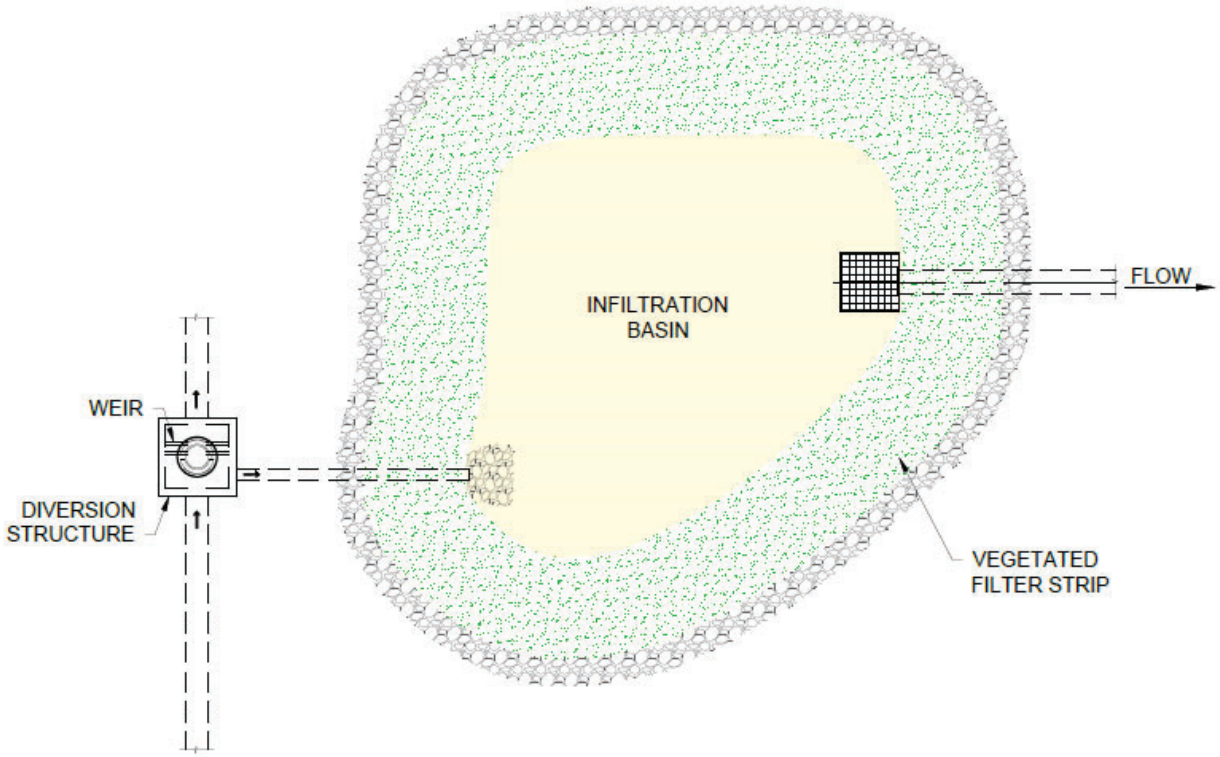
Trash FCS

Maintenance to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

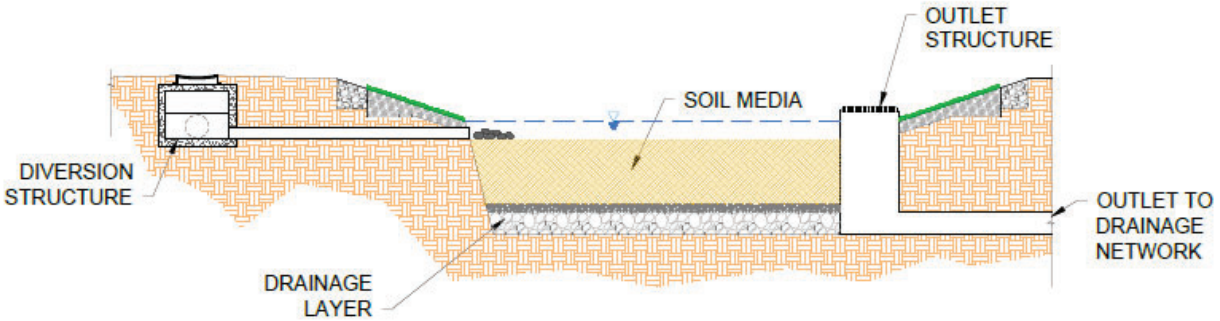
For Multi-Benefit Treatment Systems to be qualified as Full Capture Systems, the State Water Board requires regular maintenance to maintain adequate trash capture capacity and to ensure that trapped trash does not migrate offsite. Additionally, the State Water Board requires the BMP owner to establish a maintenance schedule based on site-specific factors, including the design trash capacity of the Infiltration Basin Multi-Benefit Trash Treatment System, storm frequency, and estimated or measured trash loading from the drainage area. To meet those criteria, it is likely that the frequency of trash and debris removal will have to be increased above the recommended monthly interval during the wet season to prevent trash from being blown from the BMP or being washed out of the infiltration basin in the subsequent rain events (see Table 3). Depending on the frequency and size of storms, and upstream pollutant characteristics, trash and debris removal can be as frequent as before and after every wet weather event. The optimum maintenance frequency is best determined by site observation over an average water year.

Trash maintenance not only plays a role in the functionality of the infiltration basin but also in the aesthetics and public perception of the infiltration basin (and of all BMPs). Part of maintaining positive perception among the public is the visibility of a well-maintained BMP. This positive perception can self-perpetuate further support for integrated stormwater management practices and therefore further investment in regular maintenance.

Schematic



A - INFILTRATION BASIN - PLAN VIEW
NOT TO SCALE



A - INFILTRATION BASIN - SECTION
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Extended Detention Basin TC-22

Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

Targeted Constituent	Removal
Sediment	Med
Nutrients	Low
Trash	High
Metals	Med
Bacteria	Med
Oil and Grease	Med
Organics	Med
Flow Control	High

Description

Extended detention basins (dry ponds, dry extended detention ponds, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (typically 48 hours) to allow particles, trash and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

California Experience

Caltrans constructed and monitored five extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. Extended detention basins, while not as effective as systems that provide filtration such as bioretention areas or sand filters, have been shown to be effective at reducing many of the pollutants regulated by the State and Regional Water Boards. Additionally, the Water Boards have determined that extended detention basins can qualify as a "Full Capture System (FCS)[1]" for trash. Accordingly, in addition to providing general specifications, this fact sheet includes trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. See the "**Full Trash Capture Compliance**" section and "***Trash FCS***" subsections in this fact sheet for more information.

[1] Full Capture System (FCS): A treatment control, or series of treatment controls, including but not limited to, a multi-benefit project or a low impact development control that traps all particles that are 5 mm or greater, and has a design treatment capacity that is either: a) of not less than the peak flow rate, Q, resulting from a one-year, one-hour, storm in the subdrainage area, or b) appropriately sized to, and designed to carry at least the same flows as, the corresponding storm drain.

Advantages

- Extended detention basins can have a simple, low-cost design, and meet hydromodification management requirements and the full capture system definition for trash control.
- Widespread application can provide significant control of channel erosion and flood management.

Limitations

- The recommended minimum orifice diameter of 0.5" may be too large in drainages less than 5 acres.
- Dry extended detention basins are relatively ineffective at removing soluble pollutants.
- Can detract from property value due to the aesthetics of dry and bare areas.

Performance

The primary purpose of most detention basins is flood control, but they can also garner pollutant removal performance (Table 1). Variations in design can vary this performance, for example vegetated detention basins provide improved pollutant removal when compared to concrete basins. An optional micropool at the basin's outlet can be incorporated to increase performance of soluble pollutants.

Table 1. Typical pollutant removal and removal processes for constituents

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	References
Sediment	Med/High 50-99%	23.3 mg/L	Settling in pretreatment, filtration	Geosyntec Consultants and Wright Water Engineering 2012; Barrett 2008; Harper 1999; Revitt 2004; Scholes 2007
Metals	Medium TCd: 88% TCu: 46-96% TCr: 95% TPb: 92% TZn: 35-95%	TAs: 1.71 µg/L TCd: 0.24 µg/L TCr: 2.55 µg/L TCu: 4.99 µg/L TPb: 3.86 µg/L TNi: 2.73 µg/L TZn: 21.3 µg/L	Removal with sediment, sorption	Geosyntec Consultants and Wright Water Engineering 2012; Barrett 2008; Scholes 2007
Total phosphorus	Low	0.197 mg/L	Settling with sediment, sorption, biological uptake	Barrett 2008; Harper 1999; Geosyntec Consultants and Wright Water Engineering 2012; Walker 1987
Total nitrogen	Low	TN: 1.60 mg/L, TKN: 1.49 mg/L, $NO_{2,3}$-N: 0.27 mg/L	Settling with sediment, sorption, filtration, biological uptake	Barrett 2008; Harper 1999; Geosyntec Consultants and Wright Water Engineering 2012

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	References
Bacteria	Medium	E. coli – 429 (MPN/100 mL) Fecal Coliform - 727 (MPN/100 mL)	Sorption, microbial degradation, settling, photolysis	Geosyntec Consultants and Wright Water Engineering 2012; Barrett 2008, Harper 1999; Scholes 2007
Trash	High	N/A	Filtration (Media treatment depth of 1.5 feet) and/or outlet screen	Barrett et al. 2013

[1] Underlined effluent concentrations were (statistically) significantly lower than influent concentrations, as determined by statistical hypothesis testing on the available sampled data.

Trash FCS

The Trash Amendments adopted by the State Water Board in April 2015 provide a performance standard for treatment of stormwater for trash in the form of the definition of FCS, which extended detention basins meet (see Section 5.6.1. for FCS details).

Suitability and Design

Dry extended detention basins are among the most widely applicable BMPs and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. Fundamental extended detention basin design components and suitability are as follows:

- Drawdown time of 48 hours is required for vector control, but design should also incorporate long flow paths, promote the establishment of low velocities, for improved water quality.
- A facility's drawdown time is regulated by an orifice or weir; with minor design adjustments in outlet design, extended detention basins are applicable in all soils and geology.
- 10-ft setback from foundations, 100-ft from septic fields and water supply wells, and 50-ft from steep slopes.

Extended detention basin design is highly dependent on the constraints of the considered site and costs vary accordingly with design. An optional micropool at the basin's outlet can be incorporated to increase performance of soluble pollutants. Table 2 details a number of core construction components and corresponding design considerations.

Table 2. Cost of design components and associated considerations

Component	Cost	Design Consideration
Excavation	$5.00–$15.00/ft^2	Capture volume determined by local requirements or sized to treat runoff produced by the 85th percentile storm. Length to width ratio of 1.5:1 if feasible. Basin depth of 2 to 5 feet is optimal. Include energy dissipation

Component	Cost	Design Consideration
		in the inlet design to reduce resuspension of sediment. Incorporate maintenance access to the basin design
Vegetation Sod (buffalo) Seeding	 $0.67/ft^2 $0.15–$0.22/ft^2	Turf grasses (not bunch grasses) should be maintained on the surface to prevent erosion and improve treatment. Water and spot fertilize during first year.
Subsurface Option (Figure 3**)** Excavation, Installation, and Backfill Concrete Unit	 $9.20/ft^2 $59.93/ft^2	Constructing a subsurface facility includes excavating to depth, installing concrete unit, overdig, and backfill. Concrete unit assumed here: 11' 4". Requires pretreatment BMP to capture trash and debris.
Outlet Structure		No more than 50% of the water quality volume drains within the first 24 hours.

Outlet Design

Design of the outflow structure is crucial in successful operation of the basin. Outlet design can include an outlet riser with orifices sized to discharge the water quality volume, and riser overflow height set to the design storm elevation. A trash rack (i.e. stainless steel screen) should be implemented to prevent clogging at the entrance to the outflow pipes. Screens should have a mesh smaller than 5 mm to meet the full capture requirement for trash. An image with these design components is presented in Figure 1. Alternative outlet design includes a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. Figure 2 shows an example of an outlet that provides a variable flow as outlet flow increase with depth.

Figure 1. Example of outlet structure.

Figure 2. Variable flow outlet structure.

Outlet design should also ensure that no more than 50% of the water quality volume drains within the first 24 hours. Discharge through a control orifice is calculated from:

$$Q = CA(2gH-H_o)^{0.5}$$

Where:

Q = discharge (ft^3/s)

C = orifice coefficient

A = area of the orifice (ft^2)

g = gravitational constant (32.2)

H = water surface elevation (ft)

H_o= orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the basin stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_o. When using multiple orifices the discharge from each is summed.

Subsurface Option

Subsurface extended detention basin are ideal when a surface detention basin is infeasible because of land constraints (Figure 3). Open space parks (e.g., baseball fields, etc.) are an example of where a subsurface extended detention basin is ideal because the park's purpose as a recreational area is not compromised. Additionally, recreational areas typically lack large structures, therefore the issue of overhead weight over the subsurface unit is not a concern.

Figure 3. Subsurface design of an extended detention basin, during construction.

Full Trash Capture Compliance

This section provides trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. In addition to developing and adopting the Trash Amendments, the State Water Board provides implementation information on its Trash Implementation web page: https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html.

The web page includes information on best management practices or Full Capture Systems, including lists of State-certified Multi-Benefit Trash Treatment Systems. So, when selecting BMPs for trash control, fact sheet users should refer to both this BMP fact sheet and the State Water Board's Trash Implementation web page.

Design Modifications to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

The extended detention basin must be configured to allow trash to enter the system and for trash to remain in the system until it can be collected and removed. To meet the requirement, inlets must be designed to pass the peak flow produced by the 1 year 1 hour design storm and solids that would be retained by a 5 mm screen or mesh must remain in the system. Preventing trash migration may require modifications to the inlets, and outlets.

Inlets

There are a multitude of inlet configurations that will allow trash to enter and be captured in an extended detention basin. In general, an open inlet is recommended to allow for flow and trash to enter the extended detention basin unrestricted (Figure 4). A forebay or other pretreatment configuration is recommended to consolidate trash collection in the basin.

Figure 4. Example inlet structure.

Trash Containment

Once trash has been captured in an extended detention basin it must be contained so trash does not escape the extended detention basin. Containment may be provided by one or more of these features:

- an external design feature or up-gradient structure designed to bypass flows exceeding the region-specific one-year, one-hour storm event; or
- the BMP having sufficient capacity to trap particles from flows exceeding those generated by the one-year, one-hour storm event; or
- the BMP having sufficient capacity to treat either the design flows or volumes through media filtration or infiltration into native or amended soils; or
- use of a maximum 5 mm mesh screen on all outlets.

Figure 5 shows an example of an outlet with a screen to contain trash. A larger grate on the top of the structure allows larger flows to safely flow out of the system.

Figure 5. Outlet structure with a 5mm screen.

Maintenance

Routine maintenance activity consists primarily of sediment, trash, and debris removal, but also mowing the turf to meet aesthetic and flow routing design of the basin. Vector control can also a significant investment of maintenance hours when poor drainage exists or stilling basins are installed as energy dissipaters.

Table 3. Typical maintenance activities and associated costs and frequency

Frequency	Cost	Activity
Routine Maintenance (required monthly to every 2 years)		Remove excess sediment, trash, and debris across the surface, inlet, and outlet. Check for and stabilize erosion. Mowing overgrown vegetation that interferes with access, or safety.
Routine (small)	$0.44/ft^2	
Routine (medium)	$0.34/ft^2	
Routine (large)	$0.24/ft^2	
End of Life Replacement (service life of 20 years)		Excavate to the depth of soil media. Test soil for excessive soil contamination of common stormwater pollutants (e.g. metals, nutrients). Continue to remove underlying soil if pollutants exceed standard for contaminated soil. Replace with clean soil.
Replacement (small)	$8.19ft^2	
Replacement (medium)	$6.43/ft^2	
Replacement (large)	$5.99/ft^2	
Note: Small System = 500 ft^2; Medium System = 2000 ft^2; Large System = 4000 ft^2 Underlined statement indicates that the activity may be required more frequently than shown in the table to meet the SWRCB's maintenance criteria for Multi-Benefit Treatment Systems to be qualified as Full Capture Systems.		

Trash FCS

Maintenance to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

For Multi-Benefit Treatment Systems to be qualified as Full Capture Systems, the State Water Board requires regular maintenance to maintain adequate trash capture capacity and to ensure that trapped trash does not migrate offsite. Additionally, the State Water Board requires the BMP owner to establish a maintenance schedule based on site-specific factors, including the design trash capacity of the Extended Detention Basin Multi-Benefit Trash Treatment System, storm frequency, and estimated or measured trash loading from the drainage area. To meet those criteria, it is likely that the frequency of trash and debris removal will have to be increased above the recommended monthly interval during the wet season to prevent trash from being blown from the extended detention basin or being washed out of the system in the subsequent rain events. Trash can also clog the inlet and the surface of the limiting the flow into the basin and reducing the surface infiltration capacity. Depending on the frequency and size of storms, and upstream pollutant characteristics, trash and debris removal can be as frequent as before and after every wet weather event. The optimum maintenance interval is best determined by observing the BMP in operation for a wet season.

Frequent trash maintenance not only plays a role in the functionality of the extended detention basin but also in the aesthetics and public perception of the extended detention basin (and of all BMPs). Part of maintaining positive perception among the public is the visibility of a well-maintained BMP. This positive perception can self-perpetuate further support for integrated stormwater management practices and therefore further investment in regular maintenance.

Schematics

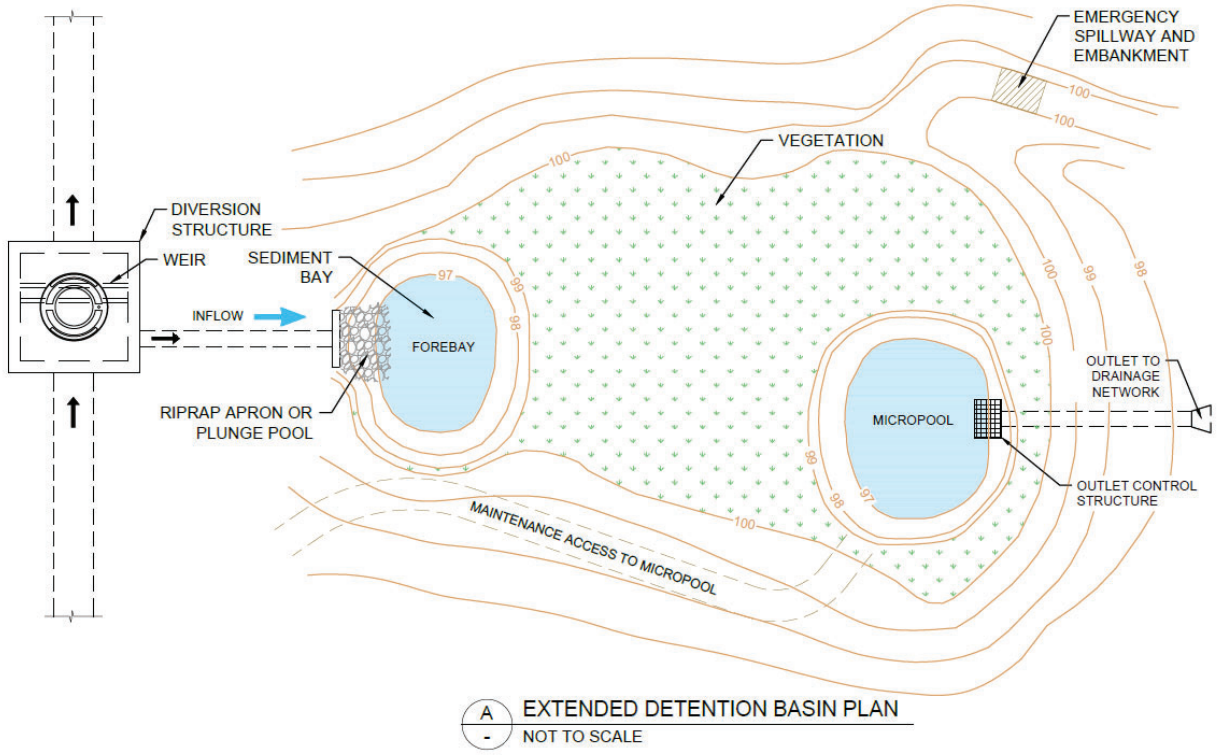

Figure 6. Schematic of an extended detention basin.

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Boards. Additionally, the Water Boards have determined that bioretention can qualify as a "Full Capture System (FCS)[1]" for trash. Accordingly, in addition to providing general specifications, this fact sheet includes trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. See the "**Full Trash Capture Compliance**" section and "***Trash FCS***" subsections in this fact sheet for more information.

Figure 2. Bioretention in the parking lot of the LA Zoo.

Advantages

- Bioretention provides stormwater treatment and can be designed to meet hydromodification management requirements and the full capture system definition for trash control.
- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape and aesthetic.
- Can be used in any soil type. When infiltration rates are too low, underdrains are installed.

Limitations

- Not recommended for areas with slopes greater than 20%.
- Bioretention is not suitable where the water table is within 3 feet of the ground surface.
- Creates an attractive habitat for mosquitoes and other vectors if drainage is insufficient.

Performance

Bioretention removes stormwater pollutants through numerous processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Media depth can have an impact on the removal of certain pollutants, particularly nitrogen and phosphorus (Hunt et al. 2012, Hunt et al. 2006; Hunt and Lord 2006). Table 1 below details expected effluent concentrations and removal processes for each pollutant constituent.

[1] Full Capture System (FCS): A treatment control, or series of treatment controls, including but not limited to, a multi-benefit project or a low impact development control that traps all particles that are 5 mm or greater, and has a design treatment capacity that is either: a) of not less than the peak flow rate, Q, resulting from a one-year, one-hour, storm in the subdrainage area, or b) appropriately sized to, and designed to carry at least the same flows as, the corresponding storm drain.

Table 1. Typical pollutant removal for constituents and removal processes

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Sediment	High	9.9 mg/L	Settling in pretreatment and mulch layer, filtration and sedimentation in top 2 to 8 inches of media.	1.5 feet of media	Hatt et al. 2008; Hunt et al. 2012; Li and Davis 2008; Geosyntec Consultants and Wright Water Engineering 2012; Stander and Borst 2010
Metals	High	TCd: 0.07 µg/L, TCr: 0.35 µg/L, TCu: 5.33 µg/L, *TFe: 1027 µg/L,* TPb: 0.19 µg/L, *TNi: 4.53 µg/L,* TZn: 12.0 µg/L	Removal with sediment and sorption to organic matter and clay in media.	2 feet of media	Hsieh and Davis 2005; Geosyntec Consultants and Wright Water Engineering 2012; Hunt et al. 2012
Hydrocarbons	High	N/A	Removal and biodegradation in mulch.	3 inches of mulch	Hong et al. 2006; Hunt et al. 2012
Total phosphorus	Medium -240% - 99%	*0.240 mg/L*	Settling with sediment, sorption to organic matter and clay in media, and plant uptake. Poor removal can result from media containing high organic matter or high background concentrations of phosphorus.	2 feet of media	Clark and Pitt 2009; Davis 2007; Geosyntec Consultants and Wright Water Engineering 2012; Hsieh and Davis 2005; Hunt et al. 2006; Hunt and Lord 2006; ; Li et al. 2010
Total nitrogen	Medium TKN: -5% - 64%, Nitrate: 1% - 80%	TN: 0.92 mg/L, TKN: 1.34 mg/L, $NO_{2,3}$-N: 0.37 mg/L	Sorption and settling (TKN), denitrification in IWS (nitrate), and plant uptake. Poor removal efficiency can result from media containing high organic matter.	3 feet of media	Barrett et al. 2013; Clark and Pitt 2009; Geosyntec Consultants and Wright Water Engineering 2012; Hunt et al. 2006, 2012; Kim et al. 2003; Li et al. 2010; Passeport et al. 2009
Bacteria	High	*Enterococcus*: 235 MPN/ 100 mL, *E.coli*: 101 MPN/100 mL	Sedimentation, filtration, sorption, desiccation, predation, and photolysis in mulch layer and media.	2 feet of media	Hathaway et al. 2009, 2011; Hunt and Lord 2006; Hunt et al. 2008, 2012; Jones and Hunt 2010; Geosyntec Consultants and Wright Water Engineering 2012
Trash	High	*N/A*	Filtration	1.5 feet of media	Barrett et al. 2013

[1] Underlined effluent concentrations were (statistically) significantly lower than influent concentrations, as determined by statistical hypothesis testing on the available sampled data. Effluent concentrations displayed in *italics* were (statistically) significantly higher than influent concentrations.

Performance Considerations

Bioretention areas provide relatively consistent and high pollutant removal for sediment, metals, and organic pollutants (e.g., hydrocarbons). Most sediment removal occurs in pretreatment practices, in the mulch layer, and in the top 2 to 8 inches of soil media (Hatt et al. 2008; Li and Davis 2008; Stander and Borst 2010). Metals are commonly sediment-bound and are removed in the top 8 inches of media (Hsieh and Davis 2005; Hunt et al. 2012).

Nitrogen and phosphorus removal is less consistent. Total phosphorus percent removal has been found to vary between a 240 percent increase (production) and a 99 percent decrease (removal). The significant increase is suspected to be the result of excessive phosphorus levels in the furnished soil media (Hsieh and Davis 2005; Hunt et al. 2006; Davis 2007). Greater total phosphorus removal can be achieved by using soil media with total phosphorus concentrations below 15 parts per million (ppm) (Hunt and Lord 2006). A study in Texas indicated that nutrient export can also occur when bioretention soils are amended with excessive compost (Li et al. 2010). Nitrate removal has been found to vary between a 1 and 80 percent decrease (Kim et al. 2003; Hunt et al. 2006). Total Kjeldahl nitrogen (TKN) has been found to vary between a 5 percent increase and 64 percent decrease (Kim et al. 2003; Hunt and Lord 2006). Greater nitrate and TKN removal can be achieved by reducing the infiltration rate in the planting soil to 1–2 in/hr and ensuring that the soil media is at least 3 feet deep (Hunt and Lord 2006). Nitrate removal can be improved by incorporating a saturated layer in the soil media to promote anaerobic conditions for denitrification (Kim et al. 2003; Hunt and Lord 2006; Passeport et al. 2009).

Bioretention represents a technology to mitigate pathogens from urban watersheds (especially when volume reduction is considered), although limited data exist for bacteria, virus, and protozoa removal. Most scientists and engineers agree that bacteria die-off occurs at the surface where organisms are exposed to solar radiation and dry (desiccating) conditions; dense vegetation in the bioretention area can limit the penetration of sunlight, but it can provide habitat for bacterivores and other beneficial pathogen predators (Hunt and Lord 2006; Hunt et al. 2008; Hathaway et al. 2009). Microbes are also sequestered by sedimentation and sorption; therefore, 2 feet minimum media depth and slower infiltration rates (1–2 in/hr) are recommended to enhance pathogen removal (Hathaway et al. 2011; Hunt et al. 2012).

In addition to chemical and biological pollutant removal, bioretention can be designed to reduce thermal loading to waterways. Thermally enriched runoff can increase stream temperatures and have adverse impacts on stream biota and dissolved oxygen (Booth et al. 2013; USEPA 1986). Research suggests that deep media beds (generally four feet or greater) can buffer extreme temperatures and that infiltration of stormwater can decrease overall thermal loading (Hunt et al. 2012; Jones and Hunt 2009; Winston et al. 2011; Wardynski et al. 2013). Thermal mitigation can likely be enhanced by shading bioretention areas with tree canopy cover and including IWS (Hunt et al. 2012; Jones et al. 2012).

Trash FCS

The Trash Amendments adopted by the State Water Board in April 2015 provide a performance standard for treatment of stormwater for trash in the form of the definition of FCS, which bioretention meets (see Section 5.6.1 for FCS details).

It is worth noting that the numerous treatment processes provided by bioretention, particularly filtration, means bioretention performance far exceeds the 5 mm or greater FCS definition for particle trapping. So bioretention systems are not only trapping all particles of 5 mm or greater but effectively all particles less than 5 mm, including microplastics and "nurdles" (pre-production plastics).

Suitability and Design

Figure 1 and Figure 2 illustrate the flexibility of bioretention design in new or existing infrastructure. The constraints of each site dictate the appropriate siting and footprint. Fundamental bioretention design components are as follows:

- A fully stabilized drainage area of less than 20% slope.
- 2.5 to 3.5 inch minimum elevation difference in head between inlet and outlet.
- Typical ponding depth of 3 to 12 inches or more with 9 inches recommended.
- 10-ft setback from foundations, 100-ft from septic fields and water supply wells, and 50-ft from steep slopes.
- Geotechnical investigation required to identify soil infiltration rate. If known soil contamination is present, line restricting infiltration is not allowed.

Bioretention design is highly dependent on the constraints of the considered site. Costs will vary in accordance with the design. Table 2 details a number of core construction components and corresponding design considerations. Retrofitting can increase costs because of demolition of existing pervious surfaces.

Table 2. Cost of design components and associated considerations

Component	Cost	Design Consideration
Excavation		Underdrain required if subsoil infiltration rate < 0.5 in/hr or when contamination present. When infiltrating ensure that subgrade compaction is minimized.
Without underdrains (unlined)	$2.75–$5.00/ft^2	
With underdrains (lined)	$3.90–$6.15/ft^2	
Soil Media		1.5–4 feet (deeper for better pollutant removal, hydrologic benefits, and rooting depths) at minimum 5 in/hr infiltration. Total phosphorus < 15 ppm, pH 6–8, CEC > 5 meq/100 g soil. Organic Matter Content < 5% by weight. 65% sand, 20% sandy loam, and 15% compost (from vegetation-based feedstock) by volume.
Recommended mix	$2.40–$4.75/ft^2	
With engineered media	$3.40–$6.80/ft^2	
Soil Media Barrier		When utilizing an underdrain, separate media from underdrain with 2 to 4 inches of washed sand (ASTM C-
Geotextile	$0.45/ft^2	

Component	Cost	Design Consideration
Washed sand (2-inch layer) No. 8 aggregate (min 2 inches thick) No. 57 stone (1.5 + feet)	$0.20/ft^2 $0.28/ft^2 $2.49/ft^2	33), followed by 2 inches of choking stone (ASTM No. 8) over a 1.5 ft envelope of ASTM No. 57 stone.
Underdrain Pipe (includes drainage stone, with 5-foot spacing)	$3.60/ft^2	4-inch diameter minimum, schedule 40 PVC pipe with perforations (slots or holes) every 6 inches at 0.5% slope. Provide cleanout ports/observation wells for each underdrain pipe.
Curb and Gutter	$18/ft	When installed adjacent to road, provide stabilized inlets at least 12 inches wide
Mulch Native hardwood	$0.24–$0.39/ft^2	Dimensional chipped hardwood or triple shredded, well-aged hardwood mulch 3-inches-deep.
Hydraulic Restriction Layer Filter fabric Clay 30-mil liner Concrete barrier	$0.45/ft^2 $0.65/ft^2 $0.35/ft^2 $12.00/ft^2	If non-infiltrating, use hydraulic restriction layer. If infiltrating may use on vertical surfaces to restrict lateral flows to adjacent subgrades, foundations, or utilities.
Vegetation	$0.20–$3.50/ft^2	Native, deep rooting, drought tolerant plants. Apply one-time spot fertilization upon planting. Water until plants are established.

Vegetation

Figure 3. Bioretention in a landscaped area in San Diego, CA.

Vegetation is an integral component of bioretention and has been shown to provide some increase in metals reduction (Sun and Davis 2007, Li, et al. 2011) and a significant increase in nutrient reduction (Glaister, et al., 2014; Henderson, et al., 2007; Barrett, et al., 2013; Limouzin, et al., 2011; Li, et al., 2011; Houdeshel, et al., 2015). Three species each of trees, shrubs, and perennials are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Drought tolerant native species are recommended and should be planted when conditions are most favorable. Vegetation should be watered at the end of each day for fourteen days following planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area. The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species

should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities.

Figure 4 Bioretention in San Francisco, CA. Source: Jim Hook

The designers should evaluate the best placement of vegetation within the bioretention area. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site. Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Full Trash Capture Compliance

This section provides trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. In addition to developing and adopting the Trash Amendments, the State Water Board provides implementation information on its Trash Implementation web page: https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html.

The web page includes information on best management practices or Full Capture Systems, including lists of State-certified Multi-Benefit Trash Treatment Systems. So, when selecting BMPs for trash control, fact sheet users should refer to both this BMP fact sheet and the State Water Board's Trash Implementation web page.

Design Modifications to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

The bioretention area must be configured to allow trash to enter the system and for trash to remain in the bioretention area until it can be collected and removed. To meet the requirement, inlets must be designed to pass the peak flow produced by the one-year, one-hour design storm or the same flows as the capacity of the inlet storm drain and solids that would be retained by a 5 mm screen or mesh, must remain in the system.

Inlets

There are a multitude of inlet configurations that will allow trash to enter and be captured in a bioretention area. An open curb cut is recommended for high traffic areas (Figure 5). A minimum 2 inch drop from the gutter line of the curb to the inlet is recommended as demonstrated in Figure 6 to ensure that flow is routed into the bioretention area and trash will not clog the inlet.

Figure 5. Example of an open curb cut.

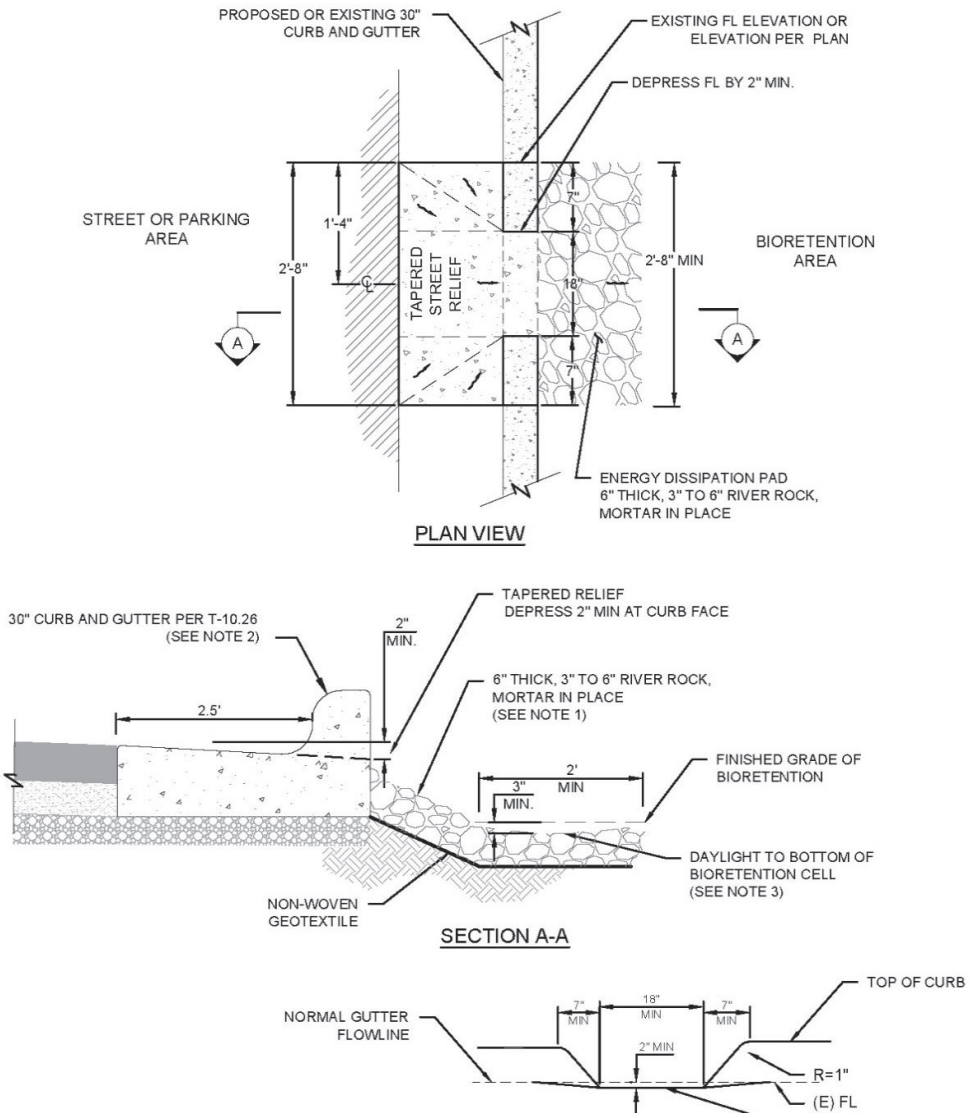

Figure 6. Example Inlet Detail

Pretreatment

Pretreatment is beneficial to increase and consolidate trash capture while managing maintenance requirements. A forebay (Figure 7), filter strip (Figure 8), or mortared cobble inside the curb cut (Figure 9) can slow flow and allow trash and gross solids to settle out while consolidating at the edge of the bioretention area to make it easier for maintenance crews to collect and remove.

Figure 7. Example of a forebay as pretreatment for a bioretention area.

Figure 8. Example of filter strip as pretreatment for a bioretention area.

Figure 9. Example of mortared cobble for pretreatment in a bioretention inlet with a curb cut.

Trash Containment

Once trash has been captured in the bioretention area it must be contained so trash does not escape the bioretention area. Containment may be provided by one or more of these features:

- an external design feature or up-gradient structure designed to bypass flows exceeding the region-specific one-year, one-hour storm event; or
- the BMP having sufficient capacity to trap particles from flows exceeding those generated by the one-year, one-hour storm event; or

Figure 10. Example of an outlet with 5 mm screen.

- the BMP having sufficient capacity to treat either the design flows or volumes through media filtration or infiltration into native or amended soils; or
- use of a maximum 5 mm mesh screen on all outlets.

Figure 10 shows an example of an outlet with a screen to contain trash.

Maintenance

The primary maintenance requirement for bioretention areas is inspection and repair or replacement of the treatment area's components. Appropriately selected plants will aid in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural soil horizon. These processes will lengthen the facility's life and reduce the need for extensive maintenance. Maintaining soil porosity and basic housekeeping practices such as removal of debris accumulations and vegetation management are necessary to ensure that the system dewaters completely (recommended 72-hour or less residence time) to prevent creating mosquito and other vector habitats. If a bioretention cell has an underdrain, the functionality of the underdrain needs to be maintained to ensure that the drainage and drawdown of stormwater is not hindered. Bioretention requires monthly landscaping maintenance, including measures to ensure that the area is functioning properly, and irrigation during dry periods. In many cases, bioretention areas initially require intense maintenance, but less maintenance over time. Maintenance tasks can be conducted by a landscaping contractor, who might already be hired at the site. Additionally, a bioretention cell's efficacy to reduce pollutant loads and provide hydrologic benefits is severely diminished when frequent and complete maintenance is not conducted. For typical maintenance activities, Table 3 provides recommended frequencies and associated costs.

Table 3. Typical maintenance activities and associated costs and frequency

Frequency	Cost	Activity
As needed		• Irrigate area during dry periods. Make structural changes or repairs as needed to eliminate pools of water, particularly during the warmer months of the year. Coordinate with the local mosquito and vector control agency to control mosquitoes.
Biweekly, at project completion		Water plants daily for 2 weeks.
Routine Maintenance (required monthly to every 2 years)		Remove excess sediment, trash, and debris across the surface, inlet, and outlet. Check for and stabilize erosion. Pruning and mowing overgrown vegetation that interferes with access, or safety. Remove and replant dead or dying plants. Replace tree stakes and wires. If there is an underdrain, unclog drainage structure.
Routine (small)	$7.62/ft^2	
Routine (medium)	$1.91/ft^2	
Routine (large)	$1.91/ft^2	
Intermediate Maintenance (required every 6 to 10 years)		Remove and replace mulch upon decomposition. Replace soil media for areas receiving especially
Intermediate (small)	$5.62/ft^2	

Frequency	Cost	Activity
Intermediate (medium)	$2.94/ft^2	high pollutant loads. Repair erosion at inflow points and outflow structures.
Intermediate (large)	$2.50/ft^2	
End of Life Replacement (service life of 20 years)		Excavate to the depth of soil media. Test soil for excessive soil contamination of common stormwater pollutants (e.g. metals, nutrients). Continue to remove underlying soil if pollutants exceed standard for contaminated soil. Replace with clean soil.
Replacement (small)	$10.52/ft^2	
Replacement (medium)	$10.17/ft^2	
Replacement (large)	$10.11/ft^2	
Note: Small System = 500 ft^2; Medium System = 2000 ft^2; Large System = 4000 ft^2 Underlined statement indicates that the activity may be required more frequently than shown in the table to meet the State Water Board maintenance criteria for Multi-Benefit Treatment Systems to be qualified as Full Capture Systems.		

Trash FCS

Maintenance to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

For Multi-Benefit Treatment Systems to be qualified as Full Capture Systems, the State Water Board requires regular maintenance to maintain adequate trash capture capacity and to ensure that trapped trash does not migrate offsite. Additionally, the State Water Board requires the BMP owner to establish a maintenance schedule based on site-specific factors, including the design trash capacity of the Bioretention Multi-Benefit Trash Treatment System, storm frequency, and estimated or measured trash loading from the drainage area. To meet those criteria, it is likely that the frequency of trash and debris removal will have to be increased above the recommended monthly interval during the wet season to prevent trash from being blown from the BMP or being washed out of the bioretention area in the subsequent rain events (see Table 3). Depending on the frequency and size of storms, and upstream pollutant characteristics, trash and debris removal can be as frequent as before and after every wet weather event. The optimum maintenance interval is best determined by observing the BMP in operation for a wet season.

Trash maintenance not only plays a role in the functionality of the bioretention area but also in the aesthetics and public perception of the bioretention area (and of all BMPs). Part of maintaining positive perception among the public is the visibility of a well-maintained BMP. This positive perception can self-perpetuate further support for integrated stormwater management practices and therefore further investment in regular maintenance.

Schematic

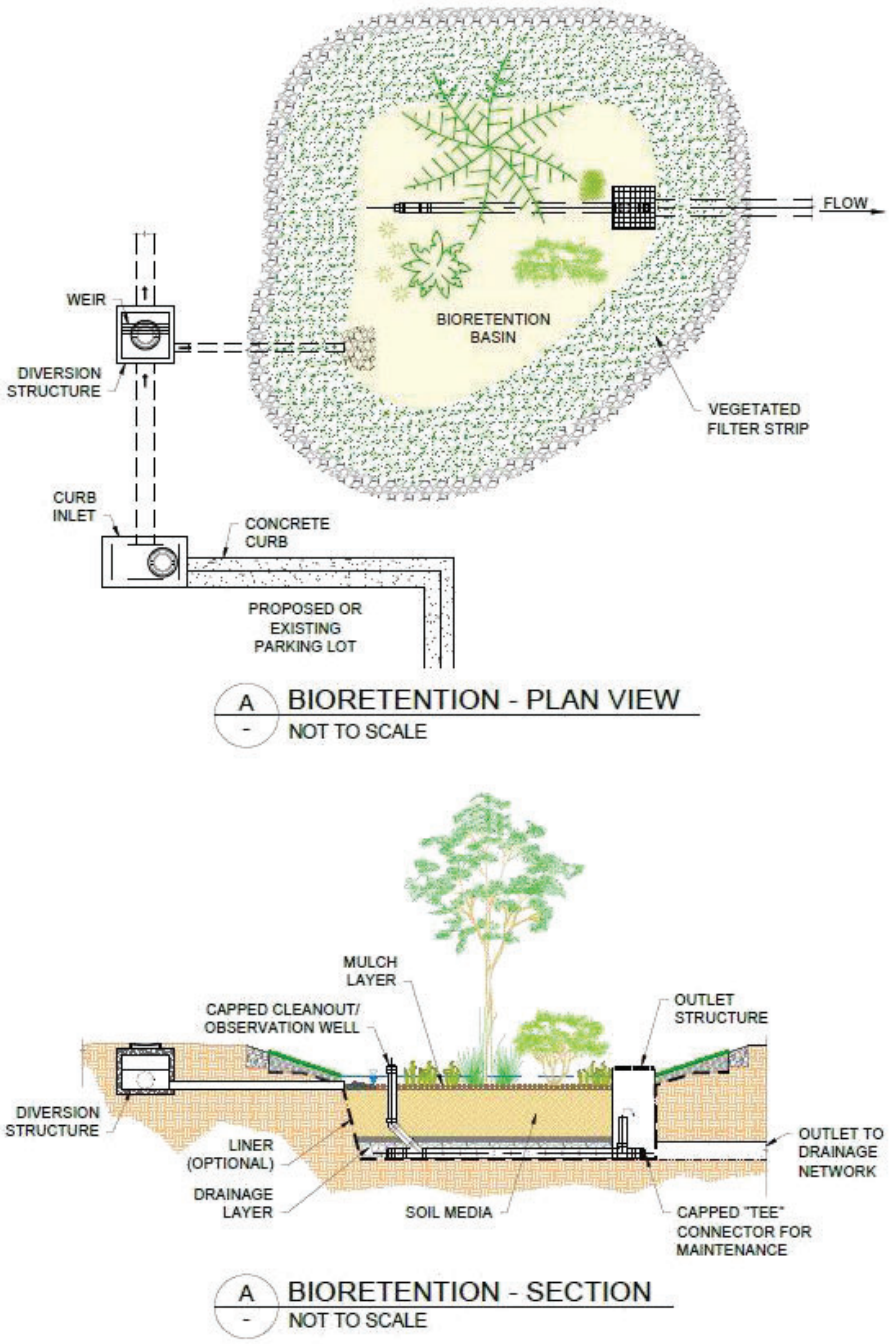

Figure 11. Schematic of a Bioretention Area.

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- An export of dissolved pollutants may occur as accumulated organic matter (e.g., leaves) decomposes in the units.

Design and Sizing Guidelines

Stormwater enters the separator, typically below the effluent line, tangentially into the basin, thereby imparting a circular motion in the system (Figure 1). Due to centrifugal forces created by the circular motion, the suspended particles move to the wall of the device, and fall along the wall to the bottom. Trash accumulates in the low pressure area of the center of the vortex.

Figure 1. Looking down a hydrodynamic separator from the top where stormwater tangentially enters the unit.

There are a wide variety of system designs commercially available with treatment capacities ranging from less than 1 cfs to more than 100 cfs. Some designs include internal screens suitable for capturing neutrally buoyant materials. Some incorporate internal bypass features that direct peak flows exceeding the design water quality flow rate around the separation zone. Many systems can accommodate multiple inlet pipes, grate inlets or curb inlets. Most systems are designed within standard manhole or utility vaults and can support HS20 loading, with additional reinforcement for greater loads available as an option.

Design of hydrodynamic separators is flow-based with the system size increasing as the design water quality flow rate increases. Some hydrodynamic separators have a characteristic hydraulic loading rate expressed as flow rate per system volume or separation chamber surface area that is associated with a specific targeted pollutant concentration reduction or effluent concentration. Sizing most commonly entails dividing the design water quality flow rate by the hydraulic loading rate to get a minimum system size.

Most, if not all commercially available systems also have sizing tables available for standard models listing the maximum treatment flow rate for a particular model and target performance level. It should be noted that the default target particle diameter and removal rate varies widely between manufactured systems so direct comparison of different models can be difficult. In most cases, a specific system can also be scaled larger or smaller to achieve a greater or lesser performance target at a particular flow rate. Results of full scale field monitoring or standardized laboratory testing with a standard sediment gradation are available for many hydrodynamic separators and should be the basis for selection and sizing decisions.

Construction/Inspection Considerations

No special considerations.

Performance

The primary mechanism of pollutant removal is gravitational separation for all hydrodynamic separators, with some models also employing screens to capture neutrally buoyant materials such as trash. There are numerous hydrodynamic separator design variations commercially available with performance of a particular design depending primarily on the residence time within the system.

Protocols for testing and verifying the performance of innovative stormwater treatment systems have been developed by the Washington State Department of Ecology and the New Jersey Department of Environmental Protection. Both programs provide certification or approval of treatment systems following independent verification that those systems meet certain performance targets. Both programs have been endorsed by numerous states and public agencies including EPA and the Water Environment Federation (WEF) and have been supported by the Stormwater Equipment Manufacturers Association (SWEMA).

The Technology Assessment Protocol – Ecology (TAPE) from the Washington State Department of Ecology program has a "Pretreatment" standard that is applicable to hydrodynamic separators. It is intended to achieve 50% removal of fine (50 micron-mean size) and 80% removal of coarse (125-micron-mean size) total suspended solids.

A list of technologies, including several hydrodynamic separators that have met this treatment standard can be found on the Ecology web page for emerging technologies at:
http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html

The New Jersey DEP laboratory protocol for hydrodynamic separators requires 50% removal of a TSS gradation with a mean particle diameter of 75 microns. A list of technologies, including several hydrodynamic separators that have met this standard can be found on the NJ DEP web page for Stormwater Manufactured Treatment Devices at:
http://www.njstormwater.org/treatment.html

To ensure acceptable hydrodynamic separator performance and operational feasibility, selection of systems that have been verified by the Ecology and/or NJ DEP programs is recommended. Furthermore, design and sizing should be consistent with approvals issued by those programs.

Siting Criteria

Hydrodynamic separators can be configured to receive runoff from the surface through a curb inlet, grate inlet, or through one or more inlet pipes. They can be installed under vehicular or pedestrian traffic areas or under landscaped areas. Maintenance typically requires a vacuum truck so hydrodynamic separators should be located where they can be accessed without unduly disrupting traffic flow or site operations.

Additional Design Guidelines

Hydrodynamic separators may be susceptible to washout if flows significantly higher than the design treatment capacity are directed through the separation chamber or the sediment storage zone. Therefore, it is important that the system either be designed in an off-line configuration

where peak flows are routed around the treatment system, or that the peak flow rate does not exceed the rate at which significant resuspension of previously captured materials will occur. For most designs, the maximum flow rate that the system can handle without resuspension is significantly higher than the design treatment flow rate for particles in the range of 100 microns. The New Jersey DEP protocol for hydrodynamic separator testing includes scour testing which is used to establish the maximum allowable hydraulic loading rate prior to bypass.

Maintenance

Maintenance consists of the removal of accumulated material with a vacuum truck which should be performed annually unless experience indicates the need for more or less frequent maintenance. It may be necessary to remove and dispose of the floatables separately due to the presence of petroleum product.

Cost

Manufacturers provide costs for the units including delivery. Installation costs are generally on the order of 25 to 50% of the manufacturer's cost. For most sites the units are cleaned annually.

Cost Considerations

- Treatment with one larger systems is typically more cost effective than using multiple smaller systems.

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New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device:
http://www.njstormwater.org/pdf/hds-protocol-1-25-13.pdf

Washington State manufactured stormwater devices' performance verification:
http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html

CHAPTER 9.46 SPECIFIC USE REGULATIONS FOR INDUSTRIAL DISTRICTS

SECTIONS:

9.46.010 Purpose and General Plan Consistency 1
9.46.020 Planned Industrial District Standards 1
9.46.030 High Desert Corridor Near Industrial Districts 2
9.46.040 Accessory Uses and Structures 2
9.46.050 Outdoor Uses 3
9.46.060 Intensity Bonus 5
9.46.070 Pre-fabricated Structures *(Amended Ord. 313)* 5
9.46.080 Trash Enclosures 6

9.46.010 PURPOSE AND GENERAL PLAN CONSISTENCY

A. ***Purpose and General Plan Consistency.*** The purpose of this Chapter is to:

1. Protect and enhance the quality of the natural and built environment and to promote the public health, safety and welfare by minimizing public exposure to potential emissions and hazards generated by industrial operations and to encourage future development that is compatible with adjacent uses and surrounding neighborhoods;

2. Implement the goals, objectives, strategies and action plans of the General Plan, and the Town's Comprehensive Economic Development Plan through industrial development featuring design and planning excellence;

3. Support measures which buffer both new and established residences and businesses from potential adverse impacts caused by adjacent commercial, industrial and agricultural uses in order to ensure that land use conflicts are minimized and that long-term interests for industrial projects are maintained;

4. Promote commercial and industrial developments that are capable of strengthening the local economy and enhancing the quality of life of Town residents;

5. Achieve design and planning excellence in both public and private development projects;

6. Expand the industrial base and encourages both large and small-scale industrial development to locate within the Town;

7. Encourage long-term investment in the community;

8. Promote an area's long-term economic viability by not allowing unnecessary visual nuisances to degrade the appearance of a site.

9.46.020 PLANNED INDUSTRIAL DISTRICT STANDARDS

A. ***Purpose.*** The purpose of the Planned Industrial District is to provide flexibility in the standards for industrial development in exchange for higher quality development than is possible through the implementation of the standards contained in this Development Code.

B. ***Performance Standards.*** The processes and equipment employed and the goods processed shall be limited to those that are low in emissions consisting of odors, dust, smoke, cinders, gas, fumes, noise, vibrations, refuse matter, water carried waste, or other emissions in accordance with the provisions of Chapter 9.70 of this Development Code.

C. ***Access.*** All uses shall have direct access to a major or secondary street, such access may be through the interior local industrial street network of the industrial park. In no case shall any access be permitted onto local residential streets (street types are defined in Figures II-5 and II-6 of the Circulation Element of the General Plan).

D. ***Lot Size.*** The area included within a planned industrial district shall be a minimum of ten (10) acres. The minimum lot size within the district shall be 20,000 square feet.

E. ***Buffering and Screening***

1. ***Buffering and Screening.*** Buffering and screening shall be provided in accordance with the provisions of Section 9.37.070, of this Code.

2. ***Street Frontages Across from Residential Districts.*** Along all street frontages situated across from residentially zoned property, a three-foot high landscaped earthen berm shall be constructed.

3. ***All Other Lot Lines Adjacent to Residential Districts.*** Along all other lot lines adjacent to residential districts, a maximum eight-foot high decorative masonry wall or fence and a minimum ten (10) foot wide landscape planter shall be constructed. Such planter shall contain the following minimum sizes of plant material at the initial planting:

a. twenty-four (24)-inch box trees;

b. fifteen (15)-gallon plants;

c. other approved dense screening material.

The number and placement of the plant material shall be approved by the Director and shall be in accordance with Chapter 9.75, *Water Conservation/Landscaping Regulations,* of this Code.

9.46.030 HIGH DESERT CORRIDOR NEAR INDUSTRIAL DISTRICTS

A. ***Applicability.*** The following regulations shall apply to all Industrial Districts adjacent to or abutting the High Desert Corridor right of way, as depicted on the General Plan Land Use Map, or established by the California Department of Transportation.

B. ***General Provisions***. Any proposed industrial development occurring adjacent to the High Desert Corridor shall submit a request letter to the California Department of Transportation (Caltrans) in order to ascertain Caltrans requirements for development occurring in proximity to the High Desert Corridor. Current contact information for the High Desert Corridor design/construction team shall be available in the Planning and Engineering Divisions at the Town offices.

9.46.040 ACCESSORY USES AND STRUCTURES

A. ***Purpose.*** The purpose of this Section is to mitigate the potential adverse health, safety and aesthetic impacts of accessory uses in all of the industrial districts, consistent with the goals, objectives and policies of the General Plan.

B. ***Accessory Uses in Office or Industrial Buildings.*** Barber shops, beauty shops, coffee shops, cafeterias and newsstands may be located in an office or industrial building provided that:

1. There are no entrances directly from the street to such businesses.

2. There are no signs or other evidence indicating the existence of such businesses visible from the outside.

3. Patronage of such businesses may be expected to be furnished substantially or wholly by tenants of the office or industrial building.

C. ***Accessory Retailing.*** Industrial establishments may include accessory retailing. For purposes of this Chapter, accessory retailing is defined as retailing not to exceed twenty-five (25) percent of the gross floor area of the building.

D. ***Accessory Uses for Service Stations***

1. Vehicle washing and lubricating services;

2. The sale and servicing of tires, batteries, replacement items and other automotive accessories;

3. Minor automotive repair;

4. Towing service limited to two (2) tow trucks.

E. ***Accessory Structures.*** The following provisions for accessory structures shall apply to all industrial districts:

1. Accessory structures shall not be located in the front or street side setback or in front of the primary structure.

2. Accessory structures shall meet all of the setback requirements of the applicable zoning district.

3. Accessory structures may not exceed the height of the primary structure.

4. Accessory structures shall be architecturally compatible with the primary structure, i.e., similar building materials, architectural style, color, etc.

5. Pre-fabricated accessory structures shall comply with Section 9.46.070, of this Chapter.

9.46.050 OUTDOOR USES

A. ***Enclosed Building Requirement.*** All uses within the industrial districts shall be conducted within a completely enclosed building unless the use is specifically permitted in Section 9.45.030, *Permitted Uses*, of this Code, as an outdoor use or is specifically approved through a Conditional Use Permit.

B. ***Outdoor Manufacturing***

1. ***Permit Required.*** Applications for proposed outdoor manufacturing uses are subject to approval of a Conditional Use Permit in the I-RE district. Outdoor manufacturing is not permitted in the I-P district.

2. ***Location***

a. Outdoor manufacturing uses shall be located a minimum of 1,000 feet from a residential use or district or public facility.

b. Outdoor manufacturing uses shall be located a minimum of 200 feet from restaurant, office or retail uses or a commercial district.

3. ***Screening.*** Outdoor manufacturing uses shall be appropriately screened on all sides. Screening shall consist of all of the following:

a. A minimum twenty-five (25)-foot wide landscaped area shall be provided and maintained along each street which abuts the property used for outdoor manufacturing. Within the landscaped area a blend of desert appropriate trees, shrubs and groundcover shall be planted;

b. A minimum eight (8)-foot high solid masonry wall shall be erected at the rear of the landscaped area adjacent to all streets. Walls shall also have offsets, indentations or pilasters to break up long, flat planar sections of wall. The wall may be reduced to six (6) feet in height where such height will fully screen all materials and operations;

c. Property lines not adjacent to a street shall be fenced with chain link fencing with appropriate opaque inserts (plastic or redwood slats); and

d. Gates for vehicular access into the site shall be solid metal gates the same height as the wall and of the sliding/rolling type rather than the swinging type. Such gates shall be closed except during periods of entry and exit of vehicles.

4. ***Paving of Work Areas.*** Work areas within the site shall be paved with a minimum of two (2) inches of asphaltic concrete or equivalent. Storage areas and other areas shall also be paved or may be treated in some non-paved manner such as gravel base over six (6) millimeter plastic film, to control dust and erosion.

5. ***Plan of Operation.*** Each applicant for an outdoor manufacturing use shall submit a plan of operation which describes all aspects of the business, including, but not limited to:

a. Number of employees;

b. Hours and days of operation;

c. Type of machinery, equipment and materials to be used and noise, vibration, glare, odor and possible air pollution and other impacts which can be expected;

d. Quantities and types of materials which will be stored on the site and used in the manufacturing process;

e. Size of trucks, and the time and frequency of delivery of materials to the site;

f. Size of trucks, and the time and frequency of removal of materials from the site;

g. Description of the quantities and properties of hazardous materials which will be used on the site;

h. Description of any possible health and safety hazards that may exist due to materials, equipment and processes involved in the proposed outdoor manufacturing use; and

i. Methods proposed to mitigate impacts from the proposed use.

6. ***Permanent Buildings.*** Outdoor manufacturing and assembly uses shall only be allowed in conjunction with a permanent building for office, restroom, and eating areas.

7. ***Performance Standards.*** All performance standards relating to noise, vibration, air quality, glare, heat, electrical disturbances, fire hazards and waste disposal contained in Chapter 9.70 of this Development Code, shall apply to all outdoor uses in this district.

8. ***Utilities.*** Electrical and telephone lines shall be placed underground as required by the Town's Underground Utilities Ordinance.

9. ***Lighting.*** Lighting fixtures shall be shielded so that no light is directed above the horizontal plane of the fixture. Lighting not necessary for security shall be on timers set to turn off at the close of business.

C. ***Outdoor Storage.*** Outdoor storage of materials and equipment is permitted in the I-P District. Such storage shall be located in the rear one-half of the site and screened completely from view from any adjoining property or roadway by a solid wall or fence at least six (6) feet in height, but not to exceed ten (10) feet in height. Said fence or wall shall be constructed of or finished with materials that match those of the primary building on the site. Items that are being stored outdoors shall not be stacked to a height exceeding the height of the required wall or fence.

D. ***Visible Storage.*** Except as may be otherwise permitted in this Chapter, there shall be no visible storage of motor vehicles (except display areas for sales or rentals), trailers, airplanes, boats, recreational vehicles, or their composite parts; loose rubbish, garbage, junk, or their receptacles; building materials; or any other items on any portion of a lot or parcel. No storage shall occur on a vacant parcel.

E. ***Permitted Storage of Building Materials.*** Building materials for use on the same parcel or building site may be stored on the parcel or building site during the time that a valid building permit is in effect.

F. ***Other Outdoor Storage Standards***

1. Storage shall not be permitted in the required setback areas.

2. Storage shall not be permitted in required parking spaces or driveways and shall not at any time impede the use of any required parking space or driveway.

3. The limits of the outdoor storage area shall be clearly delineated on the approved site plan.

9.46.060 INTENSITY BONUS

A. ***Purpose.*** The purpose of this Section is to encourage the addition of enhanced site amenities and increased flexibility in design for new developments in the industrial districts through the granting of additional floor space (increased floor area ratio, F.A.R.), additional building height, or other differences from Site Development Standards, Section 9.45.040, of this Code. Such differences are subject to the approval of a Conditional Use Permit.

B. ***Types of Amenities***

1. Employee trip reduction incentives

2. Public spaces, plazas

3. Public art, sculptures

4. Enhanced landscaping

5. Other amenities as approved by the Planning Commission.

C. ***Exceptions.*** Exceptions from the provisions of Section 9.45.040, Site Development Standards, of this Code, may be granted by the Planning Commission through the approval of a Conditional Use Permit when enhanced site amenities described in subsection B of this Section are provided. Such exceptions are limited to:

1. Fifteen (15)-foot increase in height, except within 100 feet of a residential use or district; or

2. Ten (10) percent decrease in required landscape coverage, (e.g., 10% to 9%, 15% to 13.5%); or

3. Ten (10) percent decrease in required setbacks, except when adjacent to residential uses or districts.

9.46.070 PRE-FABRICATED STRUCTURES *(AMENDED ORD. 313)*

A. ***Pre-fabricated Structures.***

The following standards shall apply to the use of pre-fabricated structures in industrial districts:

1. The design of pre-fabricated structures shall be compatible with surrounding uses.

2. The design and finish of the pre-fabricated structures shall be compatible with and complementary to existing structures on the site.

3. Pre-fabricated structures shall conform to all standards, goals and objectives of this Chapter and the General Plan.

4. Adequate screening from adjacent residential uses and public streets shall be provided.

5. A permanent foundation system shall be provided.

6. Access for the handicapped and adequate sanitary facilities shall be provided.

7. Prefabricated structures in the industrial districts shall also be compatible with, and complementary to surrounding development.

B. ***Metal Buildings***

1. Buildings constructed on site, or structures assembled from modular or similar units on site, or structures assembled off site and moved on site as one unit, may use metal exteriors when the Planning Commission determines, during a project's Development Permit or Conditional Use Permit review, that the proposed structure shall have an appearance emulating and simulating the color, texture and appearance of other structures within the surrounding area or where it can be clearly demonstrated that the proposed structure shall be an enhancement to the surrounding area. Said metal exterior must provide the same texture depth and other physical characteristics as the exterior of the main structure on the surrounding properties.

2. All other sides shall have a factory processed color finish such as baked enamel.

3. Where large wall or roof areas are adjacent to public parking areas, such areas shall be designed with architectural relief through the use of various materials, varying setbacks, accent colors and landscaping.

4. Landscaping shall be used to soften the building lines.

5. Main entryways shall be clearly defined and smoothly integrated with building and landscape designs. They shall be designed as focal points and pleasant invitations to visitors.

6. Material of less than twenty-six (26)-guage shall not be used.

9.46.080 TRASH ENCLOSURES

Garbage containers or trash bins shall not be kept, placed or maintained so as to be visible from any public street or alley, except on days designated for trash collection, in accordance with Section 6.20.130 of the Town Municipal Code. In addition, the standards cited below shall apply.

A. ***Size of Trash Enclosures.*** Trash receptacles for industrial district uses shall be of sufficient size to accommodate the trash generated by the uses being served, consistent with the Town trash enclosure standards (see Figures 9.45.080-A and B), providing a minimum of:

1. One (1) trash bin per each three (3) industrial uses or units (or fraction thereof) where the units contain 5,000 square feet or less.

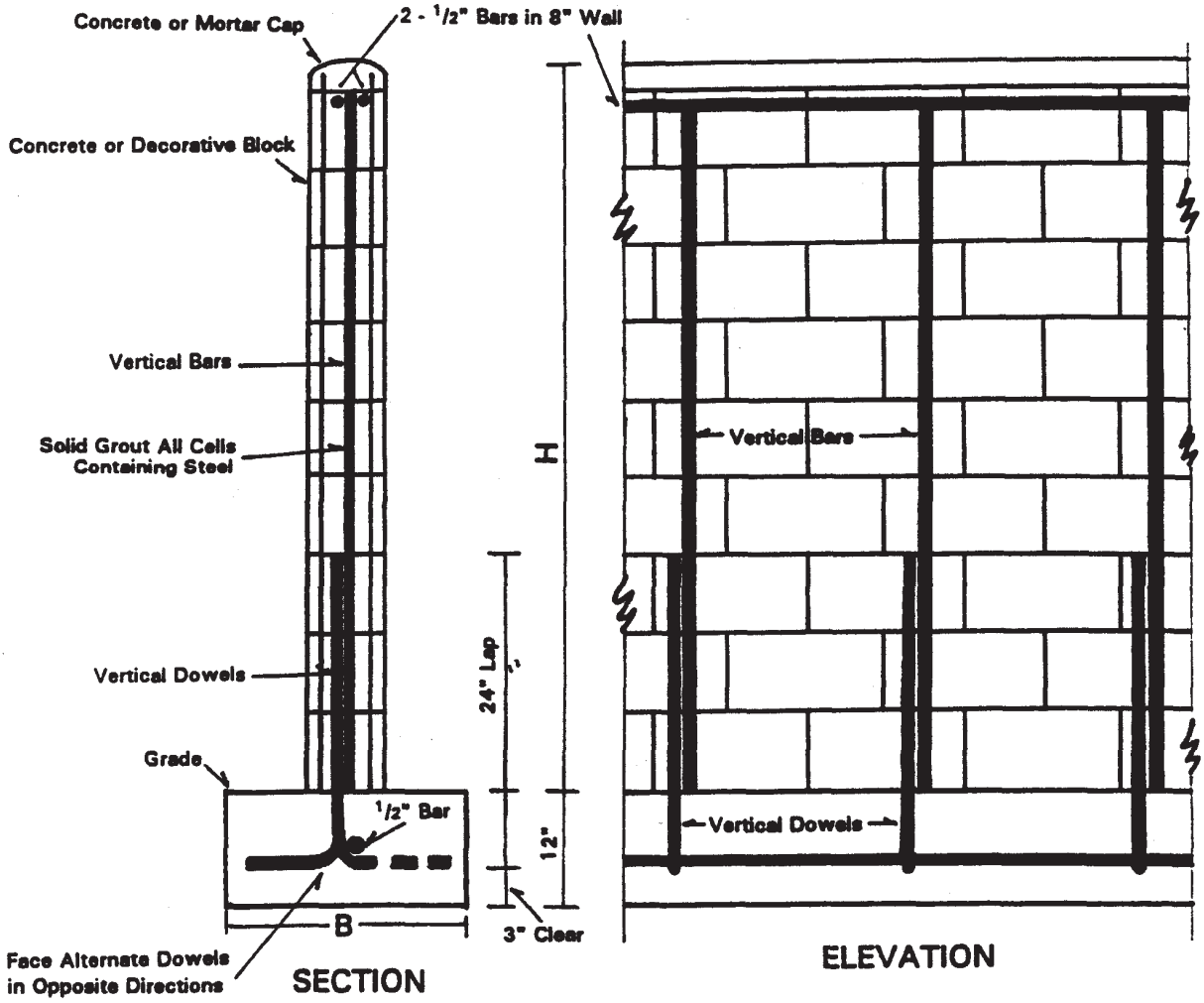
2. One (1) trash bin per industrial use or unit where such use or unit contains between 5,001 and 15,000 square feet in size.

3. Two (2) trash bins per industrial use or unit where such use or unit contains greater than 15,000 square feet.

B. ***Screening of Trash Storage Areas.*** All outdoor storage of trash, garbage, refuse, and other items or material intended for discarding or collection shall be screened from public view on three sides by a six (6)-foot high wall of eight (8)-inch block construction. The fourth side shall be an opaque gate six (6) feet in height made of wood or metal. Gates of trash enclosures shall remain closed at all times except when the enclosure is being accessed for refuse disposal or pick up.

A covered storage area at least three (3) feet by six (6) feet in size, or other size enclosure depending on the nature and quantity of recyclable materials generated, and accessible for truck loading, shall be incorporated into each trash enclosure for collection of recyclable materials.

C. ***Architectural Treatment.*** All trash enclosures visible from streets or public parking areas shall be constructed and finished to match the architectural details and decor of the primary structure.

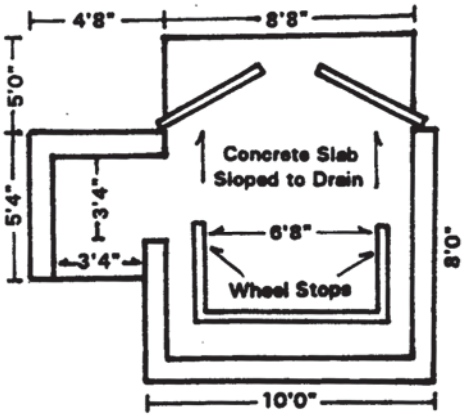


WALL SPECIFICATION:

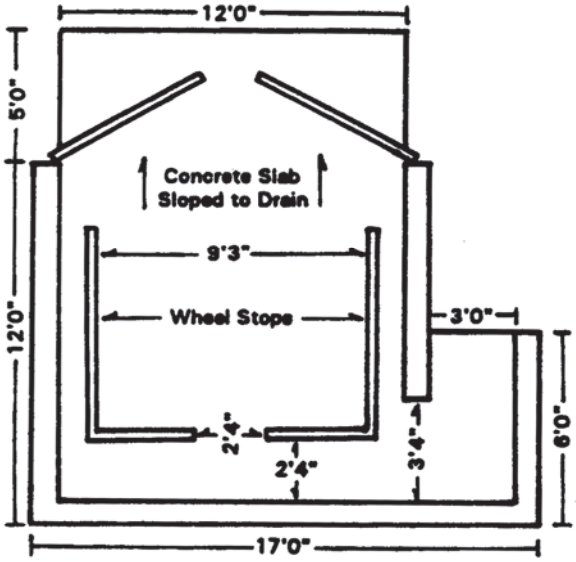
Height (H)	*Base (B)*	*Vertical Reinforcing*
6'0"	24"	1/2" @ 32" O.C.
5'0"	20"	1/2" @ 32" O.C.
4'0"	18"	3/8" @ 48" O.C.
3'0"	12"	3/8" @ 48" O.C.

Notes: 1. Trash enclosure walls shall be constructed of eight (8)-inch concrete or decorative block.
2. All vertical cells containing reinforcing steel shall be filled with grout.
3. Two 1/2-inch diameter vertical bars are required at each side of each opening, foundation dowels of same number, size and spacing required.

Figure 9.45.080-B Trash Enclosure Wall Specification



SINGLE BIN ENCLOSURE



DOUBLE BIN ENCLOSURE

MATERIALS: Six (6)-foot high, eight (8)-inch block construction per Trash Enclosure Wall Detail (figure 9.45.080-B) with wood or metal opaque gates; set on four (4)-inch P.C.C. pad; pad to be at ground level; all hardware to be corrosive resistant.

FINISH: The decorative block or stucco used shall be finished to be compatible with surrounding architectural features.

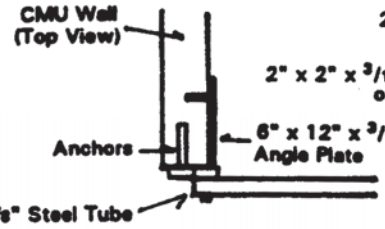
NUMBER REQUIRED:

Residential: One (1) - 8' x 14' enclosure per eight (8) dwelling units

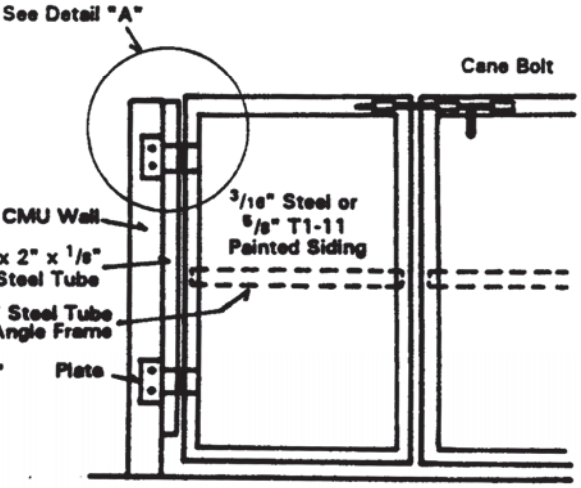
Commercial/Industrial:
One (1) trash bin per each three (3) units where the units are 5,000 sq. ft. or less
One (1) trash bin per unit where the units are between 5,001 and 15,000 sq. ft.
Two (2) trash bins per unit where the units are larger than 15,000 sq. ft.

Note: Any variations from these standards shall be approved by the Director.

Note: Wheel stops shall be 6" x 6" concrete curbs with 1" bevel on edges, anchored to floor with 1/2" x 8" bolts or approved equal at 6" from ends and corners.



DETAIL "A"



GATE DETAIL

9.46.090 CREATIVE/SUSTAINABLE DESIGN INCENTIVES FOR COMMERCIAL AND/OR INDUSTRIAL DEVELOPMENT

Design incentives are included for new commercial or industrial development that integrates creative and sustainable site design principles, as described below and/or that involves the incorporation of innovative and creative architectural design as well as sustainable building materials and practices and energy-conservation measures for both exterior and interior spaces.

Incentives are also considered for existing commercial or industrial development and involve rehabilitation, remodeling and/or retrofitting to improve and enhance aesthetics and to improve energy efficiency.

Suggested Concessions and Incentives for Qualifying Commercial and Industrial Developments

1. For the purposes development under Development Code Section 9.35 the Town shall utilize the following incentives and concessions for qualifying commercial and/or industrial projects:

a. Reduction in commercial or industrial site development standards or a modification of zoning code requirements or architectural design requirements that exceed the minimum building standards approved by the California Building Standards Commission as provided in Part 2.5 of Division 13 of the Health and Safety Code, including but not limited to:

1. A reduction of up to ten (10) percent in setback requirements;

2. An increase of up to ten (10) percent in maximum building coverage requirements;

3. A reduction of up to ten (10) percent in the ratio of vehicular parking spaces;

4. Other regulatory incentives or concessions proposed by the developer or the Town that result in identifiable, financially sufficient and actual reductions in energy or water use.

b. A range of financial incentives for qualifying business owners or commercial an/or industrial project developers:

1. Plan check fee reduction of ten (10) percent for new or expanding commercial and/or industrial development projects incorporating two or more of the following:

- alternative energy systems on-site;
- design parameters that allow for frequent, reliable and convenient public transit;
- site design that utilizes appropriate site orientation to assure solar access and the use of shade and windbreak trees to enhance the use of alternative energy systems;
- site design that utilizes a minimum of fifty (50) percent sustainable and energy efficient interior and exterior building materials;
- landscape plans that exceed Town water efficient landscape requirements by at least fifteen (15) percent through the use of landscape materials and efficient irrigation systems;
- installation of energy-efficient indoor and outdoor lighting that reduces energy use at least twenty-five (25) percent over traditional or existing lighting fixtures;

For an additional ten (10) percent:

- certification as LEED Gold or Platinum.

2. Rebates and low interest loan programs for energy saving improvements that may include any combination of the following (rebate/loan program will be adopted annually by the Economic Development Department):

- Rebate of up to a specified amount to cover the cost and installation of energy-saving devices and improvements that demonstrably increase energy efficiency by at least twenty-five (25) percent, based on specified criteria and timelines as approved by the Town.

- Rebates or deferred/low interest loans of up to a specified amount to cover the cost and installation of solar photovoltaic systems in existing commercial or industrial establishments or sites, based on specified criteria and timelines as approved by the Town.
- Rebates offered via a system of points tied to financial incentives such as tax credits for demonstrated energy savings of at least twenty-five (25) percent for existing commercial or industrial establishments.
- Tax credits or other incentives for new commercial or industrial development projects that provide incentives for transit and/or alternative programs for employee transit.

Appendix I: BMP Maintenance Guides

Treatment Control Maintenance

TCM-11 Infiltration Basin Maintenance

TCM-22 Extended Detention Basin Maintenance

TCM-32 Bioretention Maintenance

TCM-60 Multiple Systems Maintenance

Manufactured Proprietary Maintenance

MPM-51 Gravity Separator

TCM-11 Infiltration Basin

Description

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

Inspection/Maintenance Considerations

A considerable cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time. To mitigate failure, ensure that particulate loading of the stormwater is minimal or is reduced with an adjacent pretreatment (e.g., vegetated buffer strip). Reducing the particulate loading enables the soil's infiltrative capacity to stay high and functional. Regular inspection can also increase the effectiveness of an infiltration basin and reduce the amount of maintenance required. Table 1 provides the inspection tasks associated with an infiltration basin and the associated frequency.

Advanced BMPs Covered

Maintenance Concerns

- *Vector Control*
- *Clogged Soil or Outlet Structures*
- *Vegetation/Landscape Maintenance*
- *Groundwater Contamination*
- *Accumulation of Metals*
- *Aesthetics*

Targeted Constituents

Sediment	■
Nutrients	■
Trash	■
Metals	■
Bacteria	■
Oil and Grease	■
Flow Control	■
Organics	■

Legend (Removal Effectiveness)

● Low ▲ Medium ■ High

✱ Requires Pretreatment

Note: The removal effectiveness ratings shown in the table are for properly designed, sited, and maintained BMPs; some configurations will have variations in pollutant effectiveness.

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TCM-11 Infiltration Basin

Table 1. Typical inspection activities and frequency

Suggested Frequency	Inspection Activities
Postconstruction and semiannually (beginning and end of rainy season)	☐ Observe drain time for a storm after completion or modification of the facility to confirm that the desired drain time of 48 hours has been obtained. ☐ Inspect newly established vegetation several times to determine if any landscape maintenance (e.g., reseeding, irrigation) is necessary. ☐ Inspect for upslope or adjacent contributing sediment sources and ensure that pretreatment systems are in place.
Semiannually and after extreme events	☐ Inspect for differential accumulation of sediment, signs of wetness or damage to structures, erosion of the basin floor, dead or dying grass on the bottom, condition of riprap, drain time, signs of petroleum hydrocarbon contamination, standing water, trash and debris, sediment accumulation, slope stability, and pretreatment device condition.

Clogged infiltration basins reduce water quality performance but can also enable standing water to become a nuisance due to mosquito breeding. If the basin takes more than 48 hours to drain, then the rock-fill should be removed and all dimensions of the basin should be increased by 2 inches to provide a fresh surface for infiltration. To mitigate failure, ensure that particulate loading of the stormwater is minimal or is reduced with an adjacent pretreatment. Reducing particulate loading enables the soil's infiltrative capacity to remain high and functional. Table 2 provides maintenance activity details, frequency, and costs.

Table 2. Typical maintenance activities and associated costs and frequency

Suggested Frequency	Cost	Maintenance Activities
Immediately	Varies	☐ Repair factors responsible for clogging immediately.
Standard maintenance (as needed) Routine (small) Routine (medium) Routine (large)	 $7.62/ft² $1.91/ft² $1.91/ft²	☐ Remove invasive weeds once monthly during the first two growing seasons. ☐ Stabilize eroded banks with erosion control mat or mulch and revegetate. ☐ Repair undercut and eroded areas at inflow and outflow structures. ☐ Maintain access to the basin for regular maintenance activities. ☐ Mow as appropriate for vegetative cover species. ☐ Monitor health of vegetation and replace as necessary. ☐ Control mosquitoes as necessary.

TCM-11 Infiltration Basin

Suggested Frequency	Cost	Maintenance Activities
		☐ Remove litter and debris from infiltration basin area as required. ☐ Trim vegetation to prevent establishment of woody vegetation that decreases storage volume.
Semiannual Routine (small) Routine (medium) Routine (large)	 $7.62/ft² $1.91/ft² $1.91/ft²	☐ <u>Mow and remove grass clippings, litter, and debris.</u> ☐ Replant eroded or barren spots to prevent erosion and accumulation of sediment.
3–5-year maintenance Replacement (small) Replacement (medium) Replacement (large)	 $10.52/ft² $10.17/ft² $10.11/ft²	☐ Scrape bottom and remove sediment when accumulated sediment reduces original infiltration rate by 25–50%. Restore original cross-section and infiltration rate. Properly dispose of sediment. ☐ Seed or sod to restore ground cover. ☐ Disc or otherwise aerate bottom. ☐ Dethatch basin bottom.
Notes: ft² = square feet; large = 4,000 ft²; medium = 2,000 ft²; small = 500 ft². <u>Underlined</u> statement indicates that the activity may be required more frequently than shown in the table to meet the State Water Board's maintenance criteria for Multi-Benefit Treatment Systems to be qualified as Full Capture Systems.		

If there are actual signs of clogging or significant loss of infiltrative capacity, consider the following maintenance activities:

- ☐ Mechanically dethatching and/or aerating the top soils along the sides and bottom of the basin.
- ☐ Tilling or deicing to scarify the bottom of the basin.

These activities should be performed on an as-needed rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a light tractor.

Trash

<u>Maintenance to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality</u>

Pretreatment is beneficial to increase and consolidate trash capture while managing maintenance requirements. For Multi-Benefit Treatment Systems to be qualified as Full Capture Systems, the State Water Board requires regular maintenance to maintain adequate trash capture capacity and to ensure that trapped trash does not migrate offsite. Further, to ensure maintenance is regular, the State Water Board requires the BMP owner to establish a maintenance schedule based on site-specific factors, including the design trash capacity of the Multi-Benefit Trash Treatment System, storm frequency, and estimated or measured trash loading from the drainage area. To meet those criteria, it is likely that the frequency of trash and debris removal will have to be increased above the recommended monthly interval during the wet season to prevent trash from being blown from the BMP or being washed out of the infiltration basin in the subsequent rain events (see Table 2).

Depending on the frequency and size of storms, and upstream pollutant characteristics, trash and debris removal can be as frequent as before and after every wet weather event.

Trash maintenance not only plays a role in the functionality of the infiltration basin but also in the aesthetics and public perception of the infiltration basin (and of all BMPs). Part of maintaining positive perception among the public is the visibility of a well-maintained BMP. This positive perception can self-perpetuate further support for integrated stormwater management practices and, therefore, further investment in regular maintenance. The appropriate maintenance interval is best determined through observation of the infiltration basin over an average water year.

Additional Information

In most cases, surface sediment removed from an infiltration basin during periodic maintenance to restore capacity does not contain toxic materials (e.g., metals, oil and grease, or organics) at levels posing a hazardous concern. Studies to date indicate that pond sediments are generally below toxicity limits and can be safely landfilled or disposed of on-site. On-site sediment disposal is always preferable (if local authorities permit) as long as the sediments are deposited away from the perimeter to prevent their reentry into the basin. Sediments should be tested for toxic materials in compliance with current landfill requirements and disposed of properly.

Maintenance activities should use lightweight equipment (e.g., a bobcat) that will not compact the underlying soil while removing the top layer of sediment. The remaining soil should be tilled and revegetated as soon as possible.

Sediment removal within the basin should be performed when the sediment is dry enough so that it is cracked and readily separates from the basin floor. This minimizes intermixing of the finer sediment with underlying coarser material on the basin floor.

Special maintenance considerations are required to maintain infiltration basin effectiveness in cold climates. Treating runoff containing salt-based deicers in an infiltration basin may reduce soil fertility and cause vegetation to fail. Incorporating mulch into the soil can help to mitigate this problem. Infiltration basins should not be used to store snow plowed from highways or parking lots. The sand in this snow can clog the basin. In addition, the chlorides and other pollutants can contaminate the groundwater.

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TCM-22 Extended Detention Basin

Description

Extended detention basins—also called dry ponds, dry extended detention ponds, detention ponds, and extended detention ponds—are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (typically 48 hours) to allow particles, trash, and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

Inspection/Maintenance Considerations

Frequent inspection and maintenance not only plays a role in the functionality of the extended detention basin but also in the aesthetics and public perception of the extended detention basin (and of all best management practices [BMPs]). To adhere to the California design drain time of 72 hours, extended detention basins must be inspected and maintained regularly.

Table 1 provides a list of the recommended inspection activities and frequency.

Advanced BMPs Covered

Stormwater Containment and Discharge Reduction

Treatment Control

Maintenance Concerns

- *Accumulation of Metals and Toxics*
- *Clogged Soil Outlet Structures*
- *Vegetation/Landscape Maintenance*
- *Erosion*
- *Vector Control*

Targeted Constituents

Sediment	▲
Nutrients	●
Trash	■
Metals	▲
Bacteria	▲
Oil and Grease	▲
Flow Control	■
Organics	▲

Legend (Removal Effectiveness)

● Low ■ High ▲ Medium

✱ Requires Pretreatment

Note: The removal effectiveness ratings shown in the table are for properly designed, sited, and maintained BMPs; some configurations will have variations in pollutant effectiveness.

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Table 1. Typical inspection activities and associated frequency

Suggested Frequency	Inspection Activities
After construction and semiannually (beginning and end of rainy season)	☐ Inspect after several storm events for bank stability and vegetation growth, and to determine if the desired residence time has been achieved. ☐ Inspect outlet structure for evidence of clogging or outflow release velocities that are greater than design flow.
Semiannual and after major storm events	☐ Inspect for differential settlement, cracking, erosion of pond banks or bottom, leakage, tree growth on the embankment, the condition of the riprap in the inlet, clogging of outlet and pilot channels, standing water, slope stability, presence of burrows, sediment accumulation in the basin, forebay, and outlet structures, trash and debris, and the vigor and density of vegetation on the basin side slopes and floor.
Annual	☐ Inspect for subsidence, damage to the emergency spillway, inadequacy of the inlet/outlet channel erosion control measures, changes in the condition of the pilot channel, accumulated sediment volume, and semiannual inspection items. ☐ During inspections, changes to the extended storage pond or the contributing watershed should be noted, as these may affect basin performance.

Routine maintenance activity consists primarily of sediment, trash, and debris removal, but also mowing the turf to meet aesthetic and flow routing design of the basin. Vector control can also be a significant investment of maintenance hours when poor drainage exists or stilling basins are installed as energy dissipaters. Table 2 provides the recommended maintenance activities for an extended detention basin and their associated cost and frequency.

Table 2. Typical maintenance activities and associated costs and frequency

Suggested Frequency	Cost	Maintenance Activities
Standard maintenance (as needed) Routine (small) Routine (medium) Routine (large)	 $0.44/ft² $0.34/ft² $0.24/ft²	☐ If necessary, modify the outlet orifice to achieve design values if inspection indicates modifications are necessary. ☐ Repair undercut or eroded areas. ☐ Mow side slopes for aesthetics and to remove woody debris that reduces storage volume. ☐ Maintain vegetation in and around basin to prevent any erosion and minimize aesthetic concerns. Minimize use of fertilizers and pesticides. Reseed if necessary. ☐ Remove litter and debris. ☐ Make structural changes or repairs as needed to eliminate pools of water that stand longer than 72 hrs. to prevent mosquito production, particularly during the warmer months of the year. Identify and eliminate sources of non-stormwater runoff that feeds standing water pools. Coordinate with the local mosquito and vector control agency to control mosquitoes, if necessary.

Semiannual, more often as needed Routine (small) Routine (medium) Routine (large)	 $0.44/ft² $0.34/ft² $0.24/ft²	☐ Remove trash, debris, grass clippings, trees, and other large vegetation from the basin perimeter and dispose of properly. ☐ Mow and trim vegetation to prevent establishment of woody vegetation, and for aesthetic and vector reasons.
Annual (as needed) Routine (small) Routine (medium) Routine (large)		☐ Seed or sod to restore dead or damaged ground cover. ☐ Repair erosion to banks and bottom as required. ☐ Supplement vegetation if a significant portion has not been established (at least 50% of the surface area). ☐ Remove nuisance plant species.
Every 5 years Intermediate (small) Intermediate (medium) Intermediate (large)	 $0.44/ft² $0.34/ft² $0.24/ft²	☐ Remove sediment from the forebay to reduce frequency of main basin cleaning. ☐ Remove sediment from the basin bottom and thatch, aerate, or scarify soils to maintain infiltrative capacity.
Upon reaching target threshold Replacement (small) Replacement (medium) Replacement (large)	 $8.19/ft² $6.43/ft² $5.99/ft²	☐ Monitor sediment accumulation and remove accumulated sediment and regrade about every 10 years, when the accumulated sediment volume exceeds 10%–20% of the basin volume, when accumulation reaches 6 inches, or if resuspension is observed. Clean in early spring so vegetation damaged during cleaning has time to reestablish.
Notes: ft² = square feet; large = 4,000 ft²; medium = 2,000 ft²; small = 500 ft². Underlined statement indicates that the activity may be required more frequently than shown in the table to the State Water Board's maintenance criteria for Multi-Benefit Treatment Systems to be qualified as Full Capture Systems.		

If infiltration is desired for stormwater reduction, the following additional maintenance activities might be required to maintain infiltrative capacity:

- ☐ Mechanically dethatching and/or aerating the top soils along the sides and bottom of the basin
- ☐ Tilling or deicing to scarify the bottom of the basin
- ☐ Maintaining adequate vegetative cover

Refer to TCM-11 Infiltration Basin for further information.

Trash

Maintenance to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

For Multi-Benefit Treatment Systems to be qualified as Full Capture Systems, the State Water Board requires regular maintenance to maintain adequate trash capture capacity and to ensure that trapped trash does not migrate offsite. Further, to ensure maintenance is regular, the State Water Board requires the BMP owner to establish a maintenance schedule based on site-specific factors, including the design trash capacity of the Multi-Benefit Trash Treatment System, storm frequency, and estimated or measured trash loading from the drainage area. To meet those criteria, it is likely that the frequency of trash and debris removal will have to be increased above the recommended monthly interval during the wet season to prevent trash from being blown from

the extended detention basin or being washed out of the system in the subsequent rain events. Trash can also clog the inlet and the surface limiting the flow into the basin and reducing the surface infiltration capacity. Depending on the frequency and size of storms, and upstream pollutant characteristics, trash and debris removal can be as frequent as before and after every wet weather event.

Trash maintenance not only plays a role in the functionality of the extended detention basin but also in the aesthetics and public perception of extended detention basins (and of all BMPs). Part of maintaining positive perception among the public is the visibility of a well-maintained BMP. This positive perception can self-perpetuate further support for integrated stormwater management practices and, therefore, further investment in regular maintenance. The appropriate maintenance interval is best determined through observation of the extended detention basin over an average water year.

Additional Information

In most cases, surface sediment removed from an extended detention basin during periodic maintenance to restore capacity does not contain toxic materials (e.g., metals, oil and grease, and organics) at levels posing a hazardous concern. Studies to date indicate that pond sediments are generally below toxicity limits and can be safely landfilled or disposed of on-site. On-site sediment disposal is always preferable (if local authorities permit) as long as the sediments are deposited away from the perimeter to prevent their reentry into the basin. Sediments should be tested for toxic materials in compliance with current landfill requirements and disposed of properly.

TCM-22 Extended Detention Basin

References

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TCM-32 Bioretention

Description

The *bioretention* cell functions as a soil- and plant-based filtration device that removes pollutants, including trash, through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, ponding area, organic or mulch layer, planting soil, and native vegetation. Runoff velocity is reduced by passing over or through a buffer strip, which can increase sedimentation and debris capture in heavily trafficked areas. Stormwater is infiltrated through engineered media to the native soils or can be directed to an underdrain.

Inspection/Maintenance Considerations

The primary maintenance requirement for bioretention areas is inspection and repair or replacement of the treatment area's components. Bioretention requires monthly landscaping maintenance, including measures to ensure that the area is functioning properly, and irrigation during dry periods. In many cases, bioretention areas initially require intense maintenance, but less maintenance over time. Maintenance tasks can be conducted by a landscaping contractor, who might already be hired at the site.

Appropriately selected plants will aid in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural soil horizon. These processes will lengthen the facility's life and reduce the need for extensive maintenance.

Advanced BMPs Covered

- Stormwater Containment and Discharge Reduction
- Treatment Control

Maintenance Concerns

- *Clogged Soil or Outlet Structures*
- *Sediment Accumulation*
- *Invasive Species Management*
- *Vegetation/Landscape Maintenance*
- *Erosion*
- *Channelization of Flow*
- *Vector Control*

Targeted Constituents

Sediment	■
Nutrients	▲
Trash	■
Metals	■
Bacteria	■
Oil and Grease	■
Organics	■
Flow Control	■

Legend (Removal Effectiveness)

● Low ■High ▲ Medium

✱ Requires Pretreatment

Note: The removal effectiveness ratings shown in the table are for properly designed, sited, and maintained BMPs; some configurations will have variations in pollutant effectiveness.

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TCM-32 Bioretention

If a bioretention cell has an underdrain, the functionality of the underdrain needs to be maintained to ensure that the drainage and drawdown of stormwater is not hindered. A bioretention cell's efficacy in reducing pollutant loads and providing hydrologic benefits is severely diminished when frequent and complete maintenance is not performed. Table 1 identifies the inspection tasks that are required for bioretention system maintenance.

Table 1. Typical inspection activities and frequency

Frequency	Inspection Activity
Monthly	• Inspect soil and repair eroded areas. Check soil pH.
Semiannual inspection	• Inspect for erosion or damage to vegetation, preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the strips are ready for winter. However, additional inspection after periods of heavy runoff is desirable. • Ensure that there are no water pools that stand longer than 96 hours to prevent mosquito production. • Identify sources of non-stormwater runoff that feeds standing water pools.
	• Ensure that vegetation is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket. • Check for debris and litter, and areas of sediment accumulation. • Inspect health of trees and shrubs.

Maintaining soil porosity and basic housekeeping practices such as removal of debris accumulations and vegetation management are necessary to ensure that the system dewaters completely (recommended 72-hour or less residence time) to prevent creating mosquito and other vector habitats. For typical maintenance activities, Table 2 provides recommended frequencies and associated costs.

Table 2. Typical maintenance activities and associated costs and frequency

Frequency	Cost	Maintenance Activity
As needed		• Irrigate area during dry periods. • Make structural changes or repairs as needed to eliminate pools of water, particularly during the warmer months of the year. Coordinate with the local mosquito and vector control agency to control mosquitoes.
Biweekly, at project completion		• Water plants daily for 2 weeks.
Routine Maintenance (required monthly to every 2 years)		• Remove excess sediment, trash, and debris across the surface, inlet, and outlet. Check for and stabilize erosion. Prune and mow overgrown vegetation that interferes with access or safety.
Routine (small)	$7.62/ft^2	
Routine (medium)	$1.91/ft^2	
Routine (large)	$1.91/ft^2	

		• Remove and replant dead or dying plants. Replace tree stakes and wires. • If there is an underdrain, unclog drainage structure.
Intermediate Maintenance (required every 6–10 years)		• Remove and replace mulch upon decomposition. • Replace soil media for areas receiving especially high pollutant loads. • Repair erosion at inflow points and outflow structures.
Intermediate (small)	$5.62/ft^2	
Intermediate (medium)	$2.94/ft^2	
Intermediate (large)	$2.50/ft^2	
End-of-Life Replacement (service life of 20 years)		• Excavate to the depth of soil media. Test soil for excessive soil contamination of common stormwater pollutants (e.g., metals, nutrients). • Continue to remove underlying soil if pollutants exceed standard for contaminated soil. Replace with clean soil.
Replacement (small)	$10.52/ft^2	
Replacement (medium)	$10.17/ft^2	
Replacement (large)	$10.11/ft^2	
Notes: ft^2 = square feet; large = 4,000 ft^2; medium = 2,000 ft^2; small = 500 ft^2. Underlined statement indicates that the activity may be required more frequently than shown in the table to meet the State Water Board's maintenance criteria for Multi-Benefit Treatment Systems to be qualified as Full Capture Systems.		

Trash

Maintenance to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

For Multi-Benefit Treatment Systems to be qualified as Full Capture Systems, the State Water Board requires regular maintenance to maintain adequate trash capture capacity and to ensure that trapped trash does not migrate offsite. Further, to ensure maintenance is regular, the State Water Board requires the BMP owner to establish a maintenance schedule based on site-specific factors, including the design trash capacity of the Multi-Benefit Trash Treatment System, storm frequency, and estimated or measured trash loading from the drainage area. To meet those criteria, it is likely that the frequency of trash and debris removal will have to be increased above the recommended monthly interval during the wet season to prevent trash from being blown from the BMP or being washed out of the bioretention area in the subsequent rain events (see Table 2). Depending on the frequency and size of storms, and upstream pollutant characteristics, trash and debris removal can be as frequent as before and after every wet weather event.

Trash maintenance not only plays a role in the functionality of the bioretention area but also in the aesthetics and public perception of the bioretention area (and of all BMPs). Part of maintaining positive perception among the public is the visibility of a well-maintained BMP. This positive perception can self-perpetuate further support for integrated stormwater management practices and, therefore, further investment in regular maintenance. The appropriate maintenance interval is best determined through observation of the bioretention area over an average water year.

Additional Information

Landscaping is critical to the function and aesthetic value of bioretention areas. It is preferable to plant the area with native vegetation or plants that provide habitat value, where possible. Another important design feature is to select species that can withstand the hydrologic regime they will experience. At the bottom of the bioretention facility, plants that tolerate both wet and

dry conditions are preferable. At the edges, which will remain primarily dry, upland species will be the most resilient. It is best to select a combination of trees, shrubs, and herbaceous materials.

Sediment may enter the bioretention cell and form a crust on the soil surface, limiting the porosity of the soil. Raking the mulch and soil surface may be necessary to maintain high infiltration rates. In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

For areas with low-permeability native soils or steep slopes, bioretention areas can be designed with an underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration.

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TCM-60 Multiple Systems

Pervious Pavement adjacent to a Vegetate Swale

Advanced BMPs Covered

- *Refer to Individual Treatment Control (TC) Fact Sheets; Development BMP Handbook*

Maintenance Concerns

- *Refer to Individual Treatment Control Maintenance (TCM) Sheets*

Targeted Constituents

- *Refer to Individual Treatment Control (TC) Fact Sheets; Development BMP Handbook*

Description

A multiple treatment system uses two or more treatment control BMPs in series to enhance pollutant removal and minimize maintenance efforts. There are many different combinations of treatment control BMPs to consider, and selection should be based on site-specific conditions and needs. Examples of multiple systems include:

- Water quality inlet combined with a media filter, infiltration basin, or infiltration trench;
- Vegetated swale or bioretention unit combined with a media filter, infiltration basin, or infiltration trench;
- Vegetated buffer strip combined with a vegetated swale;
- Extended detention zone on a wet pond; and
- Extended detention basin or media filter combined with a harvest and use system.

Inspection/Maintenance Considerations

Each of the separate treatment processes will require maintenance as described in the previous fact sheets. For example, a multiple system comprised of a biofilter combined with an infiltration basin would require the inspection and maintenance considerations outlined on the fact sheet for each process.

MPM-51 Gravity Separators

Photo Credit: Contec

General Description

Gravity separators: (alternatively, swirl concentrators, swirl or vortex separators, or hydrodynamic separators) are gravity separators, and in principle are essentially wet vaults. The difference from wet vaults, however, is that the gravity separator is round, rather than rectangular, and the water moves in a centrifugal fashion before exiting. By having the water move in a circular fashion, rather than a straight line as is the case with a standard wet vault, it is possible to obtain significant removal of suspended sediments and attached pollutants with less space. They can provide effective pretreatment when paired with filtration devices, such as media filters or bioretention systems.

Gravity separators were originally developed for combined sewer overflows (CSOs), where they are used primarily to remove coarse inorganic solids. Gravity separation has been adapted to stormwater treatment by several manufacturers.

Inspection/Maintenance Considerations

Gravity separators require routine removal of accumulated sediment, trash, and debris. As some of the systems have standing water that remains between storms, gravity separators can become a nuisance due to mosquito breeding. Also, a loss of dissolved pollutants may occur as accumulated organic matter (e.g., leaves) decomposes in the units.

Advanced BMPs Covered

Treatment Control

Maintenance Concerns

- *Sediment, Trash, and Debris Accumulations*
- *Vector Control*

Targeted Constituents*

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

**Removal Effectiveness varies for different manufacturer designs. See Development BMP Handbook-Section 5 for more information.*

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MPM-51 Gravity Separators

Gravity separators installed for trash control must be operated and maintained in accordance with manufacturer's recommendations for the BMP to maintain its Trash Full Capture Systems status.

Suggested Frequency	Inspection Activities
Post construction	☐ Inspect the unit twice during the first wet season of operation, setting the cleaning frequency accordingly.
Annual	☐ Inspect for floating debris, sediment buildup, and accumulated petroleum products.
As needed	☐ Contact the local mosquito and vector control agency if mosquito breeding is observed or suspected.
Suggested Frequency	**Maintenance Activities**
Post construction	☐ Remove sediment that has accumulated in the vault after construction in the drainage area is complete.
Annual, or per manufacturers recommendations	☐ The recommended frequency of cleaning differs with the manufacturer, ranging from one to two years. ☐ Maintenance consists of the removal of accumulated material with a vactor truck. It may be necessary to remove and dispose the floatables separately due to the presence of petroleum product. Annual maintenance is typical.
Annual, or more frequent as needed	☐ Remove floating debris and accumulated petroleum products as needed. Floating oil should be removed from wet vaults that are used as oil/water separators when oil accumulation exceeds one inch.

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Appendix J: Proprietary (manufactured) Treatment System Information

SECTION (_____)
STORM WATER TREATMENT DEVICE

1.0 GENERAL

1.1 This item shall govern the furnishing and installation of the CDS® by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.

1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a CDS® device manufactured by:

Contech Engineered Solutions LLC
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

1.4 Related Sections

1.4.1 Section 02240: Dewatering
1.4.2 Section 02260: Excavation Support and Protection
1.4.3 Section 02315: Excavation and Fill
1.4.4 Section 02340: Soil Stabilization

1.5 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.

1.6 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

1.7 The SWTD manufacturer shall submit to the Engineer of Record a “Manufacturer’s Performance Certification” certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

1.8 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

2.0 MATERIALS

2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

- 2.1.1 Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
- 2.1.2 Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
- 2.1.3 Cement shall be Type III Portland Cement conforming to ASTM C 150;
- 2.1.4 Aggregates shall conform to ASTM C 33;
- 2.1.5 Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
- 2.1.6 Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
- 2.1.7 Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

2.2 Internal Components and appurtenances shall conform to the following:

- 2.2.1 Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
- 2.2.2 Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
- 2.2.3 Fiberglass components shall conform to the ASTM D-4097
- 2.2.4 Access system(s) conform to the following:
- 2.2.5 Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

3.0 PERFORMANCE

3.1 The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using a particle size distribution having a mean particle size (d_{50}) of 125 microns unless otherwise stated.

3.2 The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The

SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

3.3 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.

3.4 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.

3.5 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.6 The SWTD shall have completed field tested following TARP Tier II protocol requirements

4.0 EXECUTION

4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.

4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.

4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.

4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

TABLE 1
Storm Water Treatment Device
Storage Capacities

CDS Model	Minimum Sump Storage Capacity $(yd^3)/(m^3)$	Minimum Oil Storage Capacity (gal)/(L)
CDS2015-4	0.9(0.7)	61(232)
CDS2015-5	1.5(1.1)	83(313)
CDS2020-5	1.5(1.1)	99(376)
CDS2025-5	1.5(1.1)	116(439)
CDS3020-6	2.1 (1.6)	184(696)
CDS3025-6	2.1(1.6)	210(795)
CDS3030-6	2.1 (1.6)	236(895)
CDS3035-6	2.1 (1.6)	263(994)
CDS3535-7	2.9(2.2)	377(1426)
CDS4030-8	5.6(4.3)	426(1612)
CDS4040-8	5.6 (4.3)	520(1970)
CDS4045-8	5.6 (4.3)	568(2149)
CDS5640-10	8.7(6.7)	758(2869)
CDS5653-10	8.7(6.7)	965(3652)
CDS5668-10	8.7(6.7)	1172(4435)
CDS5678-10	8.7(6.7)	1309(4956)
CDS7070-DV	3.6(2.8)	914 (3459)
CDS10060-DV	5.0 (3.8)	792 (2997)
CDS10080-DV	5.0 (3.8)	1057 (4000)
CDS100100-DV	5.0 (3.8)	1320 (4996)

END OF SECTION

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CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

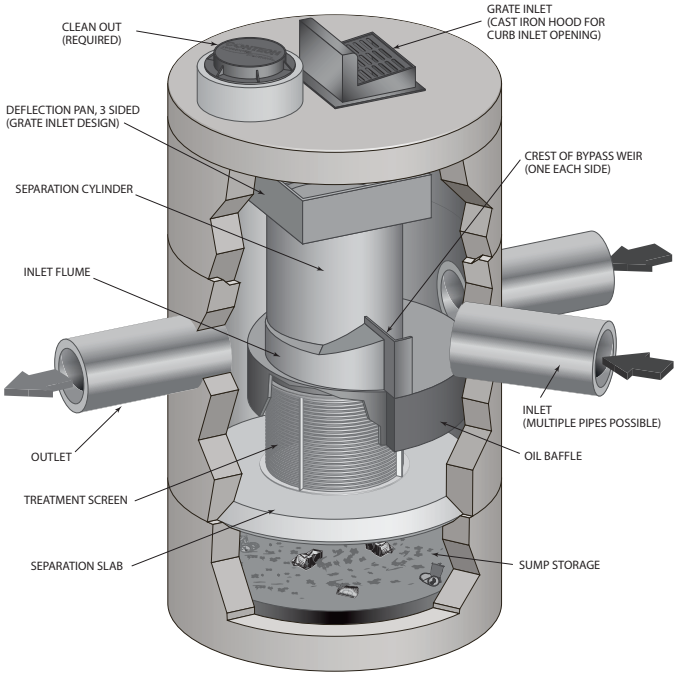
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are

determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

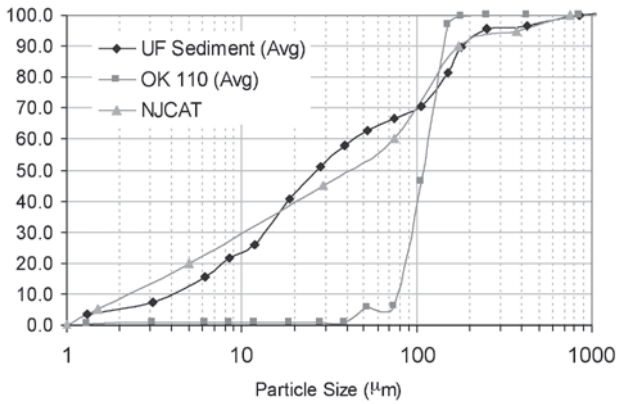


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect

to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

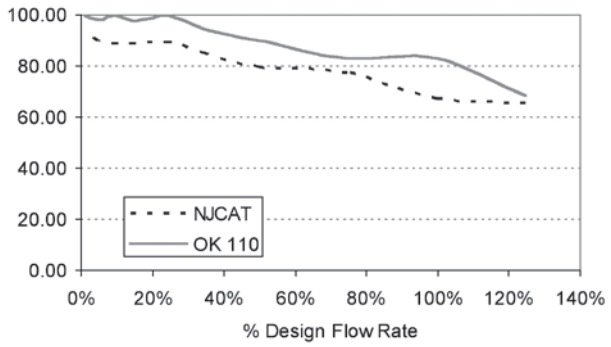


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

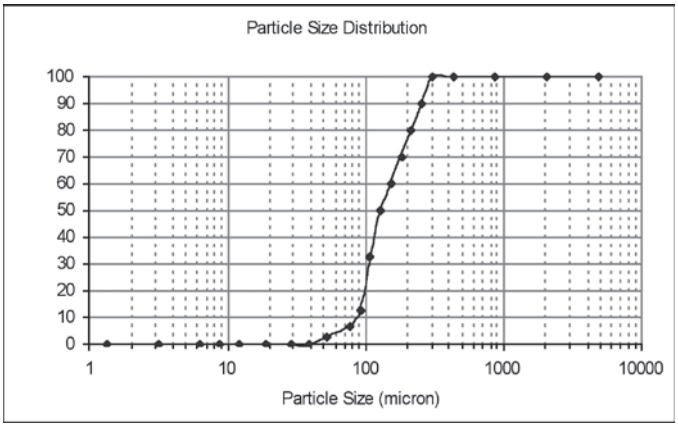


Figure 3. WASDOE PSD

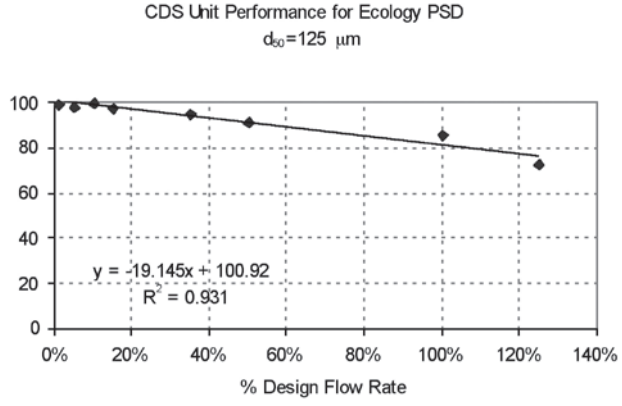


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

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The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

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In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

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CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

Appendix K: Blank Inspection and Maintenance Forms

This Appendix provide general forms found in the California Stormwater BMP Handbook for Industrial and Commercial developments.

Print/Copy to provide record keeping of site maintenance.

Site specific Inspection Forms required and provided in the Industrial General Permit SWPPP (if applicable) shall supersede this Appendix.

Worksheet 1	Activities Assessment Checklist
Worksheet 2	Materials Inventory
Worksheet 3	Materials Exposure Inventory
Worksheet 4	Spill Inventory
Worksheet 5	Non-Stormwater Discharge Assessment
Worksheet 6	Unauthorized Non-Stormwater Discharge Elimination Documentation
Worksheet 7	Checklist of Consideration of Minimum BMPs
Worksheet 8	Assessment of Potential Pollution Sources and Corresponding BMPs

Worksheet No.1
ACTIVITIES ASSESSMENT CHECKLIST

Name of Reviewer:	Date:		
ACTIVITIES - Check each activity present at site	EFFECTIVENESS		
	HIGH	MOD.	LOW
☐ Non-storm water discharges to drains. Describe BMPs in place:			
☐ Spill Prevention, Control and Cleanup. Describe BMPs in place:			
☐ Vehicle and equipment fueling. Describe BMPs in place:			
☐ Vehicle and equipment washing and steam cleaning. Describe BMPs in place:			
☐ Vehicle and equipment maintenance and repair. Describe BMPs in place:			
☐ Outdoors loading/unloading of liquid materials. Describe BMPs in place:			
☐ Outdoor container storage of liquids. Describe BMPs in place:			
☐ Outdoor process equipment operations and maintenance. Describe BMPs in place:			
☐ Outdoor storage of raw materials, products and byproducts. Describe BMPs in place:			
☐ Waste handling and disposal. Describe BMPs in place:			
☐ Contaminated or erodible surface areas. Describe BMPs in place:			
☐ Building and grounds maintenance. Describe BMPs in place:			
☐ Building repair, remodeling, and construction. Describe BMPs in place:			
☐ Parking/Storage Area Maintenance. Describe BMPs in place:			

MATERIAL INVENTORY

Worksheet No. 2
Completed By:
Title:
Date :

Instructions: List all materials used, stored, or produced onsite. Assess and evaluate these materials for their potential to contribute pollutants to storm water runoff. Also complete Worksheet 3 if the material has been exposed during the last three years.

Material	Purpose/Location	Quantity (units)		Quantity Exposed in Last 5 Years [1]	Likelihood of contact with storm water.	Past significant Spill or Leak[2]	
		Used	Produced			Yes	No

Notes:

(1) **Explain on separate sheet if quantity was more than the "minimum?"**

(2) **Explain items checked yes on a separate sheet.**

MATERIAL INVENTORY	Worksheet No. 3 Completed By: Title: Date :
Instructions:	Based on your material inventory, describe the significant materials that were exposed to storm water during the past five years and/or are currently exposed. For the definition of "significant materials" see Appendix B of the manual.

Description of Exposed Significant Material	Period of Exposure	Quantity Exposed (Units)	Location (as indicated on the site map)	Method of Storage or Disposal (e.g., pile, drum, tank	Description of Material Management Practices (e.g., pile covered, drum sealed)

SPILLS INVENTORY	**Worksheet No. 4** **Completed By:** **Title:** **Date:**

Instructions: Record below all significant spills and significant leaks of toxic or hazardous pollutants that have occurred at the facility in the five years prior to the effective date of the permit.

Definitions: Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities.

1st Year Prior

Date (month/day/year)	Check Box		Location (as indicated on site map)	Description				Response Procedure	Preventive Measures Taken
	Spill	Leak		Type of Material	Quantity	Source, If Known	Reason		

2nd Year Prior

Date (month/day/year)	Check Box		Location (as indicated on site map)	Description				Response Procedure	Preventive Measures Taken
	Spill	Leak		Type of Material	Quantity	Source, If Known	Reason		

3rd Year Prior

Date (month/day/year)	Check Box		Location (as indicated on site map)	Description				Response Procedure	Preventive Measures Taken
	Spill	Leak		Type of Material	Quantity	Source, If Known	Reason		

NON-STORM WATER DISCHARGE ASSESSMENT				**Worksheet No. 5** **Completed by:** _____ **Title:** _____ **Date:** _____			
Date of Test or Evaluation	Name of Person Who Conducted the Test or Evaluation	Outfall Directly Observed During the Test (identify as indicated on the site map)	Method Used to Test or Evaluate Discharge	Describe Results from Test for the Presence of Non-Storm Water Discharge	Identify Potential Significant Sources	Authorized NSWD?[1]	
						Yes	No

(1) If authorized NSWD, BMPs must be identified as appropriate. If unauthorized NSWD, see Worksheet 6.

Unauthorized Non-Stormwater Discharge Elimination Documentation		Worksheet No. 6 Completed by:_____ Title: _____ Date: _____	
Directions: Use this worksheet to document steps taken to eliminate unauthorized NSWDs identified in Worksheet 5			
Identify Outfall at which NSWD was identified	Description of Probable Source(s)	Description of Approach to Eliminating Source(s)	Anticipated Date for Completion

Worksheet No. 7
CHECKLIST FOR CONSIDERATION OF MINIMUM BMPs

Name of Facility	Location
Name of Reviewer:	Date:

Check "Y," "N," or "N/A," for the following questions related to the industrial facility.

Yes	No	N/A	
			Good Housekeeping
☐	☐	☐	Are outdoor areas observed to determine housekeeping needs?
☐	☐	☐	Is material tracking prevented or minimized?
☐	☐	☐	Is dust generated from industrial materials or activities minimized?
☐	☐	☐	Are all facility areas impacted by rinse/wash waters are cleaned as soon as possible?
☐	☐	☐	Are all stored industrial materials that can be readily mobilized by contact with storm water?
☐	☐	☐	Are all stored non-solid industrial materials or wastes (e.g., particulates, powders, shredded paper, etc.) that can be transported or dispersed by the wind or contact with storm water contained?
☐	☐	☐	Is disposal of any rinse/wash waters or industrial materials prevented from entering into the storm water conveyance system?
☐	☐	☐	Are storm water discharges from non-industrial areas minimized from contacting industrial areas of the facility?
☐	☐	☐	Are authorized NSWDs from non-industrial areas minimized from contacting industrial areas of the facility
			Preventive Maintenance
☐	☐	☐	Are all equipment and systems used outdoors that may spill or leak pollutants identified?
☐	☐	☐	Are the identified equipment and systems identified to detect leaks or conditions that may result in the development of leaks?
☐	☐	☐	Is an appropriate schedule established for maintenance of identified equipment and systems?
☐	☐	☐	Is there a spill prevention and response team?
☐	☐	☐	Are procedures established for prompt maintenance and repair of equipment, and maintenance of systems when conditions exist that may result in the development of spills or leaks?
			Spill and Leak Prevention and Response
☐	☐	☐	Are procedures and/or controls established to minimize spills and leaks?
☐	☐	☐	Are spill and leak response procedures developed and implemented to prevent industrial materials from discharging through the storm water conveyance system and cleaned promptly and disposed of properly?
☐	☐	☐	Are all necessary and appropriate spill and leak response equipment, location(s) of spill and leak response equipment, and spill or leak response equipment maintenance procedures identified and described?
☐	☐	☐	Are appropriate spill and leak response personnel identified and trained?
			Material Handling and Waste Management
☐	☐	☐	Is handling of industrial materials or wastes that can be readily mobilized by contact with storm water prevented or minimized during a storm event?
☐	☐	☐	Is all stored non-solid industrial materials or wastes that can be transported or dispersed by the wind or contact with storm water contained?
☐	☐	☐	Are industrial waste disposal containers and industrial material storage containers that contain industrial materials covered when not in use?
☐	☐	☐	Is run-on and storm water generated from within the facility diverted away from all stockpiled materials?
☐	☐	☐	Are all spills of industrial materials/ or wastes that occur during handling cleaned in accordance with the spill response procedures?
☐	☐	☐	Is any outdoor material/ or waste handling equipment or containers that can be contaminated by contact with industrial materials or wastes observed and cleaned as appropriate?
			Erosion and Sediment Controls (for each erodible surface facility location identified in the SWPPP)
☐	☐	☐	Are effective wind erosion controls implemented?
☐	☐	☐	Is effective stabilization provided for inactive areas, finished slopes, and other erodible areas prior to a forecasted storm event?
☐	☐	☐	Are effective perimeter controls maintained and stabilize all site entrances and exits stabilized to sufficiently control discharges of erodible materials from discharging or being tracked off the site?
☐	☐	☐	Is run-on and storm water generated from within the facility diverted away from all erodible materials?
☐	☐	☐	If sediment basins are implemented, do they comply with the design storm standards in Section X.H.6 of the General Permit?
			Employee Training Program
☐	☐	☐	Are all team members implementing the various compliance activities of the General Permit properly trained to implement the requirements of the General Permit?
☐	☐	☐	Have appropriate training manuals or training materials been prepared or acquired?
☐	☐	☐	Have the personnel that need to be trained, their responsibilities, and the type of training they shall receive been identified?
☐	☐	☐	Has a training schedule been provided?
☐	☐	☐	Is documentation maintained of all completed training classes and the personnel that received training in the SWPPP?
			Quality Assurance and Record Keeping
☐	☐	☐	Have management procedures been developed and implemented to ensure that appropriate staff implements all elements of the SWPPP, including the Monitoring Implementation Plan?
☐	☐	☐	Has a method of tracking and recording the implementation of BMPs identified in the SWPPP been developed?
☐	☐	☐	Is there a system to maintain the BMP implementation records, training records, and records related to any spills and clean-up related response activities for a minimum of five (5) years?

Any items checked "No" require consideration in the selection of BMPs.
N/A = Not Applicable.

Worksheet No. 8

ASSESSMENT OF POTENTIAL POLLUTION SOURCES AND CORRESPONDING BMPs

Area	Activity	Pollutant	Pollutant Source(s)	Best Management Practices

Appendix L: Town of Apple Valley Conditional of Approval Letter(s)

Town of Apple Valley
Planning Division

January 27, 2023

Donovan Collier
Fennemore Law LLP Representative
AP Investors Group LLC
9220 Winnetka Avenue
Chatsworth, CA, 91311

Subject: **Site Plan Review SPR2022-005 continuation to approval PA2022-004 to construct a 1 million square-foot warehouse building on 95 acres in the Industrial Specific Plan (I-SP) zoning designation in the North Apple Valley Industrial Specific Plan (NAVISP) located in the northeast corner of Lafayette Street and Central Road (Applicant: AP Investors Group LLC; APN: 0463-241-02 & -03)**

Dear Mr. Collier,

Enclosed you will find **Preliminary** Conditions of Approval by the Town's Planning Division. As a reminder, the entitlement remains deemed incomplete. Please be advised that any missing items or corrections that may have inadvertently been overlooked on the first and/or subsequent reviews and later addressed by the reviewer are still the applicant's responsibility and will have to be complied with prior to the Site Plan Review being considered for approval.

If you have any questions on this matter, please contact me at (760) 240- 7000 Ext. 7203 or ycid@applevalley.org. Town offices are open Monday through Thursday between 7:30 a.m. and 5:30 p.m., and alternating Fridays between 7:30 a.m. and 4:30 p.m. **(closed the subsequent Fridays).**

Sincerely,

Yenifer Cid
Assistant Planner

PRELIMINARY CONDITIONS OF APPROVAL
Site Plan Review SPR2022-005

Please note: Many of the suggested Conditions of Approval presented herewith are provided for informational purposes and are otherwise required by the Municipal Code. Failure to provide a Condition of Approval herein that reflects a requirement of the Municipal Code does not relieve the applicant and/or property owner from full conformance and adherence to all requirements of the Municipal Code.

Planning Division Conditions of Approval

P1. The site plan review shall comply with the provisions of the State Subdivision Map Act and the Town Development Code. When approved, the Site Plan Review shall expire three (3) years from the date of approval. The Site Plan Review becomes effective ten (10) days from the date of the decision unless an appeal is filed as stated in the Town's Development Code.

P2. The applicant agrees to defend at his sole expense (with attorneys approved by the Town) and indemnify the Town against any action brought against the Town, its agents, officers or employees resulting from or relating to this approval. The applicant shall reimburse the Town, its agents, officers or employees for any judgment, court costs and attorney's fees which the Town, its agents, officers or employees may be required to pay as a result of such action. The Town may, at its sole discretion, participate at its own expense in the defense of any such action, but such participation shall not relieve the applicant of these obligations under this condition.

P3. The filing fee for a Notice of Exemption (NOE) requires the County Clerk to collect a handling fee of $50.00. The fees must be paid within five (5) days of the approval of this application in order to reduce the Statute of Limitations to thirty (30) days. All fees must be submitted prior to the issuance of any permits. The check shall be made payable to the Clerk of the Board of Supervisors and submitted to the Planning Division for processing.

P4. Landscaping shall be installed in accordance with the North Apple Valley Industrial Specific Plan (NAVISP) Landscape Regulations. Xeriscape landscaping techniques are encouraged for use in parkway areas, which typically consists of drought tolerant, native type plants, trees and groundcover.

P5. All required and installed landscaping shall incorporate and maintain a functioning automatic sprinkler system, and said landscaping shall be maintained in a neat, orderly, disease and weed free manner at all times.

P6. Loading doors shall be screened from public rights-of-way and residential uses or districts by the use of wing walls, screening walls, landscaping or any combination thereof approved by the Planning Division.

P7. All walls/fencing proposed for construction shall be constructed of decorative slump stone, split face, or other decorative material that is compatible with the architecture of the building. Prior to the issuance of a grading permit, developer/applicant shall submit detailed plans showing all proposed walls subject to approval by the Planning Division.

P8. In accordance with the NAVISP, Lafayette Street requires a buffer area, which will require decorative fencing and dense landscaping as shown on Typical II-3 of the North Apple Valley Industrial Specific Plan (NAVISP).

P9. The project shall conform to the Industrial Specific Plan (I-SP) development standards in the North Apple Valley Industrial Specific Plan (NAVISP).

P10. No roof-mounted equipment shall be placed on any building unless screened as specifically approved by the Planning Division (except for solar collection panels).

P11. Trash enclosure detail shall be consistent with Chapter 9.46.080 of the Development Code.

P12. All identification signs shall have a separate permit and are subject to final approval by the Planning Division.

P13. Parking requirements shall be met and be in compliance with Town standards. All parking stalls shall be clearly striped and permanently maintained with double or hairpin lines.

P14. Required parking spaces shall be provided for the handicapped in accordance with Town standards and in accordance with Title 24 of the California Administrative Code. The handicapped spaces shall be located as close as practical to the entrance of the facility. Each space must be provided with access ramps and clearly marked in accordance with Title 24 of the California Administrative Code.

P15. A streambed alteration agreement from the California Department of Fish and Wildlife shall be provided to the Planning Division.

P16. All mitigation measures described in the Initial Study will be implemented as part of the project.

Engineering Conditions of Approval

EC1. A final drainage plan with street layouts shall be submitted for review and approval by the Town Engineer showing provisions for receiving and conducting offsite and onsite tributary drainage flows around or through the site in a manner which will not adversely affect adjacent or downstream properties. This plan shall consider reducing the post-development site-developed flow to 90 percent of the pre-development flow for a 100-year design storm. (Town Resolution 2000-50; Development Code 9.28.050.C, 9.28.100)

EC2. A final grading plan shall be approved by the Town Engineer prior to issuance of a grading permit.

EC3. A 64-ft wide half-width road dedication along Central Road shall be granted to the Town of Apple Valley prior to Issuance of Grading Permit.

EC4. A 33-ft (plus 6-ft) wide half-width road dedication along Lafayette Road shall be granted to the Town of Apple Valley prior to Issuance of Grading Permit.

EC5. A 33-ft (plus 6-ft) wide half-width road dedication along Johnson Road shall be granted to the Town of Apple Valley prior to Issuance of a Grading Permit.

EC6. Street improvement plans shall be submitted to the Town Engineer for review and approval.

EC7. Central Road adjacent to the property shall be improved to the Town's half-width Major Divided Arterial standards. The plans shall show sidewalks, a Class 2 Bike Lane, and ADA access improvements along the frontage of the development.

EC8. Lafayette Road adjacent to the property shall be improved to the Town's half-width Industrial Road standards.

EC9. Johnson Road adjacent to the property shall be improved to the Town's half-width Industrial Road standards.

EC10. Additional Rights of way (minimum 6’ width) may be required from offsite properties to construct the half-width industrial half-width street for Lafayette Road and Johnson Road. The minimum half width for two-way traffic is 26’ wide with shoulders. The additional right of way may come from adjacent properties or from the project’s property.

EC11. An encroachment permit shall be obtained from the Town prior to performing any work in any public right of way.

EC12. Final improvement plans and profiles shall indicate the location of any existing utility, which would affect construction and shall provide for its relocation at no cost to the Town.

EC13. Utility lines shall be placed underground in accordance with the requirements of the Town. (Municipal Code Section 14.28)

EC14. Traffic impact fees adopted by the Town shall be paid by the developer. See Town Council approved OPA.

EC15. Any developer fees adopted by the Town including but not limited to drainage fees shall be paid by the developer.

EC16. A Storm Water Pollution Prevention Plan (SWPPP) in accordance with the National Pollutant Discharge Elimination System (NPDES) shall be required.

EC17. Easements, as required for roadway slopes, drainage facilities, utilities, etc., shall be submitted and recorded as directed by the Town Engineer. No structures shall be placed on any part of the easements except those directly related to the purposes of said easements.

Building and Safety Conditions of Approval

BC1. Submit plans, engineering and obtain permits for all structures, retaining walls, signs.

BC2. Comply with State of California Disability Access requirements.

BC3. Dust palliative or hydro seed will be required on those portions of the site graded but not constructed (phased construction).

BC4. Page two of the submitted building plans will be the Conditions of Approval.

BC5. Construction must comply with the 2022 California Building Code of Regulations, Title 24, parts 1-12.

BC6. Best Management Practices (BMPs) are required for the site during construction.

Environmental & Regulatory Conditions of Approval

WM1. Pursuant to the provisions as set forth in Assembly Bill (AB) 341, businesses, including multi-family residential with 5 or more units that generate 4 cubic yards or more of commercial solid waste per week, shall have a recycling program in place, including but not limited to collection of recyclable paper and plastic waste by the Town's franchise solid waste hauler.

WM2. As of September 2020, and pursuant to the provisions as set forth in Assembly Bill (AB) 1826, businesses that generate 2 cubic yards or more of commercial solid waste per week shall arrange for organic waste recycling services with limited exceptions. Contact Burrtec Waste Industries at (760) 245-8607 for further information.

WM3. To accomplish the requirements of ER1 and ER2, listed above, the trash and recycling enclosure(s) shall be constructed to accommodate the source separated trash, recyclable material, and organic waste containers that are appropriately sized to handle the estimated water generated on-site, coupled with an appropriate service frequency; recyclables and organic waste containers are currently minimum 60 gallons. Contact Burrtec Waste Industries at (760) 245-8607 for further information.

WM4. Pursuant to AVMC § 8.19.020(a) et seq., the construction contractor shall complete and submit a Waste Management Plan ("WMP"), on a WMP form approved by the Town for this purpose as part of the application packet for the building or tenant improvement permit.

WM5. Pursuant to AVMC § 8.19.050 and prior to the issuance of a Certificate of Occupancy, the contractor shall submit documentation proving that the project has met the diversion requirement. The diversion requirement shall be at least sixty five percent (65%) of the total C&D debris generated by the project via reuse or recycling.

Public Works Conditions of Approval

PW1. Submit a sewer feasibility study for review to the Town of Apple Valley Public Works Department to demonstrate where you plan to extend the sewer from to provide sewer service to this project.

PW2. Sewage disposal shall be by connection to the Town of Apple Valley sewer system. Plans must be approved by the Town of Apple Valley Public Works Department.

PW3. Sewer connection fees required.

PW4. Submit Mylars along with three sets of approved plans upon completion of plan check. In addition, the plans must be provided in an electronic format of the Town's choosing. These requirements are the same for the approved plans and the As-Built plans.

Liberty Utilities Conditions of Approval

LU1. Offsite water mains **do not** exist on Central Road fronting this development.

LU2. Water mains must be extended to provide fire protection for this development in accordance with Apple Valley Fire Protection District's conditions.

LU3. Water main extension contract between the developer and Liberty Apple Valley is required and must comply with Rule 15 of the California Public Utilities Commission. Subject to the terms of the contract, the cost of facilities installed as advances will be reimbursed to the developer at 2.5 percent per year for 40 years with no interest. Extend minimum 16" diameter pipeline approximately 2,700 feet along Central Road and about 2,650 feet along Johnson Road to the west connecting to an existing main at Somis Avenue and Johnson Road.

LU4. Offsite fire hydrants are required to be located in accordance with Apple Valley Fire Protection District's requirements and installed per Liberty Apple Valley standard drawings.

LU5. Fire hydrants required onsite will be installed in accordance with Apple Valley Fire Protection District's requirements.

LU6. Fire service lines are required for this development and will be installed in accordance with Apple Valley Fire Protection District's conditions and must comply with Rule 16 of the California Public Utilities Commission. Approved and tested customer owned backflow protection devices are required.

LU7. The water lines and appurtenances required are to be installed in accordance with Liberty Apple Valley standards and specifications.

LU8. Water facilities need to be installed in dedicated public Rights-of-Ways and/or public utility easements and need to be identified and shown on the water improvement plans. These dedications and/or easements are needed to install, maintain, repair, connect, operate and inspect the proposed water facilities with unobstructed vehicular access.

LU9. Domestic service lines will be installed from the proposed water main to the street right-of-way line that fronts this development. Approved and tested customer owned backflow protection device is required.

LU10. Supply Facility Fee is required, which will fund development of new wells. This fee will be collected on a per meter basis, which is presently at a rate of $1,030 per 5/8" equivalent meter.

LU11. Supplemental Water Acquisition Fee is also required in order for Liberty to have the water rights to provide water to this project. This is a one-time charge that is subject to change, to be determined at the time of construction. Presently, this fee is $5,665 per residential lot or equivalent average residential water use.

LU12. These conditions are for domestic water and offsite fire flow requirements, and do not include onsite private water lines or fire hydrants. To proceed further, we recommend the owner or developer set up a meeting with our Engineering Department so we can review and provide any additional design parameters and requirements for this project. Feel free to contact us if you have any questions or need any further information. Thank you.

Fire District Conditions of Approval

FD1. The above referenced project is protected by the Apple Valley Fire Protection District. Prior to construction occurring on any parcel, the owner shall contact the Fire District for verification of current fire protection development requirements.

FD2. All new construction shall comply with applicable sections of the California Fire Code, California Building Code, and other statutes, ordinances, rules, and regulations regarding fires and fire prevention adopted by the State, County, or Apple Valley Fire Protection District.

FD3. All combustible vegetation, such as dead shrubbery and dry grasses, shall be removed from each building site a minimum distance of thirty (30) feet from any combustible building material, including the finished structure. This does not apply to single specimens of trees, ornamental shrubbery, or similar plants, which are used as ground cover if they do not form a means of transmitting fire.

FD4. Prior to combustible construction, the development, and each phase thereof, shall have two points of paved access for fire and other emergency equipment, and for routes of escape which will safely handle evacuations. Each of these points of access shall provide an independent route into the area in which the development is located.

FD5. Fire lanes shall be provided with a minimum width of twenty-six (26) feet, maintained, and identified in the parking areas.

FD6. Fire lanes shall be provided with a minimum width of thirty-six (36) feet, maintained, and identified in and throughout the facility.

Apple Valley Fire Protection District Ordinance 57

FD7. A turnaround shall be required at the end of each roadway one hundred fifty (150) feet or more in length and shall be approved by the Fire District. Cul-de-sac length shall not exceed one thousand (1,000) feet.

Turning radius on all roads within the facility shall not be less than 21 feet inside and minimum of 41 feet outside turning radius with no parking on street, or 47 feet with parking. Road grades shall not exceed twelve percent (12%) unless approved by the Chief.

Apple Valley Fire Protection District Ordinance 57

FD8. Plans for fire protection systems designed to meet the fire flow requirements specified in the Conditions of Approval for this project shall be submitted to and approved by the Apple Valley Fire Protection District and water purveyor prior to the installation of said systems.

Apple Valley Fire Protection District, Ordinance 57

A. Unless otherwise approved by the Fire Chief, on-site fire protection water systems shall be designed to be looped and fed from two (2) remote points.

B. System Standards:
*Fire Flow 3,000- 4,000 GPM @ 20 psi Residual Pressure
Duration 4 Hour(s)
Hydrant Spacing 330 Feet

*Fire Flow is determined by the type of construction

FD9. Approved numbers or addresses shall be placed on all new and existing buildings in such a position as to be plainly visible and legible from the street or road fronting the property. Said numbers shall contrast with their background.

FD10. Commercial and industrial developments shall have street addresses and location approved by the Fire District.

FD11. Where the building setback exceeds 200 feet from the roadway, additional non-illuminated contrasting (18) inch numbers shall be displayed at the property entrance. When these developments have rear doors of each unit, the unit number shall be a minimum of 6 inches and shall contrast with their background.

Apple Valley Fire Protection District, Ordinance 57

FD12. A letter shall be furnished to the Fire District from the water purveyor stating that the required fire flow for the project can be met prior to the Formal Development Review Committee meeting.

FD13. Prior to issuance of building permit, the developer shall pay all applicable fees as identified in the Apple Valley Fire Protection District Ordinance.

FD14. A Knox Box Rapid Entry System shall be required for this project.

Apple Valley Fire Protection District Ordinance 57

- END OF CONDITIONS -

Appendix M: Copies of the current Grading Plans (approval in progress)

TOWN OF APPLE VALLEY

WAREHOUSE FACILITY
APPLE VALLEY, CA 92307
PRECISE GRADING PLAN

GENERAL NOTES

ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE LATEST TOWN OF APPLE VALLEY DEPARTMENT OF PUBLIC WORKS STANDARD SPECIFICATIONS.

BENCHMARK: SEE BELOW

BASIS OF BEARINGS: SEE BELOW

A PERMIT FROM THE TOWN OF APPLE VALLEY SHALL BE OBTAINED PRIOR TO THE BEGINNING OF ANY WORK OR CONSTRUCTION WITHIN THE STREET RIGHT-OF-WAY BY THE CONTRACTOR.

CONTRACTOR SHALL FURNISH THE TOWN OF APPLE VALLEY PUBLIC WORKS DEPARTMENT WITH ONE COPY OF CUT SHEETS PRIOR TO STARTING CONSTRUCTION.

WHEN WORK IS PERFORMED ON SATURDAY, SUNDAY OR A HOLIDAY, INSPECTION SHALL BE REQUESTED BY NOON OF THE PRECEDING REGULAR WORKING DAY. ALL COSTS OF PROVIDING WEEKEND OR HOLIDAY INSPECTION SHALL BE BORNE BY THE CONTRACTOR.

PRIOR TO EXCAVATION, CONTRACTOR SHALL CALL THE UNDERGROUND SERVICE ALERT (USA) 1-800-422-4133

CONTRACTOR SHALL INSTALL ALL NECESSARY TRAFFIC CONTROL SIGNS AND DEVICES NOT LESS THAN 24 HOURS PRIOR TO STARTING ANY WORK IN THE PUBLIC RIGHT-OF-WAY IN ACCORDANCE WITH THE W.A.T.C.H. HANDBOOK.

THE ENGINEER HAS TRIED TO SHOW ALL THE EXISTING UTILITIES, BUT THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE EXACT LOCATION OF EXISTING UTILITIES PRIOR TO CONSTRUCTION.

MAP INTENDED FOR SITE GRADING ONLY, NOT PREPARED FOR ANY OTHER PURPOSES.

GENERAL CONSTRUCTION NOTES:

PRIOR TO CONSTRUCTION, THE CONTRACTOR SHALL CONTACT ALL UTILITY COMPANIES TO DETERMINE THE EXACT LOCATION OF ALL UNDERGROUND FACILITIES WHETHER SHOWN OR NOT SHOWN. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO PROTECT ALL EXISTING FACILITIES FROM DAMAGE DURING CONSTRUCTION.

THE CONTRACTOR IS RESPONSIBLE FOR THE COORDINATION OF THE REMOVAL OR RELOCATION OF ANY AND ALL EXISTING UTILITIES WITH THE RESPECTIVE UTILITY COMPANY. COST OF THIS COORDINATION IS TO BE INCLUDED IN THE PRICE BID FOR THE VARIOUS IMPROVEMENTS TO COMPLETE THE PROJECT.

THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR ANY FIELD CHANGES MADE WITHOUT PRIOR WRITTEN AUTHORIZATION FROM THE UNDERSIGNED ENGINEER, DEVELOPER AND THE COUNTY OF SAN BERNARDINO.

THE CONTRACTOR IS RESPONSIBLE FOR PROTECTING ALL SURVEY MONUMENTS AND PROTECT EXISTING FENCE. ANY SURVEY MONUMENTS DISTURBED DURING THE COURSE OF CONSTRUCTION SHALL BE REPLACED AT THE CONTRACTOR'S EXPENSE.

THE CONTRACTOR AGREES THAT HE SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY THAT THIS REQUIREMENT SHALL APPLY CONTINUALLY AND NOT BE LIMITED TO NORMAL WORKING HOURS; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE OWNER AND THE ENGINEER HARMLESS FROM ANY AND ALL LIABILITY, REAL OR ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE OWNER OR THE ENGINEER.

ALL EXCAVATION SHALL BE BACKFILLED AT THE END OF EACH WORKING DAY AND ROADS OPEN TO A VEHICULAR TRAFFIC.

ALL WORK SHALL BE CONSTRUCTED ACCORDING TO THE VERTICAL AND HORIZONTAL MEASUREMENTS OF THESES PLANS AND EXISTING DESIGN STANDARDS. ADEQUATE STAKES SHALL BE SET UNDER THE DIRECTION OF A LICENSED SURVEYOR/ENGINEER FOR THE CONSTRUCTOR. ALL CONSTRUCTION SURVEYING SHALL BE PERFORMED IN ACCORDANCE TO THE SURVEYING PROCEDURES OF THE SURVEYOR/ENGINEER OF RECORD. IF THIRD PARTY SUBCONTRACTORS PERFORM THE CONSTRUCTION LAYOUT AND SURVEYING FOR THIS PROJECT WITH OUT THE COORDINATION OF THE SURVEYOR/ENGINEER OF RECORD, THEY HAVE ASSUMED THE POSITION OF SURVEYOR/ENGINEER OF RECORD. THE FINAL CHECK OF THIS DESIGN IS TO BE THE CONSTRUCTION STAKING AS THE DESIGN MEETS THE EXISTING CONTROL AND ELEVATIONS. ALL EXISTING STREET CROSS SECTIONS SHALL BE VERIFIED FOR MINIMUM CROSS FALL AT TIME OF STAKING. ANY DISCREPANCIES TO THE STANDARD DESIGN CRITERIA SHALL BE BROUGHT TO THE SURVEYOR/ENGINEER OF RECORD ATTENTION PRIOR TO PROCEEDING WITH CONSTRUCTION. IF CONSTRUCTION CONTINUES WITHOUT VERIFICATION THE CONSTRUCTOR ASSUMES THE RESPONSIBILITY OF THE CORRECTNESS OF THE INTENDED DESIGN.

NOTICE TO CONTRACTOR FROM ENGINEER:

THE CONTRACTOR SHALL ASCERTAIN THE EXISTENCE OF ANY CONDITIONS AFFECTING THE COST OF THE WORK WHICH WOULD HAVE BEEN DISCLOSED BY REASONABLE EXAMINATION OF THE SITE.

CONTRACTOR SHALL IMMEDIATELY BRING ANY ERRORS OR OMISSIONS DISCOVERED IN THE PLANS TO THE ATTENTION OF THE ENGINEER.

CONTRACTOR SHALL REPAIR OR REPLACE ALL EXISTING IMPROVEMENTS WITHIN THE CONSTRUCTION AREA THAT ARE NOT DESIGNED FOR REMOVAL, REPAIRS AND REPLACEMENTS SHALL BE AT LEAST EQUAL TO EXISTING IMPROVEMENTS AND SHALL MATCH THEM IN FINISH AND DIMENSION.

THE EXISTENCE AND LOCATION OF ANY UNDERGROUND UTILITY PIPES OR STRUCTURES ARE NOT SHOWN ON THIS PLAN. THESE PLANS ARE NOT INTENDED TO SHOW LOCATIONS OF UNDERGROUND UTILITIES. THE CONTRACTOR SHALL TAKE PRECAUTIONARY MEASURES TO PROTECT ALL UTILITIES AND STRUCTURES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFICATION OF THE LOCATION AND DEPTH OF EXISTING UNDERGROUND UTILITIES AND SHALL PERFORM POTHOLING AS NECESSARY AT ALL CROSSINGS PRIOR TO COMMENCING CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR TAKING ALL PRECAUTIONS NECESSARY TO PROTECT ALL EXISTING UTILITIES AND STRUCTURES FROM DAMAGE DURING THE COURSE OF THE WORK, AND SHALL BE RESPONSIBLE FOR REPAIRING OR REPLACING ANY UTILITIES OR STRUCTURES DAMAGED DURING THE COURSE OF THE WORK.

ALL CONTRACTORS AND SUBCONTRACTORS PERFORMING WORK SHOWN ON OR RELATED TO THESE PLANS SHALL CONDUCT THEIR OPERATIONS SO THAT ALL EMPLOYEES ARE PROVIDED A SAFE PLACE TO WORK AND THE PUBLIC IS PROTECTED. ALL CONTRACTORS AND SUBCONTRACTORS SHALL COMPLY WITH THE "OCCUPATIONAL SAFETY AND HEALTH REGULATION" OF THE DEPARTMENT OF U.S. LABOR, AND WITH THE STATE OF CALIFORNIA DEPARTMENT OF INDUSTRIAL RELATIONS "CONSTRUCTION SAFETY ORDERS".

THE ARCHITECT/CIVIL ENGINEER SHALL NOT BE RESPONSIBLE IN ANY WAY FOR THE CONTRACTOR'S AND SUBCONTRACTORS' COMPLIANCE WITH THE "OCCUPATIONAL HEALTH AND SAFETY REGULATIONS" OF U.S. DEPARTMENT OF LABOR OR WITH THE STATE OF CALIFORNIA DEPARTMENT OF INDUSTRIAL RELATIONS "CONSTRUCTION SAFETY ORDERS".

THE CONTRACTOR IS HEREBY NOTIFIED THAT DURING THE ENTIRE TERM OF CONSTRUCTION, HE SHALL ADHERE TO N.P.D.E.S. GUIDELINES AND REQUIREMENTS RELATED TO BUT NOT LIMITED TO DUST CONTROL, ENVIRONMENTAL CONSIDERATIONS, ETC. IN ADDITION, THE CONTRACTOR SHALL PREPARE AND IMPLEMENT AN EROSION CONTROL PLAN, AND HAVE ON FILE WITH THE STATE A NOTICE OF INTENT WITH A STORM WATER POLLUTION PREVENTION PLAN ON SITE DURING THE PERIOD OF THIS NOTICE OF INTENT.

COLLAPSIBLE NON-COHESIVE SOILS SHOULD BE ANTICIPATED DURING EXCAVATION OPERATIONS.

SLOPES SHALL BE OVERBUILT AND COMPACTED IN UNIFORM LIFTS AS APPROVED BY SOILS ENGINEER AND SHALL BE CUT BACK TO FINISH GRADE. (SEE PROJECT SOILS REPORT)

FREE MOISTURE MAY BE ENCOUNTERED DURING CONSTRUCTION OPERATIONS AND EXCAVATION.

RECOMMENDATIONS OF GEOTECHNICAL REPORT IN THE CONSTRUCTION OF THIS PROJECT SHALL BE FOLLOWED.

THE CONTRACTOR IS REQUIRED BY GOVERNMENT CODE 42 16 "CALIFORNIA ONE CALL LAW" TO CALL DIG ALERT AT LEAST TWO (2) WORKING DAYS BEFORE DIGGING. CONTRACTOR IS REQUIRED BY SAME CODE TO HAND-EXPOSE TO THE POINT OF NO CONFLICT 24" ON EITHER SIDE OF THE UNDERGROUND FACILITY SO YOU CAN DETERMINE ITS EXACT LOCATION BEFORE USING POWER EQUIPMENT.

811 Know what's below. Call before you dig.

GENERAL GRADING NOTES:

PERMITS:

1. APPROXIMATE EARTHWORK QUANTITIES (FOR PERMIT PURPOSES ONLY):

CUT	=	286,700 CU.YD.
FILL	=	257,000 CU.YD.
SHRINKAGE	=	27,300 CU.YD.
SUBSIDENCE	=	15,800 CU.YD.
BORROW	=	13,400 CU.YD.
WASTE	=	CU.YD.

2. NO BUILDING PERMIT SHALL BE ISSUED PRIOR TO THE GRADING BEING CERTIFIED.
3. RETAINING WALLS SHALL BE CONSTRUCTED TO TOWN OF APPLE VALLEY STANDARDS OR WALL CALCULATIONS SHALL BE SUBMITTED TO THE TOWN OF APPLE VALLEY BUILDING AND SAFETY DIVISION FOR APPROVAL. THE CONTRACTOR SHALL OBTAIN A SEPARATE PERMIT TO CONSTRUCT RETAINING WALLS FROM THE TOWN OF APPLE VALLEY BUILDING AND SAFETY DIVISION.
4. ENGINEERING DEPARTMENT APPROVAL DOES NOT INCLUDE WATER OR SEWER SYSTEM APPROVAL OR ESTIMATE OR QUANTITIES.

NOTIFICATIONS:

1. THE CONTRACTOR SHALL NOTIFY UNDERGROUND SERVICE ALERT AT LEAST 48 HOURS PRIOR TO EXCAVATION AT 811.
2. A SITE PRE-GRADING INSPECTION SHALL BE SCHEDULED AT LEAST 48 HOURS PRIOR TO START OF GRADING.
3. NOTIFY THE TOWN OF APPLE VALLEY BUILDING AND SAFETY DIVISION TWO WORKING DAYS PRIOR TO ALL NECESSARY INSPECTIONS.
4. CONTRACTOR SHALL CONTACT SOILS ENGINEER AND UNDERSIGNED ENGINEER TWO WORKING DAYS PRIOR TO COMMENCEMENT OF GRADING OPERATIONS AND TWO DAYS PRIOR FOR INSPECTIONS AND/OR STAKING SERVICES, AS APPLICABLE.

PRECAUTIONS AND RESPONSIBILITIES:

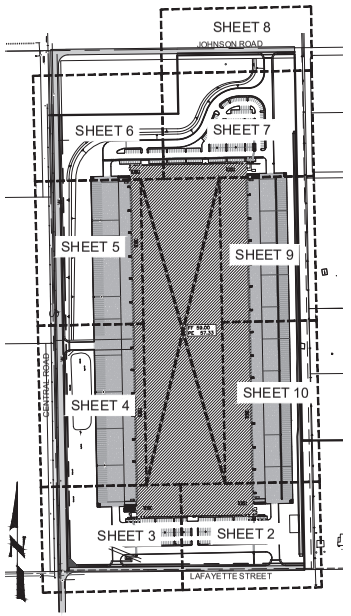
1. SLOPE STABILIZATION SHALL BE PROVIDED ON ALL SLOPES IN ACCORDANCE WITH THE CALIFORNIA BUILDING CODE'S LATEST EDITION.
2. ALL OFFSITE IMPROVEMENTS SHALL BE CONSTRUCTED TO TOWN STANDARDS.
3. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO PROTECT SURVEYING MONUMENTS IN PLACE AND THE CONTRACTOR SHALL BE FINANCIALLY RESPONSIBLE FOR RESETTING DAMAGED OR DESTROYED MONUMENTS.
4. NO GRADING/CONSTRUCTION SHALL COMMENCE PRIOR TO 7:00 A.M. EACH WORKING DAY.
5. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO FAMILIARIZE HIMSELF WITH THE JOB SITE AND THE LOCATION OF ALL UNDERGROUND FACILITIES SHOWN OR NOT SHOWN ON THESE PLANS. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ANY DAMAGE DONE TO EXISTING UTILITIES THAT ARE SHOWN OR NOT SHOWN ON THESE PLANS.
6. THE CONTRACTOR SHALL MAKE HIS OWN DETERMINATION OF THE AMOUNT OF EARTHWORK INVOLVED BEFORE SUBMITTING A BID. THE ENGINEERS ESTIMATE OF EARTHWORK QUANTITIES ARE TOTAL RAW VOLUME ONLY AND ARE TO BE USED FOR GRADING PERMIT AND PLAN CHECK FEES ONLY.
7. THE CONTRACTOR SHALL OBTAIN A COPY OF AND BECOME FAMILIAR WITH ANY PRELIMINARY SOILS INVESTIGATION REPORTS AND/OR ENGINEERING GEOLOGY REPORT PREPARED FOR THIS PROJECT PRIOR TO COMMENCEMENT OF GRADING OPERATIONS AND SHALL PROSECUTE AND COMPLETE HIS WORK IN ACCORDANCE WITH THE RECOMMENDATIONS AND GRADING SPECIFICATIONS CONTAINED IN SUCH REPORTS.
8. COMPACTION TEST REPORTS SHALL BE SUBMITTED TO THE TOWN OF APPLE VALLEY'S BUILDING AND SAFETY DIVISION FOR APPROVAL PRIOR TO FOUNDATION INSPECTIONS.
9. THE CONTRACTOR SHALL HAVE STORM WATER POLLUTION PREVENTION PLAN BMP'S (BEST MANAGEMENT PRACTICES) IN PLACE PRIOR TO GRADING, AND SHALL MAINTAIN THEM UNTIL FINAL INSPECTION.
10. APPROVAL OF PLANS BY THE TOWN OR ITS AGENTS DOES NOT RELIEVE THE DEVELOPER FROM RESPONSIBILITY FOR CORRECTION OF ERROR AND OMISSION DISCOVERED DURING CONSTRUCTION. UPON REQUEST THE REQUIRED PLAN REVISIONS SHALL BE PROMPTLY SUBMITTED TO THE TOWN ENGINEER FOR APPROVAL.
11. AN APPROVED SET OF PLANS SHALL BE AT THE JOB SITE AT ALL TIMES.
12. AN AS-BUILT GRADING PLAN SHALL BE SUBMITTED TO THE TOWN ENGINEER FOR APPROVAL.

EROSION CONTROL:

1. EROSION CONTROL (WIND AND WATER) SHALL INCLUDE;
   A. PROVISIONS FOR CONTINUOUS WATERING DURING GRADING OPERATION TO INCLUDE 24 HOUR ON-CALL OPERATOR OR AS DIRECTED BY TOWN STAFF.
   B. UPON COMPLETION OF THE PROJECT, THE ENTIRE SITE IS TO BE TREATED WITH MAGNESIUM CHLORIDE OR AS DIRECTED BY TOWN STAFF.
2. EROSION CONTROL DEVICES SHALL BE DETERMINED BY THE PROJECT'S ENGINEER OF RECORD AND THE APPROVED S.W.P.P.P.

SPECIFICATIONS:

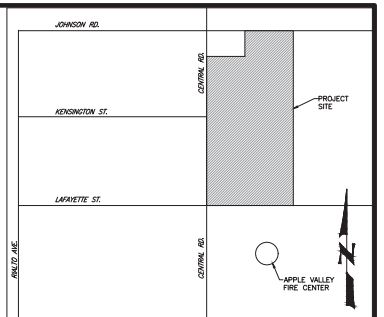
1. ALL GRADING WORK SHOWN ON THIS PLAN SHALL BE DONE IN ACCORDANCE WITH THE CALIFORNIA BUILDING CODE'S LATEST EDITION, OSHA, AND OTHER STATE LAWS AND LOCAL ORDINANCES.
2. ALL GRADING SHALL CONFORM TO THE RECOMMENDATIONS AND REQUIREMENTS OF THE PRELIMINARY SOILS REPORT DATED Dec. 5, 2022 BY: Geocon West, Inc.
   JOB REF. NO. W1523-99-01A
3. CLEAR ALL AREAS OF FILL OF VEGETATION TO A DEPTH OF SIX (6) INCHES OR MORE. NO FILL IS TO BE PLACED UNTIL PREPARATION OF ORIGINAL GROUND IS APPROVED BY THE SOILS ENGINEER, TOWN OR COUNTY INSPECTOR.
4. ALL ORGANIC SURFACE MATERIAL AND DEBRIS SHALL BE STRIPPED PRIOR TO ANY GRADING OPERATIONS AND TRANSPORTED AWAY FROM ALL AREAS THAT ARE TO RECEIVE STRUCTURES OR ENGINEERED FILL.
5. FOUNDATION BEARING VALUE SHALL BE AT LEAST PSF. 3,000
6. COMPACTION SHALL BE A MINIMUM OF NINETY PERCENT (90%). COMPACTION TESTS SHALL BE MADE FOR EACH 18-24 INCHES OF FILL.
7. FILL SHALL BE PLACED IN LIFTS OF SIX (6) INCHES OR LESS AND SUFFICIENT MOISTURE ADDED AND MATERIAL COMPACTED TO ACHIEVE THE REQUIRED PERCENT OF COMPACTION.
8. NO ROCKS GREATER THAN SIX (6") INCHES IN DIAMETER MAY BE PLACED IN FILL.
9. MAXIMUM CUT AND FILL SLOPES SHALL BE 2:1.
10. ALL GRADED AREAS SHALL SLOPE IN ACCORDANCE WITH THE CALIFORNIA BUILDING CODE'S LATEST EDITION.
11. THE PROPERTY OWNER SHALL MAINTAIN ALL ONSITE DRYWELLS AND STORM DRAIN SYSTEMS SUCH THAT TRAPPED WATER WILL PERCOLATE IN THE GROUND WITHIN (7) SEVEN DAYS AFTER A STORM EVENT.
12. BUILDING PADS AND GRADING PLAN CERTIFICATION SHALL BE COMPLETED BY A LICENSED ENGINEER AS REQUIRED BY TOWN STAFF IN ACCORDANCE WITH THE CALIFORNIA BUILDING CODE'S LATEST EDITION.
13. ALL BORROW LOCATIONS SHALL BE APPROVED BY THE TOWN OF APPLE VALLEY AND THE SOILS ENGINEER.
14. CONDITIONS OF APPROVAL DATED _____ ARE HEREBY MADE A PART OF THESE PLANS.



INDEX MAP
N.T.S.

CONSTRUCTION NOTES:

		QUANTITIES*	
1	CONSTRUCT 6" CURB AND GUTTER PER APWA STD. 120-3 TYPE A2 SEE DETAIL SHEET 11	5,800	L.F.
2	CONSTRUCT 6" CURB PER APWA STD. 120-3 TYPE A1 SEE DETAIL SHEET 11	10,950	L.F.
3	CONSTRUCT 5' RIBBON GUTTER PER SBCRD STD. 125 SEE DETAIL SHEET 11	2,455	L.F.
4	CONSTRUCT GRATING CATCH BASIN PER APWA STD. 304-4 SEE DETAIL SHEET 11	9	EA.
5	CONSTRUCT GRATING CATCH BASIN PER APWA STD. 303-4 SEE DETAIL SHEET 11	15	E.A.
6	CONSTRUCT 4" AC OVER 10" OF CLASS 2 AGG BASE	124,800	S.F.
7	CONSTRUCT CONCRETE PAVEMENT, 6" REINFORCED CONCRETE OVER 4" OF CLASS 2 AGG BASE	667,500	S.F.
8	CONSTRUCT CONCRETE DRAINAGE CHANNEL	2,150	L.F.
9	CONSTRUCT 3" AC OVER 4" OF CLASS 2 AGG BASE	238,000	S.F.
10	CONSTRUCT ACCESSIBLE ROUTE OF TRAVEL CURB RAMP TYPE A, SEE DET.ALR1 SHEET 11	8	EA.
11	CONSTRUCT ACCESSIBLE ROUTE OF TRAVEL CURB RAMP TYPE B SEE DET.ALR2 SHEET 11	17	EA.
12	CONSTRUCT RIP-RAP D_{50} = 8" DEPTH 16"	49,545	S.F.
13	CONSTRUCT HEAD WALL PER SBC STD. 209 SEE DETAIL SHEET 11	8	E.A.
14	CONSTRUCT DRAINAGE WEIR SEE SECTION DETAIL SHEET 13, PER SEPARATE PERMIT.	1	E.A.
15	CONSTRUCT BOX CULVERT PER APWA STD. 390-1 SEE DETAIL SHEET 11	385	L.F
16	CONSTRUCT STORM DRAIN CLEAN OUT PER SBC 208 SEE DETAIL SHEET 11.	4	E.A.
17	CONSTRUCT TRASH ENCLOSURE SEE ARCHITECTURAL PLANS	4	E.A.
18	CONSTRUCT RETAINING WALL AT LOADING DOCK SEE ARCHITECTURAL PLANS, PER SEPARATE PERMIT.	480	L.F.
19	CONSTRUCT 48" RCP	1,320	L.F.
20	CONSTRUCT 42" RCP	980	L.F.
21	CONSTRUCT 36" RCP	740	L.F.
22	CONSTRUCT 30" RCP	935	L.F.
23	CONSTRUCT 24" RCP	705	L.F.
24	CONSTRUCT 18" RCP	1,070	L.F.
25	CONSTRUCT UNDERGROUND RETENTION SEE SECTIONS 10 & 11 SHEET 13.	11,880	L.F.
26	INSTALL 3' SDR 35 DRAIN PIPE. WITH PERFORATIONS IN THE BURIED GRAVEL OF UNDERGROUND RETENTION WITH, CLEANOUT AT UPSTREAM END.	261	L.F.



LOCAL VICINITY MAP:
NOT TO SCALE

SHEET INDEX

SHEET NO.	DESCRIPTION
1	TITLE SHEET
2-10	GRADING PLANS
11	DETAILS
12-13	SECTIONS
14-15	ACCESSIBLE ROUTE OF TRAVEL DETAILS
16-24	HORIZONTAL CONTROL PLAN

LEGEND

- FF — INDICATES FINISH FLOOR ELEVATION
- PE — INDICATES PAD ELEVATION
- R.O.W. — INDICATES RIGHT-OF-WAY
- INDICATES JOSHUA TREE
- PP — INDICATES POWER POLE
- SD — INDICATES STORM DRAIN MH
- 3040 — INDICATES EXISTING CONTOUR
- 3040 — INDICATES PROPOSED CONTOUR
- INDICATES ROAD CENTERLINE
- INDICATES PROPOSED PROPERTY LINE
- INDICATES EXISTING PROPERTY LINE
- INDICATES EASEMENT LINE
- 45.65 TC / 45.31 FS — INDICATES PROPOSED ELEVATION
- INDICATES EXISTING ASPHALT ROAD
- INDICATES PROPOSED ASPHALT ROAD
- INDICATES CONCRETE
- INDICATES CONCRETE RIBBON GUTTER
- INDICATES PROPOSED BUILDING
- INDICATES PROPOSED RIP-RAP

OWNER STATEMENT:

A CIVIL ENGINEER, GEOTECHNICAL ENGINEER AND/OR GEOLOGIST WILL BE EMPLOYED TO GIVE TECHNICAL SUPERVISION AND MAKE INSPECTIONS OF THE WORK, WHENEVER APPROVAL OF PLANS AND ISSUANCE OF PERMIT ARE TO BE BASED ON THE CONDITION THAT SUCH PROFESSIONALS BE SO EMPLOYED.

_____
(PRINT OWNER'S NAME HERE)

_____ _____
(SIGNATURE) (DATE)

GEOTECHNICAL ENGINEER'S STATEMENT:

WE/I REPRESENTING _____, STATES THAT RECOMMENDATIONS CONTAINED IN REPORT DATED _____ PERTAINING TO GEOTECHNICAL CONDITIONS HAVE BEEN COMPLIED WITH TO OUR SATISFACTION. THIS CONFIRMATION IS NOT TO BE CONSTRUED AS AN AUTHENTICATION OF ANY DIMENSIONS OR ELEVATIONS SHOWN ON THESE PLANS.

BY:_____ DATE:_____

(GEOTECHNICAL ENGINEER'S STAMP HERE)

UTILITIES:

ELECTRIC: SOUTHERN CALIFORNIA EDISON COMPANY
12349 HESPERIA ROAD
VICTORVILLE, CALIFORNIA 92392
(760) 951-3145

TELEPHONE: FRONTIER COMMUNICATIONS
(760) 245-0800

WATER: LIBERTY UTILITIES
21760 OTTAWA RD.
APPLE VALLEY, CALIFORNIA 92307
(760) 247-6484

SEWER: TOWN OF APPLE VALLEY
14955 DALE EVANS PKWY
APPLE VALLEY, CALIFORNIA 92307
(760) 240-7000

GAS: SOUTHWEST GAS
13471 MARIPOSA RD.
VICTORVILLE, CALIFORNIA 92392
(760) 241-8120

OWNER REPRESENTATIVE / APPLICANT:

AP INVESTORS GROUP LLC.
9220 WINNETKA AVE.,
LOS ANGELES, CA 991311
(818) 894-2525

SURVEYOR/ENGINEER:

MERRELL JOHNSON COMPANIES
22221 HIGHWAY 18
APPLE VALLEY, CA 92307
(760) 240-8000

NOTE:

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SOILS ENGINEER:

GEOCON WEST, INC.
2015 West Park Avenue, Unit 1
Redlands, CA 92374
(909) 894-2175

BENCHMARK AND BASIS OF BEARING

OPUS STATIC GPS OBSERVATION
BASE POINT COORDINATES:
NORTHING: 2047019.0900'
EASTING: 6811199.3300' - CALIFORNIA STATE PLANE COORDINATE SYSTEM ZONE V NAD 83

ELEVATION: 3234.10' - NAVD 88

NO.	REVISION	DATE	BY

REGISTERED PROFESSIONAL ENGINEER — C. CARY FACER — No. C-51752 — CIVIL — STATE OF CALIFORNIA

Merrell Johnson COMPANIES
22221 HIGHWAY 18
APPLE VALLEY, CALIFORNIA 92307
(760) 240-8000
(760) 240-1400 FAX

16091 KAMANA RD
APPLE VALLEY, CALIFORNIA 92307
(760) 256-2068
(760) 530-6672 FAX

DRAWN BY:
DATE:

DESIGNED BY:
DATE:

APPROVED BY:
DATE:

TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:

NORMAN B. MILLER, TOWN ENGINEER DATE

RCE 59809, EXP. DATE:

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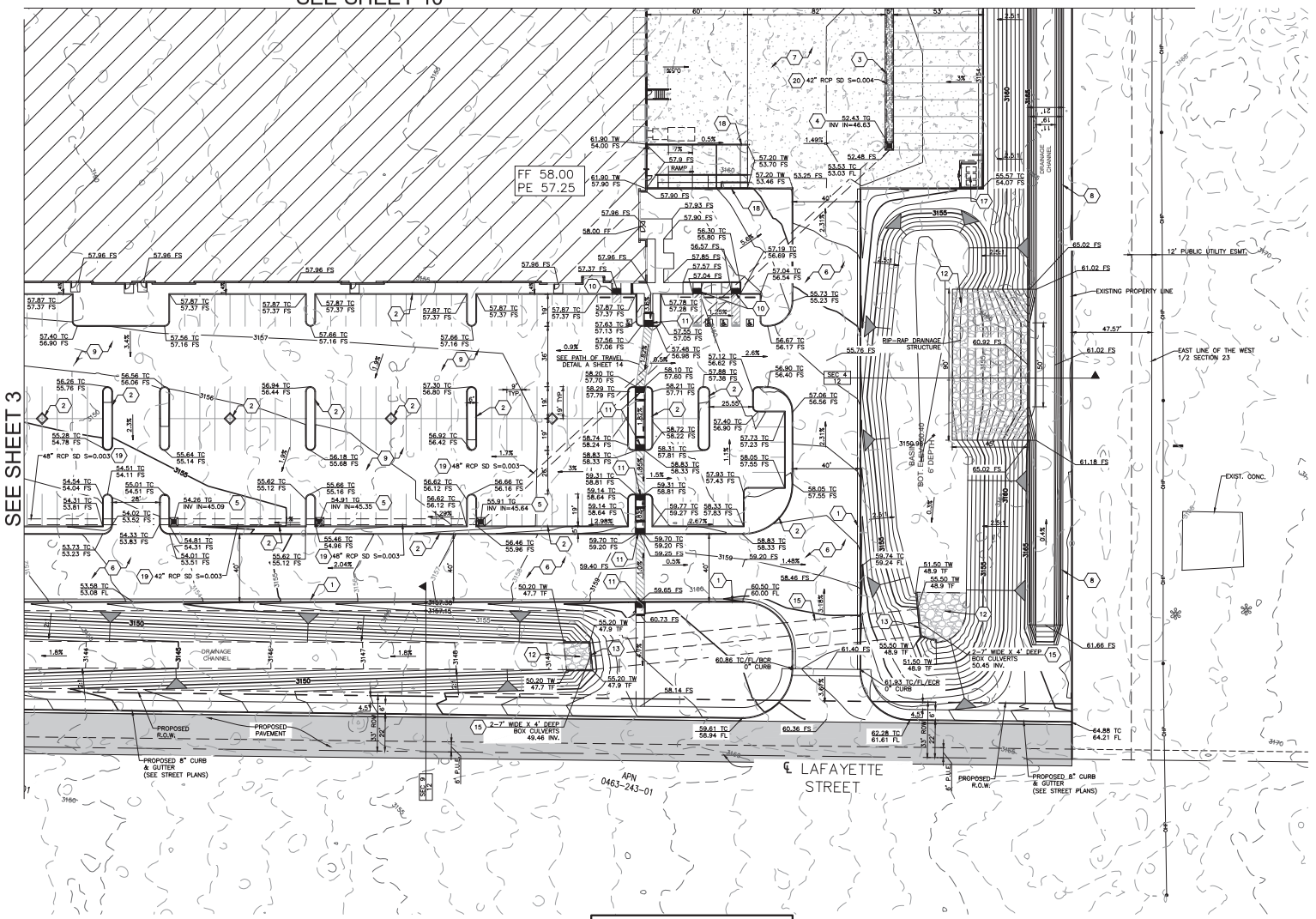
Town of Apple Valley

TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY

TITLE SHEET

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 1 OF 24



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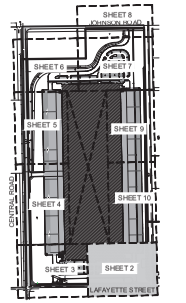

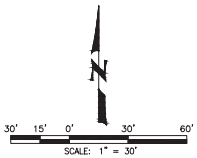

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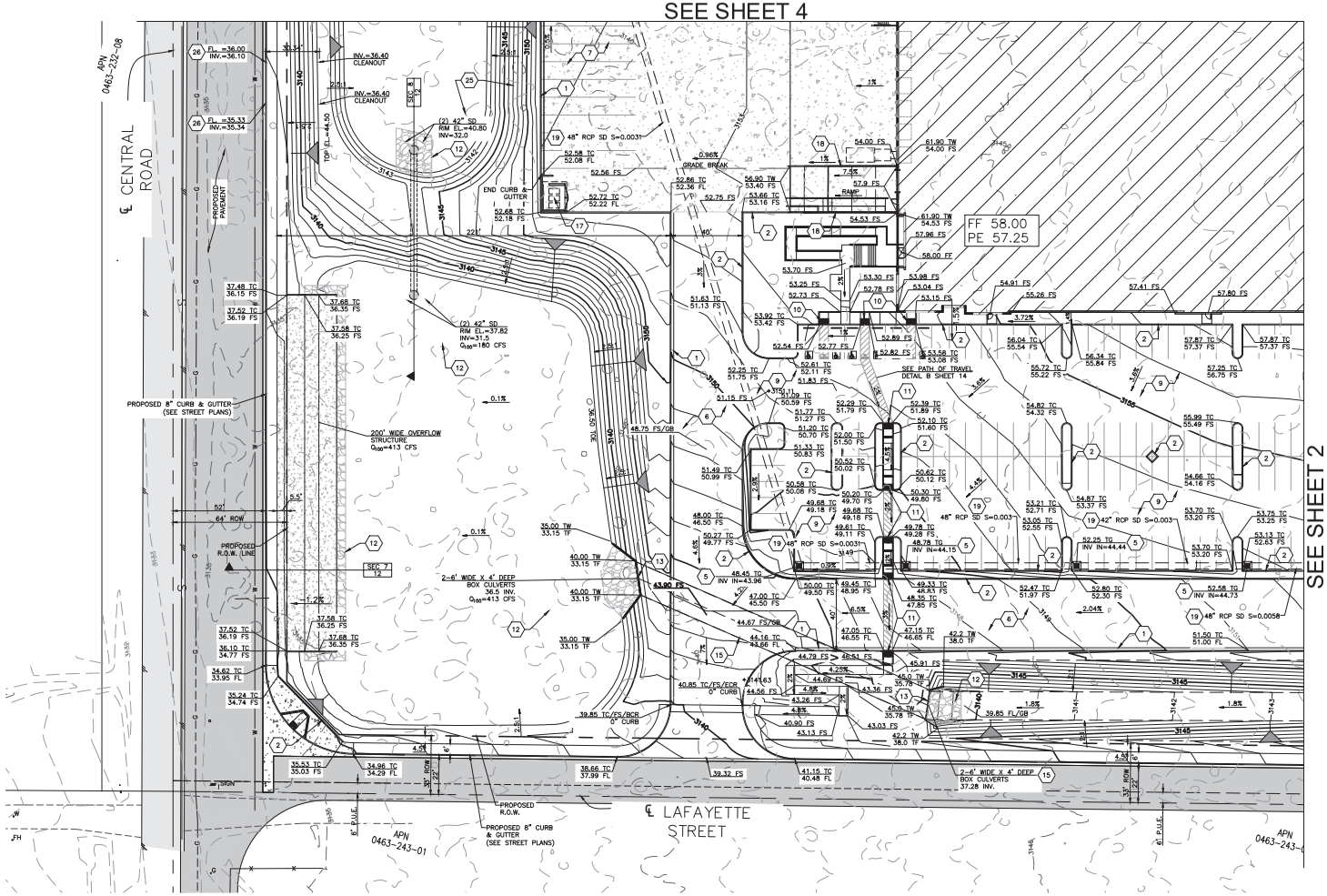
Town of Apple Valley

TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY

GRADING PLAN

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 2 OF 24



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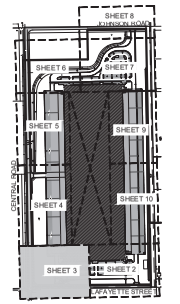

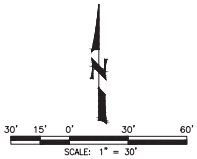

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BENCHMARK AND BASIS OF BEARING

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NO.	REVISION	DATE	BY

REGISTERED PROFESSIONAL ENGINEER — C. CARY FACER — No. C-51752 — CIVIL — STATE OF CALIFORNIA

Merrell Johnson COMPANIES
22221 HIGHWAY 18, APPLE VALLEY, CALIFORNIA 92307, (760) 240-8000, (760) 240-1400 FAX
16091 KAMANA RD, APPLE VALLEY, CALIFORNIA 92307, (760) 256-2068, (760) 530-6672 FAX

DRAWN BY:
DATE:
DESIGNED BY:
DATE:
APPROVED BY:
DATE:

TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:

NORMAN B. MILLER, TOWN ENGINEER DATE

RCE 59809, EXP. DATE:

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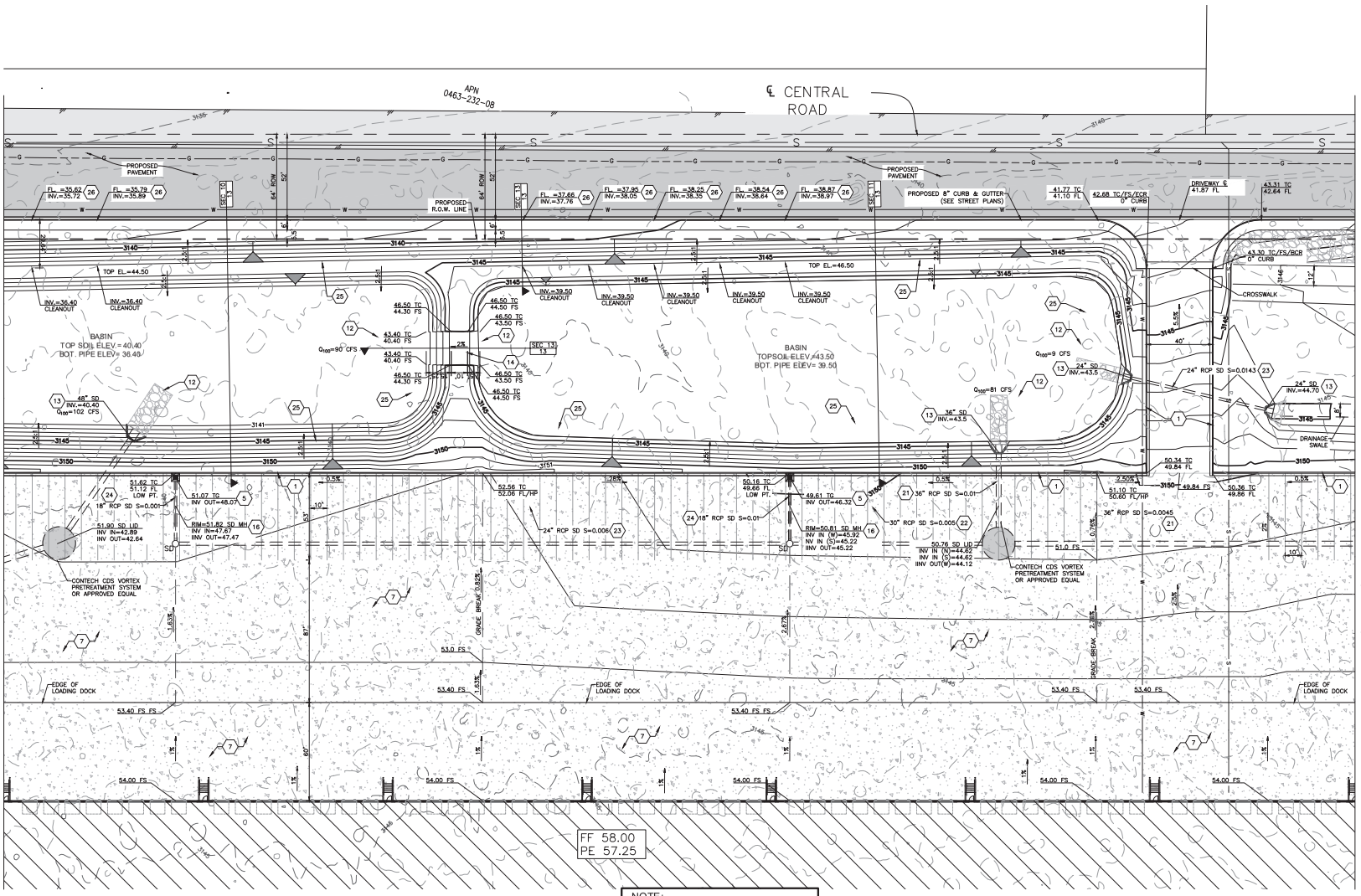
Town of Apple Valley

TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY

GRADING PLAN

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 3 OF 24



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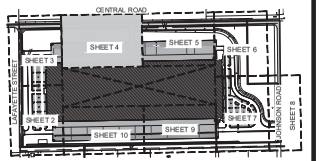

30' 15' 0' 30' 60'
SCALE: 1" = 30'

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REGISTERED PROFESSIONAL ENGINEER C. CARY FACER No. C-51752 CIVIL STATE OF CALIFORNIA

Merrell Johnson COMPANIES
22221 HIGHWAY 18 APPLE VALLEY, CALIFORNIA 92307 (760) 240-8000 (760) 240-1400 FAX
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DRAWN BY:
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TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:
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RCE 59809, EXP. DATE:

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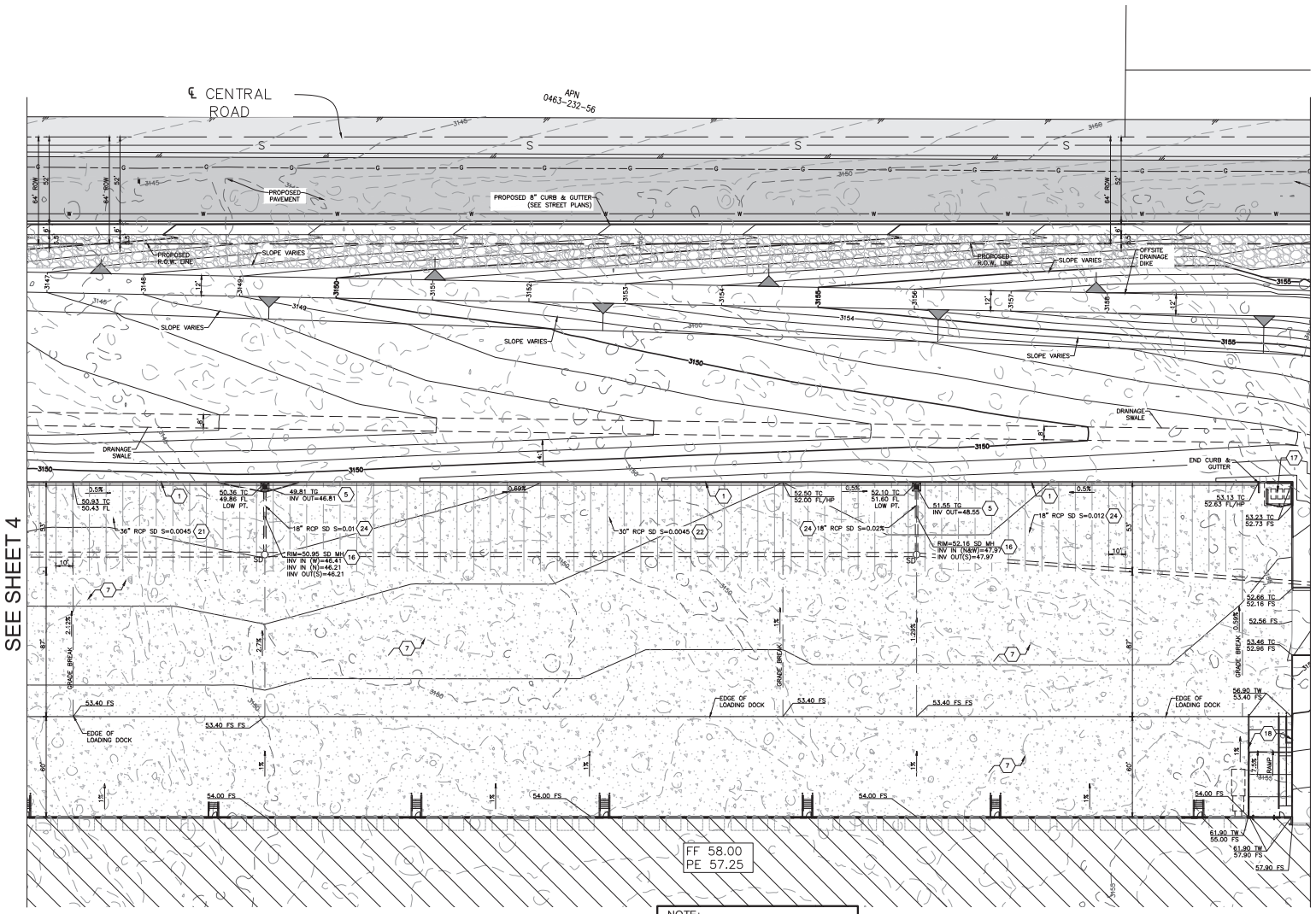
Town of Apple Valley

TOWN OF APPLE VALLEY PRECISE GRADING PLAN WAREHOUSE FACILITY

GRADING PLAN

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 4 OF 24



SEE SHEET 4

SEE SHEET 6

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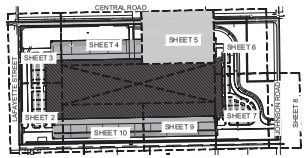
16. CONSTRUCT STORM DRAIN CLEAN OUT PER SBC 208 SEE DETAIL SHEET 11.
17. CONSTRUCT TRASH ENCLOSURE SEE ARCHITECTURAL PLANS.
18. CONSTRUCT RETAINING WALL AT LOADING DOCK SEE ARCHITECTURAL PLANS, PER SEPARATE PERMIT.
21. CONSTRUCT 36" RCP.
23. CONSTRUCT 24" RCP.



30' 15' 0' 30' 60'

SCALE: 1" = 30'

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BENCHMARK AND BASIS OF BEARING

OPUS STATIC GPS OBSERVATION
BASE POINT COORDINATES:
NORTHING: 2047019.0900'
EASTING: 6811199.3300' - CALIFORNIA STATE PLANE COORDINATE SYSTEM ZONE V NAD 83

ELEVATION: 3234.10' - NAVD 88

NO.	REVISION	DATE	BY

REGISTERED PROFESSIONAL ENGINEER — C. CARY FACER — No. C-51752 — CIVIL — STATE OF CALIFORNIA

Merrell Johnson COMPANIES
22221 HIGHWAY 18
APPLE VALLEY, CALIFORNIA 92307
(760) 240-8000
(760) 240-1400 FAX
16091 KAMANA RD
APPLE VALLEY, CALIFORNIA 92307
(760) 256-2068
(760) 530-6672 FAX

DRAWN BY:
DATE:
DESIGNED BY:
DATE:
APPROVED BY:
DATE:

TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:

NORMAN B. MILLER, TOWN ENGINEER DATE

RCE 59809, EXP. DATE:

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Town of Apple Valley

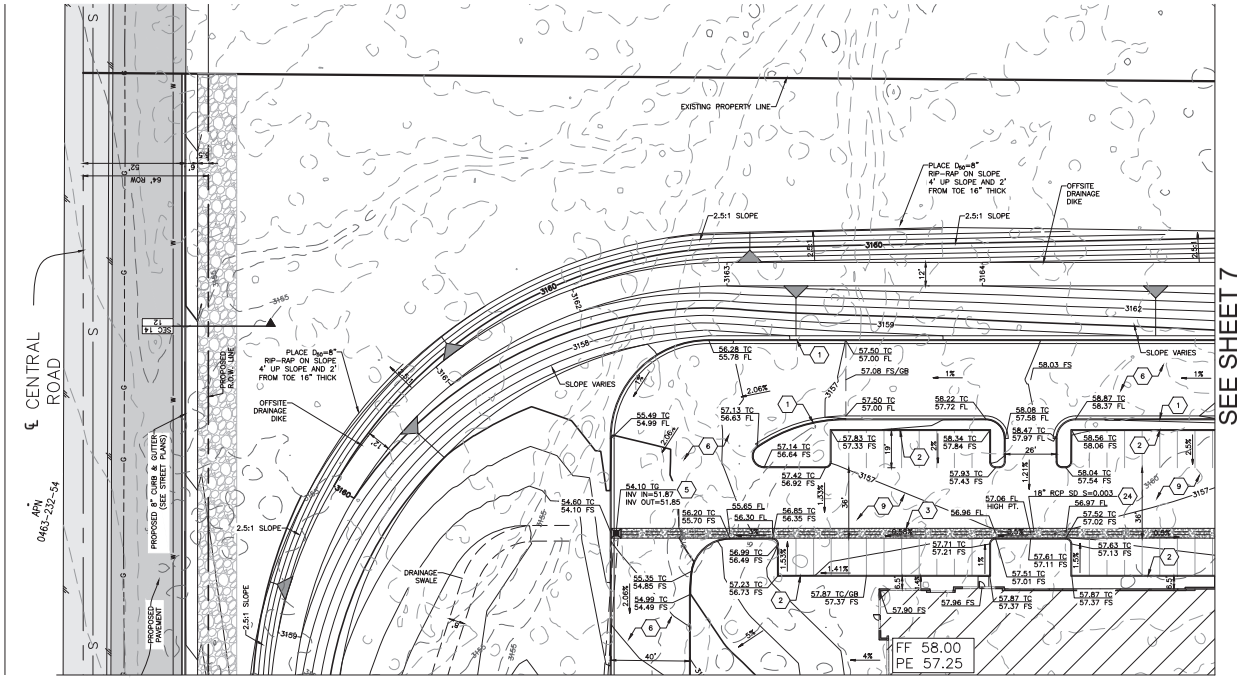
TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY

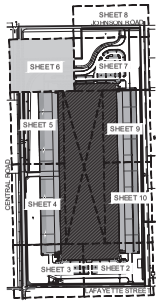
GRADING PLAN

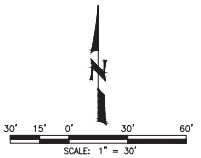
SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 5 OF 24

CONSTRUCTION NOTES:

1. CONSTRUCT 6" CURB AND GUTTER PER APWA STD. 120-3 TYPE A2 SEE DETAIL SHEET 11.
2. CONSTRUCT 6" CURB PER APWA STD. 120-3 TYPE A1 SEE DETAIL SHEET 11.
3. CONSTRUCT 5' RIBBON GUTTER PER SBCRD STD. 125 SEE DETAIL SHEET 11.
5. CONSTRUCT GRATING CATCH BASIN PER APWA STD. 303-4 SEE DETAIL SHEET 11.
6. CONSTRUCT 4" AC OVER 10" OF CLASS 2 AGG BASE.
9. CONSTRUCT 3" AC OVER 4" OF CLASS 2 AGG BASE.
23. CONSTRUCT 24" RCP.







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BENCHMARK AND BASIS OF BEARING

OPUS STATIC GPS OBSERVATION
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NO.	REVISION	DATE	BY

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16091 KAMANA RD APPLE VALLEY, CALIFORNIA 92307 (760) 256-2368 (760) 530-6672 FAX

DRAWN BY: DATE:
DESIGNED BY: DATE:
APPROVED BY: DATE:

TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT
REVIEWED BY:
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RCE 59809, EXP. DATE:
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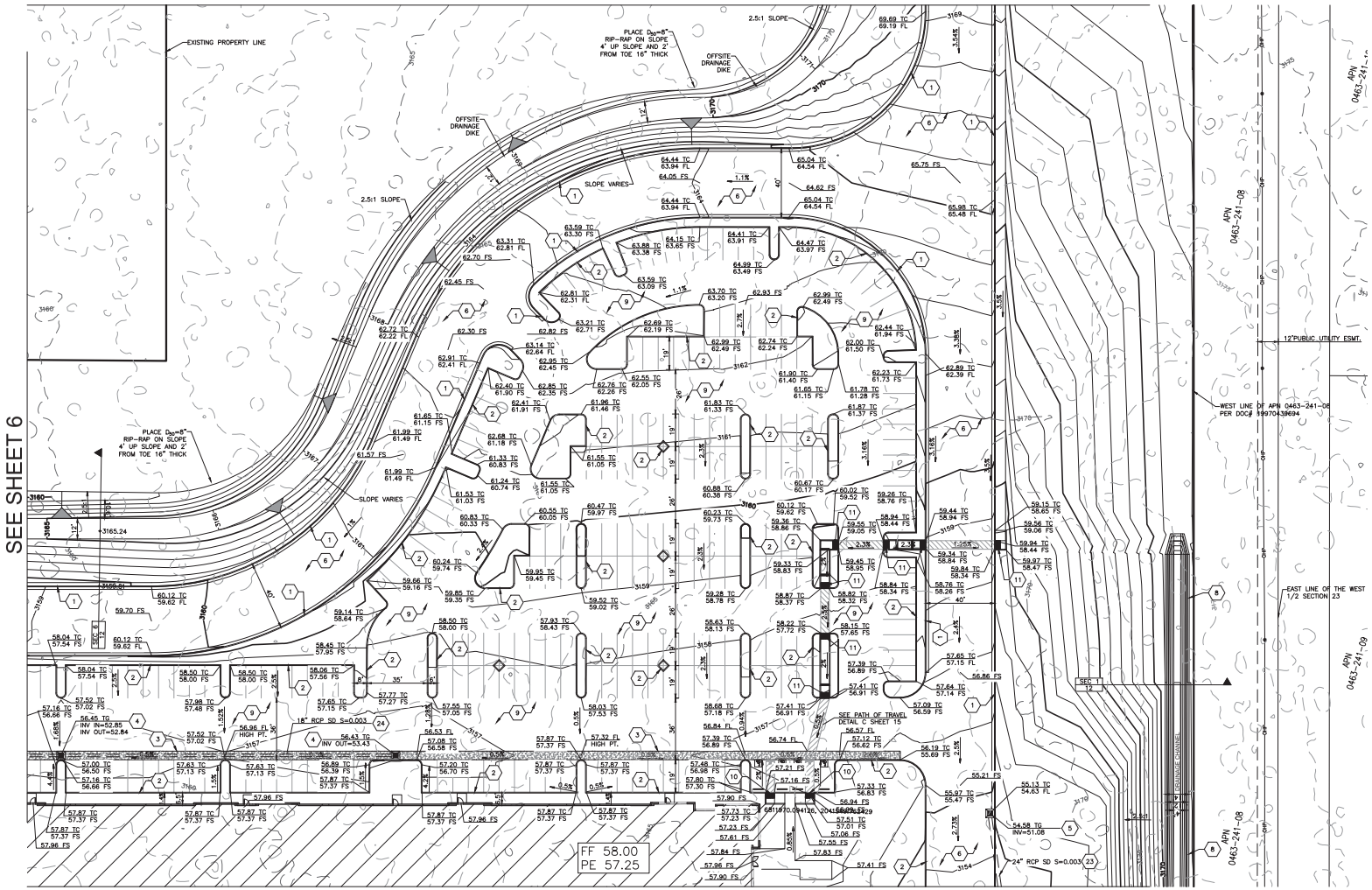
Town of Apple Valley

TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY

GRADING PLAN

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 6 OF 24

SEE SHEET 8

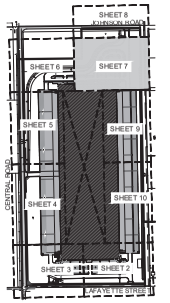


SEE SHEET 6

SEE SHEET 9

CONSTRUCTION NOTES:

1. CONSTRUCT 6" CURB AND GUTTER PER APWA STD. 120-3 TYPE A2 SEE DETAIL SHEET 11.
2. CONSTRUCT 6" CURB PER APWA STD. 120-3 TYPE A1 SEE DETAIL SHEET 11.
3. CONSTRUCT 5' RIBBON GUTTER PER SBCRD STD. 125 SEE DETAIL SHEET 11.
4. CONSTRUCT GRATING CATCH BASIN PER APWA STD. 304-4 SEE DETAIL SHEET 11.
6. CONSTRUCT 4" AC OVER 10" OF CLASS 2 AGG BASE.
9. CONSTRUCT 3" AC OVER 4" OF CLASS 2 AGG BASE.
10. CONSTRUCT ACCESSIBLE ROUTE OF TRAVEL CURB RAMP TYPE A. SEE DETAIL R1 SHEET 11
11. CONSTRUCT ACCESSIBLE ROUTE OF TRAVEL CURB RAMP TYPE B SEE DETAIL R2 SHEET 11
22. CONSTRUCT 30" RCP.
23. CONSTRUCT 24" RCP.



N

30' 15' 0' 30' 60'

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REGISTERED PROFESSIONAL ENGINEER C. CARY FACER No. C-51752 CIVIL STATE OF CALIFORNIA

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TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:

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Town of Apple Valley

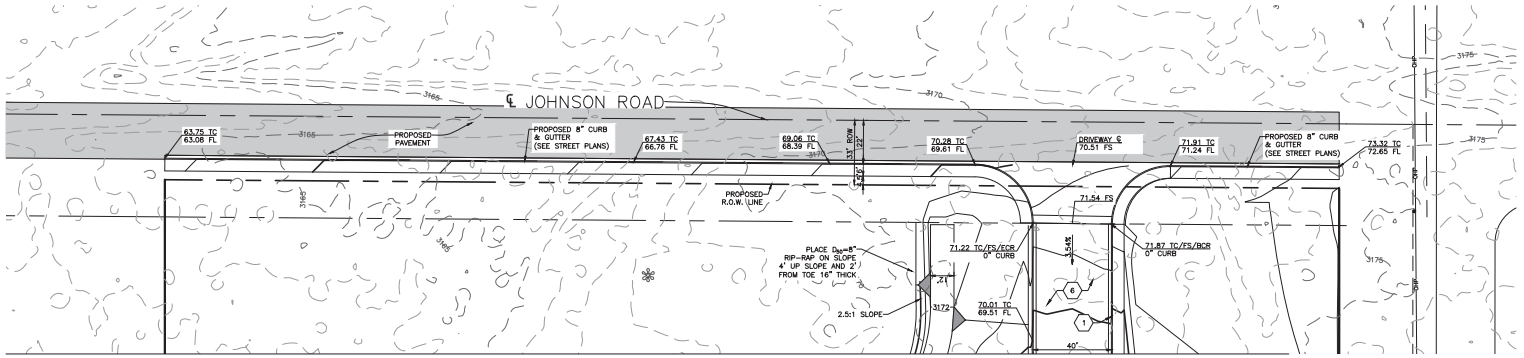
TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY

GRADING PLAN

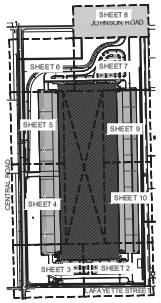
SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 7 OF 24

CONSTRUCTION NOTES:

1. CONSTRUCT 6" CURB AND GUTTER PER APWA STD. 120-3 TYPE A2 SEE DETAIL SHEET 11.
6. CONSTRUCT 4" AC OVER 10" OF CLASS 2 AGG BASE.



SEE SHEET 7



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BENCHMARK AND BASIS OF BEARING

OPUS STATIC GPS OBSERVATION
BASE POINT COORDINATES:
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ELEVATION: 3234.10' - NAVD 88

NO.	REVISION	DATE	BY

REGISTERED PROFESSIONAL ENGINEER — E. CARY FACER — No. C-51752 — CIVIL — STATE OF CALIFORNIA

Merrell Johnson COMPANIES
22221 HIGHWAY 18
APPLE VALLEY, CALIFORNIA 92307
(760) 240-8000
(760) 240-1400 FAX
16091 KAMANA RD
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DRAWN BY:
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DESIGNED BY:
DATE:
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DATE:

TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:

NORMAN B. MILLER, TOWN ENGINEER DATE

RCE 59809, EXP. DATE:

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Town of Apple Valley

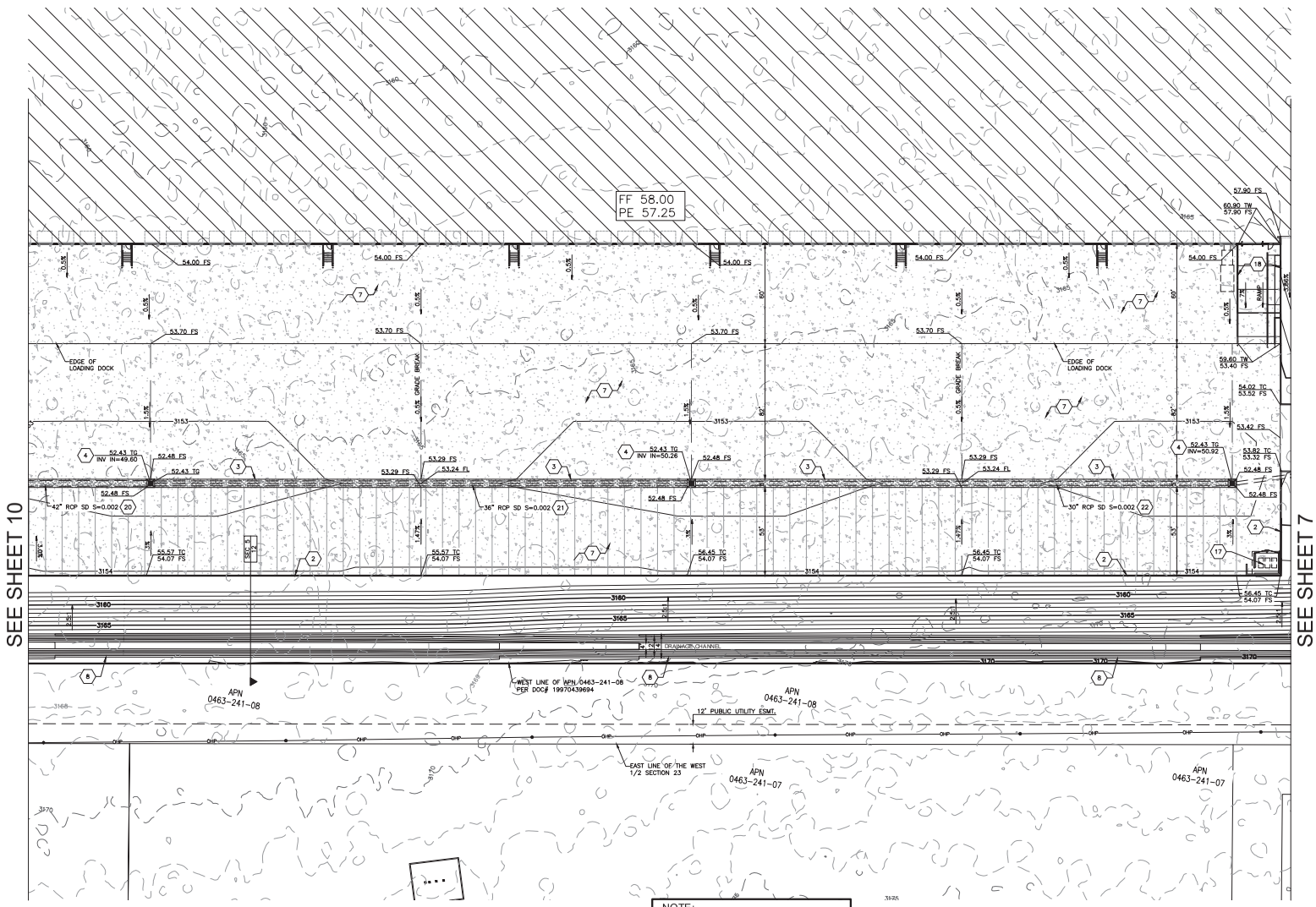
TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY

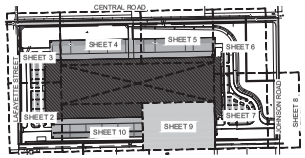
GRADING PLAN

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 8 OF 24

CONSTRUCTION NOTES:

2. CONSTRUCT 6" CURB PER APWA STD. 120-3 TYPE A1 SEE DETAIL SHEET 11.
3. CONSTRUCT 8" RIBBON GUTTER PER SBCRD STD. 125 SEE DETAIL SHEET 11.
4. CONSTRUCT GRATING CATCH BASIN PER APWA STD. 304-4 SEE DETAIL SHEET 11.
7. CONSTRUCT CONCRETE PAVEMENT, 6" REINFORCED CONCRETE OVER 4" OF CLASS 2 AGG BASE
8. CONSTRUCT CONCRETE DRAINAGE CHANNEL.
17. CONSTRUCT TRASH ENCLOSURE SEE ARCHITECTURAL PLANS.
18. CONSTRUCT RETAINING WALL AT LOADING DOCK SEE ARCHITECTURAL PLANS. PER SEPARATE PERMIT.
19. CONSTRUCT 48" RCP.
20. CONSTRUCT 42" RCP.
21. CONSTRUCT 36" RCP.





30' 15' 0' 30' 60'

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NO.	REVISION	DATE	BY

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Merrell Johnson COMPANIES

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TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:

NORMAN B. MILLER, TOWN ENGINEER DATE

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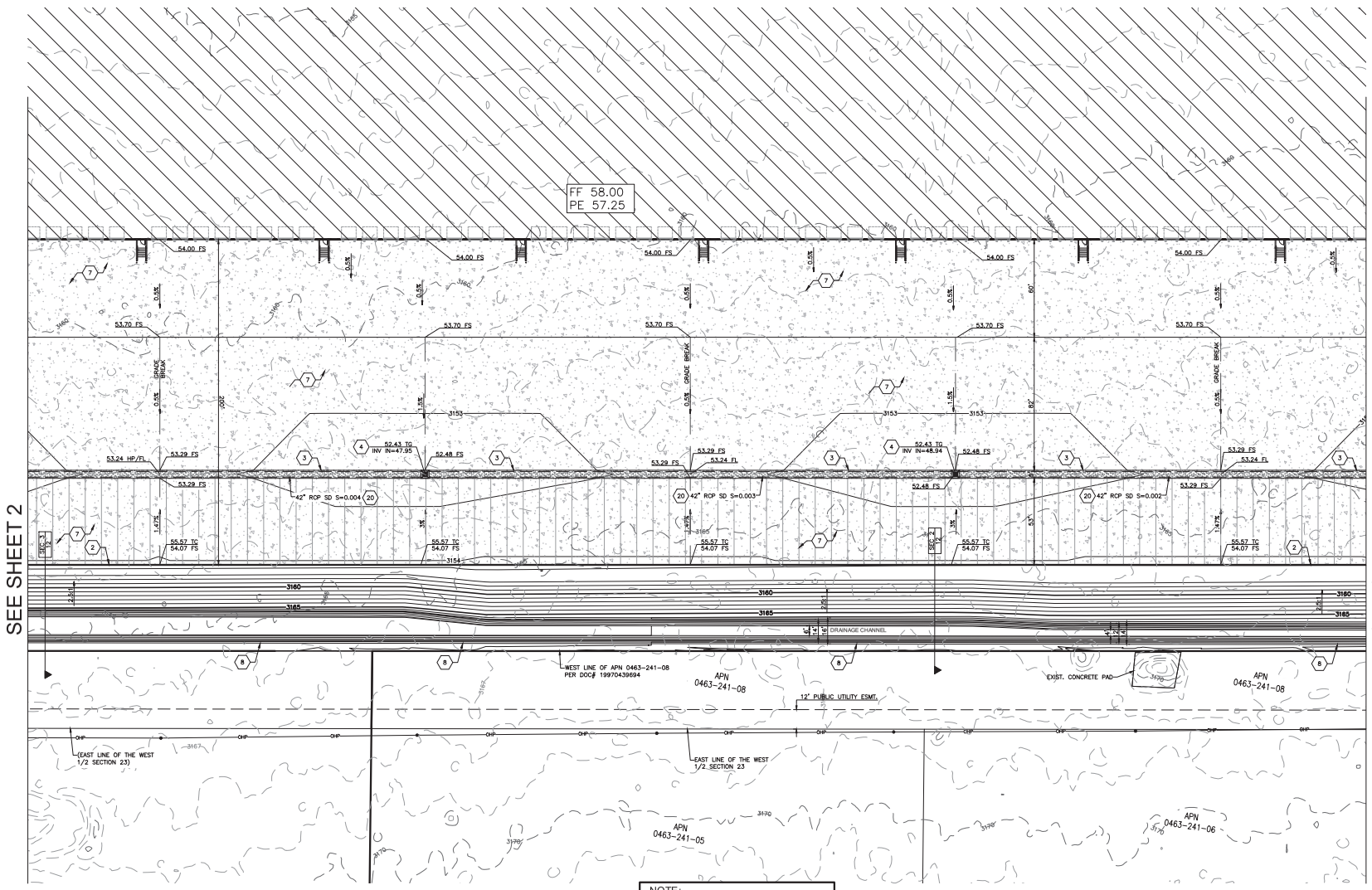
Town of Apple Valley

TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY

GRADING PLAN

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 9 OF 24



CONSTRUCTION NOTES:

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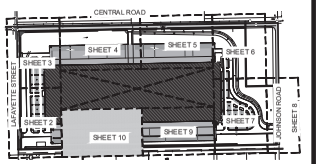

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ENGINEERING DEPARTMENT

REVIEWED BY:

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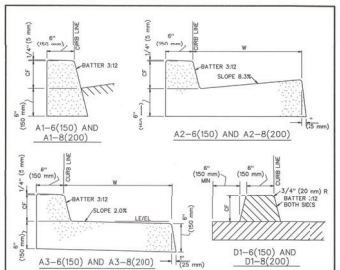
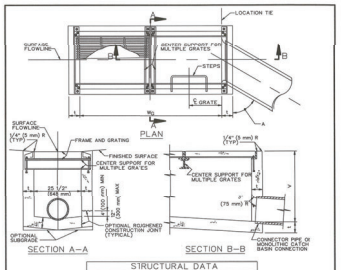
Town of Apple Valley

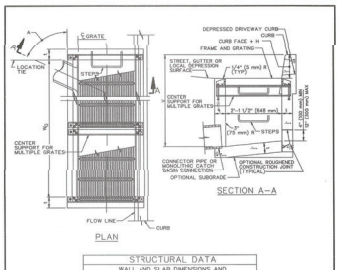
TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY

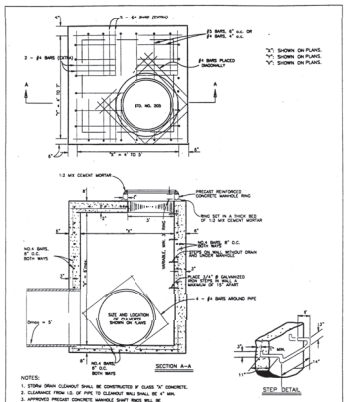
GRADING PLAN

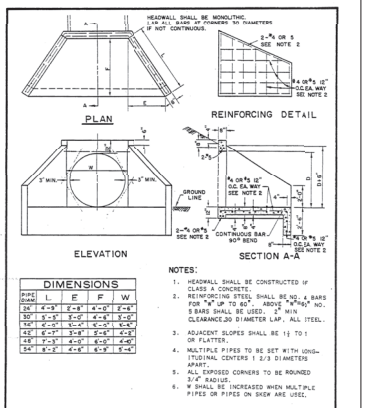
SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 10 OF 24

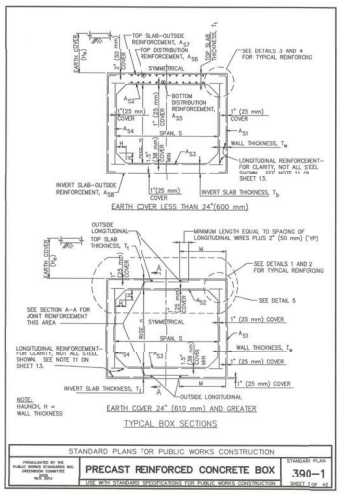


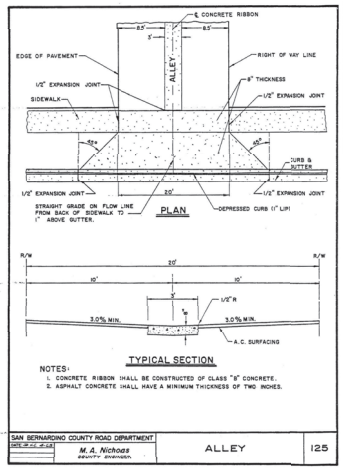


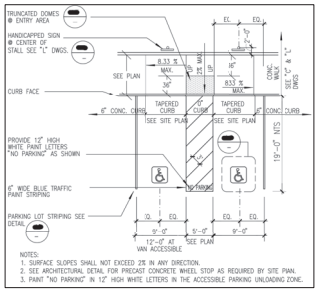


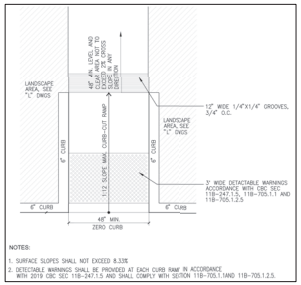












R1

R2

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ELEVATION: 3234.10' - NAVD 88

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DATE:
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REVIEWED BY:
NORMAN B. MILLER, TOWN ENGINEER DATE
RCE 59809, EXP. DATE:
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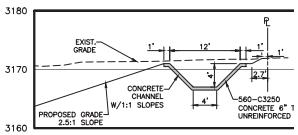
Town of Apple Valley

TOWN OF APPLE VALLEY
PRECISE GRADING PLAN
WAREHOUSE FACILITY
DETAILS

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 11 OF 24



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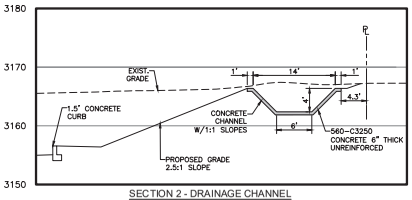

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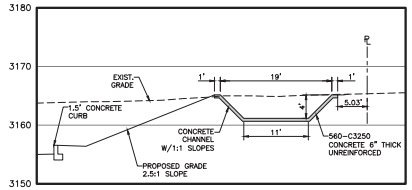

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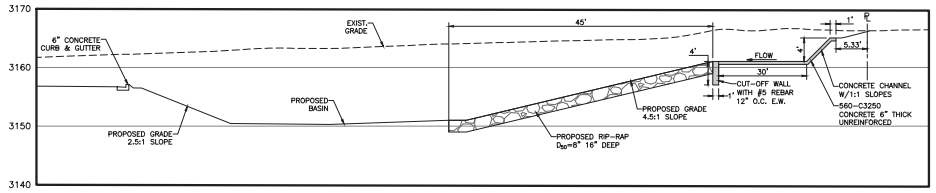

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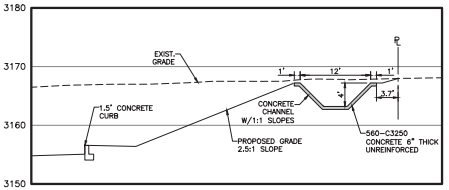

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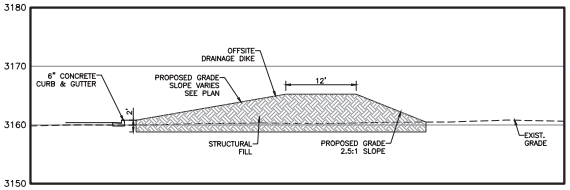

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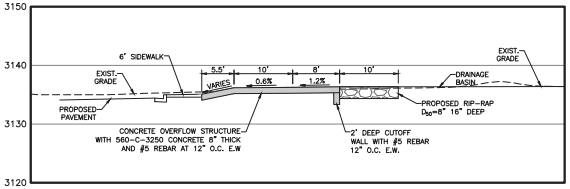

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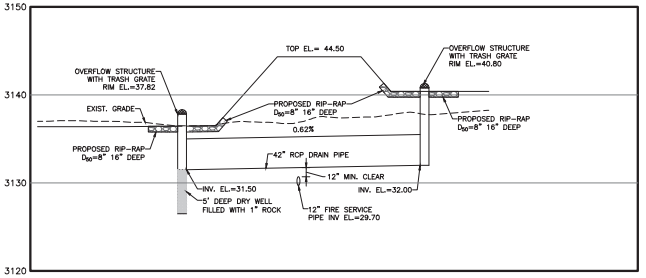

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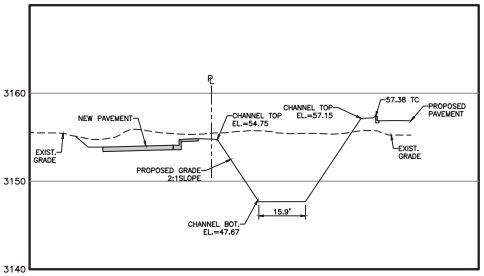

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BASE POINT COORDINATES:
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EASTING: 6811199.3300 - CALIFORNIA STATE PLANE COORDINATE SYSTEM ZONE V NAD 83

ELEVATION: 3234.10' - NAVD 88

NO.	REVISION	DATE	BY

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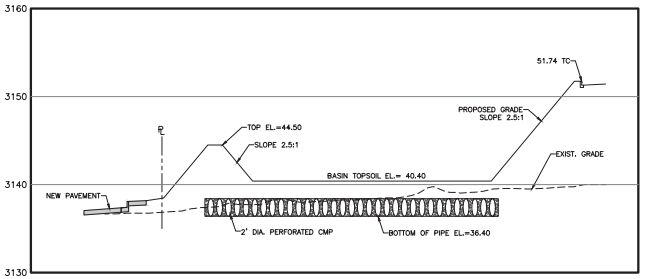
SHEET 12 OF 24



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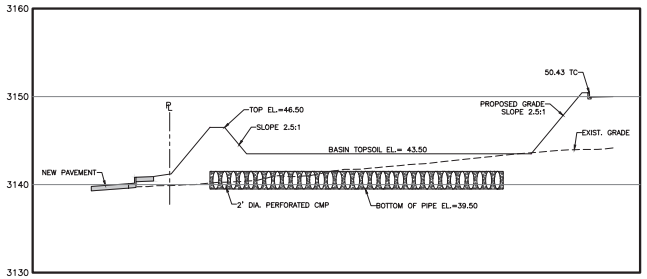

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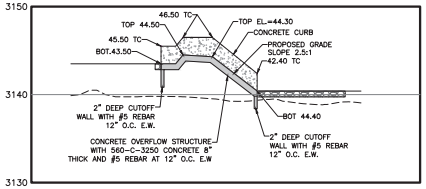

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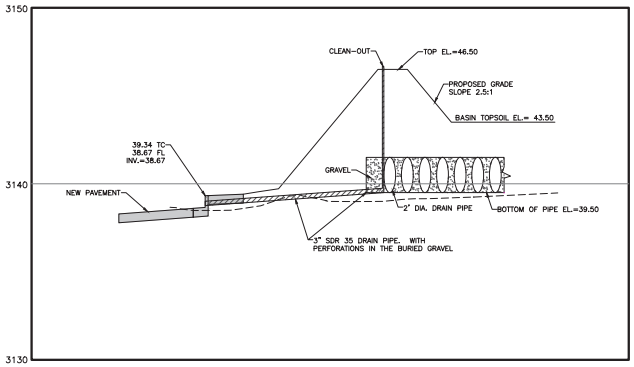

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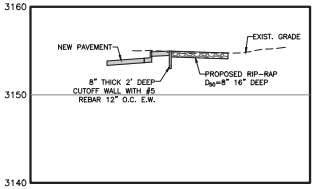

SECTION 14 - TYP. RIP-RAP AT SIDEWALK
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TOWN OF APPLE VALLEY
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SECTION DETAILS

SCALE: AS SHOWN
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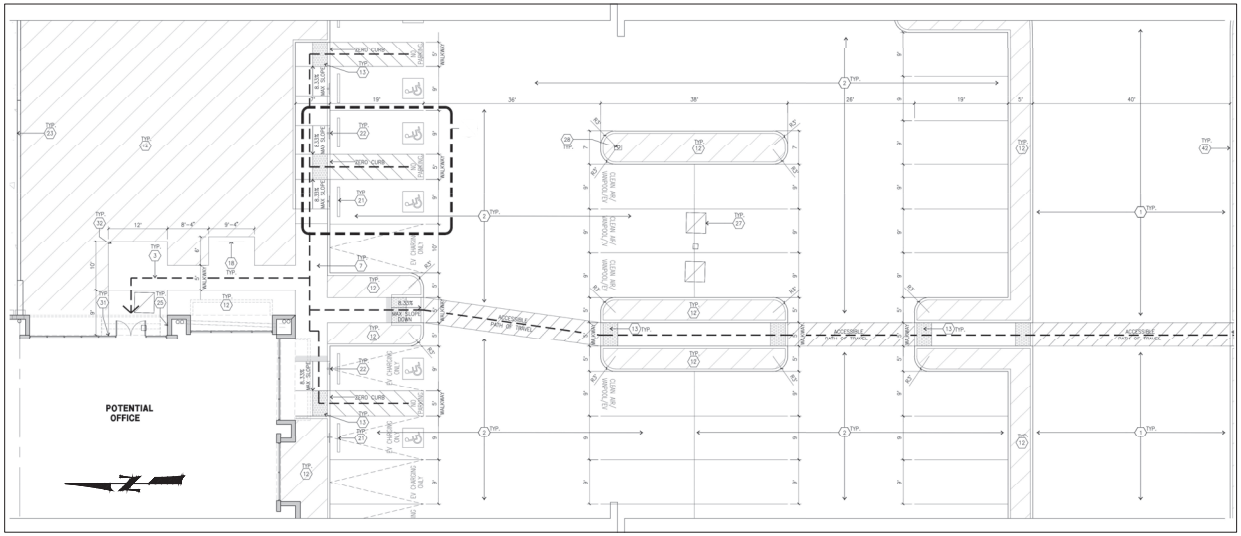
SHEET 13 OF 24



ACCESSIBLE PATH OF TRAVEL DETAIL A
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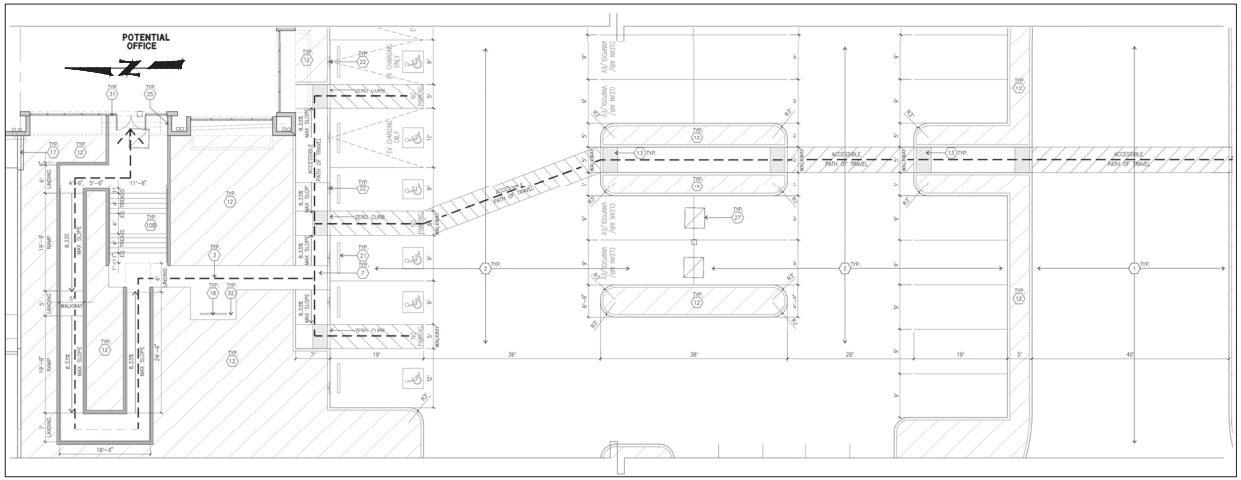

ACCESSIBLE PATH OF TRAVEL DETAIL B
N.T.S.

SITE PLAN KEYNOTES

1. HEAVY BROOM FINISH CONCRETE PAVEMENT. SEE "C" DRAWINGS.
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PRECISE GRADING PLAN
WAREHOUSE FACILITY
ACCESSIBLE ROUT OF TRAVEL DETAILS

SCALE: AS SHOWN
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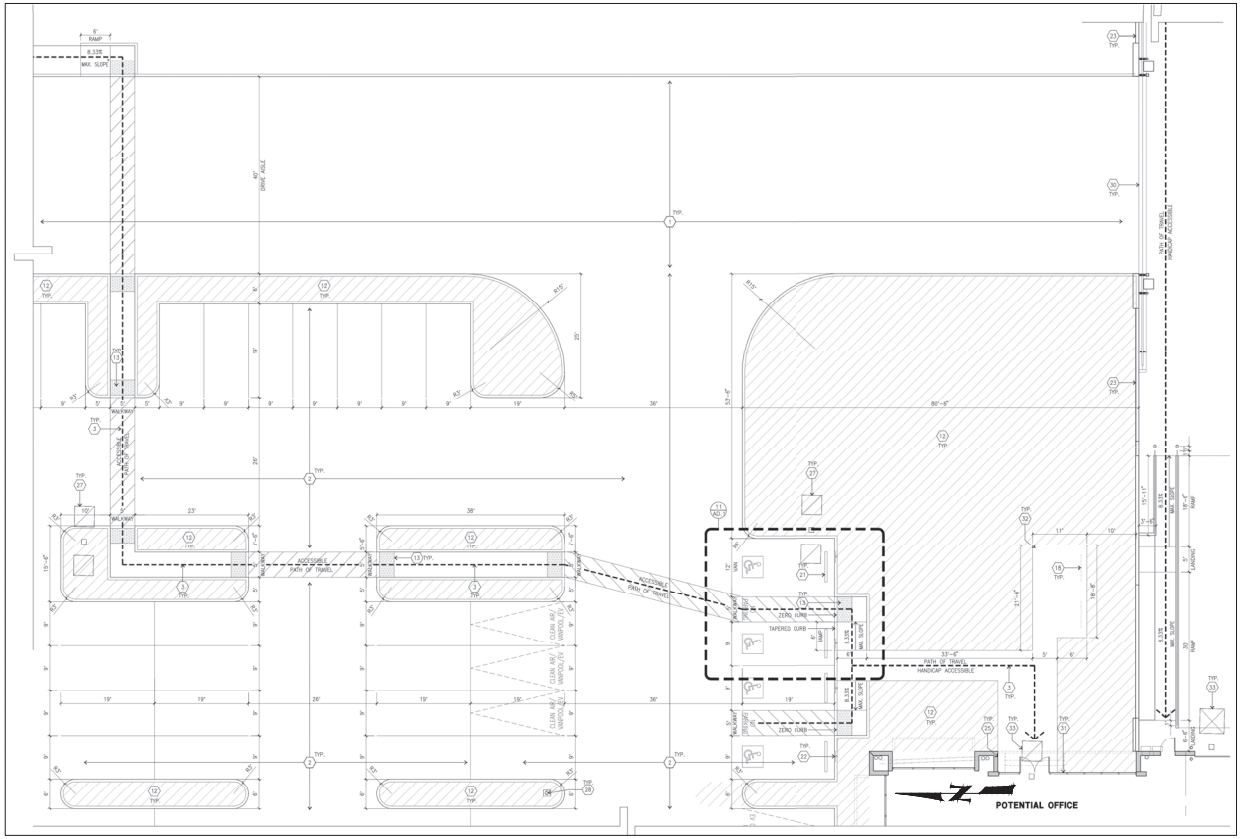
SHEET 14 OF 23



ACCESSIBLE PATH OF TRAVEL DETAIL C
N.T.S.

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PRECISE GRADING PLAN
WAREHOUSE FACILITY

ACCESSIBLE ROUT OF TRAVEL DETAILS

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 15 OF 24

Appendix N: Landscape Plans

1M Warehouse

Sheet Index

L-T	Cover Sheet
LI-1 thru LI-15	Irrigation Plans
LI-16	Irrigation Schedules
LI-17	Irrigation Details
LI-18	Irrigation Details
LP-1 thru LP-15	Planting Plans
LP-16	Planting Details
LS-1	Specifications
LS-2	Specifications

ABBREVIATIONS

AC	ASPHALT CONCRETE	PIP	POURED IN PLACE
C J	COLD JOINT	PL	PROPERTY LINE
℄	CENTERLINE	R or RAD	RADIUS
CONC	CONCRETE	R	RISER
CONT	CONTINUOUS	RWD	REDWOOD
DIA	DIAMETER	RS	ROUGH SAWN
D.F.	DOUGLAS FIR	SL	SCORELINE
EA	EACH	SHT	SHEET
EJ	EXPANSION JOINT	SPECS	SPECIFICATIONS
EQ	EQUAL	SQ	SQUARE
EXIST.	EXISTING	STD	STANDARD
FRH	FIRE HYDRANT	STRUCT	STRUCTURAL
FS	FINISH SURFACE	S4S	SURFACE FOUR SIDES
FT	FEET	T	TREAD
FTG	FOOTING	THK	THICK
GA	GAUGE	TOC	TOP OF CONCRETE or CURB
GALV	GALVANIZE(D)	TYP	TYPICAL
GB	GRADE	TOW	TOP OF WALL
HP	HIGH POINT	TOF	TOP OF FOOTING
MAX	MAXIMUM	UNO	UNLESS NOTED OTHERWISE
MIN	MINIMUM	VEH	VEHICULAR
NIC	NOT IN CONTRACT	VERT	VERTICAL
NTS	NOT TO SCALE	WWM	WOVEN WIRE MESH
OC	ON CENTER	WI	WROUGHT IRON
PA	PLANTING AREA	d	NAIL PENNY SIZE

General Notes

IRRIGATION

1. FINAL LOCATION OF CONTROLLER TO BE DETERMINED IN THE FIELD WITH APPROVAL OF OWNER AND LANDSCAPE ARCHITECT.
2. REFER TO GENERAL IRRIGATION NOTES ON IRRIGATION PLAN.

PLANTING

1. ALL BOX TREES ARE TO BE SELECTED BY THE LANDSCAPE ARCHITECT.
2. CONTRACTOR IS TO SPOT ALL PLANT MATERIAL AND HAVE LANDSCAPE ARCHITECT APPROVE THE SPOTTING PRIOR TO THE EXCAVATION OF ANY PLANT PIT. ALLOW 48 HOURS LEAD TIME. ANY TREE, SHRUB, OR VINE THAT IS PLANTED WITHOUT APPROVAL OF THE LANDSCAPE ARCHITECT MAY BE MOVED AT THE CONTRACTOR'S EXPENSE.
3. REMOVE STAKES FROM ALL ESPALIERS AND VINES AND ATTACH TO WALLS, POST, ETC.
4. PRIOR TO PLANTING INSTALLATION, CONTRACTOR SHALL HAVE SOIL TESTED AND SEND RESULTS TO PUBLIC WORKS INSPECTOR. REFER TO SPECIFICATIONS FOR SOIL PREPARATION INFORMATION.
5. CONTRACTOR TO CONTACT LANDSCAPE ARCHITECT AND CITY INSPECTOR FOR FINAL INSPECTION WHEN INSTALLATION IS COMPLETE, AND FOR A FINAL MAINTENANCE INSPECTION AT THE END OF THE MAINTENANCE PERIOD.

DIGALERT
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TOLL FREE
TWO WORKING DAYS BEFORE YOU DIG
1-800-227-2600
A PUBLIC SERVICE BY UNDERGROUND SERVICE ALERT

Vicinity Map

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia, California 92870
Ph: 714.986-2400
Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT
TIMOTHY A. HUNTER
12/31/2025
STATE OF CALIFORNIA

Project

1M Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

Cover Sheet

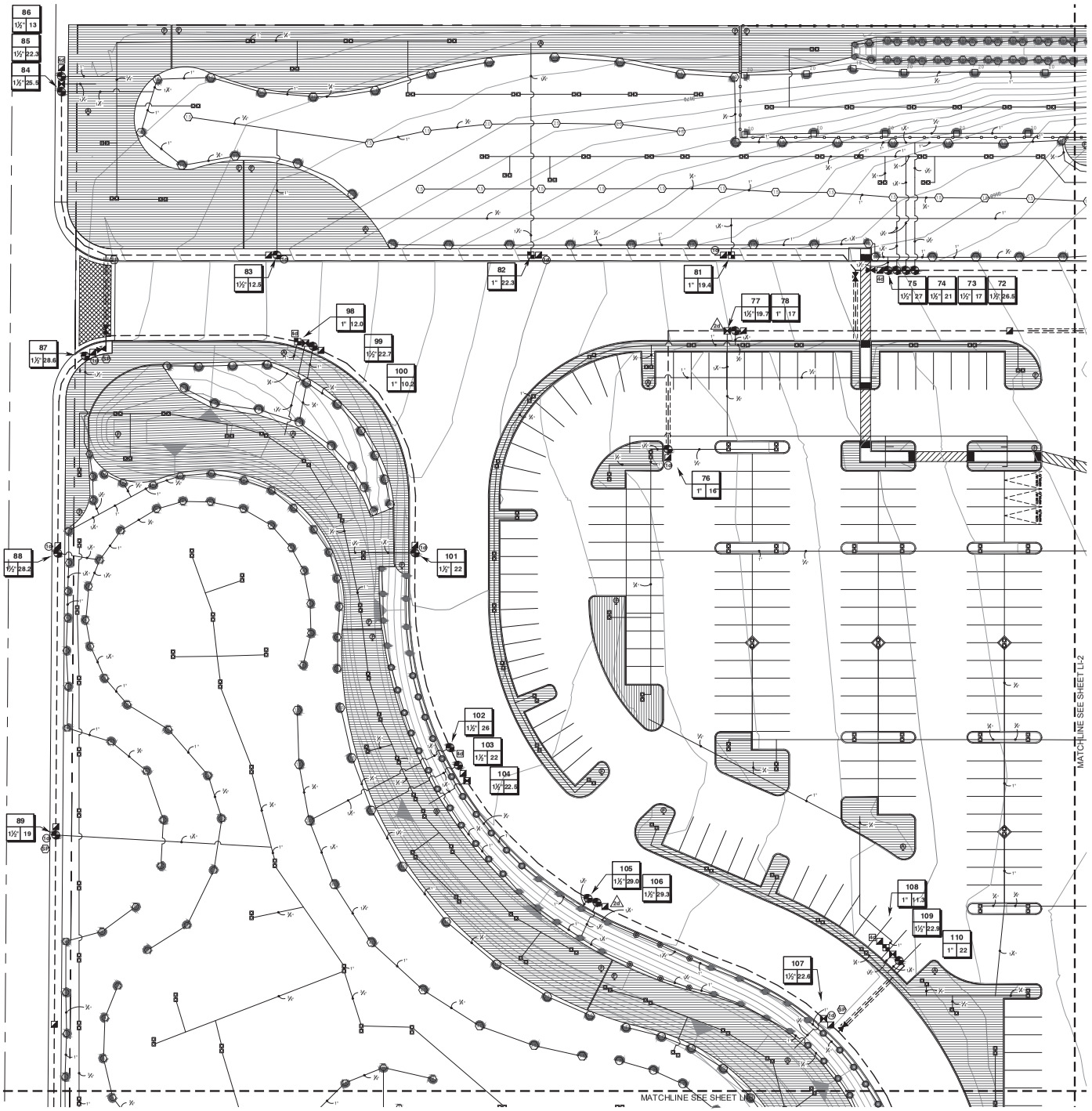
Scale

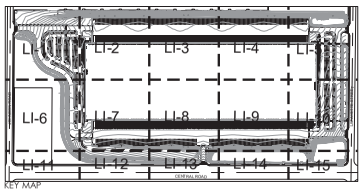
Date 03/07/2023

Drawn by TH

Job Number 22-101

Sheet No L-T





HUNTER LANDSCAPE

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Placentia, California 92870
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REGISTERED LANDSCAPE ARCHITECT — 1/31/2025 — STATE OF CALIFORNIA

Project

1M Warehouse

Central Rd & Lafayette St
Apple Valley, California

AP Investors Group

9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

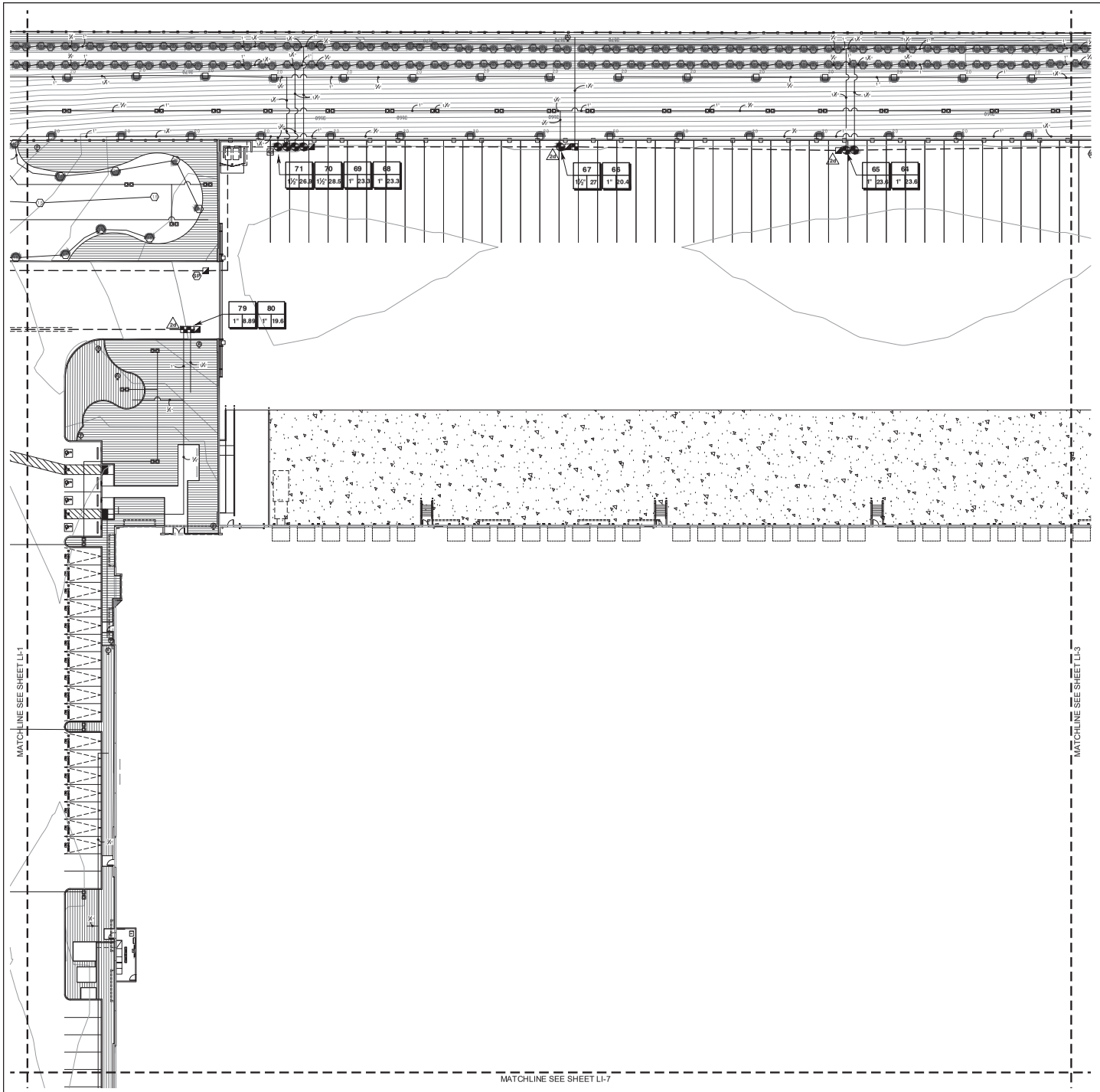
Revisions

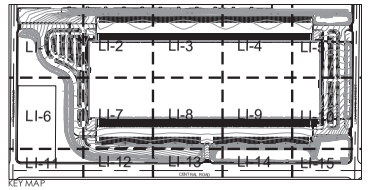
Date	Remarks

Sheet Title

Irrigation Plan

Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-1





HUNTER LANDSCAPE

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Placentia, California 92870
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Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT
TIMOTHY A. HUNTER
1/31/2026
STATE OF CALIFORNIA

Project

1M
Warehouse

Central Rd & Lafayette St
Apple Valley, California

AP Investors
Group

9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

Irrigation Plan

N

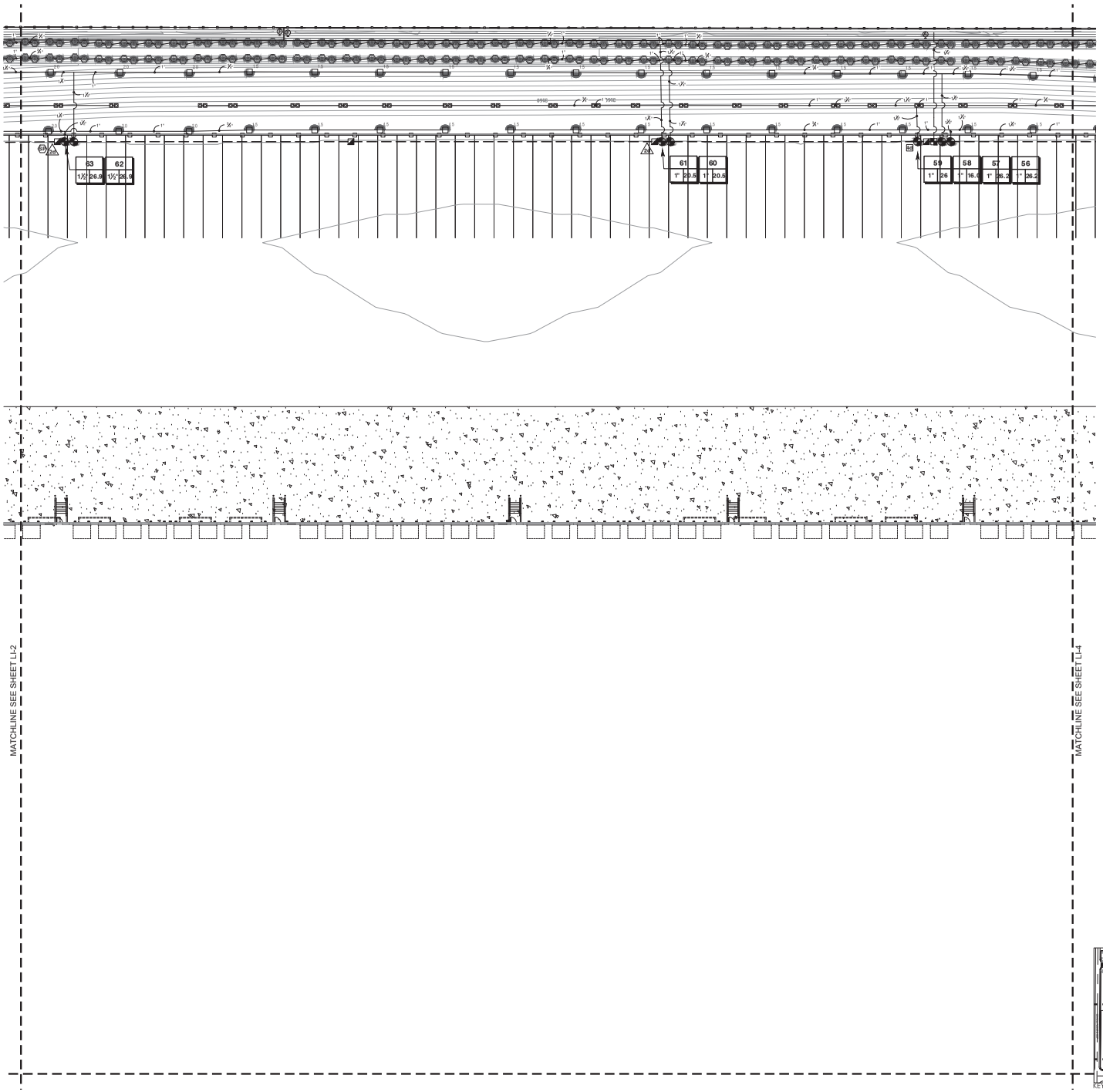
Scale 1" = 20'

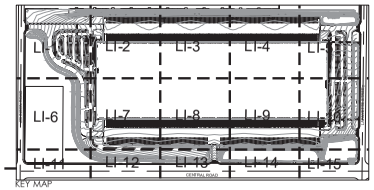
Date 03/07/2023

Drawn by TH

Job Number 22-101

Sheet No LI-2





KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
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REGISTERED LANDSCAPE ARCHITECT
1/31/2026
STATE OF CALIFORNIA

Project

1M
Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors
Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

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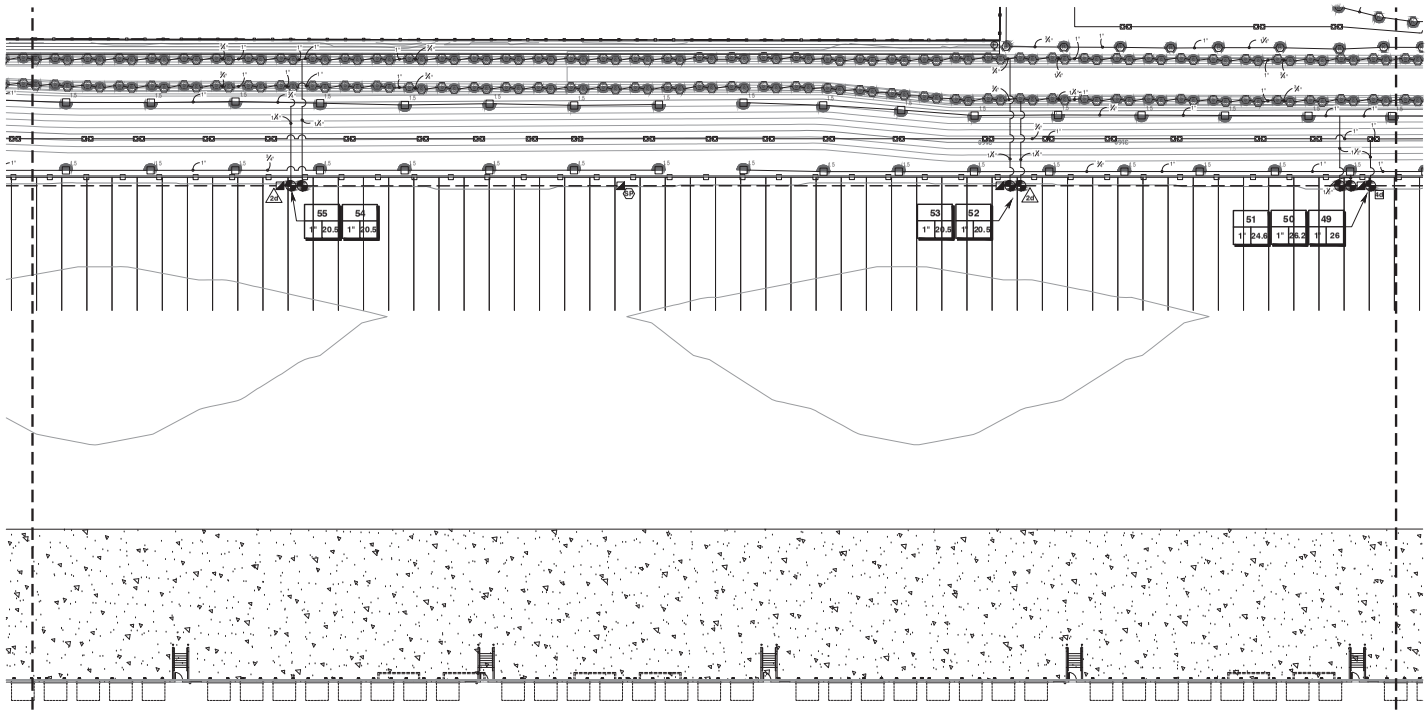
N

Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-3



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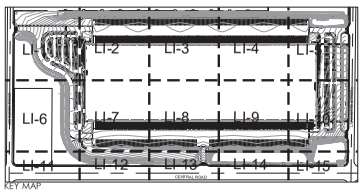
MATCHLINE SEE SHEET LI-5



KEY MAP

HUNTER LANDSCAPE

711 S. Fee Ana Street
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REGISTERED LANDSCAPE ARCHITECT
TIMOTHY A. HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

1M
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AP Investors
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9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

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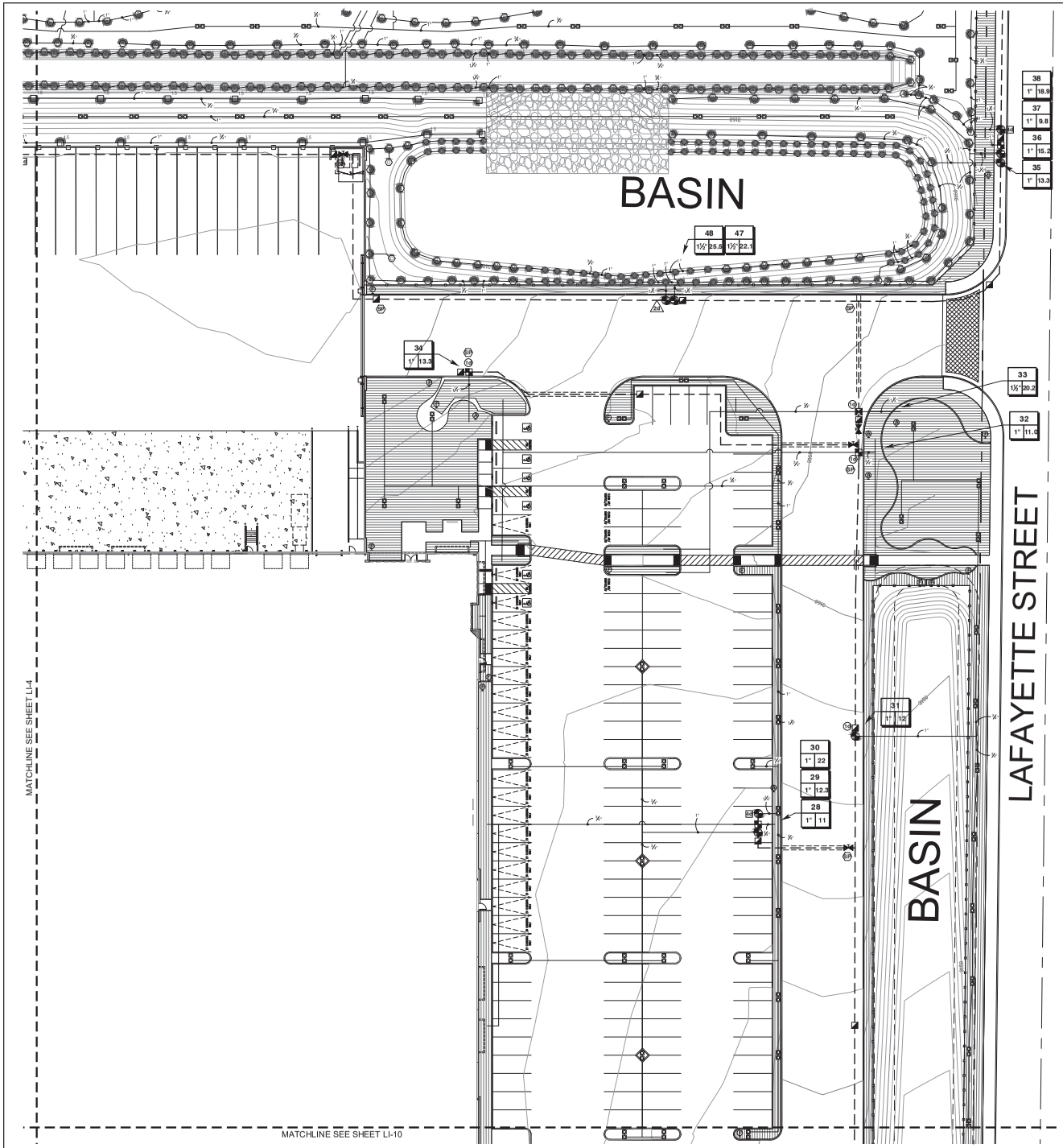
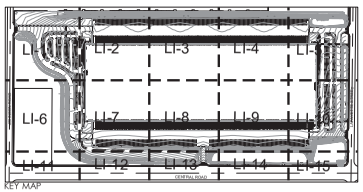
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-4





KEY MAP

HUNTER LANDSCAPE
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Placentia, California 92870
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Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT — 1/31/2025 — STATE OF CALIFORNIA

Project

1M Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

Irrigation Plan

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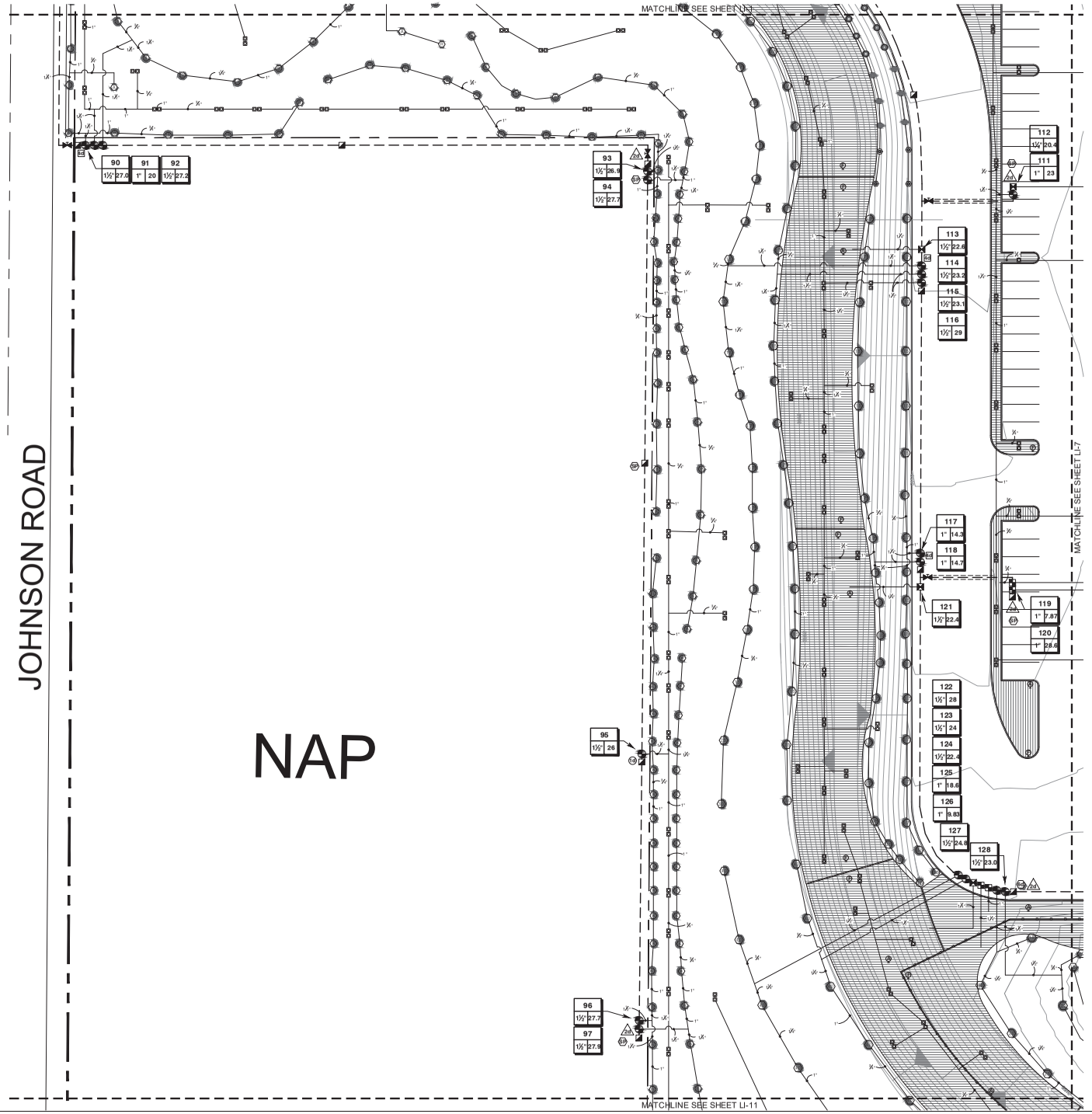
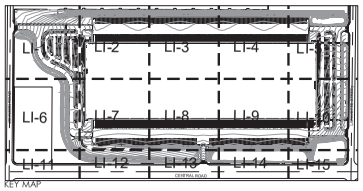
Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-5





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Ph: 714.986-2400
Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT
1/31/2025
STATE OF CALIFORNIA

Project

1M Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

Irrigation Plan

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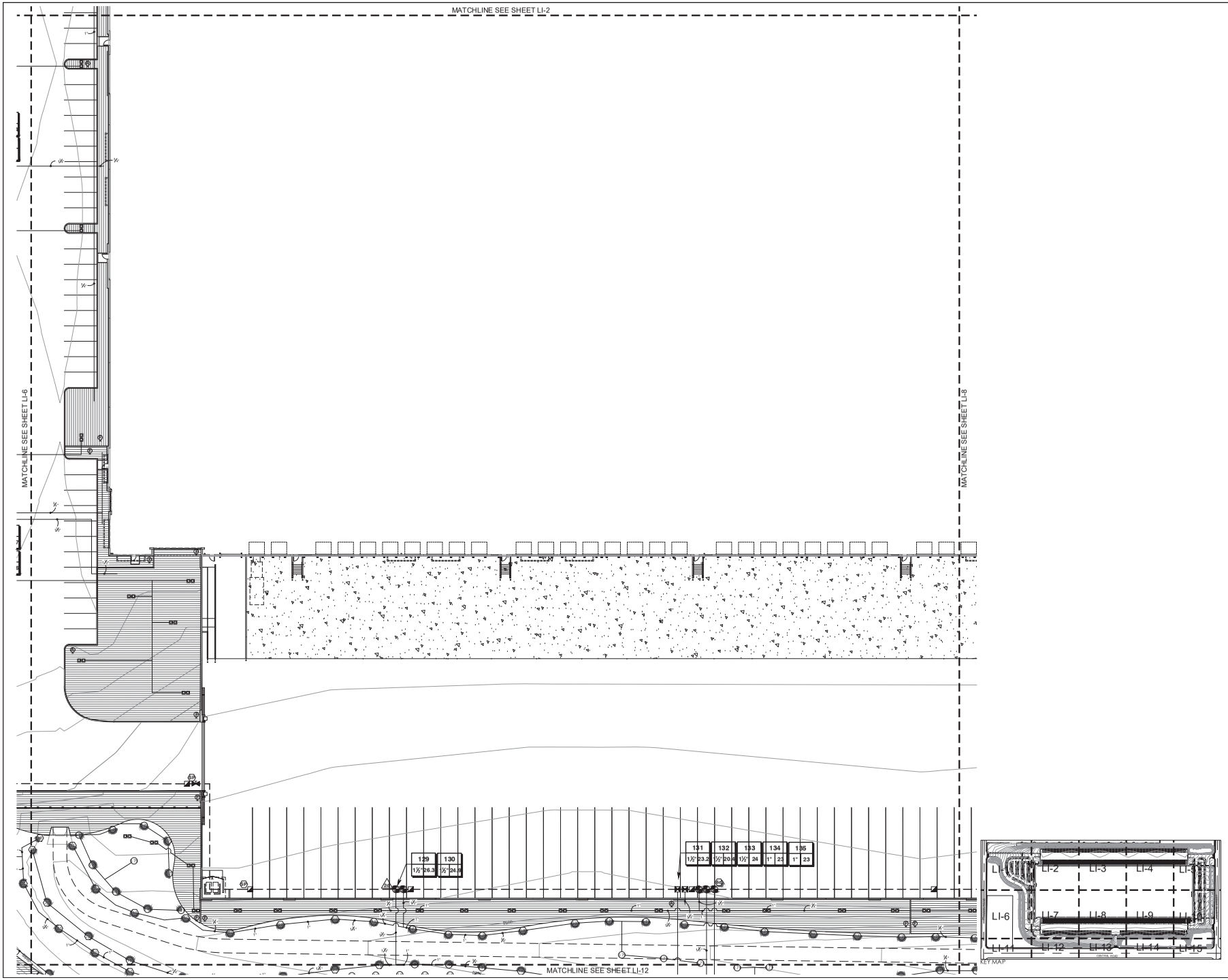
Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-6



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REGISTERED LANDSCAPE ARCHITECT
TIMOTHY J. HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

1M
Warehouse

Central Rd & Lafayette St
Apple Valley, California

AP Investors
Group

9220 Winnetka Avenue
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Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

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Date	03/07/2023
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Job Number	22-101
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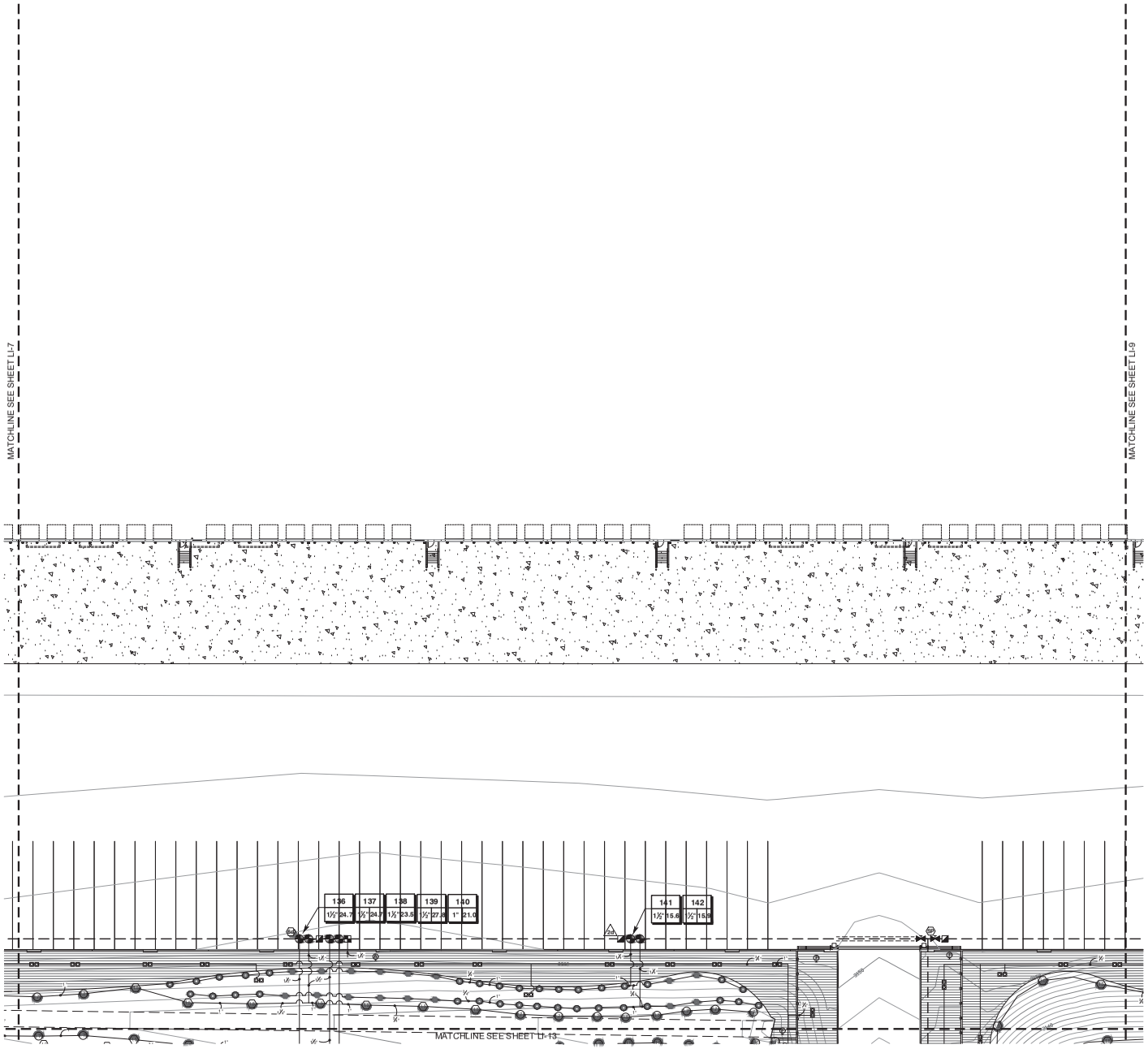

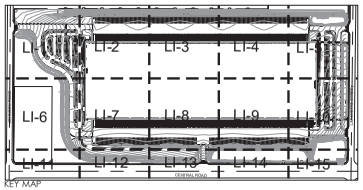

KEY MAP

HUNTER LANDSCAPE
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Placentia, California 92870
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1/31/2025

Project

1M
Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors
Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

Irrigation Plan

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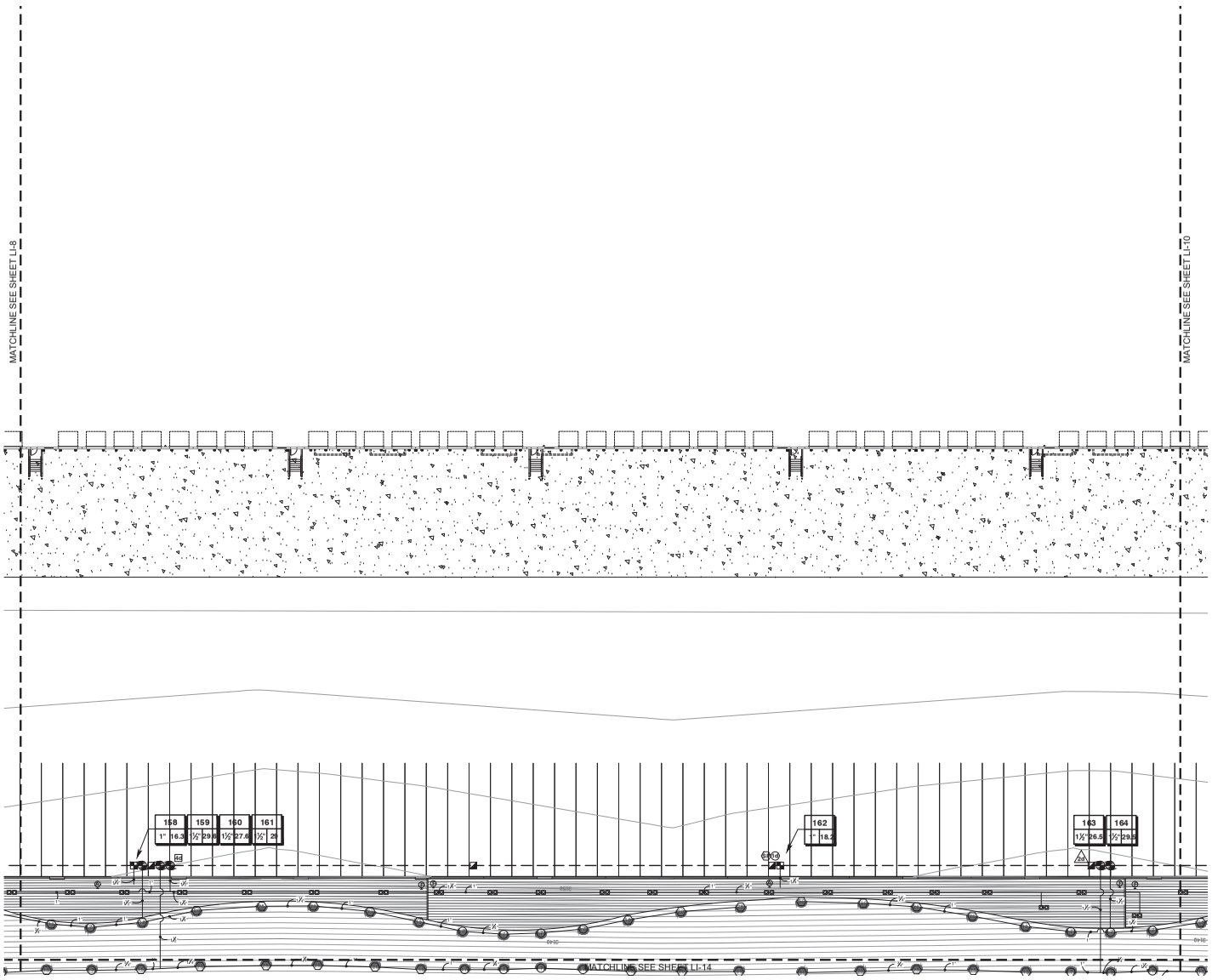
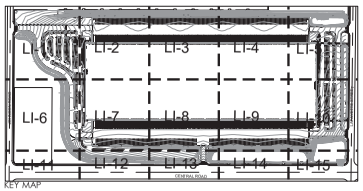
Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LI-8





HUNTER LANDSCAPE

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REGISTERED LANDSCAPE ARCHITECT
TIMOTHY M. HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

1M
Warehouse

Central Rd & Lafayette St
Apple Valley, California

AP Investors
Group

9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

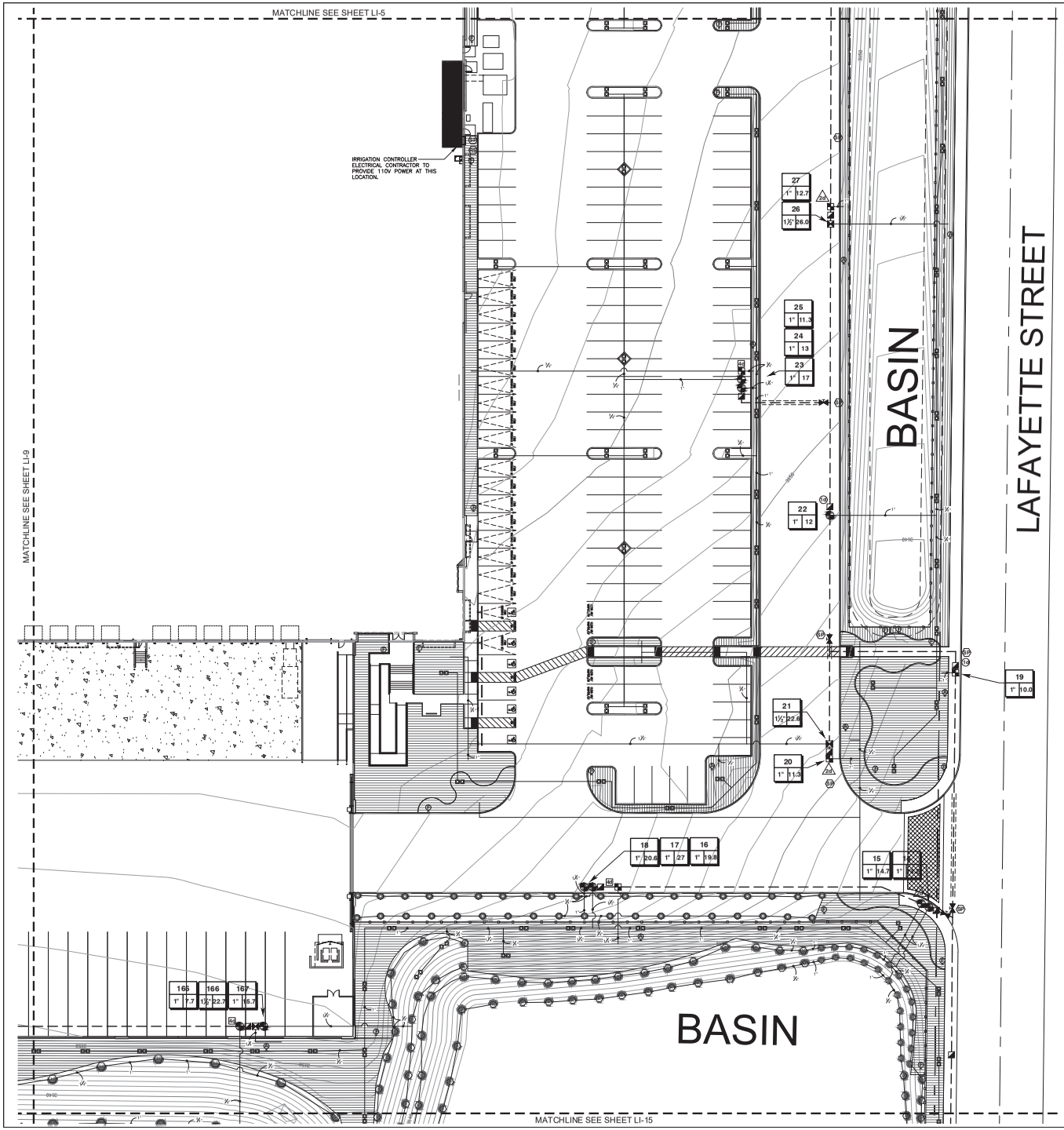
	Date	Remarks

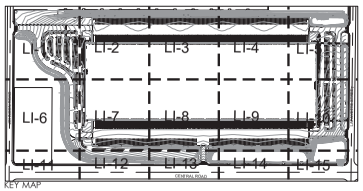
Sheet Title

Irrigation Plan

N

Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-9





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Fax: 714.986-2408

Project

1M Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

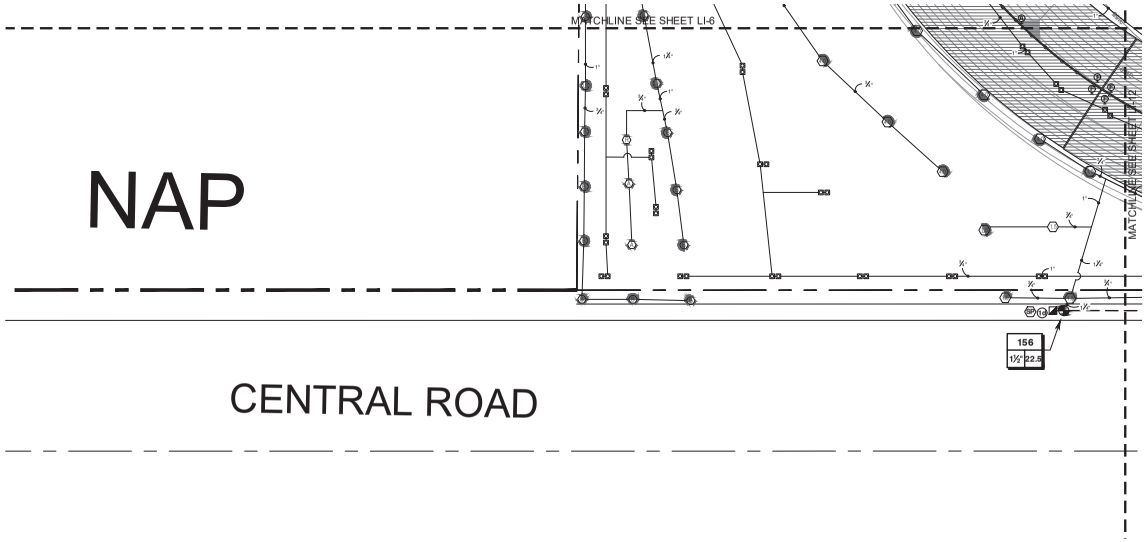
Revisions

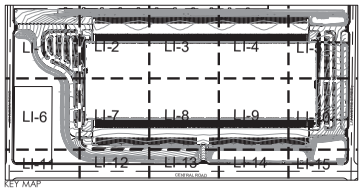
	Date	Remarks

Sheet Title

Irrigation Plan

Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-10





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Placentia, California 92870
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Project
1M Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

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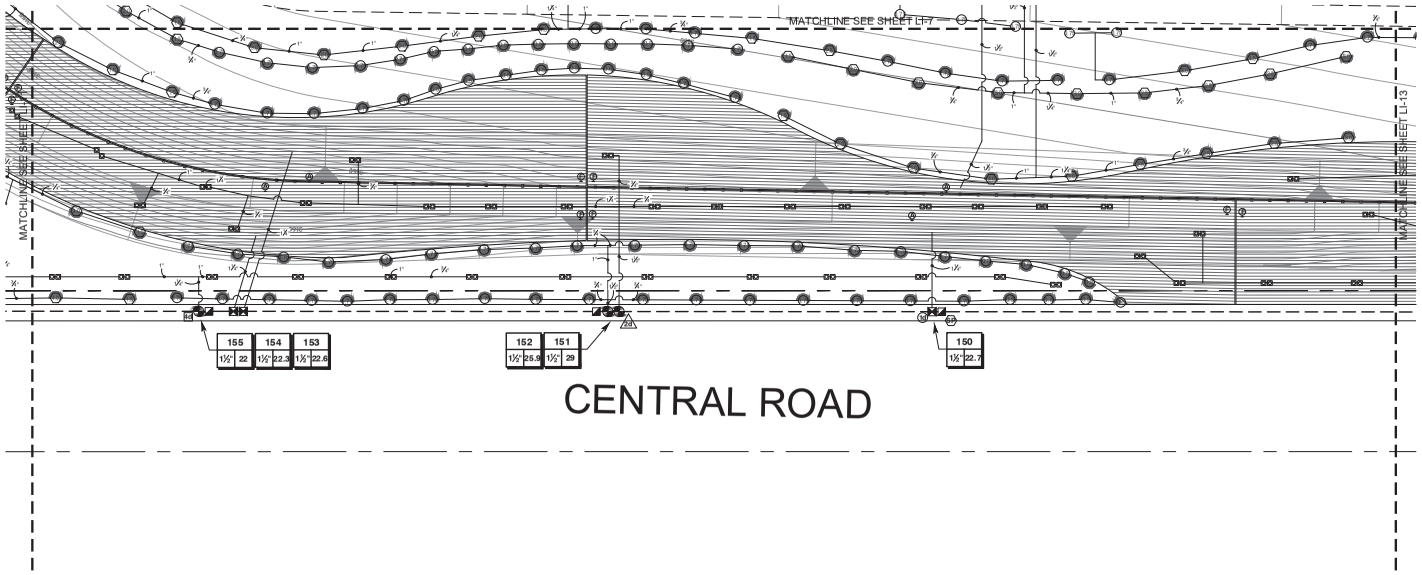
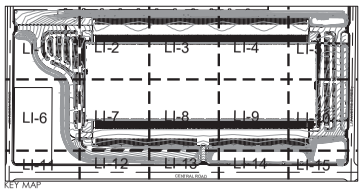
Revisions

	Date	Remarks

Sheet Title
Irrigation Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LI-11





HUNTER LANDSCAPE

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REGISTERED LANDSCAPE ARCHITECT
1/31/2025
RENEWAL
STATE OF CALIFORNIA

Project

1M
Warehouse

Central Rd & Lafayette St
Apple Valley, California

AP Investors
Group

9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

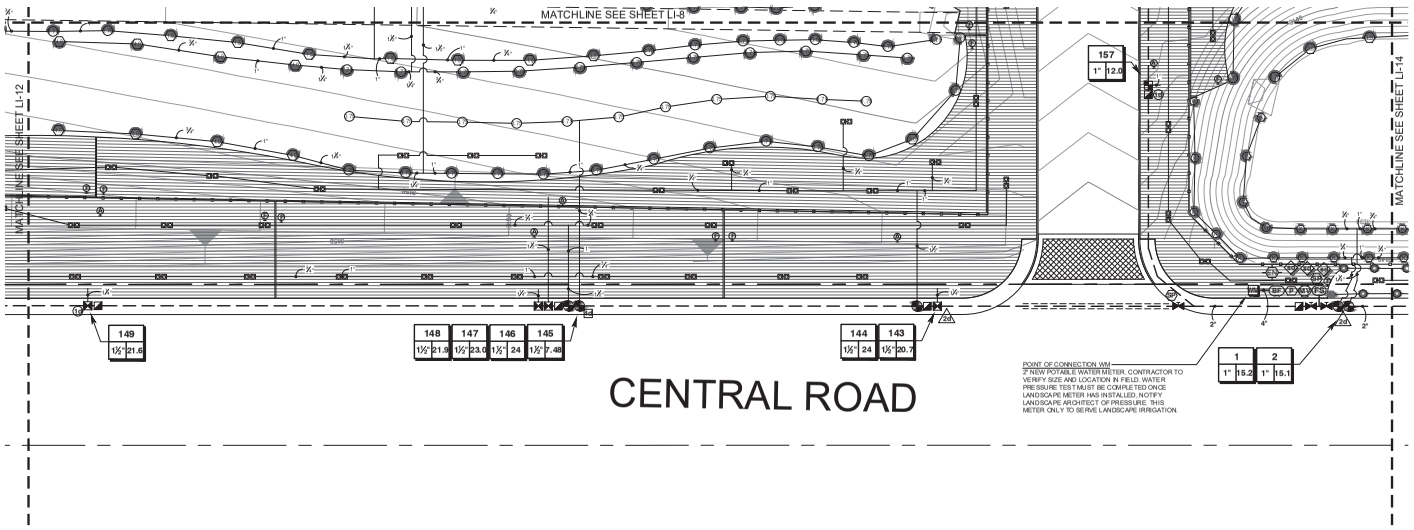
	Date	Remarks
1		

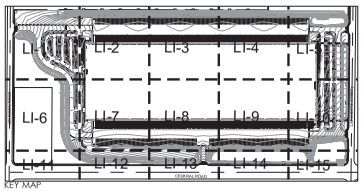
Sheet Title

Irrigation Plan

N

Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-12





HUNTER LANDSCAPE
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REGISTERED LANDSCAPE ARCHITECT
TIMOTHY A. HUNTER
12/31/2025
STATE OF CALIFORNIA

Project

1M
Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors
Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

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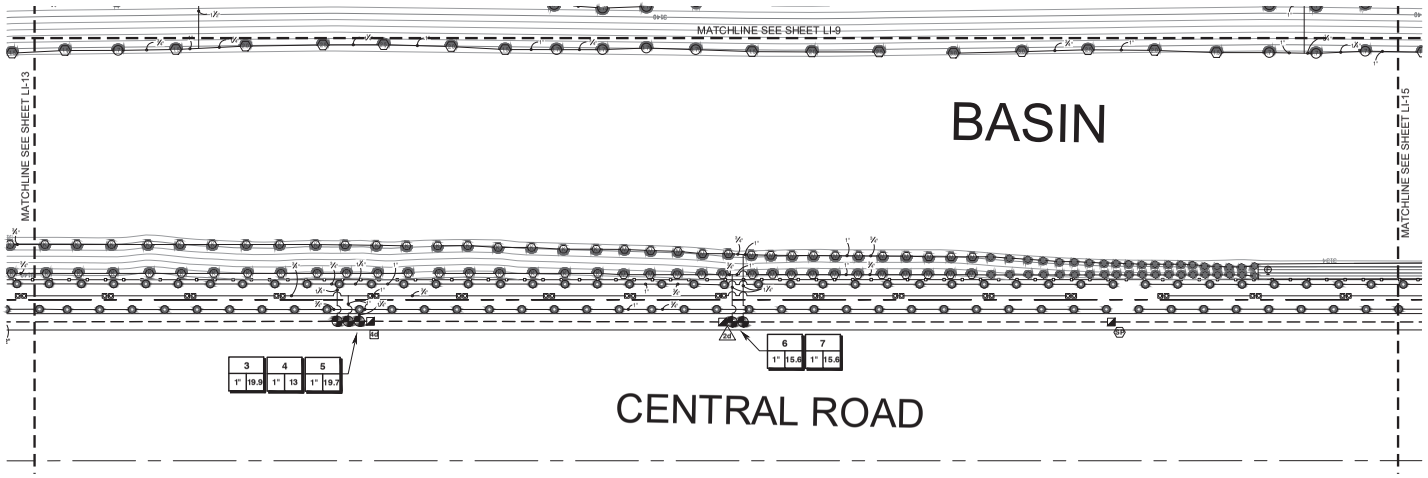
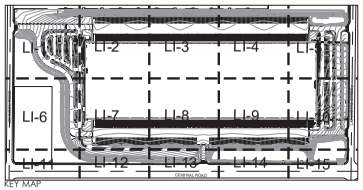
Sheet Title

Irrigation Plan

N

Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-13





HUNTER LANDSCAPE

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1/31/2026

Project

1M Warehouse

Central Rd & Lafayette St
Apple Valley, California

AP Investors Group

9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

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Sheet Title

Irrigation Plan

Scale	1" = 20'
Date	03/07/2023
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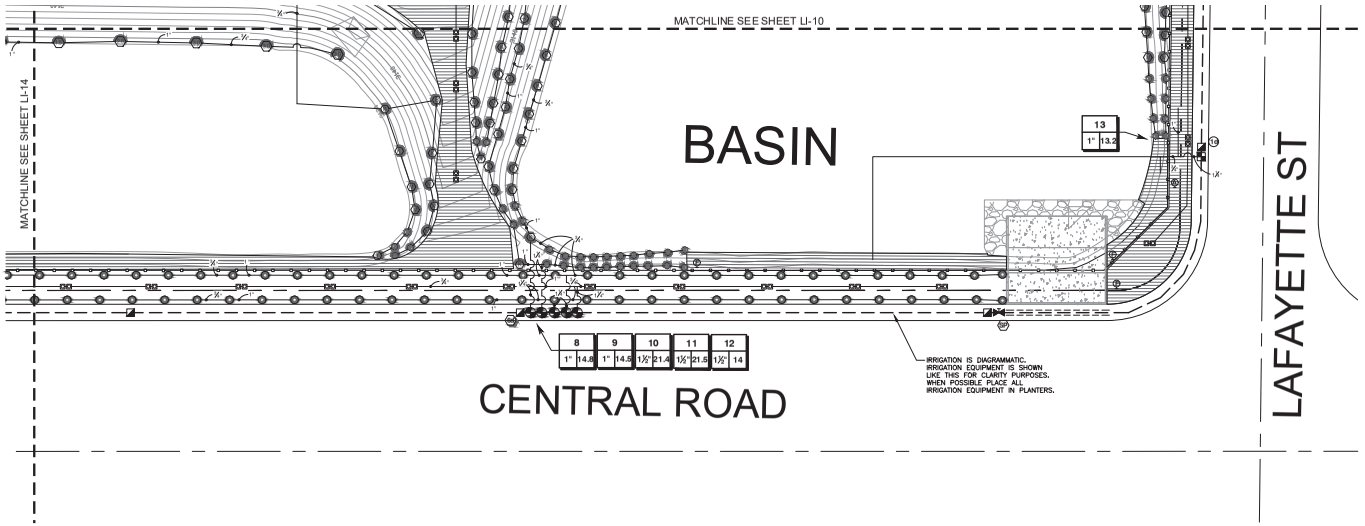
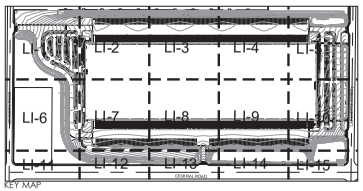
Job Number	22-101
Sheet No	LI-14





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REGISTERED LANDSCAPE ARCHITECT
1/31/2026
STATE OF CALIFORNIA

Project
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Apple Valley, California

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9220 Winnetka Avenue
Chatsworth, CA 91311

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Revisions

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1		

Sheet Title
Irrigation Plan

N

Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LI-15

IRRIGATION SCHEDULE

SYMBOL	MANUFACTURER/MODEL/DESCRIPTION	QTY	PSI
	Hunter MP Corner PROS-12-PRS30-CV Shrub Rotator, 12in. pop-up with factory installed check valve, pressure regulated to 30 psi, MP Rotator nozzle. T=Turquoise adj arc 45-105 on PRS30 body.	5	30
LSR LSST LSRT	Hunter MP Strip PROS-12-PRS30-CV Shrub Rotator, 12in. pop-up with factory installed check valve, pressure regulated to 30 psi, MP Rotator nozzle on PRS30 body. LST = Ivory left strip, SST = Brown side strip, RST = Copper right strip.	672	30
	Hunter MP1000 PROS-12-PRS30-CV Shrub Rotator, 12in. pop-up with check valve, pressure regulated to 30 psi, MP Rotator nozzle on PRS30 body. M=Maroon adj arc 90 to 210, L=Light Blue 210 to 270 arc, O=Olive 360 arc.	107	30
	Hunter MP2000 PROS-12-PRS30-CV Shrub Rotator, 12in. pop-up with factory installed check valve, pressure regulated to 30 psi, MP Rotator nozzle on PRS30 body. K=Black adj arc 90-210, G=Green adj arc 210-270, R=Red 360 arc.	219	30
	Hunter MP3000 PROS-12-PRS30-CV Shrub Rotator, 12in. pop-up with factory installed check valve, pressure regulated to 30 psi, MP Rotator nozzle on PRS30 body. B=Blue adj arc 90-210, Y=Yellow adj arc 210-270, A=Gray 360 arc.	160	30
	Hunter MP3500 PROS-12-PRS30-CV Shrub Rotator, 12in. pop-up with factory installed check valve, pressure regulated to 30 psi, MP Rotator nozzle on PRS30 body. LB=light brown adjustable arc, 90-210.	22	30
8045A 8180	Hunter MP800SR PROS-12-PRS30-CV Shrub Rotator, 12in. pop-up with check valve, pressure regulated to 30 psi, MP Rotator nozzle on PRS30 body. ADJ=Orange and Gray (arc 90-210), 360=Lime Green and Gray (arc 360)	196	30
R-VAN14 R-VAN14-360	Rain Bird R-VAN14 1812-SAM-PRS Shrub Rotary, 8 - 14' 45-270 degrees and 360 degrees. Hand Adjustable Multi-Stream Rotary w/1800 shrub spray body on 12.0" pop-up, with check valve and 30 psi in-stem pressure regulator. 1/2" NPT Female Threaded Inlet.	257	30
R-VAN18 R-VAN18-360	Rain Bird R-VAN18 1812-SAM-PRS Shrub Rotary, 13 - 18' 45-270 degrees and 360 degrees. Hand Adjustable Multi-Stream Rotary w/1800 shrub spray body on 12.0" pop-up, with check valve and 30 psi in-stem pressure regulator. 1/2" NPT Female Threaded Inlet.	49	30
R-VAN24 R-VAN24-360	Rain Bird R-VAN24 1812-SAM-PRS Shrub Rotary, 17 - 24' 45-270 degrees and 360 degrees. Hand Adjustable Multi-Stream Rotary w/1800 shrub spray body on 12.0" pop-up, with check valve and 30 psi in-stem pressure regulator. 1/2" NPT Female Threaded Inlet.	10	30
SST	Hunter MSBN Bubbler Hunter Multi-Stream Bubbler, 50=0.5gpm nozzle with Rain Bird 1804-SAM-PRS 4" pop-up with factory installed drain check valve and 30 PSI regulating body.	1,256	30

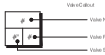
SYMBOL	MANUFACTURER/MODEL/DESCRIPTION	QTY	PSI
	Hunter I-20-12-PRB 1.5 Shrub Rotor, 12in. Pop-Up. Adjustable and Full Circle. Plastic Riser. Drain Check Valve. Standard Nozzle.	122	45
	Hunter I-20-13-PRB 2.0 Shrub Rotor, 12in. Pop-Up. Adjustable and Full Circle. Plastic Riser. Drain Check Valve. Standard Nozzle.	36	45
	Hunter I-20-12-PRB 2.5 Shrub Rotor, 12in. Pop-Up. Adjustable and Full Circle. Plastic Riser. Drain Check Valve. Standard Nozzle.	26	45
	Hunter I-20-12-PRB 3.0 Shrub Rotor, 12in. Pop-Up. Adjustable and Full Circle. Plastic Riser. Drain Check Valve. Standard Nozzle.	34	45
	Hunter I-20-12-PRB 4.0 Shrub Rotor, 12in. Pop-Up. Adjustable and Full Circle. Plastic Riser. Drain Check Valve. Standard Nozzle.	32	45
	Hunter I-20-12-PRB-SR 0.5 Shrub Rotor, 12in. Pop-Up. Adjustable and Full Circle. Plastic Riser. Drain Check Valve. Short Radius Nozzle.	45	40
	Hunter I-20-12-PRB-SR 0.75 Shrub Rotor, 12in. Pop-Up. Adjustable and Full Circle. Plastic Riser. Drain Check Valve. Short Radius Nozzle.	211	40
1.5	Rain Bird 5012-PL-PC-SAM-R 1.5 Shrub Rotor, 12in. Pop-Up with Plastic Riser. Adjustable to Full Circle. Standard Angle Nozzle, In-Stem Pressure Regulator, and Flow Shut-Off Device With Seal-A-Matic Check Valve.	76	45
2.0	Rain Bird 5012-PL-PC-SAM-R 2.0 Shrub Rotor, 12in. Pop-Up with Plastic Riser. Adjustable to Full Circle. Standard Angle Nozzle, In-Stem Pressure Regulator, and Flow Shut-Off Device With Seal-A-Matic Check Valve.	46	45

SYMBOL	MANUFACTURER/MODEL/DESCRIPTION	QTY
	Rain Bird XCZ-100-PRB-LC Wide Flow Drip Control Kit, for Light Commercial Uses. 1" PEB Valve, with 1" Pressure Regulating 40psi Basket Filter. 0.3-20 GPM.	26
	Rain Bird XCZ-150-LCS High Flow Control Zone Kit, for Large Commercial Drip Zones. 1-1/2" PEB Globe Valve with single 1-1/2" Pressure Regulating 40psi Quick-Check Basket Filter. Flow range: 15-62 GPM.	23
	GPH Irrigation GDFN Combination Drip Flush Valve Install GPH Irrigation GDFN Combination Drip Flush Valve Nozzle with Rain Bird 1812 pop up sprinkler body. This nozzle serves as flush valve and also as visual drip indicator. See detail for more information.	109
	Rain Bird AIRV050 1/2" Air Relief Valve, made of quality rust-proof materials, with a 6" drip valve box (SEB 7XB emitter box). Use with installation below soil. The valve will allow air to escape the pipeline, thus preventing water hammer or blockage.	50
	Area to Receive Dripline Rain Bird XFS-CV 06 18 (Low Water Use) XFS-CV Sub-Surface and On-Surface Landscape Dripline with a Heavy-Duty 4.3 psi Check Valve. 0.6 GPH emitters at 18" O.C. Dripline laterals spaced at 24" apart, with emitters offset for triangular pattern. Specify XF insert fittings.	248,216 s.f.

SYMBOL	MANUFACTURER/MODEL/DESCRIPTION	QTY
	Rain Bird PEB Plastic Industrial Valves. Low Flow Operating Capability, Globe Configuration.	118
	Hunter HQ-33DRC Quick coupler valve, yellow rubber cover, red brass and stainless steel, with 3/4" NPT inlet, 2-piece body.	93
	Nibco T-113 Class 125 bronze gate shut off valve with wheel handle, same size as mainline pipe diameter at valve location. Size Range - 1/4" - 3"	24
MV	Buckner-Superior 3200 3" Normally Closed Brass Master Valve that Provides Dirty Water Protection and No Minimum Flow Feature, which ensures reliable opening and closing of the valve in extreme high or low flow scenarios. Available in 3/4in.,1in.,1-1/2in.,2in.,2-1/2in. and 3in..	1
BF	Febco LF825Y 2" Lead Free Reduced Pressure Backflow Preventer	1
C	Rain Bird ESP-LXD-LXMMSS Install in LXMMSS-LXMMSSPED Stainless Steel Enclosure. Flow sensing. Two-Wire Decoder Commercial Controller. 125 Stations. Electrical power to be provided by others. Include a IQ Communication Cartridge model# IQ3GUSA and a 1 year IQ service plan. Please use Part Number C01401 when ordering for the Rain Bird Network Communication Connection (NCC) one year 3G Cellular Service for IQ Cloud. Contractor to Coordinate with Rain Bird GSP (1-866-GSP-XPRT) and Property Manager on annual Cellular Contract transfer between Landscape Maintenance contractors after contract service is completed.	1

1.0	Rain Bird FD-101TURF Field Decoder for Two-Wire system. Install in valve box for valve. Operates one valve/solenoid. Use line surge protection as per manufacturer`s directions.	23
2.0	Rain Bird FD-202TURF Field Decoder for Two-Wire system. Install in valve box for valve. Operates two valve/solenoids or two pairs of valves. Use line surge protection as per manufacturer`s directions.	26
4.0	Rain Bird FD-401TURF Field Decoder for Two-Wire system. Install in valve box for valve. Operates up to four valve/solenoids. Use line surge protection as per manufacturer`s directions.	20
6.0	Rain Bird FD-601TURF Field Decoder for Two-Wire system. Install in valve box for valve. Operates up to six valve/solenoids. Use line surge protection as per manufacturer`s directions.	5
SP	Rain Bird LSP-1TURF Line surge protection decoder directly to the ground rod or ground plate	36
SD	Rain Bird SD-210TURF Sensor Decoder interfacing signal line and analog or digital decoders.	3
WR	Rain Bird WR2-RC Wireless Rain Sensor Combo, includes 1 receiver and 1 rain sensor transmitter.	1
FS	Creative Sensor Technology FSI-720-001 2in. PVC tee type flow sensor w/socket ends, custom mounting tee and ultra-lightweight impeller enhances low flow measurement. 2 wire digital output compatible w/all irrigation controllers. Flow range 2.8 GPM - 170 GPM.	1
P	Rain Bird CLP07HAC6-HL Rain Bird CLP07HAC6-HL Booster Pump Assembly. 7.5 HP suction boost model. Up to 53 psi and 120 gpm. With Variable Frequency Drive (VFD), pump start relay, aluminum Deck and Enclosure. Stainless steel piping, isolation valve for maintenance and priming, and manual switch. VFD pump automatically adjusts flow and pressure according to system demand. Include three phase 480V AC incoming power to pump.	1
EN	All Spec VB 4230 All Spec Vandal Buster backflow metal enclosure; Model # VB-4230. Foliage Green Color. Install locks on all backflow enclosures.	1
WM	Water Meter 2" 2" New Potable Water Meter -to be used exclusively for landscape irrigation.	1
	Irrigation Lateral Line: PVC Schedule 40 PVC Schedule 40 irrigation pipe. Only lateral transition pipe sizes 1" and above are indicated on the plan, with all others being 3/4" in size.	63,249 l.f.
	Irrigation Mainline: PVC Schedule 40 2" and smaller use PVC Schedule 40 irrigation pipe. 2-1/2" and larger use PVC Class 315 irrigation pipe.	12,269 l.f.
	Pipe Sleeve: PVC Schedule 40 Sleeving to be 2 times larger than pipe being sleeved.	613.5 l.f.

Valve Detail



CRITICAL ANALYSIS

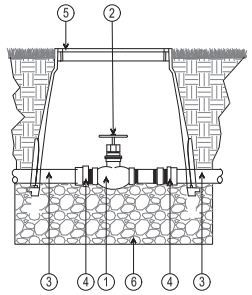
Generated:	2023-03-06 14:59
P.O.C. NUMBER 01	
Water Source Information:	2" New Potable Water Meter
-to be used exclusively for landscape irrigation	
FLOW AVAILABLE	
Water Meter Size:	2"
Flow Available:	70.58 GPM
PRESSURE AVAILABLE	
Static Pressure at POC:	84 PSI
Elevation Change:	5.00 ft
Service Line Size:	2"
Length of Service Line:	20 ft
Booster Pump pressure provided:	53 PSI
Pressure Available:	133 PSI
DESIGN ANALYSIS	
Maximum Multi-valve Flow:	50 GPM
Flow Available at POC:	70.55 GPM
Residual Flow Available:	20.55 GPM
Critical Station:	81
Design Pressure:	40 PSI
Friction Loss:	11.7 PSI
Fittings Loss:	1.17 PSI
Elevation Loss:	0 PSI
Lose through Valve:	24.0 PSI
Pressure Req. at Critical Station:	76.8 PSI
Loss for Fittings:	2.12 PSI
Loss for Main Line:	21.2 PSI
Loss for POC to Valve Elevation:	0 PSI
Loss for Backflow:	12.0 PSI
Loss for Master Valve:	2.38 PSI
Loss for Water Meter:	1.9 PSI
Critical Station Pressure at POC:	116.5 PSI
Pressure Available:	133 PSI
Residual Pressure Available:	16.5 PSI

PLEASE NOTE:

- LANDSCAPE CONTRACTOR MUST SUBMIT MATERIAL SUBMITTALS OF COMPLETE PROJECT PRIOR TO CONSTRUCTION.
- LANDSCAPE CONTRACTOR IS REQUIRED TO HAVE A MAINLINE PRESSURE SYSTEM TEST WHILE LANDSCAPE ARCHITECT IS PRESENT. IRRIGATION PIPE TRENCHES MUST BE OPEN WHILE PRESSURE SYSTEM TEST IS BEING PERFORMED. PRESSURE TO BE 150 PSI IN MAINLINE WHILE TEST IS BEING PREFORMED.
- LANDSCAPE ARCHITECT MUST BE INFORMED OF ANY REQUESTED ONSITE PRESENCE WITH A 2 BUSINESS DAY ANTICIPATION.
- LANDSCAPE CONTRACTOR TO PROVIDE PRINTED IRRIGATION SCHEDULES FOR POST-ESTABLISHMENT FROM SERVER BASED LANDSCAPE AND RUN TIME REPORTS BEFORE CALLING FOR A SUBSTANTIAL PUNCH LIST. PROVIDE SCHEDULES TO LANDSCAPE ARCHITECT BEFORE NOTIFICATION WALK.
- VERIFY ALL MAINLINE POINTS OF CONNECTION.
- ALL SPRINKLER HEADS TO BE LOCATED 24" FROM PAVING. ALL SPRINKLERS INCLUDING ROTORS, ROTARIES, AND BUBBLERS TO BE PRESSURE COMPENSATING. THIS NOTE SUPERCEDES ANY OTHER LEGEND OR NOTE.
- IT IS LANDSCAPE CONTRACTORS RESPONSIBILITY TO PROVIDE COMPLETE PROJECT WITH A WELL FUNCTIONING AND EFFICIENT PER LATEST BUILDING STANDARDS,CITY, AND WATER DEPARTMENT REQUIREMENTS.
- IF THERE IS A DISCREPANCY BETWEEN CITY APPROVED LANDSCAPE PLANS AND LANDSCAPE ORDINANCES A RFI MUST BE SUBMITTED TO LANDSCAPE ARCHITECT.
- NOTE: PRIOR TO FINAL SIGN OFF A NEATLY DRAWN LAMINATED IRRIGATION LAYOUT CHART FOR AUTOMATIC CONTROLLERS SHALL BE PROVIDED.
- CONTROLLER AND WEATHER SENSOR SHALL BE CONNECTED AND OPERATING PRIOR TO FINAL INSPECTION.
- AN IRRIGATION AUDIT REPORT BY A THIRD PARTY IRRIGATION ASSOCIATION CERTIFIED LANDSCAPE IRRIGATION AUDITOR SHALL BE PROVIDED PRIOR TO CITY LANDSCAPE INSPECTION. REPORT TO BE DONE PER LATEST IRRIGATION ASSOCIATION GUIDELINES, WHICH INCLUDES BUT NOT LIMITED TO CATCH CAN TESTS OF ALL SPRINKLER AREAS.
- IT IS LANDSCAPE CONTRACTORS RESPONSIBILITY TO CONTACT ALL REQUIRED PROJECT INSPECTORS AND OBTAIN SIGN OFF OF PROJECT.
- ALL IRRIGATION EQUIPMENT MUST BE INSTALLED WITH PRESSURE REGULATING DEVICES. THIS SUPERCEDES IRRIGATION LEGEND, NOTES, AND DETAILS.

VALVE SCHEDULE

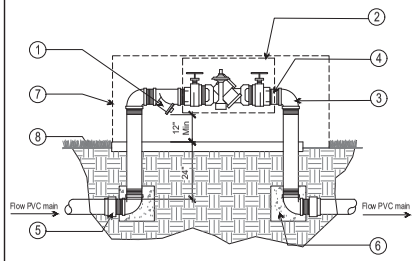
NUMBER	MODEL	SIZE	TYPE	GPM	FRICTION LOSS	PSI @ POC	PRECIP
1	Rain Bird PEB	1"	Shrub Rotary	15.2	4.09	53.6	0.27 in/h
2	Rain Bird PEB	1"	Shrub Rotary	15.09	4.2	53.8	0.26 in/h
3	Rain Bird PEB	1"	Shrub Rotary	19.89	8.39	61.1	0.33 in/h
4	Rain Bird PEB	1"	Bubbler	13	7.77	59.8	30.64 in/h
5	Rain Bird PEB	1"	Shrub Rotary	19.71	7.85	60.7	0.33 in/h
6	Rain Bird PEB	1"	Shrub Rotary	15.6	5.69	60.7	0.38 in/h
7	Rain Bird PEB	1"	Shrub Rotary	15.6	5.7	60.8	0.37 in/h
8	Rain Bird PEB	1"	Shrub Rotary	14.79	4.77	66.5	0.31 in/h
9	Rain Bird PEB	1"	Shrub Rotary	14.53	5.39	67.1	0.32 in/h
10	Rain Bird PEB	1-1/2"	Shrub Rotary	21.37	8.04	71.4	0.33 in/h
11	Rain Bird PEB	1-1/2"	Shrub Rotary	21.48	8.47	71.9	0.33 in/h
12	Rain Bird PEB	1-1/2"	Bubbler	14	7.95	71.5	30.64 in/h
13	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	13.17	1.7	87.7	0.32 in/h
14	Rain Bird PEB	1"	Shrub Rotary	14.22	4.9	71.7	0.31 in/h
15	Rain Bird PEB	1"	Shrub Rotary	14.73	4.99	71.9	0.31 in/h
16	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	19.8	0.76	102.6	0.32 in/h
17	Rain Bird PEB	1"	Bubbler	27	7.74	79.9	30.64 in/h
18	Rain Bird PEB	1"	Shrub Rotary	20.65	1.56	72.0	0.65 in/h
19	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	10.03	0.2	83.6	0.43 in/h
20	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	11.28	1.85	88.1	0.37 in/h
21	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.57	4.35	85.7	0.38 in/h
22	Rain Bird PEB	1"	Bubbler	12	6.15	74.6	30.64 in/h
23	Rain Bird PEB	1"	Bubbler	17	9.26	79.1	30.64 in/h
24	Rain Bird PEB	1"	Bubbler	13	5.64	75.1	30.64 in/h
25	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	11.3	4.29	91.7	0.49 in/h
26	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	25.95	1.21	84.5	0.43 in/h
27	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	12.65	0.29	89.9	0.43 in/h
28	Rain Bird PEB	1"	Bubbler	11	5.05	76.2	30.64 in/h
29	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	12.29	6.83	97.7	0.43 in/h
30	Rain Bird PEB	1"	Bubbler	22	9.46	82.1	30.64 in/h
31	Rain Bird PEB	1"	Bubbler	12	5.18	75.9	30.64 in/h
32	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	11.02	3.65	92.4	0.39 in/h
33	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	20.2	2.17	86.4	0.4 in/h
34	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	13.33	0.31	92.5	0.32 in/h
35	Rain Bird PEB	1"	Shrub Rotary	13.35	3.3	77.0	0.28 in/h
36	Rain Bird PEB	1"	Shrub Rotary	15.21	4.04	78.0	0.27 in/h
37	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	9.8	0.13	89.6	0.32 in/h
38	Rain Bird PEB	1"	Shrub Rotary	18.87	3.65	78.2	0.31 in/h
39	Rain Bird PEB	1"	Shrub Rotary	20.02	6.07	84.3	0.34 in/h
40	Rain Bird PEB	1"	Bubbler	15	6.68	87.6	30.64 in/h
41	Rain Bird PEB	1"	Bubbler	17	9.8	91.1	30.64 in/h
42	Rain Bird PEB	1"	Shrub Rotary	19.66	5.77	87.4	0.24 in/h
43	Rain Bird PEB	1"	Shrub Rotary	20.69	10.1	92.0	1.05 in/h
44	Rain Bird PEB	1"	Shrub Rotary	20.73	9.88	91.9	1.06 in/h
45	Rain Bird PEB	1"	Shrub Rotary	21.33	5.99	89.7	0.24 in/h
46	Rain Bird PEB	1"	Shrub Rotary	19.35	7.91	91.2	0.3 in/h
47	Rain Bird XCZ-100-PRB-LC	1-1/2"	Area for Dripline	22.06	7.2	80.5	0.38 in/h
48	Rain Bird PEB	1-1/2"	Shrub Rotary	25.53	8.68	81.9	0.41 in/h
49	Rain Bird PEB	1"	Bubbler	26	10.7	85.0	30.64 in/h
50	Rain Bird PEB	1"	Shrub Rotor	26.18	6.97	96.3	0.33 in/h
51	Rain Bird PEB	1"	Shrub Rotor	24.64	7.5	96.4	0.33 in/h
52	Rain Bird PEB	1"	Shrub Rotary	20.52	8.28	80.9	1.21 in/h
53	Rain Bird PEB	1"	Shrub Rotary	20.52	8.73	81.4	1.25 in/h
54	Rain Bird PEB	1"	Shrub Rotary	20.52	6.41	78.6	1.26 in/h
55	Rain Bird PEB	1"	Shrub Rotary	20.52	6.18	78.3	1.24 in/h
56	Rain Bird PEB	1"	Shrub Rotor	26.18	8.47	96.7	0.25 in/h
57	Rain Bird PEB	1"	Shrub Rotor	26.18	9.14	97.3	0.25 in/h
58	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	16.04	0.99	97.4	0.32 in/h
59	Rain Bird PEB	1"	Bubbler	26	10.5	83.6	30.64 in/h
60	Rain Bird PEB	1"	Shrub Rotary	20.52	6.9	78.0	1.25 in/h
61	Rain Bird PEB	1"	Shrub Rotary	20.52	6.86	78	1.25 in/h
62	Rain Bird PEB	1-1/2"	Shrub Rotor	26.86	7.05	93.1	0.3 in/h
63	Rain Bird PEB	1-1/2"	Shrub Rotor	26.86	6.41	92.5	0.3 in/h
64	Rain Bird PEB	1"	Shrub Rotary	23.56	8.29	80.1	1.26 in/h
65	Rain Bird PEB	1"	Shrub Rotary	23.56	8.47	80.3	1.26 in/h
66	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	20.36	1.56	105.0	0.32 in/h
67	Rain Bird PEB	1"	Bubbler	27	13.0	85.2	30.64 in/h
68	Rain Bird PEB	1"	Shrub Rotary	23.31	8.2	80.9	1.19 in/h
69	Rain Bird PEB	1"	Shrub Rotary	23.31	7.93	80.7	1.19 in/h
70	Rain Bird PEB	1-1/2"	Shrub Rotor	28.45	8.87	96.5	0.35 in/h
71	Rain Bird PEB	1-1/2"	Shrub Rotor	26.91	7.14	94.8	0.34 in/h
72	Rain Bird PEB	1-1/2"	Shrub Rotor	26.5	8.46	96.7	0.4 in/h
73	Rain Bird PEB	1-1/2"	Bubbler	17	7.16	80.6	30.64 in/h
74	Rain Bird PEB	1-1/2"	Shrub Rotor	21	7.67	96.1	0.16 in/h
75	Rain Bird PEB	1-1/2"	Shrub Rotor	27	7.51	95.8	0.38 in/h
76	Rain Bird PEB	1"	Bubbler	16	11.4	85.2	30.64 in/h
77	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	19.73	2.33	89.3	0.49 in/h
78	Rain Bird PEB	1"	Bubbler	17	9.26	83.1	30.64 in/h
79	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	8.89	2.41	90.4	0.43 in/h
80	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	9.63	0.84	106.3	0.43 in/h
81	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	19.42	12.9	116.5	0.37 in/h
82	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	22.34	3.35	108.2	0.32 in/h
83	Rain Bird PEB	1-1/2"	Shrub Rotor	125	8.79	97.5	0.17 in/h
84	Rain Bird PEB	1-1/2"	Shrub Rotor	25.5	5.41	95.5	0.46 in/h
85	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.34	0.56	86.9	0.32 in/h
86	Rain Bird PEB	1-1/2"	Bubbler	13	9.17	84.5	30.64 in/h
87	Rain Bird PEB	1-1/2"	Shrub Rotary	28.58	7.78	81.4	0.24 in/h
88	Rain Bird PEB	1-1/2"	Shrub Rotary	28.17	6.89	82.4	0.23 in/h
89	Rain Bird PEB	1-1/2"	Bubbler	19	6.95	85.2	30.64 in/h
90	Rain Bird PEB	1-1/2"	Shrub Rotary	26.95	4.45	86.2	0.28 in/h
91	Rain Bird PEB	1"	Bubbler	20	9.04	90.0	30.64 in/h
92	Rain Bird PEB	1-1/2"	Shrub Rotary	27.22	6.88	89.4	0.25 in/h
93	Rain Bird PEB	1-1/2"	Shrub Rotary	26.87	4.95	92.1	0.24 in/h
94	Rain Bird PEB	1-1/2"	Shrub Rotary	27.66	6.79	94.0	0.25 in/h
95	Rain Bird PEB	1-1/2"	Bubbler	26	9.28	101.9	30.64 in/h
96	Rain Bird PEB	1-1/2"	Shrub Rotary	27.71	7.5	102.5	0.27 in/h
97	Rain Bird PEB	1-1/2"	Shrub Rotary	27.92	5.05	100.1	0.28 in/h
98	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	11.99	0.37	91.1	0.32 in/h
99	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.69	1.6	86.2	0.32 in/h
100	Rain Bird PEB	1"	Shrub Rotor	10.24	1.14	82.5	0.35 in/h
101	Rain Bird PEB	1-1/2"	Bubbler	22	7.96	81.1	30.64 in/h
102	Rain Bird PEB	1-1/2"	Shrub Rotor	26	7.37	95.2	0.5 in/h
103	Rain Bird PEB	1-1/2"	Shrub Rotor	22	6.09	94.0	0.41 in/h
104	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.47	0.75	84.8	0.32 in/h
105	Rain Bird PEB	1-1/2"	Shrub Rotary	28.96	6.9	79.3	0.24 in/h
106	Rain Bird PEB	1-1/2"	Shrub Rotary	29.31	6.89	79.2	0.38 in/h
107	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.61	0.7	89.9	0.32 in/h
108	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	11.32	5.05	94.2	0.43 in/h
109	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.93	0.11	84.1	0.43 in/h
110	Rain Bird PEB	1"	Bubbler	22	7.62	80.1	30.64 in/h
111	Rain Bird PEB	1"	Bubbler	23	11.8	83.5	30.64 in/h
112	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	20.4	7.89	90.9	0.49 in/h
113	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.55	1.18	83.5	0.32 in/h
114	Rain Bird PEB	1-1/2"	Shrub Rotor	23.2	9.43	95.5	0.28 in/h
115	Rain Bird PEB	1-1/2"	Shrub Rotor	29.06	8.93	90.0	0.28 in/h
116	Rain Bird PEB	1-1/2"	Bubbler	29	9.29	80.1	30.64 in/h
117	Rain Bird PEB	1"	Shrub Rotor	14.27	4.45	83.1	0.31 in/h
118	Rain Bird PEB	1"	Shrub Rotor	14.7	4.84	83.5	0.32 in/h
119	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	7.87	0.46	83.0	0.36 in/h
120	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	28.6	2.75	104.4	0.43 in/h
121	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.43	1.19	82.4	0.32 in/h
122	Rain Bird PEB	1-1/2"	Shrub Rotor	28	7.82	91.6	0.35 in/h
123	Rain Bird PEB	1-1/2"	Shrub Rotor	24	5.93	89.8	0.33 in/h
124	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.36	1.5	81.5	0.32 in/h
125	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	18.56	0.74	98.1	0.43 in/h
126	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	9.83	0.34	83.1	0.43 in/h
127	Rain Bird PEB	1-1/2"	Shrub Rotor	24.81	10.1	89.8	0.34 in/h
128	Rain Bird PEB	1-1/2"	Shrub Rotor	23.03	8.21	86.9	0.37 in/h
129	Rain Bird PEB	1-1/2"	Shrub Rotor	26.26	7.02	82.7	0.36 in/h
130	Rain Bird PEB	1-1/2"	Shrub Rotor	24.94	6.2	81.8	0.33 in/h
131	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	23.19	1.79	76.9	0.32 in/h
132	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	20.43	0.24	75.3	0.32 in/h
133	Rain Bird PEB	1-1/2"	Bubbler	24	10.7	74.3	30.64 in/h
134	Rain Bird PEB	1"	Shrub Rotor	23	4.86	83.4	0.43 in/h
135	Rain Bird PEB	1"	Shrub Rotor	23	5.49	84.0	0.43 in/h
136	Rain Bird PEB	1-1/2"	Shrub Rotor	24.7	8.91	78.7	0.31 in/h
137	Rain Bird PEB	1-1/2"	Shrub Rotor	24.7	8.58	78.3	0.28 in/h
138	Rain Bird PEB	1-1/2"	Shrub Rotor	23.48	5.72	80.3	0.35 in/h
139	Rain Bird PEB	1-1/2"	Shrub Rotor	27.84	9.2	83.6	0.38 in/h
140	Rain Bird XCZ-100-PRB-LC	1"	Area for Dripline	21.03	0.35	90.9	0.32 in/h
141	Rain Bird PEB	1-1/2"	Shrub Rotary	15.62	5.84	69.2	0.38 in/h
142	Rain Bird PEB	1-1/2"	Shrub Rotary	15.89	6.01	69.3	0.38 in/h
143	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	20.66	0.2	65.2	0.32 in/h
144	Rain Bird PEB	1-1/2"	Bubbler	24	11.2	65.1	30.64 in/h
145	Rain Bird PEB	1-1/2"	Shrub Rotor	7.48	4.85	71.5	0.13 in/h
146	Rain Bird PEB	1-1/2"	Bubbler	24	9.6	66.2	30.64 in/h
147	Rain Bird XCZ-150-LCS	1-1/2"	Area for Dripline	22.98	0.7



LEGEND:

1. Gate or ball valve
2. Hand wheel
3. Mainline
4. PVC male adaptor
5. 10" Round plastic box and locking cover.
6. 3/4" crushed rock

4 Ball / Gate Valve — Scale: N.T.S

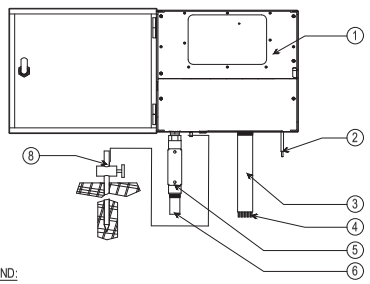


LEGEND:

1. Bronze wye strainer w/ full size blow off valve (80 mesh).
2. Reduced pressure backflow preventer w/ 2 shut off valves.
3. Brass pipes, nipples and fittings, typ.
4. Brass unions line sized both sides.
5. Sch 80 PVC male adaptor brass coupling and brass brass nipple, typ both sides.
6. 12" sq. concrete thrust block.
7. Backflow enclosure per irrigation legend, on concrete pad.
8. Finish grade.

NOTE:
A. Brass or Copper is required on all irrigation reduced pressure assembly.

3 Backflow Prevention Device — Scale: N.T.S

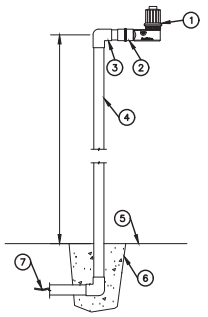


LEGEND:

1. Wall mounted controller with weather proof cabinet and locking cover. (per irrigation legend)
2. Antenna
3. 1 1/2" PVC Schd 40 conduit for UF direct burial control wires, size as required.
4. Wires to remote control valves
5. Junction Box
6. 1" PVC Schd 40 conduit to power supply.
7. Ground rod 5/8" x 6'

NOTE:
A. Installation to comply with all national and local electrical and building codes.
B. Power required 110VAC @ 1.2 amp or less.
C. Mount controller 4' above finish grade from bottom of controller.
D. Provide on/off switch.

2 Wall Mounted Controller — Scale: N.T.S

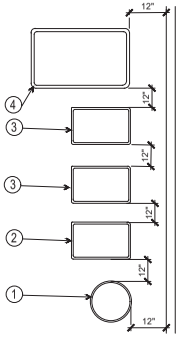


LEGEND:

1. RAIN SENSOR: RAIN BIRD RSD-CEx
2. FEMALE ADAPTER (SLIP X FPT)
3. GALVANIZED 90° EL (1 OF 2)
4. 3/4-INCH GALVANIZED PIPE
5. FINISHED GRADE
6. CONCRETE BASE
7. WIRE TO IRRIGATION CONTROLLER

NOTE:
For most accurate temperature sensing rotate the MWS so that the thermostat portion points south.

1 Mini-Weather Station — Scale: N.T.S

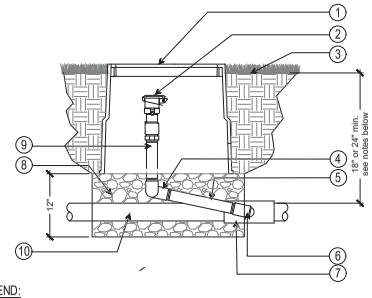


LEGEND:

1. 10" diameter circular valve box.
2. Edge of lawn, walk, fence, curb, etc.
3. 14" X 19" rectangular valve box.
4. 20" X 30" rectangular valve box.

NOTE:
A. Center valve box over valve to facilitate servicing of valve.
B. Set valve boxes 2" maximum above grade in mulch cover or ground areas. Set flush with finish grade in turf areas.
C. Set valve box and valve assembly in ground-cover/shrub area where possible - install in turf only if there is no adjacent ground cover.
D. Set valve boxes parallel to one andther and perpendicular to edge.
E. Avoid heavy compaction of soil around valve boxes to prevent their deformation/collapse.
E. Contractor to heat brand all valve boxes with valve ID.

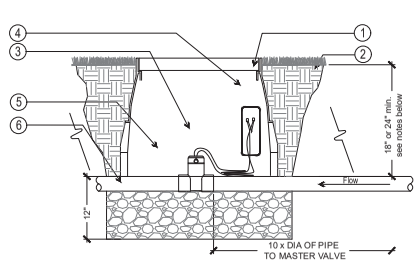
8 Valve Box Layout — Scale: N.T.S



LEGEND:

1. 10" Round plastic box and locking cover.
2. Quick coupling valve w/locking cover.
3. Finish grade.
4. 2 PVC SCH. 80.
5. PVC SCH 80 nipple.
6. PVC SCH. 40 elbow.
7. PVC tee.
8. 1 cu. ft. pea gravel.
9. PVC SCH.80 riser
10. PVC main line.

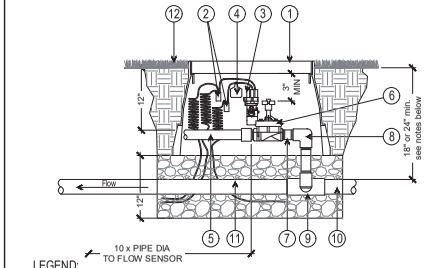
7 Quick Coupler Valve — Scale: N.T.S



LEGEND:

1. Approved 14" x 19" plastic valve box with locking cover.
2. Finish grade
3. Flow sensor
4. P.E. cable to controller
5. PVC main line
6. 3/4" crushed rock

6 Flow Sensor — Scale: N.T.S

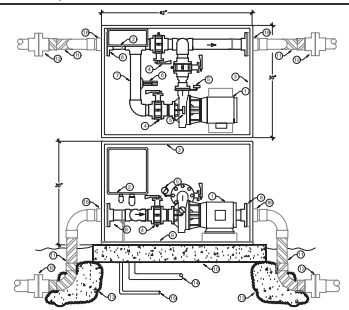


LEGEND:

1. Approved 14" x 19" plastic valve box with locking cover.
2. Silicone filled connectors. Spears DS-400
3. Control wires (minimum 10 wraps on 2" PVC pipe)
4. Valve I.D. tag
5. Lateral line
6. Master or remote control valve
7. Male adapter
8. 90 ell
9. Tee
10. Mainline
11. 3/4" crushed rock
12. Finish grade

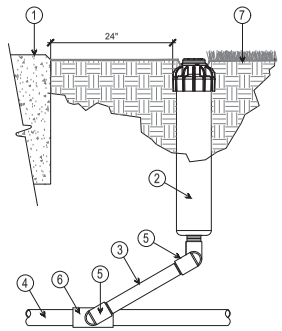
NOTE:
1. Pipe cover for CL 315 - 2" dia. and larger shall be 24".
2. Pipe cover for 1-1/2" sch 40 and smaller shall be 18".

5 Master / Remote Control Valve — Scale: N.T.S



1. CLOSE-COUPLED END SUCTION CENTRIFUGAL PUMP, CAST IRON BRONZE FITTED, BACK PULLOUT DESIGN, MECHANICAL SEAL, ODP MOTOR.
2. NEMA 4 ENCLOSED CONTROL PANEL, WITH CIRCUIT BREAKER, MAGNETIC STARTER, HOA SWITCH, AND COMPONENTS FOR AUTOMATIC BOOSTER PUMP CONTROL.
3. MARINE GRADE ALUMINUM ENCLOSURE, TOP HINGED DESIGN WITH VENTING.
4. CAST IRON ELASTOMER LINED FULL LUG WAFER STYLE BUTTERFLY VALVE.
5. PRESSURE GAUGE, 2 1/2" DIAL, LIQUID FILLED, STAINLESS CASE, 0 - 200 PSI.
6. FLOW SWITCH, THERMAL DISPERSION, 150 PSI RATED.
7. SCH. 10S 304 STAINLESS STEEL, 2 INCH.
8. 150# ANSI RATED STAINLESS OUTPUT FLANGE.
9. FABRICATED STRUCTURAL ALUMINUM BASEPLATE.
10. 4-6 INCH CONCRETE PAD, ASTM C-94, ACI STD. 318-83 DESIGN MIX, 2500 PSI RATED. PAD DIMENSIONS SHALL BE 42" X 54".
11. MAINLINE
12. COMPANION FLANGE CONNECTION.
13. CONCRETE THRUST BLOCK, ___ CU. FT. MINIMUM.
14. MAIN POWER CONDUIT.
15. IRRIGATION CONTROLLER SIGNAL CONDUIT.
16. CONTRACTOR'S RESPONSIBILITY TO PROVIDE ALL INLET AND OUTLET PIPING.

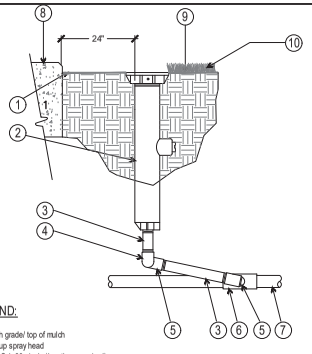
12 Pump — Scale: N.T.S



LEGEND:

1. Walk, curb, wall, etc.
2. Pop-up rotor.
3. PVC schedule 80 nipple.
4. Lateral line.
5. PVC Street Elbow Sch. 80.
6. Lateral tee or ell.
7. Finish Grade
8. Shrub or groundcover per planting plans.

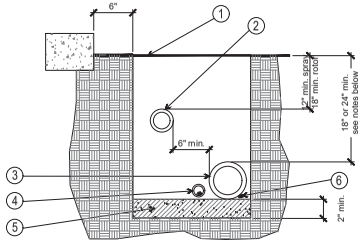
11 Pop-up Rotor — Scale: N.T.S



LEGEND:

1. Finish grade/ top of mulch
2. Pop-up spray head
3. PVC Sch 80 nipple (length as required)
4. PVC shh 40 ell
5. PVC sch 40 street ell
6. PVC sch 40 tee or ell
7. PVC lateral pipe.
8. Walk, curb, wall, etc.
9. Finish Grade
10. Shrub or groundcover behind sprayhead per planting plan.

10 Pop-up Spray Head — Scale: N.T.S



LEGEND:

1. Finish grade
2. Lateral line
3. Main line or sleeve
4. Sleeve
5. Clean or sand backfill
6. Control wire

NOTES:
1. All plastic piping to be snaked in trenches
2. Bundle & tape wiring at 10' intervals
3. Tie a loose 24" loop in wiring every 100 feet and at changes of direction greater than 30°. Untie all loops after all connections have been made.
4. In stall all control wire on the underside of the main line pipe.
5. See irrigation specifications for backfill & compaction requirements.
6. Pipe cover for CL 315 - 2" dia. and larger shall be 24".
7. Pipe cover for 1-1/2" sch 40 and smaller shall be 18".
8. Pipe cover for non-pressure lateral lines shall be 12" for spray heads.
9. Pipe cover for non-pressure lateral lines shall be 18" for rotor heads.
10. Common trench with other utilities is prohibited

9 Trenching Detail — Scale: N.T.S

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia, California 92870
Ph: 714.986-2400
Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT — 1/31/2026

Project

1M Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

Irrigation Details

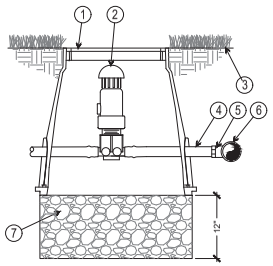
Scale

Date 03/07/2023

Drawn by TH

Job Number 22-101

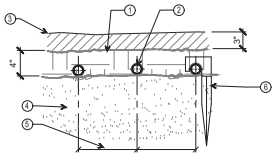
Sheet No LI-17



LEGEND:

1. Subterranian emitter box with locking purple cover.
2. Air/vacuum relief valve kit.
3. Finish grade.
4. 1/2" blank drip tubing.
5. Barb x male thread connector.
6. PVC tee connected to PVC header pipe.
7. 12" depth 3/4" washed gravel.

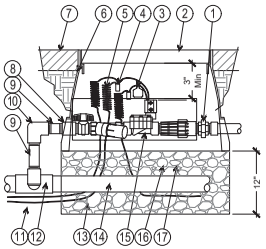
4 Air Relief Valve — Scale: N.T.S



LEGEND:

1. Prepared soil, finished grade
2. Rainbird LD dripline (typ.)
3. Mulch layer per specification.
4. Sub-grade native soil
5. See plans for Dripline lateral layout
6. Rainbird LD 16-STK tubing stake every 8'(feet) o.c.

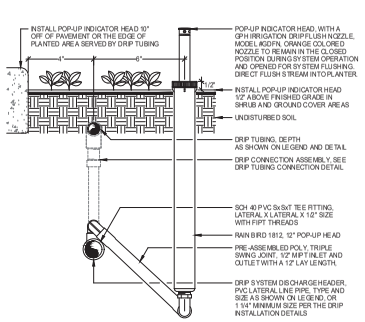
3 Drip Line Layout — Scale: N.T.S



LEGEND:

1. PVC Sca 80 nipple (closed)
2. Valve box with locking cover.
3. ID tag.
4. Waterproof connection.
5. 30" linear length of wire coil.
6. Finish grade.
7. Top of mulch.
8. PVC sch 40 coupling.
9. PVC sch 80 nipple
10. PVC sch 40 ell.
11. PVC sch 80 nipple and PVC sch 40 ell
12. PVC sch 40 tee or ell.
13. 12" minimum depth of 3/4" washed gravel.
14. PVC mainline.
15. Control zone kit.
16. PVC sch 80 union for servicing assembly
17. PVC schd 40 male adapter.

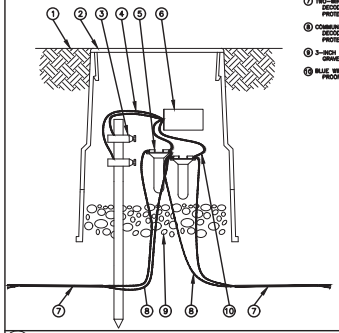
2 Drip Remote Control Valve — Scale: N.T.S



NOTE:
INSTALL INDICATOR HEAD 10" FROM THE EDGE OF PAVING OR THE PLANTER EDGE.
INSTALL ORANGE COLORED INDICATOR NOZZLE ON POP-UP HEAD AND ADJUST TO FULLY CLOSED.
FOR RECYCLED WATER USE 4 GPH IRRIGATION GDFN-R, PURPLE COLOR CODED FLUSH NOZZLE.

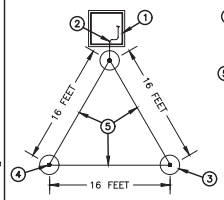
1 Flush Valve Kit — Scale: N.T.S

NOTES:
1. LSP–1TURF SHOULD BE INSTALLED EVERY 500–FEET OR FOR EVERY EIGHT DECODERS ON TWO–WIRE PATH.
2. LSP–1TURF TO BE INSTALLED AT END OF WIRE RUN THAT TERMINATES IN THE FIELD (STAR CONFIGURATION).
3. RAIN BIRD FD–401TURF AND FD–601TURF FIELD DECODERS COME WITH LSP–1TURF'S BUILT–IN. FD–102TURF, FD–202TURF AND FD–402TURF REQUIRE SEPARATE LSP–1TURF PROTECTION.
4. PLACE LSP–1 INSIDE VALVE BOX WHEN POSSIBLE.

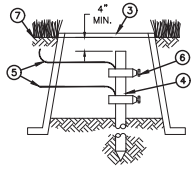


1. FINISH GRADE OR TOP OF MULCH
2. 10–INCH GRAY VALVE BOX WITH COVER.
3. GROUNDING RODS 10 OHMS OR LESS
4. GREEN/YELLOW WIRE FROM LSP–1TURF TO GROUNDING ROD BRASS CLAMPS (1 OF 2)
5. DBRY20 WATERPROOF WIRE CONNECTOR.
6. LINE SURGE PROTECTOR: RAIN BIRD LSP–1TURF M10008
7. TWO–WIRE CABLE TO NEXT DEVICE (FIELD DECODER, SENSOR DECODER, LINE SURGE PROTECTOR OR ESP–LXD CONTROLLER)
8. COMMUNICATION WIRE TO NEXT DEVICE (FIELD DECODER, SENSOR DECODER, LINE SURGE PROTECTOR OR ESP–LXD CONTROLLER)
9. 3–INCH MINIMUM DEPTH OF 3/4–INCH WASHED GRAVEL
10. BLUE WIRE FROM LSP–1TURF TO DBRY20 WATER PROOF WIRE CONNECTOR

8 Line Surge Protector — Scale: N.T.S



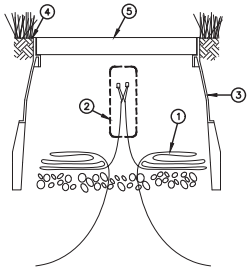
GROUND ROD LAYOUT



GROUND ROD ASSEMBLY

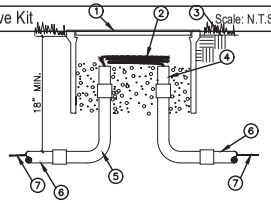
1. RAIN BIRD CONTROLLER
2. SOLID BARE COPPER WIRE (#10 AWG) FROM GROUNDING ROD TO CONTROLLER. MAKE WIRE AS SHORT AND STRAIGHT AS POSSIBLE
3. COVER GROUNDING ROD WITH 10–INCH GRAY ROUND VALVE BOX AS SHOWN
4. 5/8–INCH X 8 FT COPPER CLAD GROUNDING ROD OR GROUNDING PLATE. INSTALL RODS IN SOIL IN A TRIANGULAR PATTERN SPACED A MINIMUM OF 16 FT APART FROM EACH OTHER. GROUNDING GRID TO HAVE A RESISTANCE OF TEN (10) OHMS OR LESS
5. BARE COPPER WIRE (#10 AWG MIN.) BETWEEN GROUNDING RODS
6. GROUND ROD CLAMP OR WELDS
7. FINISH GRADE

7 Grounding Layout — Scale: N.T.S



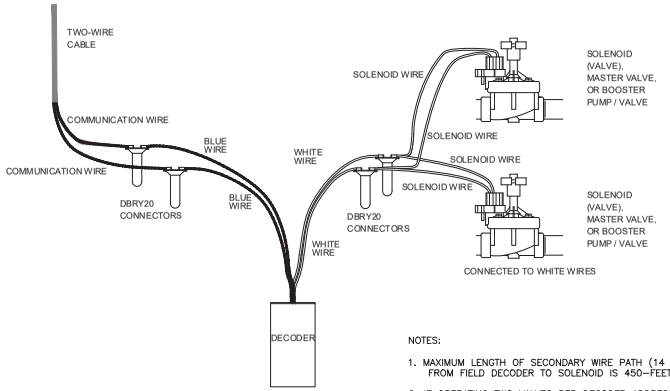
1. TWO WIRE CABLE (36–INCH LOOP)
2. DBRY20 WATERPROOF WIRE CONNECTOR
3. SPLICE BOX WITH COVER
4. FINISH GRADE
5. STANDARD 6" GRAY ROUND VALVE BOX

6 Two Wire Cable Splice — Scale: N.T.S



1. STANDARD 6" GRAY ROUND VALVE BOX EVERY 500' MAXIMUM
2. 36" LOOP OF TWO WIRE CABLE IN PULL BOX
3. FINISH GRADE
4. ENDS OF CONDUIT SEALED WITH WATERPROOF SILICONE (IF REQUIRED)
5. 90 DEGREE SWEEP ELL (IF REQUIRED)
6. 1" CONDUIT (MIMIMUM)
7. TWO WIRE CABLE

5 Two Wire Cable Pull Box — Scale: N.T.S



NOTES:

1. MAXIMUM LENGTH OF SECONDARY WIRE PATH (14 AWG) FROM FIELD DECODER TO SOLENOID IS 450–FEET.
2. IF OPERATING TWO VALVES PER DECODER ADDRESS, THE TOTAL DISTANCE OF EACH VALVE MUST BE ADDED TOGETHER AND NOT EXCEED THE LIMIT SET.

9 Decoder Wire Schematic — Scale: N.T.S

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia,California 92870
Phn: 714.986-2400
Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT — 1/31/2025 — RENEWAL DATE — STATE OF CALIFORNIA

Project

1M Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

Irrigation Details

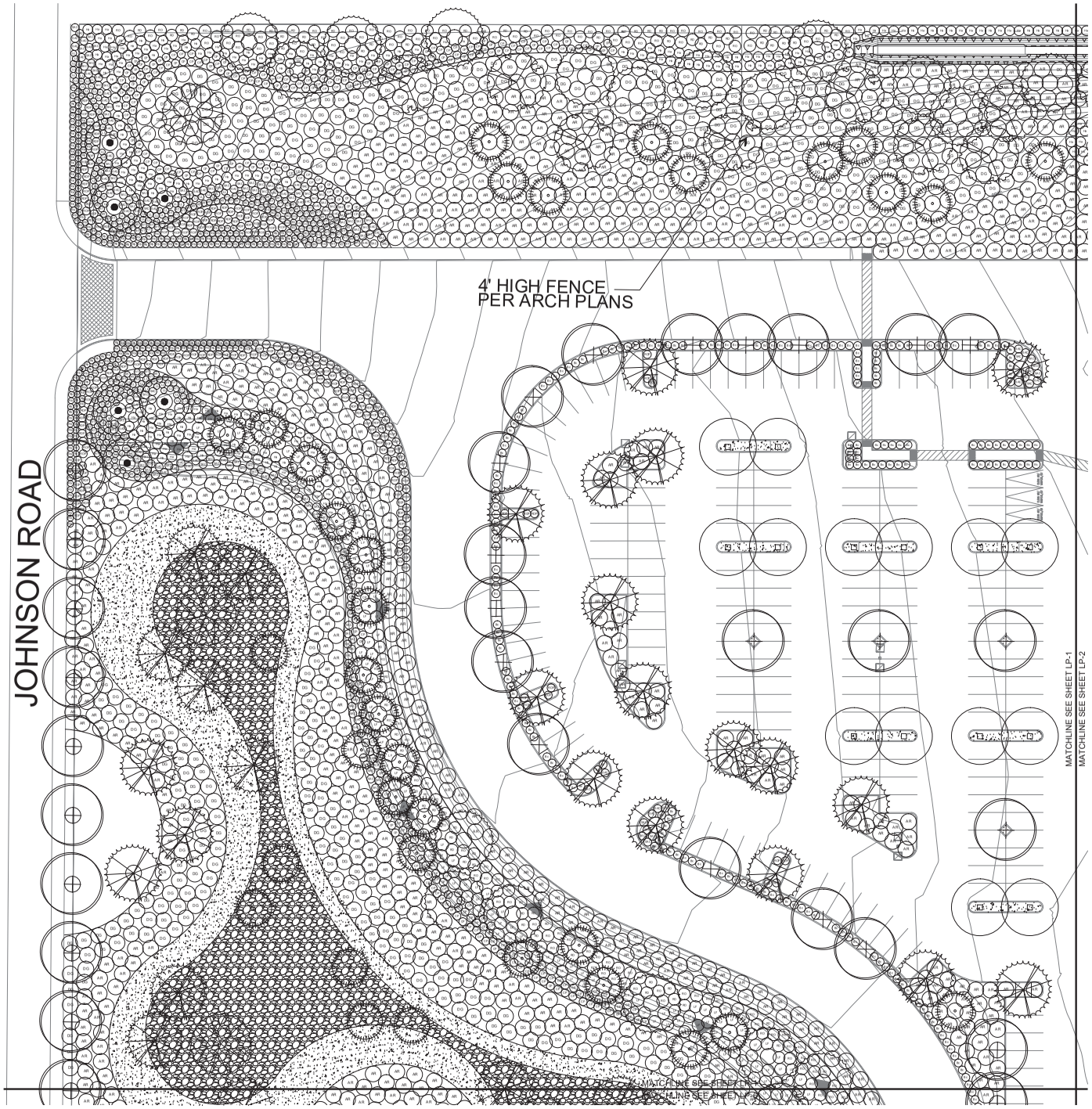
Scale

Date 03/07/2023

Drawn by TH

Job Number 22-101

Sheet No LI-18



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
	Cercidium 'Desert Museum' Blue Palo Verde	24" Box	24	L	Multi
	Chilopsis linearis Desert Willow	24" Box	81	L	Multi
	Geijera parviflora Australian Willow	24" Box	99	L	Multi
	Pinus eldarica Afghan Pine	24" Box	172	L	Standard
	Pistacia chinensis Chinese Pistache	24" Box	67	L	Standard
	Platanus acerifolia London Plane	24" Box	60	M	Standard
	Prosopis chilensis Chilean Mesquite	24" Box	72	M	Standard
	Quercus agrifolia Live Oak	24" Box	7	M	Multi
	Rhus lancea African Sumac	24" Box	31	L	Standard
	Ulmus parvifolia Chinese Elm	15 Gal	27	L	Standard

SHRUBS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
	Baccharis p. 'Centennial' Coyote Bush	5 Gal	661	L	4' OC 2.5' from hardscape
	Cassia phyllodenia Silvelleaf Cassia	5 Gal	897	L	4' OC 2.5' from hardscape
	Heteromeles arbutifolia Toyon	5 Gal	1597	M	5' OC 3' from hardscape
	Leonotis leonurus Lion's Tail	5 Gal	289	M	3' OC 2' from hardscape
	Leucophyllum frutescens Texas Ranger	5 Gal	1393	M	4' OC 2.5' from hardscape
	Rhus ovata Sugar Bush	5 Gal	1557	M	5' OC 3.5' from hardscape
	Rosmarinus o. 'Tuscan Blue' Rosemary	5 Gal	676	L	3' OC 2' from hardscape
	Salvia c. 'Allen Chickering' Allen Chickering Sage	5 Gal	848	L	4' OC 2.5' from hardscape
	Salvia greggii Autumn Sage	5 Gal	292	L	3' OC 2' from hardscape

ACCENTS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
	Agave americana 'Century Plant'	5 Gal	17	L	
	Agave 'Blue Glow' Blue Glow Agave	5 Gal	23	L	
	Agave parryi Parry's Agave	5 Gal	75	L	
	Dasylirion wheeleri Desert Spoon	5 Gal	33	L	
	Hesperaloe parviflora Red Yucca	5 Gal	140	L	
	Pachycereus marginatus Mexican Fence Post	5 Gal	12	L	

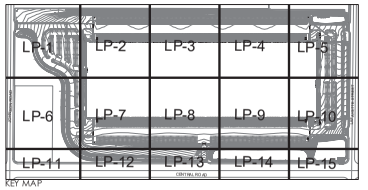
GROUNDCOVER

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
	Acacia redolens 'Low Boy' Dwarf Acacia	1 Gal	3140	L	8' OC 4.5' from hardscape
	Baccharis p. 'Pigeon Point' Dwarf Coyote Bush	1 Gal	49	L	6' OC 3.5' from hardscape
	Dalea greggii Trailing Indio Bush	1 Gal	1626	L	8' OC 4.5' from hardscape
	Rosmarinus o. 'Huntington Carpet' Prostrate Rosemary	1 Gal	445	L	4' OC 2.5' from hardscape
	Ruellia brittoniana Mexicna petuntia	1 Gal	447	L	3' OC 2' from hardscape

Hydro-seed - Bouteloua gracilis - Blue grama.

3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

4-6" crushed rock decorative rock -Desert Gold. single layer over filter fabric under all planting areas..



KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia, California 92870
Ph: 714.986-2400
Fax: 714.986-2408

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

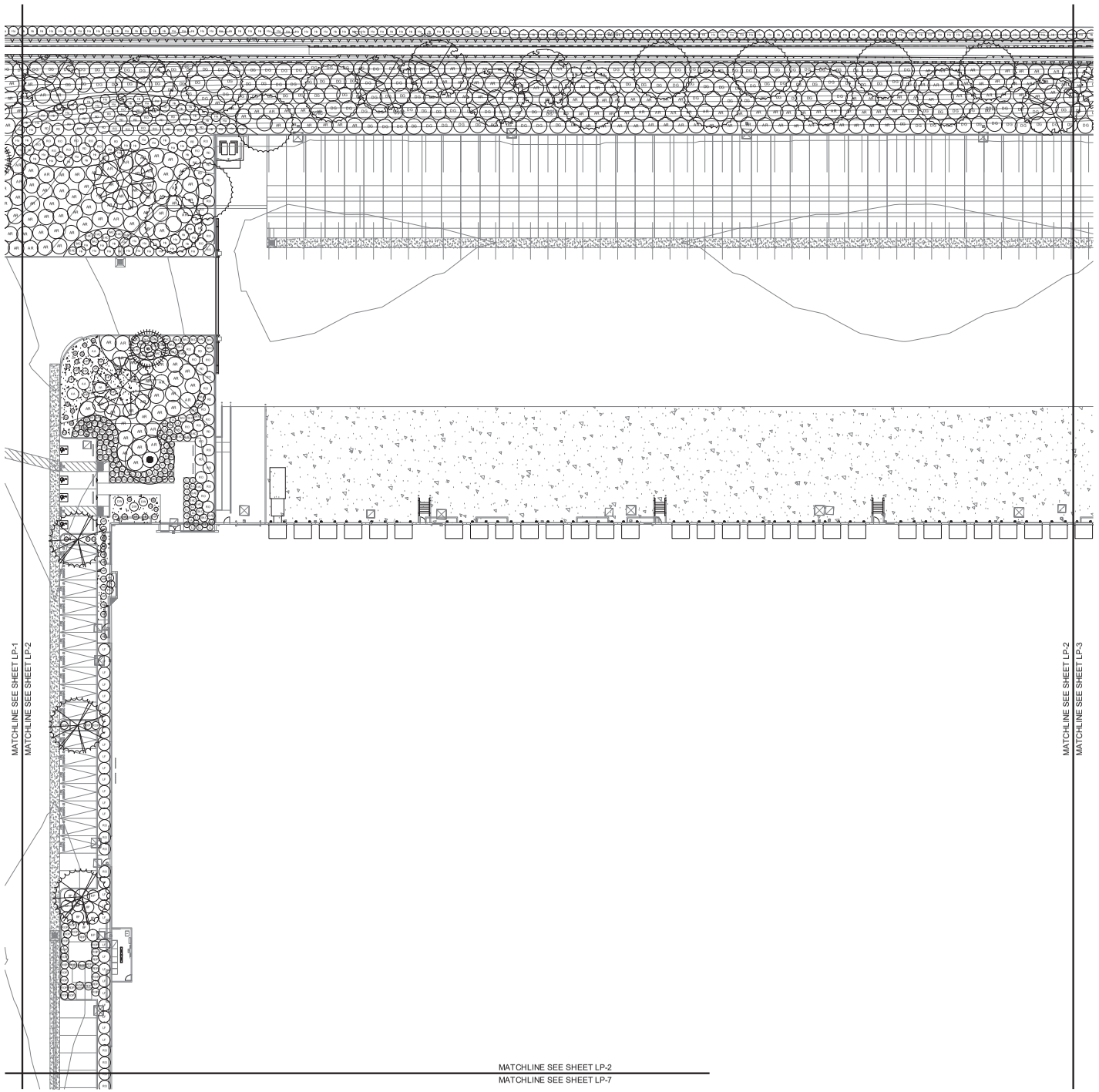
Revisions

	Date	Remarks

Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-1



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
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	Chilopsis linearis Desert Willow	24" Box	81	L	Multi
	Geijera parviflora Australian Willow	24" Box	99	L	Multi
	Pinus eldarica Afghan Pine	24" Box	172	L	Standard
	Pistacia chinensis Chinese Pistache	24" Box	67	L	Standard
	Platanus acerifolia London Plane	24" Box	60	M	Standard
	Prosopis chilensis Chilean Mesquite	24" Box	72	M	Standard
	Quercus agrifolia Live Oak	24" Box	7	M	Multi
	Rhus lancea African Sumac	24" Box	31	L	Standard
	Ulmus parvifolia Chinese Elm	15 Gal	27	L	Standard

SHRUBS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
BC	Baccharis p. 'Centennial' Coyote Bush	5 Gal	661	L	4' OC 2.5' from hardscape
CP	Cassia phyllodenia Silverleaf Cassia	5 Gal	897	L	4' OC 2.5' from hardscape
HA	Heteromeles arbutifolia Toyon	5 Gal	1597	M	5' OC 3' from hardscape
L	Leonotis leonurus Lion's Tail	5 Gal	289	M	3' OC 2' from hardscape
LF	Leucophyllum frutescens Texas Ranger	5 Gal	1393	M	4' OC 2.5' from hardscape
RO	Rhus ovata Sugar Bush	5 Gal	1557	M	6' OC 3.5' from hardscape
R	Rosmarinus o. 'Tuscan Blue' Rosemary	5 Gal	676	L	3' OC 2' from hardscape
SC	Salvia c. 'Allen Chickering' Allen Chickering Sage	5 Gal	848	L	4' OC 2.5' from hardscape
S	Salvia greggii Autumn Sage	5 Gal	292	L	3' OC 2' from hardscape

ACCENTS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
A	Agave americana Century Plant	5 Gal	17	L	
AB	Agave 'Blue Glow Blue Glow Agave	5 Gal	23	L	
AP	Agave parryi Parry's Agave	5 Gal	75	L	
DW	Dasylerion wheeleri Desert Spoon	5 Gal	33	L	
HP	Hesperaloe parviflora Red Yucca	5 Gal	140	L	
PM	Pachycereus marginatus Mexican Fence Post	5 Gal	12	L	

GROUNDCOVER

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
AR	Acacia redolens 'Low Boy' Dwarf Acacia	1 Gal	3140	L	8' OC 4.5' from hardscape
BP	Baccharis p. 'Pigeon Point' Dwarf Coyote Bush	1 Gal	49	L	6' OC 3.5' from hardscape
DG	Dalea greggii Trailing Indigo Bush	1 Gal	1626	L	8' OC 4.5' from hardscape
RH	Rosmarinus o. 'Huntington Carpet' Prostrate Rosemary	1 Gal	445	L	4' OC 2.5' from hardscape
RB	Ruellia brittoniana Mexicna petunia	1 Gal	447	L	3' OC 2' from hardscape

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3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

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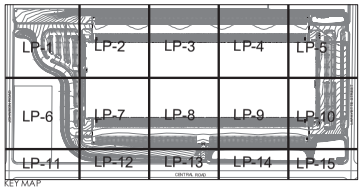

HUNTER LANDSCAPE
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Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

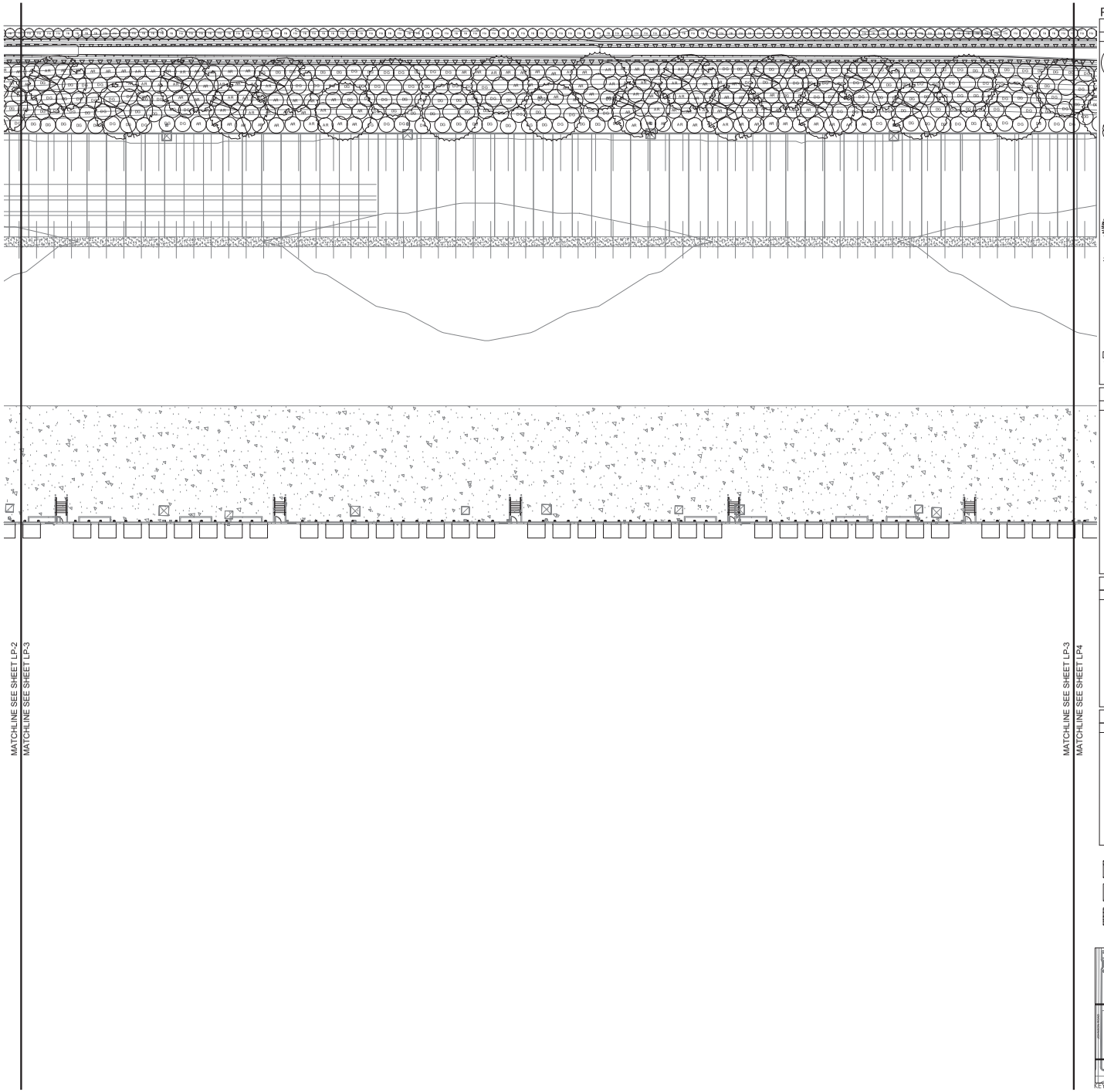
Revisions

	Date	Remarks

Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-2



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
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SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
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LF	Leucophyllum frutescens Texas Ranger	5 Gal	1393	M	4' OC 2.5' from hardscape
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SCA	Salvia c. 'Allen Chickering' Allen Chickering Sage	5 Gal	848	L	4' OC 2.5' from hardscape
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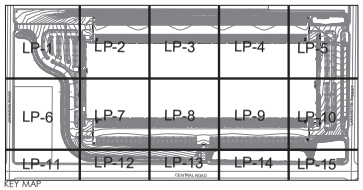
Hydro-seed - Boutelou a gracilis - Blue grama.

3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

4-6" crushed rock decorative rock -Desert Gold. single layer over filter fabric under all planting areas..



KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia,California 92870
Ph: 714.986-2400
Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT
RICHARD W. HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

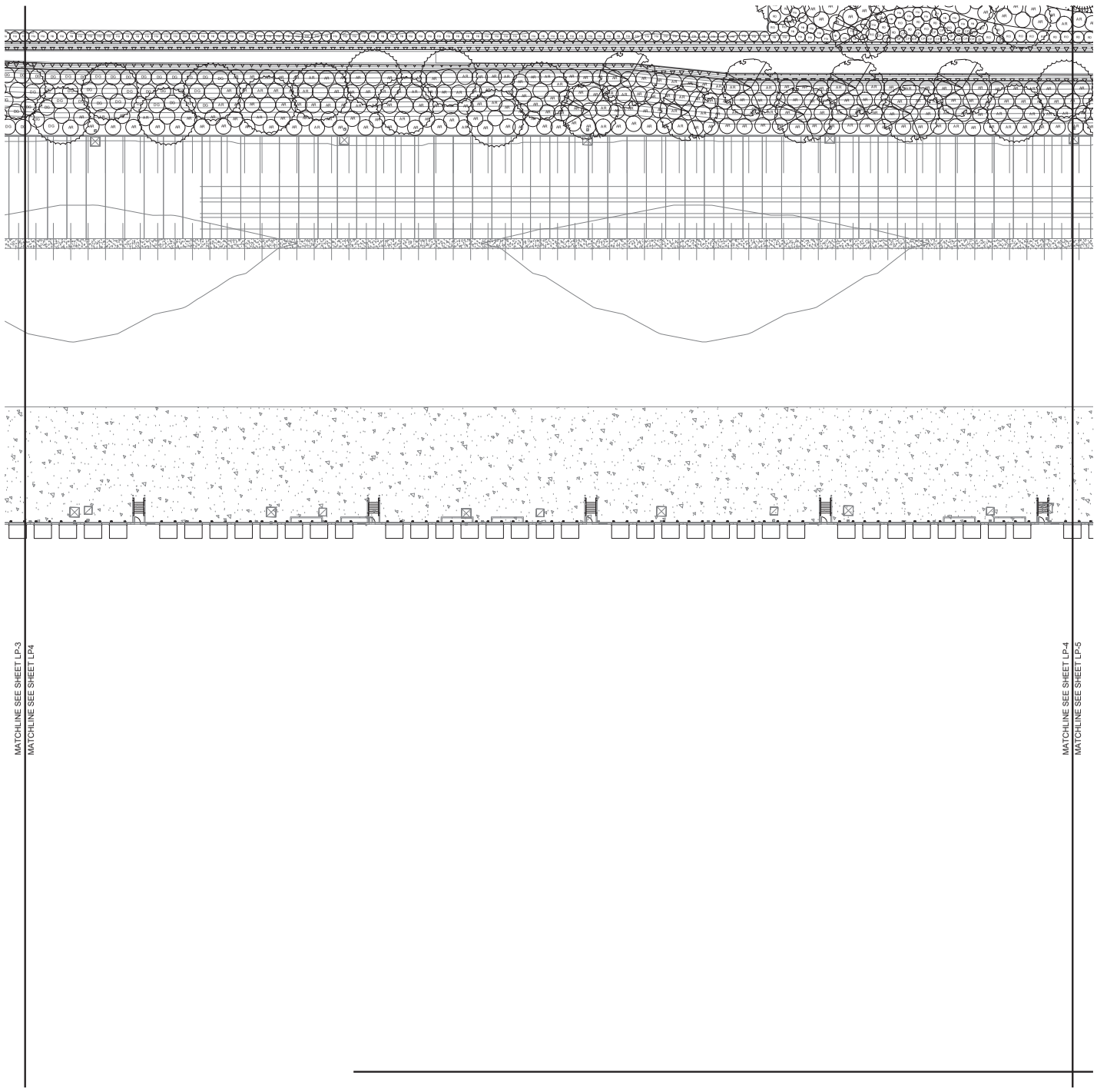
Revisions

	Date	Remarks

Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-3



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
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SHRUBS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
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HA	Heteromeles arbutifolia Toyon	5 Gal	1597	M	5' OC 3' from hardscape
LL	Leonotis leonurus Lion's Tail	5 Gal	289	M	3' OC 2' from hardscape
LT	Leucophyllum frutescens Texas Ranger	5 Gal	1393	M	4' OC 2.5' from hardscape
RO	Rhus ovata Sugar Bush	5 Gal	1557	M	6' OC 3.5' from hardscape
RM	Rosmarinus o. 'Tuscan Blue' Rosemary	5 Gal	676	L	3' OC 2' from hardscape
SCH	Salvia c. 'Allen Chickering' Allen Chickering Sage	5 Gal	848	L	4' OC 2.5' from hardscape
SG	Salvia greggii Autumn Sage	5 Gal	292	L	3' OC 2' from hardscape

ACCENTS

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GROUNDCOVER

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
AR	Acacia redolens 'Low Boy' Dwarf Acacia	1 Gal	3140	L	8' OC 4.5' from hardscape
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Hydro-seed - Boutelou a gracilis - Blue grama.

3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

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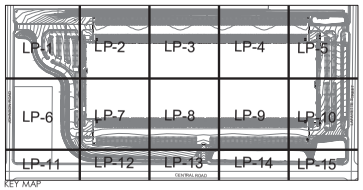

KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
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Ph: 714.986-2400
Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT
JEFF HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

Revisions

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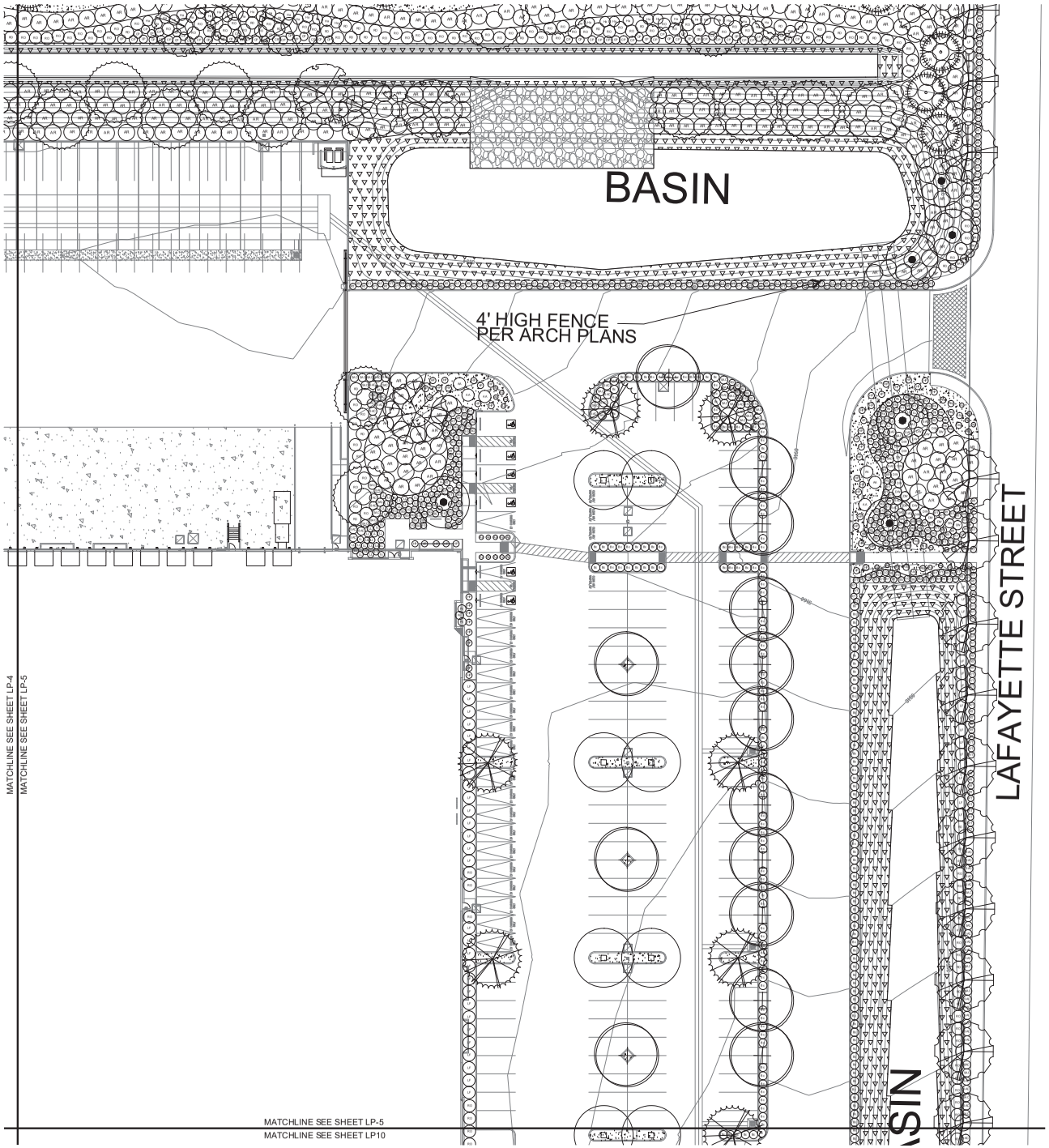
Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-4



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
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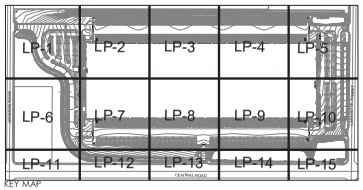

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Planting Plan

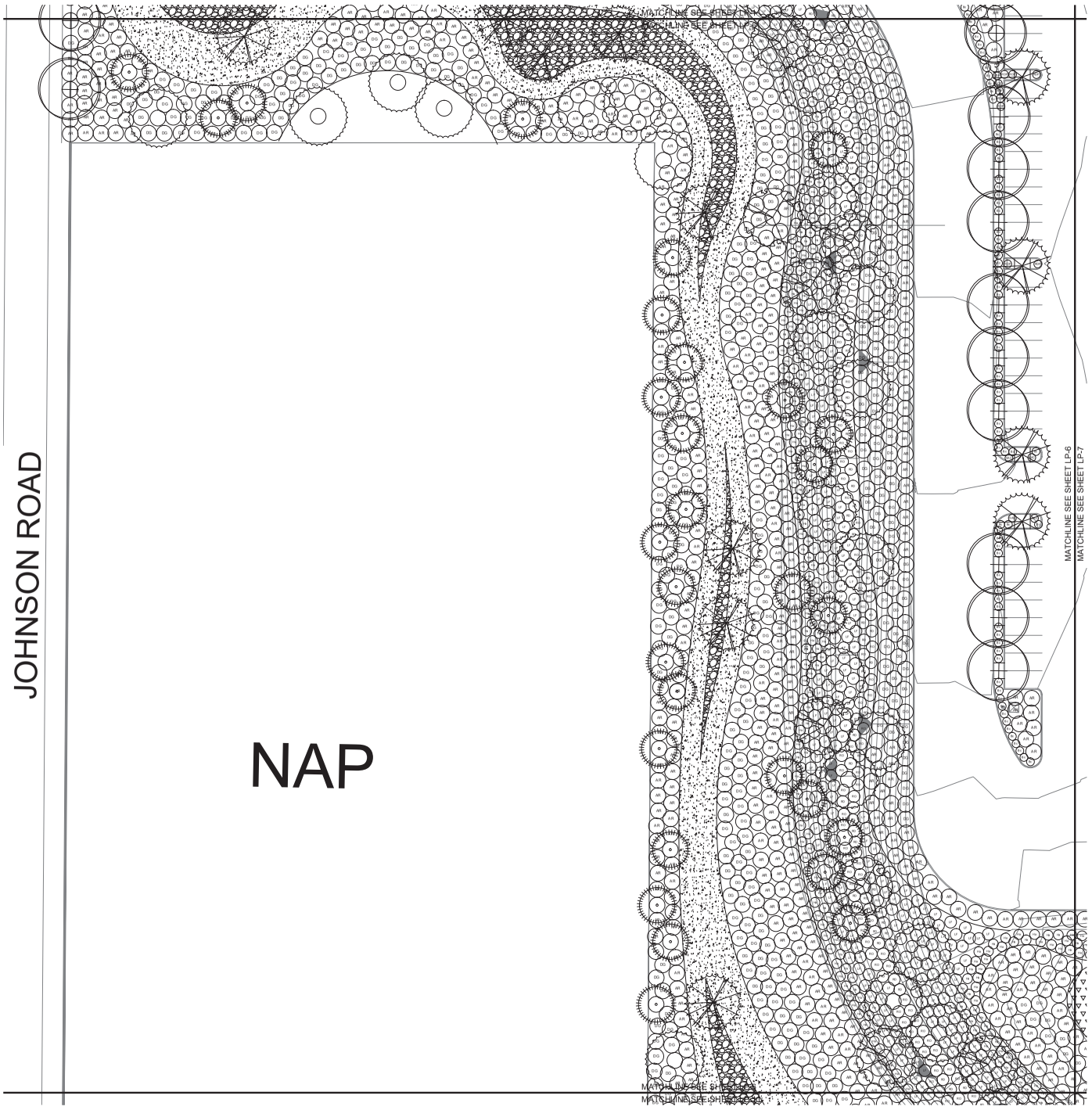
Scale 1" = 20'

Date 03/07/2023

Drawn by TH

Job Number 22-101

Sheet No LP-5



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
	Cercidium 'Desert Museum' Blue Palo Verde	24" Box	24	L	Multi
	Chilopsis linearis Desert Willow	24" Box	81	L	Multi
	Geijera parviflora Australian Willow	24" Box	99	L	Multi
	Pinus eldarica Afghan Pine	24" Box	172	L	Standard
	Pistacia chinensis Chinese Pistache	24" Box	67	L	Standard
	Platanus acerifolia London Plane	24" Box	60	M	Standard
	Prosopis chilensis Chilean Mesquite	24" Box	72	M	Standard
	Quercus agrifolia Live Oak	24" Box	7	M	Multi
	Rhus lancea African Sumac	24" Box	31	L	Standard
	Ulmus parvifolia Chinese Elm	15 Gal	27	L	Standard

SHRUBS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
BP	Baccharis p. 'Centennial' Coyote Bush	5 Gal	661	L	4' OC 2.5' from hardscape
CP	Cassia phyllodenia Silverleaf Cassia	5 Gal	897	L	4' OC 2.5' from hardscape
HA	Heteromeles arbutifolia Toyon	5 Gal	1597	M	5' OC 3' from hardscape
L	Leonotis leonurus Lion's Tail	5 Gal	289	M	3' OC 2' from hardscape
LF	Leucophyllum frutescens Texas Ranger	5 Gal	1393	M	4' OC 2.5' from hardscape
RO	Rhus ovata Sugar Bush	5 Gal	1557	M	6' OC 3.5' from hardscape
R	Rosmarinus o. 'Tuscan Blue' Rosemary	5 Gal	676	L	3' OC 2' from hardscape
SC	Salvia c. 'Allen Chickering' Allen Chickering Sage	5 Gal	848	L	4' OC 2.5' from hardscape
S	Salvia greggii Autumn Sage	5 Gal	292	L	3' OC 2' from hardscape

ACCENTS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
A	Agave americana Century Plant	5 Gal	17	L	
AB	Agave 'Blue Glow Blue Glow Agave	5 Gal	23	L	
AP	Agave parryi Parry's Agave	5 Gal	75	L	
DW	Dasylerion wheeleri Desert Spoon	5 Gal	33	L	
HP	Hesperaloe parviflora Red Yucca	5 Gal	140	L	
PM	Pachycereus marginatus Mexican Fence Post	5 Gal	12	L	

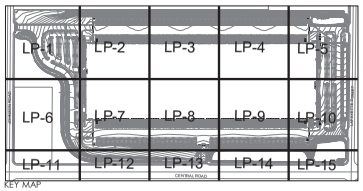
GROUNDCOVER

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
AR	Acacia redolens 'Low Boy' Dwarf Acacia	1 Gal	3140	L	8' OC 4.5' from hardscape
BP	Baccharis p. 'Pigeon Point' Dwarf Coyote Bush	1 Gal	49	L	6' OC 3.5' from hardscape
DG	Dalea greggii Trailing Indigo Bush	1 Gal	1626	L	8' OC 4.5' from hardscape
RH	Rosmarinus o. 'Huntington Carpet' Prostrate Rosemary	1 Gal	445	L	4' OC 2.5' from hardscape
RB	Ruellia brittoniana Mexicna petunia	1 Gal	447	L	3' OC 2' from hardscape

Hydro-seed - Boutelou a gracilis - Blue grama.

3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

4-6" crushed rock decorative rock -Desert Gold. single layer over filter fabric under all planting areas..



KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia,California 92870
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Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT
RICHARD D. HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

Revisions

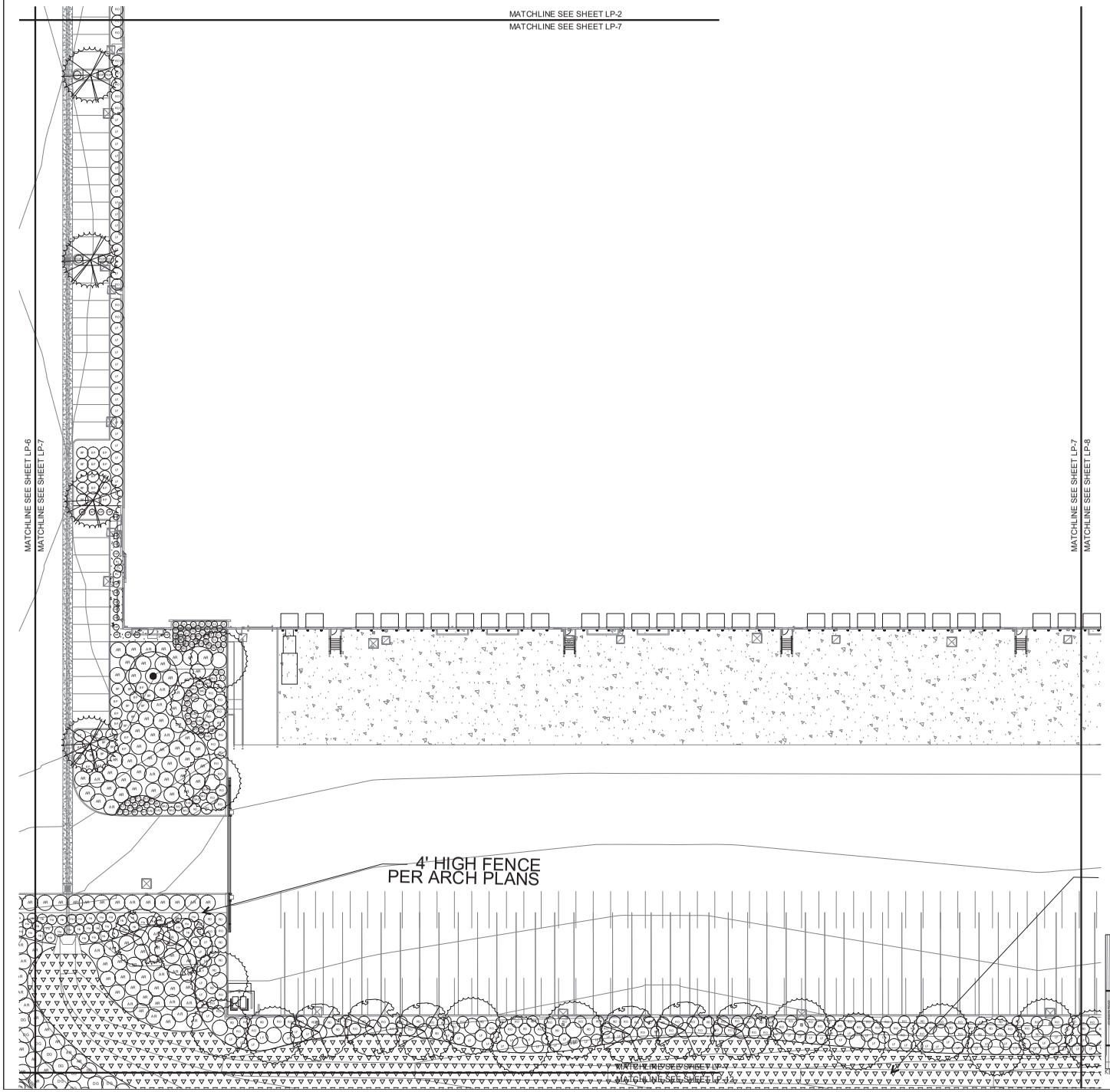
Date	Remarks

Sheet Title

Planting Plan

N

Scale	1" = 20'
Date	03/07/2023
Drawn by	TH
Job Number	22-101
Sheet No	LP-6



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
	Cercidium 'Desert Museum' Blue Palo Verde	24" Box	24	L	Multi
	Chilopsis linearis Desert Willow	24" Box	81	L	Multi
	Geijera parviflora Australian Willow	24" Box	99	L	Multi
	Pinus eldarica Afghan Pine	24" Box	172	L	Standard
	Pistacia chinensis Chinese Pistache	24" Box	67	L	Standard
	Platanus acerifolia London Plane	24" Box	60	M	Standard
	Prosopis chilensis Chilean Mesquite	24" Box	72	M	Standard
	Quercus agrifolia Live Oak	24" Box	7	M	Multi
	Rhus lancea African Sumac	24" Box	31	L	Standard
	Ulmus parvifolia Chinese Elm	15 Gal	27	L	Standard

SHRUBS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
BC	Baccharis p. 'Centennial' Coyote Bush	5 Gal	661	L	4' OC 2.5' from hardscape
CH	Cassia phyllodenia Silverleaf Cassia	5 Gal	897	L	4' OC 2.5' from hardscape
HA	Heteromeles arbutifolia Toyon	5 Gal	1597	M	5' OC 3' from hardscape
L	Leonotis leonurus Lion's Tail	5 Gal	289	M	3' OC 2' from hardscape
LF	Leucophyllum frutescens Texas Ranger	5 Gal	1393	M	4' OC 2.5' from hardscape
RI	Rhus ovata Sugar Bush	5 Gal	1557	M	6' OC 3.5' from hardscape
R	Rosmarinus o. 'Tuscan Blue' Rosemary	5 Gal	676	L	3' OC 2' from hardscape
SC	Salvia c. 'Allen Chickering' Allen Chickering Sage	5 Gal	848	L	4' OC 2.5' from hardscape
S	Salvia greggii Autumn Sage	5 Gal	292	L	3' OC 2' from hardscape

ACCENTS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
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AB	Agave 'Blue Glow Blue Glow Agave	5 Gal	23	L	
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HP	Hesperaloe parviflora Red Yucca	5 Gal	140	L	
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SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
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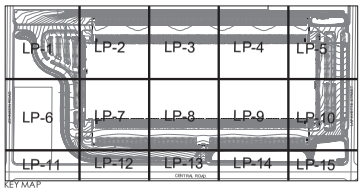
3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

4-6" crushed rock decorative rock -Desert Gold. single layer over filter fabric under all planting areas..



KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
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REGISTERED LANDSCAPE ARCHITECT TIMOTHY A. HUNTER 1/31/2025 STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

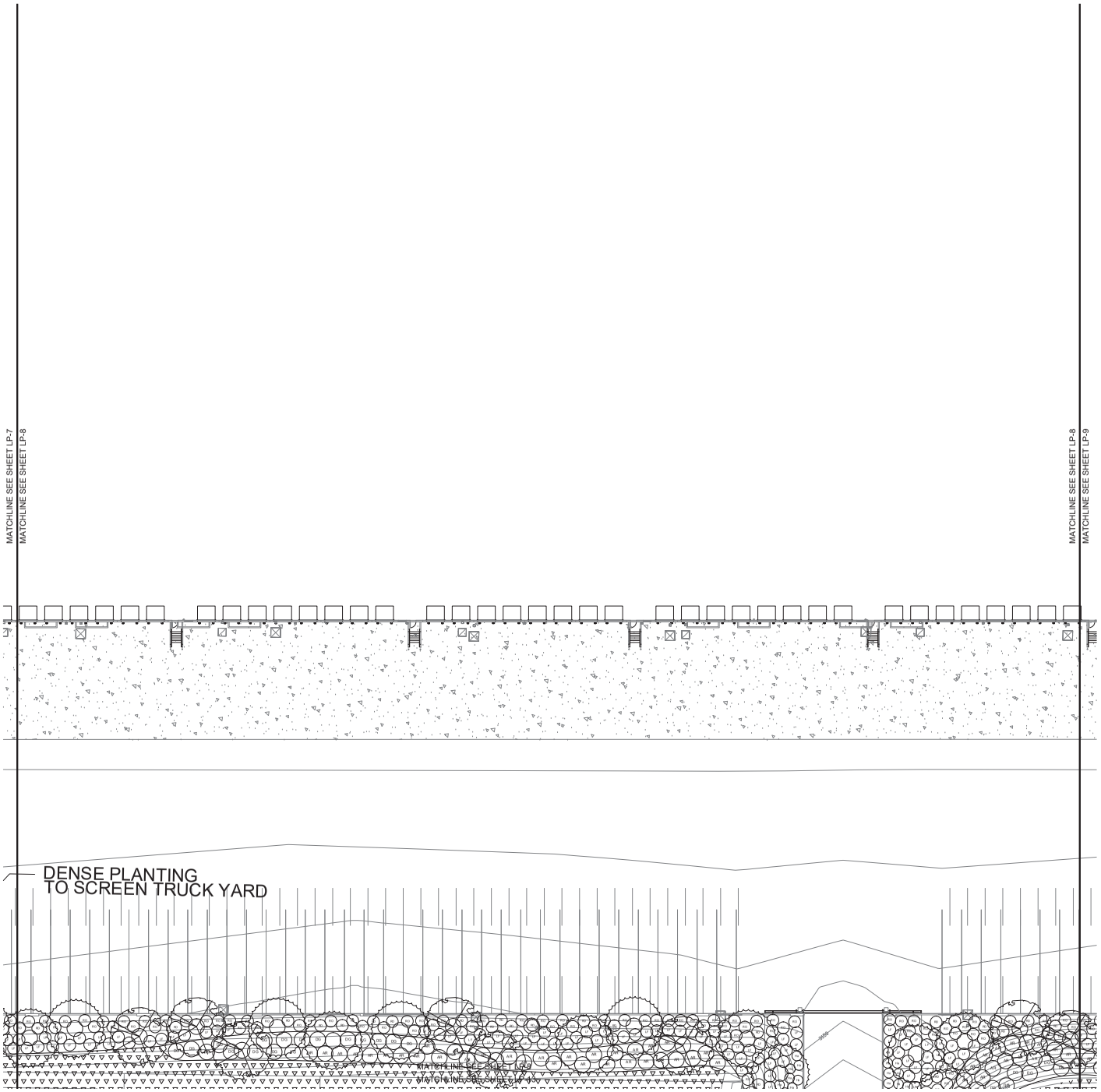
Revisions

Date	Remarks

Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-7



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
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	Platanus acerifolia London Plane	24" Box	60	M	Standard
	Prosopis chilensis Chilean Mesquite	24" Box	72	M	Standard
	Quercus agrifolia Live Oak	24" Box	7	M	Multi
	Rhus lancea African Sumac	24" Box	31	L	Standard
	Ulmus parvifolia Chinese Elm	15 Gal	27	L	Standard

SHRUBS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
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GROUNDCOVER

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
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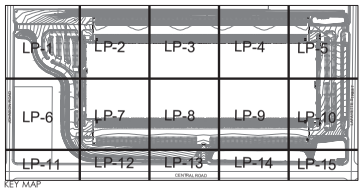
Hydro-seed - Boutelous gracilis - Blue grama.

3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

4-6" crushed rock decorative rock -Desert Gold. single layer over filter fabric under all planting areas..



KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia, California 92870
Ph: 714.986-2400
Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT
JAMES W. HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

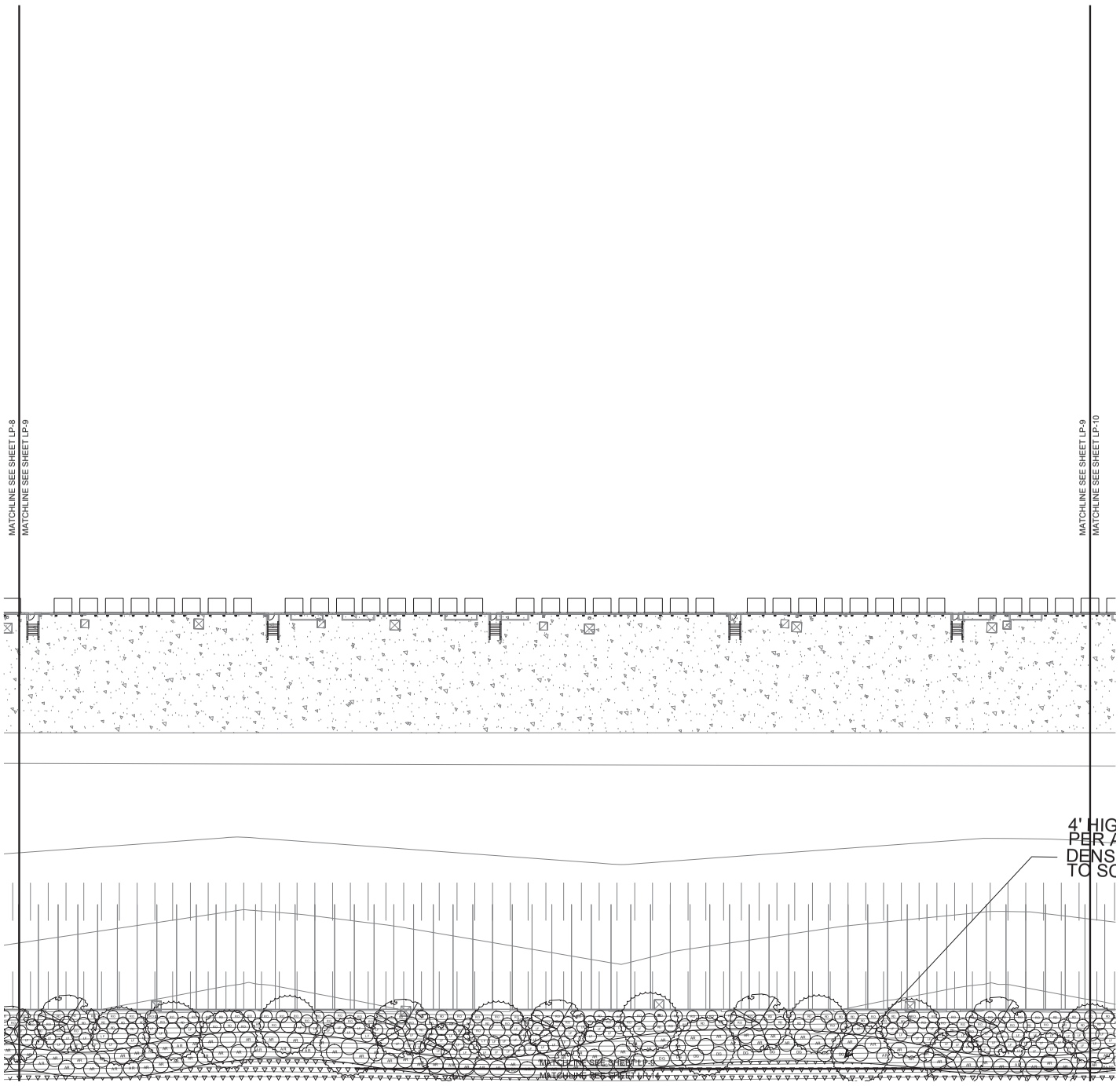
Revisions

	Date	Remarks

Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-8



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
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SHRUBS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
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L	Leonotis leonurus Lion's Tail	5 Gal	289	M	3' OC 2' from hardscape
LF	Leucophyllum frutescens Texas Ranger	5 Gal	1393	M	4' OC 2.5' from hardscape
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ACCENTS

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GROUNDCOVER

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
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Hydro-seed - Bouteloua gracilis - Blue grama.

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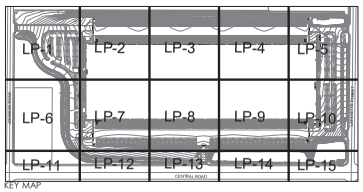

KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia,California 92870
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Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT CHRISTOPHER A. HUNTER 1/31/2025 STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

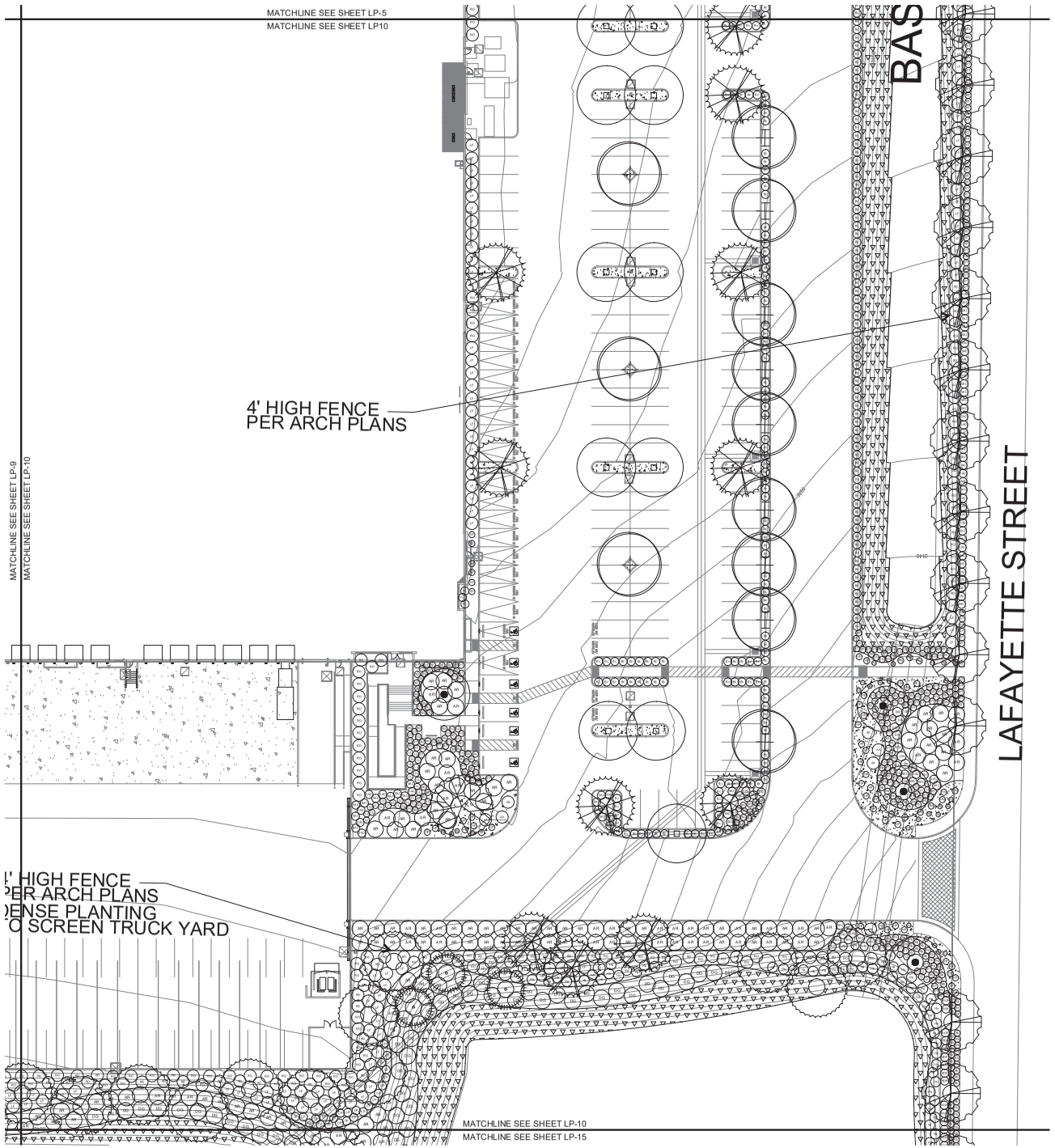
Revisions

Date	Remarks

Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-9



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	W.UCOLS	REMARKS
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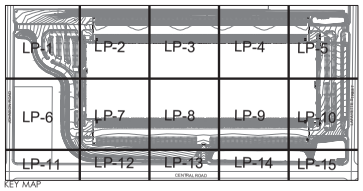

KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia,California 92870
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Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT — 1/31/2025 — STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

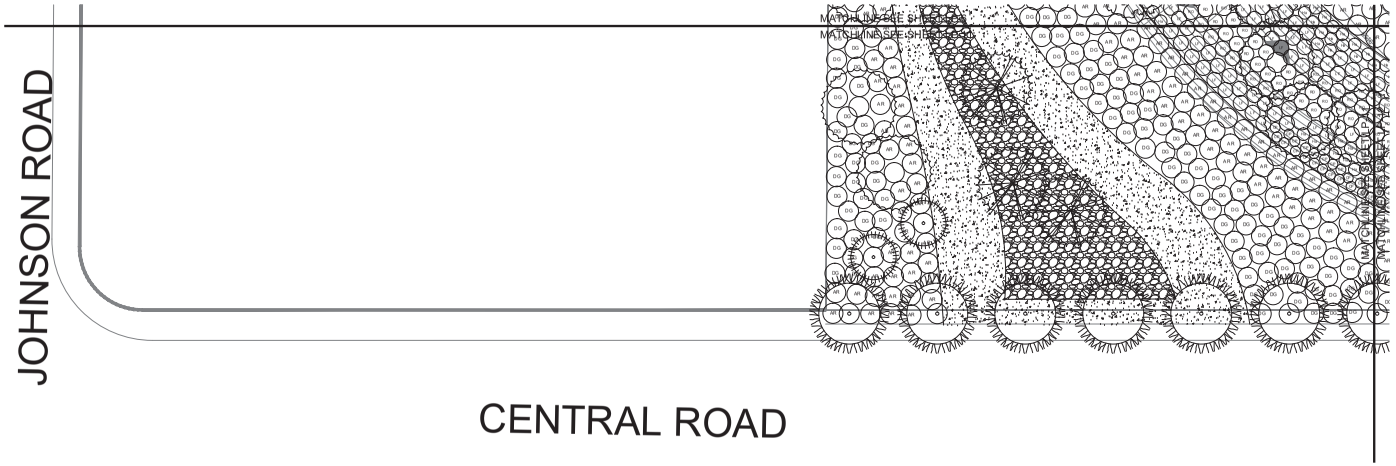
Revisions

Date	Remarks

Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-10



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
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RI	Rhus ovata Sugar Bush	5 Gal	1557	M	6' OC 3.5' from hardscape
R	Rosmarinus o. 'Tuscan Blue' Rosemary	5 Gal	676	L	3' OC 2' from hardscape
SC	Salvia c. 'Allen Chickering' Allen Chickering Sage	5 Gal	848	L	4' OC 2.5' from hardscape
S	Salvia greggii Autumn Sage	5 Gal	292	L	3' OC 2' from hardscape

ACCENTS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
A	Agave americana Century Plant	5 Gal	17	L	
AB	Agave 'Blue Glow Blue Glow Agave	5 Gal	23	L	
AP	Agave parryi Parry's Agave	5 Gal	75	L	
DW	Dasylerion wheeleri Desert Spoon	5 Gal	33	L	
HP	Hesperaloe parviflora Red Yucca	5 Gal	140	L	
PM	Pachycereus marginatus Mexican Fence Post	5 Gal	12	L	

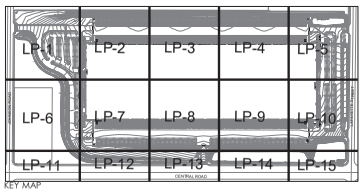
GROUNDCOVER

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
AR	Acacia redolens 'Low Boy' Dwarf Acacia	1 Gal	3140	L	8' OC 4.5' from hardscape
BP	Baccharis p. 'Pigeon Point' Dwarf Coyote Bush	1 Gal	49	L	6' OC 3.5' from hardscape
DG	Dalea greggii Trailing Indio Bush	1 Gal	1626	L	8' OC 4.5' from hardscape
RW	Rosmarinus o. 'Huntington Carpet' Prostrate Rosemary	1 Gal	445	L	4' OC 2.5' from hardscape
RI	Ruellia brittoniana Mexicna petunia	1 Gal	447	L	3' OC 2' from hardscape

Hydro-seed - Boutelloua gracilis - Blue grama.

3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

4-6" crushed rock decorative rock -Desert Gold. single layer over filter fabric under all planting areas..



KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia, California 92870
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Fax: 714.986-2408

REGISTERED LANDSCAPE ARCHITECT
TIMOTHY A. HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

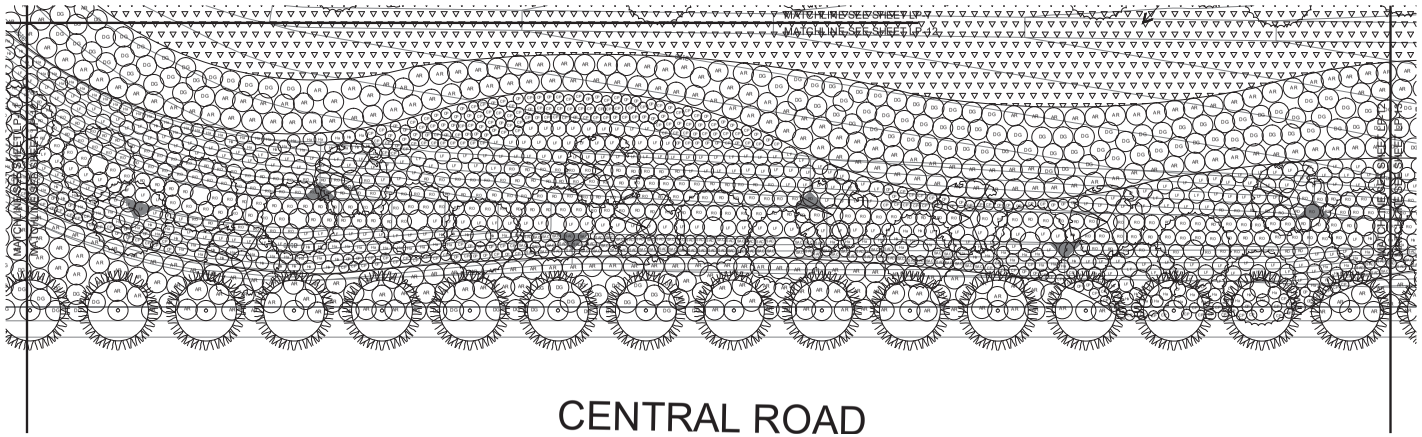
Revisions

	Date	Remarks

Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-11



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
	Cercidium 'Desert Museum' Blue Palo Verde	24" Box	24	L	Multi
	Chilopsis linearis Desert Willow	24" Box	81	L	Multi
	Geijera parviflora Australian Willow	24" Box	99	L	Multi
	Pinus eldarica Afghan Pine	24" Box	172	L	Standard
	Pistacia chinensis Chinese Pistache	24" Box	67	L	Standard
	Platanus acerifolia London Plane	24" Box	60	M	Standard
	Prosopis chilensis Chilean Mesquite	24" Box	72	M	Standard
	Quercus agrifolia Live Oak	24" Box	7	M	Multi
	Rhus lancea African Sumac	24" Box	31	L	Standard
	Ulmus parvifolia Chinese Elm	15 Gal	27	L	Standard

SHRUBS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	SPACING
BC	Baccharis p. 'Centennial' Coyote Bush	5 Gal	661	L	4' OC 2.5' from hardscape
CP	Caesia phyllodenia Silverleaf Cassia	5 Gal	897	L	4' OC 2.5' from hardscape
HA	Heteromeles arbutifolia Toyon	5 Gal	1597	M	5' OC 3' from hardscape
LO	Leonotis leonurus Lion's Tail	5 Gal	289	M	3' OC 2' from hardscape
LF	Leucophyllum frutescens Texas Ranger	5 Gal	1393	M	4' OC 2.5' from hardscape
RO	Rhus ovata Sugar Bush	5 Gal	1557	M	6' OC 3.5' from hardscape
RM	Rosmarinus o. 'Tuscan Blue' Rosemary	5 Gal	676	L	3' OC 2' from hardscape
SC	Salvia c. 'Allen Chickering' Allen Chickering Sage	5 Gal	848	L	4' OC 2.5' from hardscape
SG	Salvia greggii Autumn Sage	5 Gal	292	L	3' OC 2' from hardscape

ACCENTS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	WUCOLS	REMARKS
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AP	Agave parryi Parry's Agave	5 Gal	75	L	
DW	Dasylerion wheeleri Desert Spoon	5 Gal	33	L	
HP	Hesperaloe parviflora Red Yucca	5 Gal	140	L	
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GROUNDCOVER

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RH	Rosmarinus o. 'Huntington Carpet' Prostrate Rosemary	1 Gal	445	L	4' OC 2.5' from hardscape
RI	Ruellia brittoniana Mexicna petuntia	1 Gal	447	L	3' OC 2' from hardscape

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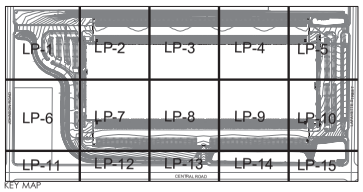
3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

4-6" crushed rock decorative rock -Desert Gold. single layer over filter fabric under all planting areas..



KEY MAP

HUNTER LANDSCAPE
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REGISTERED LANDSCAPE ARCHITECT
JEFF HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

Revisions

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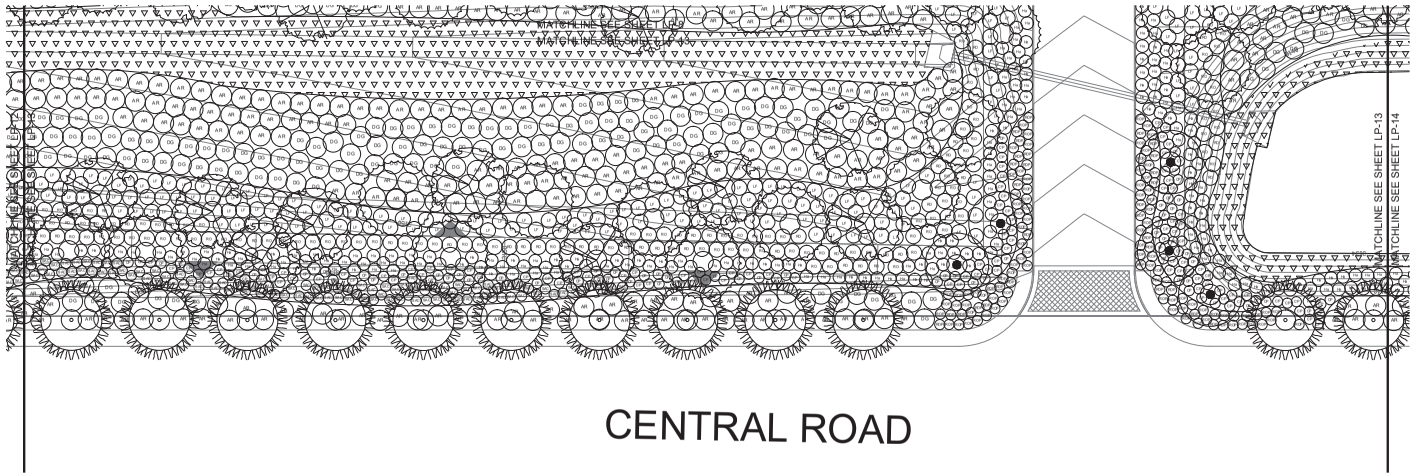
Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-12



PLANTING LEGEND

TREES

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	W.UCOLS	REMARKS
	Cercidium 'Desert Museum' Blue Palo Verde	24" Box	24	L	Multi
	Chilopsis linearis Desert Willow	24" Box	81	L	Multi
	Geijera parviflora Australian Willow	24" Box	99	L	Multi
	Pinus eldarica Afghan Pine	24" Box	172	L	Standard
	Pistacia chinensis Chinese Pistache	24" Box	67	L	Standard
	Platanus acerifolia London Plane	24" Box	60	M	Standard
	Prosopis chilensis Chilean Mesquite	24" Box	72	M	Standard
	Quercus agrifolia Live Oak	24" Box	7	M	Multi
	Rhus lancea African Sumac	24" Box	31	L	Standard
	Ulmus parvifolia Chinese Elm	15 Gal	27	L	Standard

SHRUBS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	W.UCOLS	SPACING
BC	Baccharis p. 'Centenial' Coyote Bush	5 Gal	661	L	4' OC 2.5' from hardscape
CP	Cassia phyllodenia Silverleaf Cassia	5 Gal	897	L	4' OC 2.5' from hardscape
HA	Heteromeles arbutifolia Toyon	5 Gal	1597	M	8' OC 3' from hardscape
L	Leonotis leonurus Lion's Tail	5 Gal	289	M	3' OC 2' from hardscape
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ACCENTS

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	W.UCOLS	REMARKS
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GROUNDCOVER

SYMBOL	BOTANICAL/COMMON NAME	SIZE	QTY	W.UCOLS	SPACING
AR	Acacia redolens 'Low Boy' Dwarf Acacia	1 Gal	3140	L	8' OC 4.5' from hardscape
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Hydro-seed - Boutelou a gracilis - Blue grama.

3/4" crushed rock decorative rock -Desert Gold. 2" layer over filter fabric under all planting areas..

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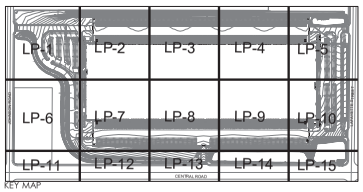

KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
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REGISTERED LANDSCAPE ARCHITECT
JEFF HUNTER
12/31/2025
STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

Revisions

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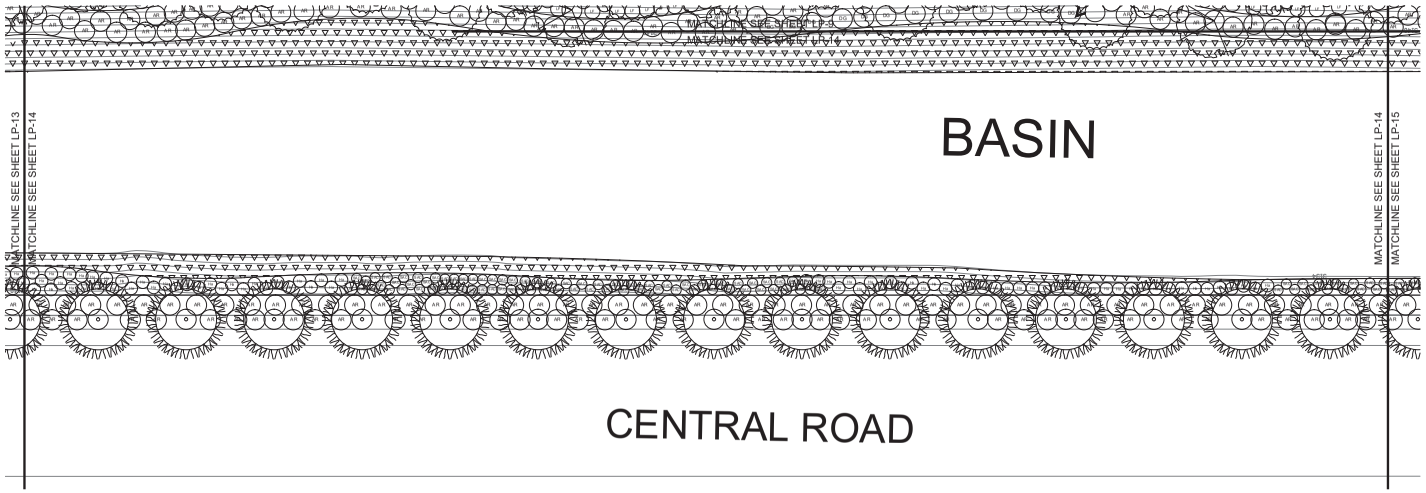
Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-13



PLANTING LEGEND

TREES

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GROUNDCOVER

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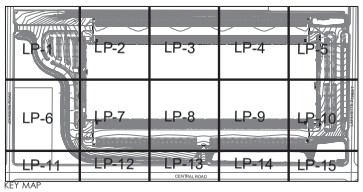

KEY MAP

HUNTER LANDSCAPE
711 S. Fee Ana Street
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REGISTERED LANDSCAPE ARCHITECT
RICHARD W. HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

Uncommon Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
Newport Beach, CA 92660

Submittals

Date	Description

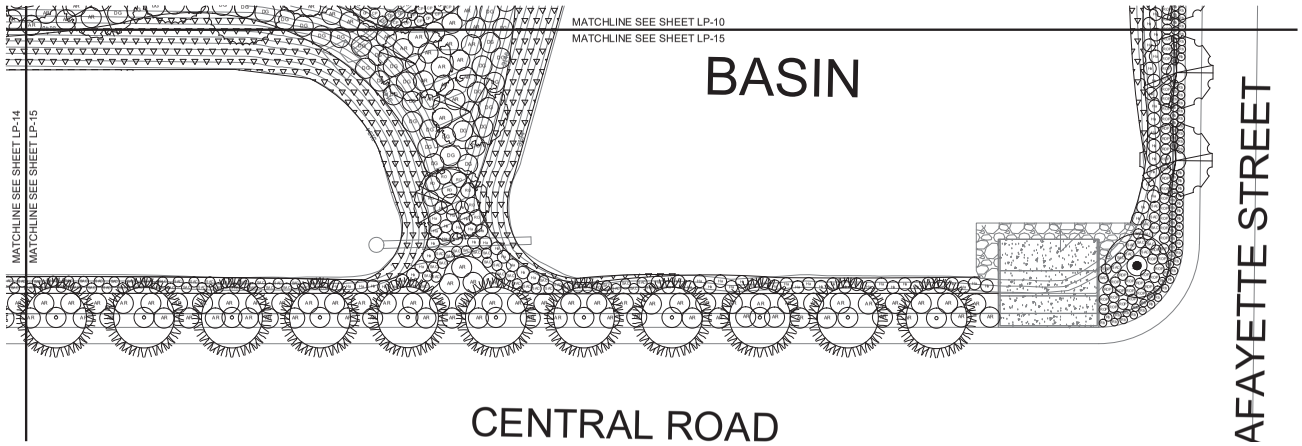
Revisions

	Date	Remarks

Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-14



PLANTING LEGEND

TREES

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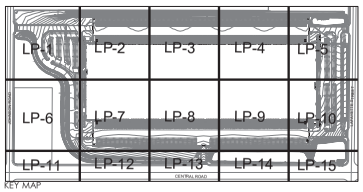

KEY MAP

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REGISTERED LANDSCAPE ARCHITECT
JEFF HUNTER
1/31/2025
STATE OF CALIFORNIA

Project

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Apple Valley, California

AP Investors Group
3 Corporate Plaza, Suite 230
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Submittals

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Revisions

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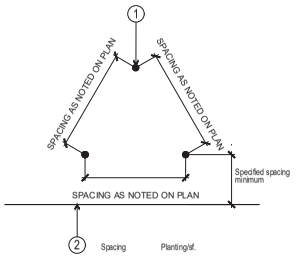
Sheet Title

Planting Plan

Scale 1" = 20'
Date 03/07/2023
Drawn by TH
Job Number 22-101
Sheet No LP-15

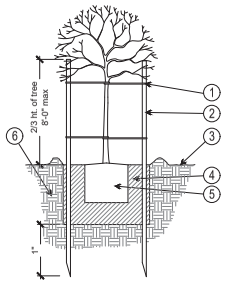


	Spacing	Planting/sf.
2	6" o.c.	4.61
	8" o.c.	2.60
	9" o.c.	1.78
	10" o.c.	1.66
	12" o.c.	1.15
	15" o.c.	0.74
	18" o.c.	0.50
	24" o.c.	0.28
	30" o.c.	0.18
	36" o.c.	0.12
	48" o.c.	0.07
	60" o.c.	0.04
	72" o.c.	0.03

LEGEND:

1. Shrub / Ground Cover
2. Curb, Wall, Pavement, or edge of bed.

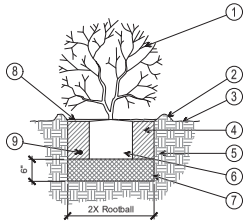
5 Triangular Spacing Diagram Scale: N.T.S



LEGEND:

1. 1/2" I.D. reinforced rubber hose Cinch Tie (V.I.T.)
2. 2" dia. x 10' long lodgepole pine stakes. Place stakes at outer edge of rootball.
3. Finish grade.
4. Plant pit.
5. Rootball.
6. Undisturbed soil.

3 Tree Staking Detail Scale: N.T.S



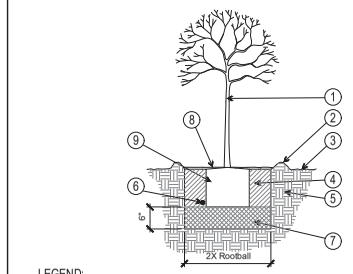
LEGEND:

1. 1 to 15 gal. shrub.
2. 4" deep water basin.
3. Finish grade.
4. Backfill mix, see specifications.
5. Undisturbed soil.
6. Rootball, size varies. Set 1" above grade.
7. 6" deep compacted backfill below rootball unless stated otherwise in the specs or a agronomic report.
8. 1" approved mulch, see specifications.
9. Plant tablets, see specifications.

NOTES:

1. Scarify the sides and bottom of planting pit.
2. Prior to plant placement, fill all backfill pits with water and allow to percolate into subsoil.
3. Plant rootball and backfill mix must be thoroughly watered indirectly after planting.

2 Shrub Planting Detail Scale: N.T.S



LEGEND:

1. Tree
2. 4" deep temporary water basin.
3. Finish grade.
4. Backfill mix, per specifications.
5. Undisturbed soil.
6. Planting tablets, per specifications.
7. 6" compacted backfill below rootball unless stated otherwise in the specs. or a agronomic report.
8. 1" approved mulch per specs.
9. Rootball, size varies. Set 1" above grade.

NOTES:

1. Scarify the sides and bottom of planting pit.
2. Prior to plant placement, fill all backfill pits with water and allow to percolate into subsoil.
3. Plant rootball and backfill mix must be thoroughly watered indirectly after planting.

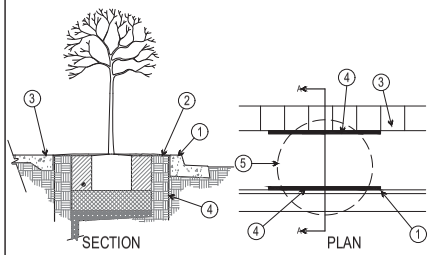
1 Tree Planting Detail Scale: N.T.S

PLANTING NOTES:

1. CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE LOCATION OF ALL–UNDERGROUND UTILITIES, PIPES AND STRUCTURES USING ALL AVAILABLE INFORMATION.
2. DO NOT WILLFULLY PROCEED WITH CONSTRUCTION AS DESIGNED WHEN IT IS OBVIOUS THAT UNKNOWN OBSTRUCTIONS AND/OR GRADE DIFFERENCES EXISTING THAT MAY NOT HAVE BEEN KNOWN DURING DESIGN. SUCH CONDITIONS SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE OWNER'S AUTHORIZED REPRESENTATIVE.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR ANY COORDINATION WITH SUBCONTRACTORS AS REQUIRED TO ACCOMPLISH PLANTING OPERATIONS.
4. LANDSCAPE CONTRACTOR TO RECEIVE SITE GRADE TO +0.10. CONTRACTOR SHALL OBTAIN LETTER OF GRADE CERTIFICATION FROM OWNER PRIOR TO PROJECT EXECUTION.
5. SEE SPECIFICATIONS FOR PLANTING REQUIREMENTS, MATERIALS AND EXECUTION.
6. CONTRACTOR SHALL NOTIFY OWNER'S AUTHORIZED REPRESENTATIVE 72 HOURS (WEEKENDS NOT INCLUDED) PRIOR TO COMMENCEMENT OF WORK TO COORDINATE PROJECT OBSERVATION SCHEDULES.
7. SEE DETAILS AND NOTES FOR STAKING METHODS, PLANT PIT DIMENSIONS, AND BACKFILL REQUIREMENTS.
8. IF CONFLICTS ARISE BETWEEN SIZE OF AREAS AND PLANS, CONTRACTOR IS TO CONTACT LANDSCAPE ARCHITECT FOR RESOLUTION.
9. ALL PLANTS SHALL BE TRIANGULARLY SPACED UNLESS OTHERWISE INDICATED.
10. INSTALL 6"X6" CONCRETE MOW CURB BETWEEN ALL SHRUB, TURF AND ROCK/ DECOMPOSED GRANITE AREAS.
11. MULTI–TRUNK INDICATES (3) TRUNKS (MIN) BRANCHED FROM THE BASE OF THE TREE.
12. CONTRACTOR SHALL SUBMIT PHOTOS OF ALL REPRESENTATIVE TREES AND SHRUBS WITH SPECIFICATIONS ON THE BACK OF PHOTO INDICATING HEIGHT, WIDTH AND CALIPER.
13. IT IS THE CONTRACTOR'S RESPONSIBILITY TO FURNISH PLANT MATERIALS FREE OF PESTS OR PLANT DISEASES. PRE–SELECTED OR "TAGGED" MATERIAL MUST BE INSPECTED BY THE CONTRACTOR AND CERTIFIED PEST AND DISEASE FREE. IT IS THE CONTRACTOR'S OBLIGATION TO WARRANTY ALL PLANT MATERIALS PER THE SPECIFICATIONS.
14. ALL SHRUB LOTS SHALL BE LABELED CLEARLY INDICATING THE SPECIES AND VARIETY OF PLANT MATERIAL.
15. INSTALL LINEAR ROOT BARRIERS AT ALL TREES WITHIN 5' OF CONCRETE WALKWAYS, STRUCTURES, WALLS, CURBS, ETC.. OR PER CITY REQUIREMENTS.
16. INSTALL 3" OF MEDIUM WALK ON BARK MULCH (1/2"–3/4") IN ALL PLANTING BEDS. (SEE SPECIFICATIONS)
17. ALL ABOVE GROUND UTILITIES TO BE SCREENED WITH APPROPRIATE PLANT MATERIAL.

SUBMITTALS AND INSPECTIONS

1. CONTRACTOR SHALL PROVIDE PHOTOS OF ALL PLANT MATERIAL WITH SCALE REFERENCE FOR APPROVAL OF LANDSCAPE ARCHITECT.
2. CONTRACTOR SHALL NOTIFY THE LANDSCAPE ARCHITECT 48 HOURS IN ADVANCE OF TREE, SHRUB AND GROUNDCOVER PLANTING. PLANT MATERAIL SHALL BE LAID OUT AND READY FOR PLANTING. LANDSCAPE ARCHITECT TO APPROVE LAYOUT PRIOR TO PLANTING. PRE–PLANTING MAY RESULT IN REPLANTING AT THE DISCRETION OF LANDSCAPE ARCHITECT.



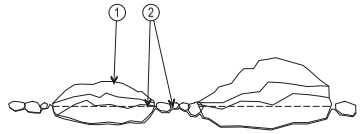
NOTES:

A. Position barrier as close to curb or sidewalk as possible. Raised root protectors shall be facing towards the tree.
B. Top of barrier shall be 1" above finished grade.
C. Length of root barrier shall be 10' in each direction of tree trunk.
D. Apply a mastic sealer to joint between concrete surfaces and root control barrier.
E. Root barriers are to be used on trees within 6'-0" of a curb, sidewalk or wall.
F. Installation of panels within soil preparation area will be rejected.
G. Install per manufacturer's recommendations.
H. For planting, see Tree Planting Details this sheet.

LEGEND:

1. Concrete curb.
2. Finished grade.
3. Sidewalk.
4. Root barrier.
5. Dripline of tree (defined by the minimum spacing distance in the Root Barrier Notes

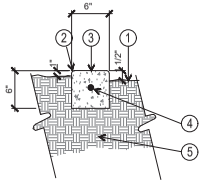
6 Root Barrier Detail Scale: N.T.S



LEGEND:

1. Boulders - size varies. Bury 1/3 in grade.
2. Surrounding grade/gravel.

5 Boulder Detail Scale: N.T.S.



LEGEND:

1. Finished grade, adjacent planting area
2. 1/2" radius, typical.
3. Poured in place concrete curb.
4. #3 rebar continuous.
5. Compacted subgrade per soils engineer's report.

ALL IMPROVEMENTS TO BE MAINTAINED BY THE PROPERY OWNER.

7 Concrete Mow Curb Scale: N.T.S

HUNTER LANDSCAPE
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Placentia, California 92870
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Project

1M Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks

Sheet Title

Planting Details

Scale

Date 03/07/2023

Drawn by TH

Job Number 22-101

Sheet No LP-16

LANDSCAPE CONSTRUCTION

1. SCOPE

The scope of this section includes all labor, materials and equipment required to complete work indicated on the drawings. The work shall be performed in accordance with the best standards practiced relating to the various trades and under the continuous supervision of a competent foreman, capable of interpreting the drawings and these specifications. The work included in this section is as follows: Finish Grading for Planting; Soil Preparation; Fertilization; Planting, including Lawn; Maintenance; Inspection and Certifications; Guarantees; Cleanup; Staking; Guying; Espalliering; and Miscellaneous Allowance.

2. APPROVALS

A. All sprinkler work shall be inspected and approved prior to the start of any work.

B. Prior to excavation for planting or placement of stakes, locate all utilities, electric cables, conduits, sprinklers lines, heads, valves and valve control wires, and all utility lines so that proper precautions may be taken not to damage such improvements. In the event of a conflict between such lines and plant locations, promptly notify Landscape Architect (LA) who shall arrange for relocation for one or the other. Failure to follow this procedure places upon Contractor the responsibility for, at his own expense, making any and all repairs for damages resulting from work hereunder.

3. QUANTITIES AND TYPES

Plant materials shall be furnished in the quantities and /or spacing as shown noted for each location, and shall be of the species, kinds, sizes, etc. as symbolized and/or described in the "Plant Materials Legend", as indicated on the drawings. The LA has prepared this list only as a convenience to Contractor and assumes no responsibility for its accuracy. The Landscape Contractor is to verify all sizes and quantities

4. VERIFICATION OF DIMENSIONS AND QUANTITIES

Dimensions are approximate before proceeding with any work, Contractor shall verify all dimensions and quantities and shall immediately inform LA and Owner of any discrepancies between the drawings and/or specifications and actual conditions. No work shall be done in any area where there is such a discrepancy until approval for same has been given by LA and owner.

5. INSPECTION

A. All inspections shall be made by LA and Owner. Contractor shall request inspection at least two (2) days in advance of the time inspection is required.

B. Inspection will be required for the following parts of the work.

(1) During finish grading and soil preparation.
(2) Plants, after delivery to site and prior to planting.
(3) When vines, shrubs and trees are spotted for planting. But planting holes are not excavated.
(4) Specimen trees at source before delivery.
(5) Lawn areas prior to planting.
(6) Planting areas prior to planting.
(7) All landscape construction items, prior to the start of the calendar day maintenance period ("final inspection")
(8) At completion of calendar day maintenance period ("Final Maintenance Inspection").
(9) Inspection reports shall be made for each inspection by the LA and one copy shall be submitted to Owner and Contractor.

6. CERTIFICATION

Prior to job acceptance written certifications shall be submitted to the LA for the following:

A. Quantity and Quality for Commercial Fertilizer and Organic Fertilizer.

B. Quantity and Quality of all Soil Amendments called for by Plans and Specifications

7. MATERIALS

Plant materials indicated on the drawings and herein specified shall conform to the following:

A. Nomenclature - Plant names indicated on the drawings conform to "Standard Plant Names" established by the American Joint Committee on Horticulture. Except for names covered therein, the established custom of the nursery followed.

B. Condition - Plants shall be symmetrical, typical for variety and species, sound, healthy, vigorous, free from plant diseases, insect pests, or their eggs, and shall have healthy, normal root systems, well filling their containers, but not to the point of being root bound. Plants shall not be pruned prior to delivery, except as authorized by the LA or his representative. In no case shall trees be topped before delivery.

C. Dimensions - The height and spread of all plant material shall be measured with branches in their normal position, and shall be as indicated on the drawings. The caliper of all trees shall be measured 4'-0" above the surface of the ground. Where caliper other dimensions of any plant materials are omitted from the "Plant Legend", it shall be understood that these plant materials shall be normal stock for type listed

D. Inspection - All plant materials must have been previously inspected at the nursery by the County Horticultural Department shall be subject to the inspection and approval of the LA before planting.

E. Plant List - is indicated on drawings.

F. Size of Plants - Shall be as stated on the plan. Container stock (1 - gallon, 5 gallon and 15 - gallon), shall have been grown in containers for at least one (1) year, but not over two years.

G. Substitutions - Substitutions for the indicated plant materials will be permitted provided the substituted materials are approved in advance by the LA, and the substitutions are made at no additional cost to Owner. Except for authorized variations, all substitute plant materials shall conform to the requirements of these specifications. If the accepted substitute plant materials are of a less value than those indicated or specified, the Contract price will be adjusted in accordance with the provisions of the Contract.

H. Plants Not Approved - Plants not approved are to be removed from site immediately and replaced with suitable plants The LA and/or Owner reserves the right to reject entire Lots of plant represented by defective samples.

8. FERTILIZERS AND SOIL CONDITIONERS

Samples of all soil amendments, sod and plants shall be submitted for inspection and stored on the site until furnishing of materials is completed. Delivery may begin upon approval of samples or as directed by LA and the Owner.

A. Organic fertilizer shall be processed sewage sludge with a minimum content of 1% Nitrogen and 2% Phosphoric Acid similar to "Nitrohumius". Method of processing shall not destroy normal bacterial content.

B. Nitrogen stabilized sawdust shall be bulk, with the following nitrogen content based on dry weight:

0.5% for redwood Sawdust
0.7% for Fir Sawdust
1.0% for Bark or Pine Bark or Mixture

Salinity - the saturation extract conductivity shall not exceed 3.5 millimhos/cm at 25

C. Commercial fertilizer shall be delivered in sacks with manufacturer's label showing weight and analysis attached to each sack.

9. STAKING MATERIALS

A. Tree staking shall be as per plan.

B. Ties for holding trees shall be as per plan.

10. GRADING AND SOIL PREPARATION

A. Contractor is to finish grade to with 1/10th of a foot or 1" below paving where paving exists.

B. Moisture Content - the soils shall not be worked when the moisture content is so great that excessive compaction will occur, and not when it is so dry that dust will form in the air or that clods will not break readily. Water shall be applied if necessary to provide ideal moisture content for tilling and for planting.

C. Preliminary Grading - Preliminary grading shall be done in such manner as to anticipate the finish grading. Excess soils is to be replaced by plants and mulch, allowance shall be made so that when finish grading has begun, there shall be no deficiency in the specified depth of mulched planting beds.

D. Weeding - Before and during preliminary and finish grading, all weed and grass shall be dug out by the roots and disposed of off site (except those weeds and grasses not of the perennial type, less than 2-1/2" high and not bearing seeds, which may be turned under). Oats more than 2" 1/2" high and not bearing seeds may be turned under. Perennial weeds and grasses to be removed include, but are not limited to, the following: Nut Grass, Puncture Vine, Dallas Grass, Mustard Plant, St. Augustine, Alfalfa, Johnson Grass, Wire Weed, Morning Glory.

E. All planting areas shall be scarified to a depth of 12 inches below grade with the spacing of the ripper teeth no greater than 12 inches on center prior to placing conditioners and fertilizers. All rock and debris more than 2" in diameter shall be removed from the site.

F. Trenches - If irrigation system is installed after grading and fertilizing is completed, the upper portion of the backfill shall be refilled and fertilized to the depth specified for the area required, to conform to the specifications.

11. SOIL CONDITIONERS

A. Turf, Ground Cover and Shrub Area: With the exception of the slopes the areas to be landscaped should be cross-ripped or otherwise tilled to a depth of 9-12 inched. For turf and ground cover planting, the following amendments should be uniform by broadcast and thoroughly incorporated to a depth of 6 inches by means of rototilling or equal; AMT Per 1,000 Square Feet 6 cu. yrds. nitrogen stabilized organic amendment derived form redwood sawdust, fir sawdust or cedar sawdust 12 lb. 16-20-0 ammonium phosphate (to be incorporated to the 6" depth following leaching). Following amending and prior to planting, including trees and shrubs, leaching irrigation should be made in a manner that will pass the minimum of 12 inches of water through the surface soil zone. When the leaching program has been completed, additional samples should be collected for soil fertility analysis only.

B. Slopes

300 lbs /acre 16-20-0 ammonium phosphate
300 lbs/acre urea formaldehyde
Mulch Silva Fiber Plus, 2,000 lb./acre
Binding agent (per contractor's accepted proceedure)

While the urea formaldehyde is a slow release nitrogen fertilizer, it will probably be necessary to make dry supplemental fertilizer applications, particularly during the establishment period. If this is the case, the 16-20-0 should be uniformly broadcast over dry slope areas to the rate of 6 pounds per 1,000 square feet and followed with normal irrigation at each fertilizing period.

C. Planting Pots - Tree and Shrub, All areas including slopes: Planting pits shall be excavated twice the diameter and twice the depth of the rootball. Backfill shall then be added as specified.

(1) A chemically suitable sandy textured import soil meeting the following specifications should be used for backfill to the depth of the rootball. For trees, shrub and vines (other than azaleas, ferns and palms).

Silt plus clay content to the import soil shall not exceed 30% by weight with a minimum 95% passing the 2.0 millimeter seeve. The sodium absorption ratio (SAR) shall not exceed 6 and the electrical conductivity (ECe) shall not exceed 3.0 millimhos per centimeter at 25 degrees centigrade. The boron content shall be no greater than 1 ppm as measured on the saturation extract. In order to insure conformance, samples of the import soil should be submitted to the laboratory for analysis prior to and follow backfilling. The backfill mix for use are in the following, should be prepared as follows:

6 parts be volume sandy textured import soil
4 parts by volume nitrogen stabilized wood residual
1 lb. 16-20-0 per cu. yd. of mix
2 lb. iron sulfate per cu. yd. of mix

The above materials should be thoroughly blended prior to use for backfill purposes. Also, the iron sulfate should not contact cement surfaces since severe staining could occur. Apply planting tablets as per manufacturer's recommendations. If the 16-20-0 is incorporated preplant as recommended the post plant maintenance can consist primarily of a nitrogen-only fertilizer program. Beginning approximately 30 days after planting, ammonium sulfate should be applied at the rate of 5 lbs./1000 s.f. or ammonium nitrate at the rate of 3 lbs./1000 s.f. on a monthly basis. However, in order to ensure continuing adequate soil phosphorus and potassium nutrition, Best Fertilizer Company's 16-2-8 or equal should be substituted for the nitrogen materials twice a year at the rate of 6 pounds per 1000 square feet. Also, when plants have become well established, the frequency of fertilizer applications can be decreased.

D. The prepared soil shall be uniformly blended in an area adjacent to the plant work and shall be accurately proportioned using a suitable measuring container. Excavation soil shall be removed from site. Protect the mix from water until to has been placed in backfill around plants.

12. FINISH GRADING

When preliminary grading, including weeding and fertilizing, has been completed and the soil has dried sufficiently to be readily worked, all lawn and planting areas shall be graded to the elevation indicated on the drawings. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given. Minor adjustments of finish grades shall be made at the direction of the LA, if required

Finish grade shall be a smooth, even and uniform plane without abrupt change of surface. Soil areas adjacent to buildings to allow a natural run-off of water, and surface drainage shall be directed as indicated on the drawings by remodeling surfaces to facilitate the natural "run-off" of water. Low spots and pockets shall be one inch below grade of adjacent pavement of any kind. Grading shall be done when soil is at optimum moisture content for working.

13. METHOD OF PLANT AND WORK PROCEDURE

A. No planting shall be done until all operations in conjunction with the installation of the irrigation system have been completed, final grades have been established, the planting areas have been properly graded and prepared as specified, and the work approved by the LA.

B. The relative position of all trees and plants is subject to approval by LA and Owner, and they shall, if necessary, be relocated as directed as part of the contract.

C. All plants shall be removed form their container and set so that, when settled, they bear the same relation to the required grade that they bore to the natural grade before being transplanted. Each plant shall be planted in the center of the pit and backfilled unless otherwise specified, with the prepared soil. No soil in muddy condition shall be used for backfilling. No filling will be permitted around trunks or stems. All broken or frayed roots shall be properly cut off.

D. LA and/or Owner shall supervised the placing and planting of all plants.

E. In the event the underground construction work or obstructions are encountered in the planting operation, alternate locations for plant material will be selected by LA and Owner; operation will be done at no extra cost to Owner.

14. PLANTING OF TREES

A. Position plants in plant location as indicated on drawings and secure approval before excavating pits, making necessary adjustments as indicated.

B. All pits for trees shall be dug square with bottoms level, the length of sides equal to 2 1/2 times the diameter of the tree ball. Compacted solid at sides and bottoms shall be loosened by scarifying or other approved method. Pits shall be backfilled with "prepared soil" to the required grade , and the balance of the pit filled with "prepared soil" thoroughly settled by water application.

C. Set plant in center of pit, in a vertical position, so that crown of ball will be level with finish grade after allowing for watering and settling and shall bear the same relationship to the finish grade that it did to the soil surface in the container.
Prepare depressed water basin as wide as plant balls at each plant. Water thoroughly, backfilling any voids with additional prepared plant mix.

15. PLANTING VINES SHRUBS AND GROUND COVERS

A. Vines and shrubs shall be planted in pits at least 18" greater than their ball of earth and at least 12" below the bottom of the ball. Compacted soil at bottom of pit shall be loosened and the pit filled with "prepared soil" to the bottom of the ball. When the plant has been properly set, the pit shall be filled to the required grade with "prepared soil" and thoroughly settled by taping and watering. All vines shall be removed from stakes, untied, and securely fastened in an approved manner to the wall, fence or other surface next to which they are planted.

B. Prepare a depressed water basin as wide as plant balls at each plant. Water thoroughly, backfilling any voids with additional prepared planting mix

C. Ground Covers

(1) Pits for flat sized plants to be at lest 6"x6"x6". Ground cover areas shall be moistened prior to planting. No flat plants shall be planted in dry soil.

(2) Set plants in center of pits so that crown of plant will be level with finished grade after setting of soil, then backfill and water

(3) Flatted plants shall be well -rooted with runners at least 4" but not more than 6" in length.

16. TREES AND VINES OCCURRING IN LAWN

Trees and vines occurring in lawn shall be planted before final preparation of those areas.

17. CARE OF PLANTS BEFORE AND DURING PLANTING

Plants shall not be allowed to dry out before or while being planted. Keep moist by means of wet sawdust, peat moss or burlap at all times during planting operations. Do not expose roots to the air except while being placed in the ground. Wilted plants, whether in place or not, will not be accepted and shall be replaced at the Contractor's expense.

18. WATERING BASINS

A. Construct a firmly compacted mound of soil around each tree and plant to form a watering basin at the edge of and following the shape of the planting pit area. Mounds or trees and for vines from -5 gallon or larger containers, shall be at least 4" high. Mounds for all other trees, vines or plants not otherwise specified shall be at least 2" high. Excavated earth if capable of retaining water, may be used. Any settlement within the basins retaining water shall be refilled to the required grade with prepared soil, and additional nitrogen stabilized sawdust worked into the surface as required to restore the mulch condition.

B. At the end of the day maintenance period all watering basins in lawn areas shall be leveled to finish grade and the area shall be sodded with the specified sod.

19. SODDED LAWN

A. Cultivate all lawn areas to a depth of 8". Rocks and debris larger than 1" in diameter which are brought to the surface by cultivation shall be removed from the site. If cultivation does not break lumps, a spike tooth harrow shall be pulled behind a mechanical seeder or tractor.

B. Areas to be planted in lawn shall be finished smooth to present a neat and uniform grade prior to installation of sod. The lawn bed shall be inspected by the LA to determine suitability for planting prior to sodding. Contractor shall obtain such approval before sodding

C. All sodded areas shall be thoroughly watered. Lawns are to be kept continuously moist by watering as often as required.

Any lawn areas that do not show a prompt catch of grass shall be re-sodded at ten day intervals until an acceptable stand of grass is assured.

20. WATERING

A. Immediately after planting, water shall be applied to each tree by means of a hose. the water shall be applied in a moderate stream in the planting holes until the material about the roots is completely saturated from the bottom of the hole to the top of the ground.

B. Plants which can not be watered efficiently with the existing water system shall be watered by means of a hose.

C. Apply water in sufficient quantities, and as often as seasonal conditions require, to keep the ground wet at all times, well below the root system of grass and planting. Care is to be taken in watering slopes so as not to cause erosion damage.

D. Following the planting of ground cover plants furnished in flats, each plant shall be immediately and thoroughly watered by means of a hose with a slow running stream of water.

21. TREE STAKING

A. Stake all non-guyed trees at time of planting by placing stake in the prepared hole and driving it 18" into solid ground. Plant the tree as close to the stake as possible without crowding the roots. Fasten the tree to the upper end of stake in at least two places using "V.I.T. Cinch-Tie". (see drawings.)

B. Tree 48" box size or larger, shall be immediately guyed after planting with not less than three guys per tree, or as directed by the LA

(1) Protect bark of tree by covering wire with green 1/2" diameter rubber hose.
(2) Guys to be anchored by 2"x2"x2" redwood driven flush with finish grade or 1"x2" galvanized pipe in rocky areas.
(3) Guy wires shall be #12 Ga. galvanized wired. Mark guys with 3'-0" long 1/2" dia. white PVC pipe.
(4) Guy lines are to be tightened to firm tension.

22. ESPALIER OF VINES

All trellises and stakes are to be removed form plants and the plants shall be fastened and trained against fences or walls as directed by the LA

23. CERTIFICATES

In addition to any other certificates specified, Contractor shall furnish a certificate with each delivery of bulk material, stating the source, quantity and type of material and that the material conforms to the specification requirements. For bulk delivered organic fertilizer, the certificate shall also state the volume, net weight, percent of Nitrogen and percent of Phosphoric acid. For each fertilizer and soil conditioner, in containers, a similar certificate or invoice shall be furnished stating total quantities by weight and volume for each material. These certificates shall be submitted to the LA and Owner prior to the start of the maintenance period.

24. PROTECTION

Contractor shall carefully and continuously protect all areas included in the Contract, including plant materials, fences, supports, etc., until final acceptance of the work by the LA and Owner.

25. MAINTENANCE

A. Contractor shall maintain a sufficient number of men and adequate equipment to perform the work here in specified. Plant maintenance work shall consist of applying water, weeding, caring for plants, including ground covers, shrubs and trees, edging, aerating and mowing of lawns, fertilizing and control of pests and diseases.

B. Damage to any planted area shall be repaired immediately. Depressions caused by vehicles or foot traffic shall be filled with topsoil, leveled and replanted. Exterminate gophers and moles, and repair damage.

C. The entire project shall be maintained for a period of 60 days commencing from the time all items of work have been completed to the satisfaction of LA and Owner.

D. The project shall be cared for in a neat, clean condition at all times to the satisfaction of Owner and LA

26. LAWN MAINTENANCE

A. Watering - Water every day once per day for two weeks and thereafter gradually reduce frequency of watering to three times per week. Contractor shall continue to maintain the lawn until final acceptance by the LA and Owner.

B. Fertilizing - Apply 16-6-8 at the rate of 5 ponds per 1000 square feet three weeks after installation and water immediately thereafter.

C. Diseases and Pest Control - Two weeks after installation of lawn, apply a granular mercurial fungicide of 1.8% mercurous chloride as per manufacturer's recommendation.

D. Mowing - The lawn shall be mowed at a height of 1 1/2" with a rotary mower, equipped with rollers, before it reaches 2" in height. Collect grass clipping during mowing operations and remove from the site.

27. GROUND COVER AND SHRUB AREA MAINTENANCE

A. Watering - New plants shall be watered once per day for two (2) weeks after installation. Reduce watering to every other day for the next two (2) weeks. Water thereafter three (3) times per week until final acceptance.

B. Fertilize - Fertilize three (3) weeks after planting with 5 pounds 16-6-8 per 1000 square feet; fertilize thereafter every thirty (30) days.

C. Disease and Pest Control - For control of slugs and sails, apply pelletized tricalcium arsinate 5% by weight and metaldehyde 5% by weight as per manufacturer's recommendations two (2) weeks after installation.

D. Pruning - All shrubs and trees shall be pinch pruned as necessary to encourage new growth and to eliminate rank sucker growth. Old flowers, and dead foliage and limbs shall be removed. No major pruning shall be done without the approval of the LA

E. Weeding - all planting areas including lawn, ground cover and shrub areas shall be kept weed free at all times. Weed shall be dug out by the roots and disposed of off site. Upon completion of the day maintenance period, the Contractor shall fertilize per #26 - lawn Maintenance and #27 Ground Covers and Shrub Area maintenance of these specifications.

28. GUARANTEE AND REPLACEMENTS

A. all shrub and ground cover shall be guaranteed by Contractor as to growth and health for a period of ninety (90) days after completion of the specified maintenance period, and/or final acceptance by the LA. All trees up to 20" box size shall be guaranteed by Contractor to live and grow in an acceptable upright position for a period of six (6) months after completion of the specified maintenance period, and/or final acceptance by the LA.

B. All plants that show signs of failing growth at any time during the life of the Contract, including the maintenance period, or those plants injured of damaged as to render them unsuitable for the purpose intended shall be guaranteed as specified for the original guaranteed materials.

29. CLEAN-UP
Upon completion of the work in this section, Contractor shall remove all rubbish, trash and debris resulting from the operations; remove disused equipment and implements of service; leave entire area involved in a neat and acceptable condition such as to meet the approval of the Landscape Architect (LA).

HYDROSEED

1. GENERAL

A. Equipment must have minimum capacity of 1500 gallons and a positive displacement pump with the ability to agitate and properly mix the specified materials. Pump must be capable of creating 100 pounds psi pressure with sufficient volume to distribute above slurry evenly over 12,000 sq. ft. within a 15 minute period.

B. Vendor furnished label: Vendor agrees to furnish not less then two (2) employees during all hydromulching applications.

C. The vendor shall fully guarantee his work and services and shall be fully insured and be prepared to furnish satisfactory evidence of such insurance upon demand.

2. SLOPE & PLANTING AREA PREPARATION

A. Scarification - Prior to installation of the irrigation system, the surface of all slopes shall be cleaned and grubbed to prepare the slope surface for weeding.

B. Mulch - shall be Silva Fiber Plus (at 2,000 pounds per acre), a green colored, fibrous mulch, no growth or germination inhibiting factors. Silva Fiber Plus is manufactured in such a manner that after addition of seed, fertilizer, water and additives in a special 1500-gallon slurry tank, the fibers and above materials will become uniformly mixed to form a homogeneous slurry; and using the green color to facilitate proper distribution, the slurry shall be hydraulically sprayed onto the ground forming a blotter-like ground cover which after application will allow the absorption and retention of moisture. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished, and that it meets all of the foregoing requirements, based on testing. Weight specifications of these material from suppliers, and for all application, shall refer only to air dry weight of the fiber material. Absolute air dry weight based on the normal standards of the Technical Association of the Pulp Industry for Silva Fiber Plus is considered equivalent to 10% moisture. Each package of Silva Fiber Plus shall be marked by the manufacturer to show the air dry weight content.

C. Seed Mixes For Turf

Turf Seed Mix: "Rebel"
45,000 sq ft - 1 move
2500.00 #/A wood cellulose fiber
500.00 #/A turf type tall fescue blend
400.00 #/A 15-15-15 commercial fertilizer

D. Weed Abatement Program - Upon completion of the irrigation system and after all existing weeds have been removed form the planting areas, the following weed preservation shall be used:

Apply fertilizer mixture by spray per acre as follows:

300 lb. 12-12-12 commercial fertilizer
300 lb. urea formaldehyde
1000 lb. agricultural gypsum

Apply pre-emergent herbicide as recommended by a licensed pest control advisor to be compatible with the seeded plant varieties.

Apply mixture per the following time schedule:

Fertilize/water	21 days
Wait	2 days
Spray the pre-emergent per Pest control Advisor recommendations	7-10 days
Fertilize/water	14 days
Spray Weed Mixture	7 days
Fertilize/water	14 days
Spray Weed Mixture	7 days
Grub/Clean all areas to prepare for Seeding	2 days
Plant	23 days maximum
TOTAL	100 days maximum

3. PLANTING

A. Trees and Shrubs - Trees and shrubs can be planted after weed germination and during the contact kill of weeds, as specified.

B. Hydroseeding

(1) When all weeds have been eliminated to the satisfaction of the landscape architect and Owner's authorized representative, the hydroseeding operation may begin.

(2) The materials for seeded areas shall be machine mixed before application.

(3) The mixture of stolons or seed and additives are to be applied by a Hydro-Mulching machine. The nozzle height shall be between 6' and 10' above the ground level. Discharged pressure at the nozzle shall be 100 psi.

(4) Spraying shall be done in a sweeping motion allowing the slurry to fall evenly and eventually build up a consistent matting.

(5) Soil moisture: Area to be planted shall be irrigated to obtain 12 inched of penetration. Spraying shall be done 4 to 7 days prior to planting.

C. Mixture For Planting

(1) Commercial fertilizer shall be applied at the following rates: 50 lb/acre 16-20-0 (Best Fertilizer Company Crop maker or equal)

(2) Fiber material (Conwed 2000) at the rate of 2,000 lb/acre.

(3) Water with mixture of 3,000 gallons/acre.

(4) Stabilizing binder - 120 lb/acre for slopes, 80 lb/acre for flat areas

D. Watering - Immediately after planting, the slopes and other planting areas shall be watered with a fine spray, care being taken to avoid erosion, and the planted area kept moist until the seed has germinated (or the plants have become established).

E. Cleanup - After completion of the work, all rubbish and surplus material shall be removed from the site, and it shall be left neat and clean.

4. PLANT ESTABLISHMENT

A. Irrigation - The irrigation will be operated to provide an optimum amount of surface moisture for germination of the seeded varieties avoiding all run-off and deep saturation of water.

B. Fertilization - The area shall be hydro-fertilized every 30 days after planting with the following combination of materials: 250 lb. acre 16-6-8 (Best Fertilizer Company Crop Maker or equal)

C. Pre-Emergent Herbicide - Sixty (60) days after planting, apply a broad spectrum pre-emergent herbicide as recommended by an experience licensed pest control advisor.

5. MAINTENANCE

A. Maintenance of the project shall be for a period of 60 days.

B. Maintenance shall include all watering, fertilization, mowing, weeding, cultivation, spraying and pruning necessary to keep the plant materials in a healthy growing condition and to keep the planted areas neat and attractive throughout the maintenance period.

C. Protect all planted areas against damage, including erosion and trespassing, by providing and maintaining proper safeguards.

D. During the maintenance period, all planted areas shall be kept well watered and weed free at all times.

E. From the time any planting is done, until the end of the maintenance period, the Contractor shall maintain a sufficient number of men and adequate equipment to perform the work herein specified.

F. The Contractor will be relieved from maintenance work when the final plant establishment and maintenance work had been completed to the satisfaction of the Owner.

G. Damage to planting areas shall be replaced immediately at the Contractor's expense.

H. Depressions caused by vehicles, bicycles, or foot traffic, shall be filled and leveled. Replant damaged areas.

I. Exterminate gophers and moles, ground squirrels, and repair damaged as above.

J. All paved areas will be washed and maintained in a neat and clean condition at all times, as directed by the Owner.

K. Pinch-prune all shrubs and trees to encourage new growth and to eliminate rank sucker growth, remove all old flowers and dead foliage and limbs. Do no major pruning without the approval of the Owner. Remove damaged branches on tree back to point of growth. Treat cuts over 2" in diameter with an approved tree wound dressing.

L. During the maintenance period, should the appearance of any plant indicate weakness and probability of dying, immediately replace that plant with a new and healthy plant of the same type and size without additional cost to the Owner.

M. At the end of the maintenance period, all plant material shall be in a healthy growing condition.

N. Contractor shall continue the maintenance period past the specified data at no additional cost to the Owner until all deficiencies have been corrected.

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia, California 92870
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Project

1M Warehouse
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Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks
1		

Sheet Title

Specifications

Scale

Date 03/07/2023

Drawn by TH

Job Number 22-101

Sheet No LS-1

IRRIGATION

1. SCOPE

Furnish all materials, tools, equipment and labor required to install a complete operable irrigation system as indicated on the drawings, as specified and as necessary to complete the contract, including, but not limited to, these major items:

A. Irrigation system and related appurtenances.

B. Connections to water and electrical utilities.

C. Excavation and backfill of pipe trenches.

D. Record drawings and guarantees.

E. Permits and licenses.

F. Testing of completed systems.

G. Cleanup

2. QUALITY ASSURANCE

A. Qualifications of Installers - Provide at least one person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the material manufacturers' recommended methods of installation and who shall direct all work performed under this section.

B. Codes and Standards - In addition to complying with all pertinent codes and regulation, comply with the latest rules of the National Electrical Code and the Electrical Safety Orders of the State of California, Division of Industrial Safety Orders of the State of California, Division of Industrial Safety, for all electrical work and materials.

3. SUBMITTALS

A. Materials List - Within thirty-five (35) calendar days after award of contract, and before any irrigation system materials are delivered to the job site, submit to the Owner a complete list of all irrigation system materials proposed to be furnished and installed.

(1) Show manufacturer's name and catalog number for each item; furnish the manufacturer's recommendations as to method of installation.

(2) Upon approval by the Owner, the manufacturer's recommendations shall become the basis for acceptance or rejection of actual methods of installation used in the work.

(3) Do not permit any irrigation system component to be brought onto the job site until it has been approved by the Owner or his representative.

(4) Approval of any item or alternate item indicates only that it apparently meets the requirements of the drawings on the basis of the information submitted, and does not relieve Contractor of any responsibility.

B. As-Built Drawings

(1) During the course of installation, carefully show in red line on a print of the irrigation system drawings all changes made to the irrigation system during installation.

(2) Dimension from easily identifiable permanent features (buildings, monuments, sidewalks, pavement, etc.) points of connection (water and electrical), wire routing, sprinkler main routing, valve locations and other related equipment as directed by Owner.

(3) Upon completion of the irrigation system installation, carefully transfer the as-built data to reproducibles as specified in the General Conditions and submit one legible copy as described under "As-Builts" below, to the Owner.

C. Submittal of "As-Builts" - Upon completion of the irrigation system installation, and as a condition of it's acceptance, deliver to the Owner the As-Built drawings referred to above. The delivery of the As-Built Drawings shall not relieve the Contractor of the responsibility of furnishing required information that may have been omitted.

4. Product Handling

A. Protection - Use all means necessary to protect irrigation system materials before, during, and after installation and to protect the installed work and materials of all other trades.

B. Replacements - In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner and at no additional cost to the Owner.

(1) Exercise care in handling, loading, unloading, and storing plastic pipe and fittings under cover until ready to install; transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load.

(2) Repair all dented or damaged pipe by cutting out the dented or damaged section and rejoining with a coupling.

C. Connection to Utilities

(1) Source of water and power supply: Verify and be familiar with the location, size and detail of stubouts provided as the source of water and electrical supply to the irrigation system, as shown on the plans. Source of supply and point of connection shall be existing stub-outs at approximate locations as shown on plans (unless otherwise noted).

(2) Existing utilities and conditions: Prior to cutting into the soil, locate all cables, conduits, sewer septic tanks, and other utilities as are commonly encountered underground and take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, promptly notify the Owner who will arrange for relocations. Proceed in the same manner if rock layer or any other conditions encountered underground make changes advisable.

a. Where investigation of subsurface conditions has been made by a qualified body in areas in which local materials may be obtained, the Contractor may request the use of such information but will be directly responsible for its verification and accuracy.

D. Inspection

(1) At all times permit the Owner or his authorized agents to visit and observe the work or any part thereof. Maintain proper facilities and provide safe access for such observations to all parts of the work. Where the specifications require work to be tested, it shall not be covered up until tested or approved by the Owner and governing agencies. The Contractor shall be solely responsible for notifying the Owner and required agency (48 hours notice minimum required), where and when such work is in readiness for testing. Should any such work be covered without such test or approval, it shall, if so ordered, be uncovered at the Contractor's expense.

(2) Observations Required

a. Prestart Meeting
b. Layout of control equipment and heads.
c. Main line pressure test and trench depth check.
d. Lateral trench depth check.
e. Coverage test and prefinal observation.
f. Final observation.

E. Standard of Installation - Material and workmanship shall be in accordance with local codes and ordinances of legally constituted authorities, except that where provisions of these specifications exceed such requirements, these specifications shall govern.

F. Preservation and Cleaning - Cleanup all work as it progresses. At frequent intervals, and at all times when directed by the Owner, remove and dispose of accumulations of rubbish and debris of all kinds. At the time of completion, the entire site shall be cleared of tools, equipment, rubbish, etc., all of which shall be left in proper, clean condition ready for acceptance.

G. Completion - The work shall be accepted in writing when the entire scope of work has been completed satisfactorily to the Owner. In judging the work, no allowance for deviation from the original plans and specifications will be made unless previously approved by the Owner.

(1) When any item appears on the plan and not in the specifications, or in the specifications and not on the plan, it shall be considered in both.

(2) The Owner or his authorized representative shall have the final authority on all items of the project.

H. Equipment to be Furnished - Irrigation equipment, operating keys and spare parts shall be furnished to the Owner as shown on the plans.

I. Service by the Contractor - The Contractor shall service the system at the Owner's request during the guarantee period and shall be paid for work performed which is not covered by the guarantee. If requested by the Owner, the Contractor shall furnish the Owner with a schedule of service fees.

J. Final Acceptance - Within 10 days of the Contractor's notification that the installation is complete, the Owner and required agencies will observe the installation and, if final acceptance is not given, will prepare a "punch list" which, upon completion by the Contractor, and approved by the Owner, will signify final acceptance by the Owner.

K. Irrigation Guarantee

(1) The entire irrigation system shall be unconditionally guaranteed by the Contractor as to material and workmanship, including setting of backfilled areas below grade for a period of one year following the date of final acceptance of the work.

(2) If, within one year from the date of completion, settlement occurs and adjustments in pipe, valves, and irrigation heads, sod or paving to the proper level of the permanent grades, the Contractor as part of the work under this Contract, shall make all adjustments without extra cost to the Owner, including complete restoration of all damage planting, paving or other improvements.

(3) Should any operational difficulties in connection with the irrigation system develop within the specified guarantee period, which in the opinion of the Owner may be due to inferior material or workmanship, said difficulties shall be immediately repaired at no additional cost to the Owner, including any and all other damage caused by such defects.

L. Permits and Licenses - Unless otherwise stated, secure the required licenses and permits including payments of charges and fees, give required notices to public authorities, and verify permits secured or arrangements made by others affecting the work of this section.

5. MATERIALS

Materials listed in this section encompass the general items encountered. If products listed below are not used for the project being installed, they are to be omitted.

6. PIPE

A. PVC

(1) PVC Pressure Rated Pipe - Type 1220 (PVC Class 200 and 315 and PVC Schedule 40- 1120.

a. Type I Grade II pressure rated pipe.
b. Materials shall meet requirements set forth in the ASTM current standards.
c. Outside diameter of pipe shall be the same size as iron pipe.
d. Pipe shall be marked at intervals not to exceed 5 feet with the following information:
Manufacturer's name, nominal pipe size, PVC type and grade (i.e. PVC 1220), S.D.R. rating class, NSF approval and commercial standard designation CS 256-63.
e. PVC pipe shall comply with standards set forth in CS 256-63.
f. PVC Type I shall not be threaded.
g. PVC fittings shall be Schedule 40 or 80, PVC Type II.
h. Solvent shall be #715 Gray NSF approved as manufactured by Industrial Polychemical Service, Gardena, California, or approved equal.
i. Caution shall be utilized in handling Type I pipe due to the possibility of cracking or splitting when dropped or handled carelessly.
j. Where called for on drawings, pipe shall be bell end, conforming to ASTMD-2672. Install concrete thrust blocks as recommended in Johns-Mansville installation guide No. TR-624, where conditions dictate.

(2) PVC High Impact Pipe - Type 2110 (PVC Schedule 40 and 80)

a. Type II Grade I High Impact Pipe.
b. Outside diameter of pipe shall be the same size as iron pipe.
c. Pipe shall be marked at intervals not to exceed 5 feet with the following information:
Manufacturer's name, nominal pipe size, PVC type and grade (i.e. PVC 2110), schedule, NSF approval and commercial standard designation CS 207-60.
d. PVC pipe shall comply with standards set forth in CS 207-60.
e. PVC schedule 40 shall not be threaded.
f. Fittings shall be PVC Schedule 40 or 80, Type II, NSF approved, as required.
g. All threaded PVC pipe shall be Schedule 80, Type 2110.
h. Solvent shall be #175 or #710 Gray, NSF approved as manufactured by Industrial Polychemical Service, Gardena, California, or approved equal.

(3) UVR - PVC - "Browniine" pipe.
Where called for - on grade pipe shall be UVR - PVC pipe anchored at 10 intervals with re-bar. All UVR - PVC pipe shall be installed per manufacturer's recommendations.

(4) When connection is plastic to metal, male adapters shall be used. The male adapter shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be nonhardening sealing compound compatible to plastics. Compound must not lubricate the joint.

B. Brass Pipe

(1) Where indicated on the drawings, brass pipe shall be red brass screwed pipe conforming to Federal Specification #WW-P-351.

(2) Fittings shall be red brass conforming to federal specification WW-P-460.

C. Galvanized Pipe

(1) Where indicated on the drawings, galvanized steel pipe shall be ASA Schedule 40, mild steel screwed pipe.

(2) Fittings shall be medium galvanized screwed beaded malleable iron. Galvanized couplings may be merchant coupling.

(3) All galvanized pipe and fittings installed below grade shall be painted with two (2) coats of Koppers #50 Bitumastic and wrapped with 20 mil tape.

(4) All nondomestic galvanized pipe installed on grade shall be stenciled or identified with green tape at all connections and continuously along its length.

D. Copper Pipe and Fittings - Where indicated on the drawings, copper pipe shall be type "K" sweat soldered pipe.

7. Risers

All sprinkler heads shall have risers as shown in the detail drawings.

8. Valves

A. Gate Valves

(1) Gate valves 3" and smaller shall be 125 lb. SWP bronze gate valve with screw-in bonnet, nonrising stem and solid wedge disc.

(2) Gate valves 3" and smaller shall have threaded ends and shall be equipped with a bronze hand wheel or operating nuts.

(3) Gate valves 3" and smaller shall be similar to those manufactured by Kennedy or approved equal.

(4) All gate valves shall be installed per detailed drawings.

B. Quick Coupling Valves - Quick coupling valves shall be of manufacturer shown on the drawings or approved equal. Each quick coupler shall have a molded vinyl locking cover. Upon completion of the contract and prior to final acceptance, supply the Owner with quick coupler keys and hose ells of the quantity called for on the plans. The quick coupler keys and hose ells shall be of the same manufacturer as the coupling valve. All Quick coupling valves shall be installed per detailed drawings.

C. Remote Control Valves

(1) The electric remote control valves shall be of the type and manufacturer shown on the drawings, or approved equal, and installed per detailed drawings and manufacturer's recommendations.

(2) Valves shall be installed minimum 6" from all fixed objects and 12" apart.

D. Pressure Regulating Valves - Pressure regulating valves shall be of the type and manufacturer shown on the drawings, or approved equal, and installed per detailed drawings and manufacturer's recommendations.

E. Check Valves - Anti-drain valves shall be of heavy duty virgin PVC or brass construction with F.I.P. thread inlet and outlet. Internal parts shall be stainless steel and neoprene. Anti-for visual inspection and verification. drain valves shall be field adjustable against drain out from 5 to 40 feet of head. The anti-drain valve, where indicated on the plans, shall have an excess flow feature which will automatically stop the flow of water when it exceeds the GPM preset by the manufacturer. The anti-drain and excess flow valve shall be similar to the Valcon ADV-XS, Rain Bird SM-1 or approved equal. Sprinkler heads having check valves in heads will not require additional check valves.

9. VALVE BOXES

All valves, including pressure regulating valves, remote control valves and gate valves shall be installed in suitable valve boxes as shown in details. (RCV boxes shall have locking covers).

10. CONTROLS

A. Automatic Controller - Automatic controllers shall be of the type and manufacturer shown on the drawings or approved equal and installed per manufacturer's recommendations and detailed drawings.

B. Low Voltage Control Wire - All wiring to be used for connecting the automatic controller to the electric solenoid actuated remote control valve shall be Type UF-600v, 7-strand cr solid copper, PVC insulation, single conductor, UL approved underground feeder cable. Each pilot or "hot" wire shall be black with the common wire being white. Field splices between the controller and electric valves are not permitted. Control wire shall be of the gauge indicated on the detailed drawings.

C. Communication Cable - Communication cable from the central computer to the field control units shall be Toro P-716-D A1 cable.

D. 110 Volt Wire to Controller - 110 volt wire shall be per local code as to type and quality. Install in conduit 24" below grade.

11. BACKFLOW PREVENTION UNITS

Backflow prevention units shall be of size and type as indicated on the drawings. All backflow prevention units shall be installed in accordance with detailed drawings and the requirements set forth by local codes and/or the County Health department.

12. IRRIGATION HEADS

A. Sprinkler heads shall be of the types and sizes with the diameter (or radius) of throw, pressure, discharge and other designations necessary to determine the types and sizes as indicated on the plans. They shall be constructed of bronze, brass, stainless steel and/or high impact plastic.

B. All heads of a particular type of function in the system shall be of the same manufacturer and shall be marked with the manufacturer's name and identification in such a position that they can be identified without being removed from the system.

13. OTHER MATERIALS

All other materials not specifically described but required for a complete and proper irrigation system installation, shall be new, first quality of their respective kinds, and subject to the approval of the Owner.

14. EXECUTION

A. Inspection

(1) Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

(2) Verify that the irrigation system will be installed in strict accordance with all pertinent codes and regulations, the original design, the reference standard and the manufacturer's recommendations.

(3) Verify all field conditions including property lines, rights of way, tract boundaries, easements and any other legal or physical element as required for the successful completion of the project.

B. Discrepancies

(1) In the event of discrepancy, immediately notify the Contractor or his authorized representative.

(2) Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

15. FIELD MEASUREMENTS

Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design.

16. TRENCHING AND BACKFILLING

A. Trenching

(1) Excavation shall be open vertical construction sufficiently wide to provide free working space around the work installed and to provide ample space for backfilling and compacting.

(2) Trenches for pipe shall be cut to required grade lines, and trench bottom shall be compacted to provide an accurate grade and uniform bearing for the full length of the pipe run.

(3) When two pipes are to be placed in the same trench, maintain a six-inch space between pipes as a minimum. No pipe shall be installed directly over another.

B. Backfilling

(1) Backfill material shall be approved soil. Unsuitable material, including clods and rocks over 2 1/2" in size, shall be removed from the premises and disposed of legally at no cost to the Owner.

(2) All Backfilling shall be done carefully and shall be properly compacted.

(3) Depth of trenches shall be sufficient to provide a minimum cover above the top of the pipe as follows:

a. 14" over non-pressure rotor pop-up lines (minimum).
b. 12" over non-pressure lateral lines (minimum).
c. 18" over 24 volt conduit and non-potable irrigation main line 3" and smaller (minimum).
d. 24" cover over pipe serving potable water to a backflow preventer and 120V conduit (minimum).
e. 30" cover over pipe crossing under paving (minimum).
f. Surplus earth remaining after backfilling shall be disposed of on the premises as directed by the Owner.

17. INSTALLATION OF PIPE

A. General

(1) The irrigation piping layout is schematic. Contractor can make minor adjustments to the system as required to avoid physical elements or conform to other site conditions. In all cases there should be no conflicts between the irrigation system, planting, and structural elements. The Contractor is responsible for maintaining coverage as indicated, prior approval of any such adjustment from the Owner and for recording of any such change.

(2) Prior to installation, pressure, meter size, size of service to meter, at each point of connection. Make final connections allowing for possible minor deviations from locations shown on plans due to site conditions. Any deviation from design criteria shall be brought to the attention of the Owner. Continuation of work shall be at Contractor's risk and expense.

(3) Verify the static pressure, meter size, size of service to meter, at each point of connection. Make final connections allowing for possible minor deviations from locations shown on plans due to site conditions. Any deviation from design criteria shall be brought to the attention of the Owner. Continuations of work shall be at Contractor's risk and expense.

B. Under Existing Pavement

(1) Pipe required under existing pavement shall be installed by jacking, boring or hydraulic driving except that no hydraulic driving will be permitted under asphaltic concrete pavement.

(2) Where cutting or breaking of existing pavement is necessary, secure permission from the Owner before cutting or breaking the pavement and then make all necessary repairs and replacements to the approval of the Owner and at no additional cost to the Owner.

C. Inspection of Pipe and Fittings - Carefully inspect all pipe and fittings before installation, removing all dirt, scale, and burrs and reaming as required; install all pipe with all markings up

D. PVC Pipe

(1) PVC pipe shall be installed in a manner which will provide for expansion and contraction as recommended by the pipe manufacturer. Routing is diagrammatic and shall be installed in such a manner as to conform with the details per the drawings.

(2) In joining, use only the specified or manufacturer's recommended solvent and make all joints in strict accordance with the manufacturer's recommended methods; give solvent welds at least 15 minutes set up time before moving or handling and 24 hours curing time before filling with water.

18. INSTALLATION OF EQUIPMENT

A. Automatic Controller Location and Installation

(1) Automatic controller(s) shall be installed at the location(s) shown on the drawings.

(2) The controller location is essentially diagrammatic and shall be specifically located by the Owner or his representative.

(3) All local and applicable codes shall take precedence in the furnishing and/or connecting of 110V electrical service to the controller.

(4) Adequate coverage (18" minimum) of the 24V service wire leading from the controller shall be installed from the bottom of the controller to trenches.

(5) Controllers shall be installed within vandal-resistant enclosures as called for on the drawings.

B. Control Wires

(1) All electrical equipment and wiring shall comply with local and State Codes and be installed by those skilled and in the trade. Unless the governing code specifies otherwise, low voltage control wire may be installed by the irrigation Contractor.

(2) Connecting and splicing of wire at the valves shall be made using DBY direct burial splices as manufactured by Raychem Corporation.

C. Communication Cable

(1) Communication cable shall be installed from the field control unit to the area called for on the plans.

(2) Install cable in PVC conduit and stub in valve box as indicated on the plans. Ends of cable shall be sealed with an approved water tight connectors as specified. (See Section 18-B-2 above.)

(3) Field splices are not permitted, except where tying in to cable which has been stubbed out by others. Splices shall be made using a Paige Splice Kit No. P7162D-1 and in accordance with the manufacturer's recommendations.

(4) Install all communication cable in approved PVC electrical conduit.

D. Electrical Work - All electrical work shall be installed per code requirements.

E. Quick Coupling Valves - Quick coupling valves shall be set approximately 12' from walks, curbs, header boards, or paved areas where applicable per detail drawings.

F. Valves

(1) All valves shall be installed as shown in the details and in accordance with manufacturer's recommendations.

(2) All automatic valves shall be sized as shown on plans. Gate Valves shall be line size.

(3) Install each control valve in a separate valve box with a minimum of 12" between valves and 6" from any walk or structure.

G. Valve Boxes

(1) Valve boxes installed near walks, curbs, header boards and paving shall abut those items and the top surfaces shall be flush with items listed above.

(2) All valve boxes shall be installed as shown in the details in accordance with manufacturer's recommendations.

19. TESTING AND INSPECTION

A. General

(1) Furnish all necessary testing equipment and personnel.

(2) Correct all leaks and retest until acceptance by the Owner.

B. Covering up Uninspected Work - Do not allow or cause any of the work of this section to be covered up or enclosed until it has been inspected, tested and approved by the Owner and authorized agencies. (See Section 4-D-2)

C. Flushing - Before backfilling the main line, and with all control valves in place but before lateral pipes are connected, completely flush and test the main line and repair all leaks; flush out each section of lateral pipe before irrigation heads are attached.

D. Testing

(1) Make all necessary provisions for thoroughly bleeding the line of air and debris.

(2) Before testing, fill the line with water for a period of at least 24 hours.

(3) Prior to installation of control valves, test all line water lines for leaks at a pressure of 150 PSI for a period of (3) hours, with all couplings exposed and with all pipe sections center loaded.

(4) Adjust remote control valves so that the most remote sprinkler heads operate at the pressure recommended by the head manufacturer. Adjust remote control valves so a uniform distribution of water is applied by the sprinkler heads to the planting area for each individual valve system.

E. Final Inspection

(1) Thoroughly clean, adjust and balance all systems.

(2) Demonstrate the entire system to the Owner, his authorized agent and/or governing agencies to show that all remote control valves are properly balanced, all heads are properly adjusted for radius and arc of coverage, and that the installed system is workable, clean and efficient.

20. OPERATIONAL AND MATERIALS MANUALS

A. Operational and Product Manuals - Prepare and deliver to the Owner, prior to approved final inspection, all required and necessary descriptive material in complete detail and sufficient quantity, operation and product manual. The manual shall describe the material installed and shall be in sufficient detail to permit operating personnel to understand, operate and maintain all equipment. Spare parts lists and related manufacturer information shall be included for each equipment item installed.

B. Each complete, bound manual shall include the following information:

(1) Index sheet stating Contractor's address and telephone number.

(2) Duration of guarantee period.

(3) List of equipment with names and addresses of local manufacturer representatives.

(4) Complete operating and maintenance instructions on all major equipment.

C. In addition to the above manuals, provide the maintenance personnel with instructions for major equipment and show written evidence to the Owner, at the conclusion of the project, that this service has been rendered.

D. INSPECTION

(1) At all times permit the Owner or his authorized agents to visit and observe the work or any part thereof. Maintain proper facilities and provide safe access for such observations to all parts of the work. Where the specifications require work to be tested, it shall not be covered up until tested or approved by the Owner and governing agencies. The Contractor shall be solely responsible for notifying the Owner and required agency (48 hours notice minimum required), where and when such work is in readiness for testing. Should any such work be covered without such test or approval, it shall, if so ordered, be uncovered at the Contractor's expense.

(2) Observation Required

a. Prestart meeting
b. Layout of control equipment and heads
c. Main line pressure test and trench depth check.
d. Lateral trench depth check
e. Coverage test and prefinal observation
f. Final observation

E. Standard of Installation - Material and workmanship shall be in accordance with local codes and ordinances of legally constituted authorities, except that where provisions of these specifications exceed such requirements, these specifications shall govern.

F. Preservation and Cleaning - Cleanup all work as it progresses. At frequent intervals, and at all times when directed by the Owner, remove and dispose of accumulations of rubbish and debris of all kinds. At the time of completion, the entire site shall be cleared of tools, equipment, rubbish, etc., all of which shall be left in proper, clean condition ready for acceptance.

G. Completion - The work shall be accepted in writing when the entire scope of work has been completed satisfactorily to the Owner. In judging the work, no allowance for deviation from the original plans and specifications will be made unless previously approved by the Owner.

H. Equipment - Irrigation equipment, operating keys and spare parts shall be furnished to the Owner as shown on the plans.

I. Service by the Contractor - The contractor shall service the system as the Owner's request during the guarantee period and shall be paid for work performed which is not covered by the guarantee. If requested by the Owner, the Contractor shall furnish the Owner with a schedule of services and fees.

J. Final acceptance - Within 10 days of the Contractor's notification that the installation is complete, the Owner and required agencies will observe the installation and, if final acceptance is not given, will prepare a "punch list" which, upon completion by the Contractor, and approved by the Owner, will signify final acceptance by the Owner.

HUNTER LANDSCAPE
711 S. Fee Ana Street
Placentia, California 92870
Ph: 714.986-2400
Fax: 714.986-2408

Project

1M Warehouse
Central Rd & Lafayette St
Apple Valley, California

AP Investors Group
9220 Winnetka Avenue
Chatsworth, CA 91311

Submittals

Date	Description

Revisions

	Date	Remarks
1		

Sheet Title

Specifications

Scale

Date 03/07/2023

Drawn by TH

Job Number 22-101

Sheet No LS-2

Appendix O: Bioretention Soil Media Specification

ATTACHMENT A

BIORETENTION SOIL SPECIFICATION

1.00 BIORETENTION SOIL

Bioretention soil shall achieve an initial infiltration rate of at least 8-inch per hour nor more than 20 inches per hour “in situ” and a long-term, in-place infiltration rate of at least 5 inches per hour. Bioretention soil shall also support vigorous plant growth. Bioretention Soil shall be a mixture of fine sand, and compost, measured on a volume basis:

65% Sand
20% Sandy Loam
15% Compost

A. SUBMITTALS

Product Data: Submit manufacturer's product data and installation instructions. Include required substrate preparation, list of materials, application rate/testing and percolation rates.

Certifications: Manufacturer shall submit a letter of certification that the products meet or exceeds all physical property, endurance, performance and packaging requirements.
Submittals for Bioretention Soil: Tests must be conducted within 120 days prior to the delivery date of the bioretention soil to the project site.

Batch-specific test results and certification will be required for projects installing more than 100 cubic yards of bioretention soil.

The contractor must submit the following for approval:

1. A sample of mixed bioretention soil.
2. Grain size analysis results of the sand component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
3. Grain size analysis results of the sandy loam component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
4. Grain size analysis results of compost component performed in accordance with ASTM D 422, Standard Test Method for Particle Size Analysis of Soils.
5. Agricultural soil analysis of results for the Bioretention Soil as specified in Section 2.03 E
6. Provide the following information about the testing laboratory(ies) name of laboratory(ies) including:

    a) contact person(s)
    b) address(es)
    c) phone contact(s)

d) e-mail address(es)
e) qualifications of laboratory(ies), and including use of ASTM and USDA method of standards.

B. Sand shall be free of wood, waste, coating such as clay, stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be non-plastic.

Sand for Bioretention Soil shall be analyzed by an accredited lab using #200, #100, #40, #30, #16. #8, #4, and 3/8 inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)
3/8 inch	100
No. 4	90-100
No. 8	70-100
No. 16	40-95
No. 30	15-70
No. 40	5-55
No. 100	0-15
No. 200	0-5

Note: all sands shall consist of natural sand, manufactured sand, or a combination thereof.

C. Sandy loam for Bioretention Soil shall be free of wood, waste, coating such as stone dust, carbonate, etc., or any other deleterious material. All aggregate passing the No. 200 sieve size shall be non-plastic.

Sandy loam soil should comply with the following specifications on USDA soil textural classification scheme by weight:

Sand: 50-74%
Silt: 11-48%
Clay: 2-15%

Note: all sandy loam shall consist of natural sand, manufactured sand or a combination thereof.

D. Compost for Bioretention Soil shall be a well decomposed, stable, weed free organic matter source derived from waste materials including yard debris, wood wastes or other organic materials. Compost shall have a dark brown color and a soil like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120F) upon delivery or rewetting is not acceptable. Compost shall be produced at a facility inspected and regulated by the Local Enforcement Agency for CalRecycle.

The past 3 inspection reports shall be submitted verifying compliance with Title14 requirements of the Process to Further Reduce Pathogens (PFRP), Fecal coliform and Salmonella testing and pathogen and EPA, 40 CFR 503 regulations.

Composite Quality Analysis:

Property	Method	Requirement
pH, Units	Saturation Paste	6 to 8.5
EC, dS/m	Saturation Extract	0 to 10
Boron, ppm	Saturation Extract	less than 2.5
Moisture content, %	Gravimetric	30 to 60
Bulk Density, lbs/cubic yard		500 to 1100
Organic Matter, % of Dry Wieght	Loss on Ignition	35% to 75%
Carbon to Nitrogen Ratio		15:1 to 25:1
Maturity	Solvita	5 or above
Stability	Solvita	5 or above
Particle Size	Sieve Analysis	
Pass 1/2 inch sieve		≥80%
Pass #200 sieve		max 5%
503C Metals	Title 14	
Arsenic (As)		20
Cadmium (Cd)		15
Chromium (Cr)		100
Copper (Cu)		150
Lead (Pb)		300
Mercury (Hg)		10
Nickel (Ni)		100
Selenium (Se)		30
Zinc (Zn)		300
Pathogen		
Salmonella	Title 14	< 3 MPN per 4 gms
Fecal Coliform		<1000 MPN per 1 gm
Physical contaminants		
Plastic Metal and Glass, %> 4mm	% by Weight	< 1
Sharps, % > 4mm	% by Weight	0

E. Bioretention Soil shall be free of roots, clods, and/or stones larger than 1-inch in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, lumber, brush and other litter. It shall not be infested with nematodes, or undesirable disease-causing organisms such as insects and plant pathogens. Bioretention soil mix shall be friable and have sufficient structure in order to give good tilth and aeration to the soil.

Gradation limits – The definition of the soil should be the following USDA classification scheme by weight:

Sand 85-92%
Silt 14% maximum
Clay 5% maximum

Permeability Rate - Hydraulic conductivity rate shall be not less the 8 inch per hour nor more than 20 inches per hour when tested in accordance with USDA Handbook Number 60, method 34b or other approved methods.

Analysis for pH, salinity and nutrient levels shall be submitted for approval prior to acceptance. Nutrient tests should include the testing laboratory recommendations for supplemental additions to the soil as calculated by the amount of material to be added per volume of soil for the type of plants to be grown in the soil.

Property	Method	Requirement
pH, Units	Saturation Paste	6.0 to 8.0
EC, dS/m	Saturation Extract	0.5 to 2.5
Boron, ppm	Saturation Extract	less than 2.5
Chloride, ppm	Saturation Extract	less than 150
Sodium Adsorption Ratio		less than 3.0
Carbon to Nitrogen Ratio		10 to 20
Organic Matter, % of Dry Weight	Loss on Ignition	2 to 5
Extractable Nutrients, dry weight basis	Ammonium Bicarbonate / DPTA Extraction	
phosphorus, ppm		10 to 40
potassium, ppm		100 to 200
iron, ppm		24 to 35
manganese, ppm		0.6 to 6
zinc, ppm		1 to 8
copper, ppm		0.3 to 5
magnesium, ppm		50 to 150
sodium, ppm		0 to 100
sulfur, ppm		25 to 500
molybdenum, ppm		0.1 to 2
aluminum, ppm		less than 3.0

Bioretention Soil shall be analyzed by an accredited lab using #200, 1/4 inch, 1/2 inch, and 1 inch sieves (ASTM D 422 or as approved by municipality), and meet the following gradation:

Sieve Size	Percent Passing (by weight)
1 inch	99-100
½ inch	90-100
¼ inch	40-90
No. 200	Less than 5%

2.00 BIORETENTION SOIL PLACEMENT

A. Imported backfill material for the bioretention zones should be placed in a relatively loose condition, no rolling or other heavy equipment, to promote the planned infiltration of water, through the bioretention soil mix layer.

B. Bioretention soil shall be installed in six (6) to twelve (12) inch lifts and lightly watered to provide settlement and natural compaction. No mechanical compaction is allowed. After natural compaction has been completed, add, if needed, additional bioretention soil to proposed finish grade as indicated on the plans.

C. Rake bioretention soil as needed to level out.

D. Vehicular traffic, construction equipment shall not drive-on, move onto, or disturb the bioretention soil once placed and water compacted.

E. The geotechnical engineer shall perform at least one percolation test in accordance with the County of San Diego Department of Environment Health Percolation Testing Criteria or other approved methods “in situ” prior to planting the Bioretention area (the engineer of work may require more than one in situ test depending on size of bioretention area). “In situ” percolation test(s) shall have an initial rate of at least 8-10 inches per hour to insure a long term infiltration rate of at least 5 inches per hour. If the percolation rate does not meet at least 8-10 inches per hour, the contractor shall provide and submit corrective action to the geotechnical engineer for approval, such as rototilling or hand cultivation to improve the percolation rate. Once the approved corrections are determined, the contractor will perform the required corrective action to improve the percolation rate and re-test at his expense.

F. Erosion and Sediment Control practices during construction shall be employed to protect the long-term functionality of the bioretention basin/swale. The following practices shall be followed for this reason:

1. Provide erosion control in the contributing drainage areas to the facility and stabilize upslope areas.

2. Facilities should not be used as sediment control facilities, unless installation of all bioretention-related materials are withheld towards the end of construction allowing the temporary use of the location as a sediment control facility, and appropriate excavation of sediment is provided prior to installation of bioretention materials.

G. A two inch layer of bark mulch per Section 02900 Landscape Planting shall be installed on the surface of the bioretention soil if planting of container stock and no hydroseeding is to be installed to prevent foot compaction of the bioretention soil.

H. If hydroseeding is to be installed on the surface of the bioretention soil, no stabilized matrix shall be used in the hydroseed components or mix.

END OF REPORT

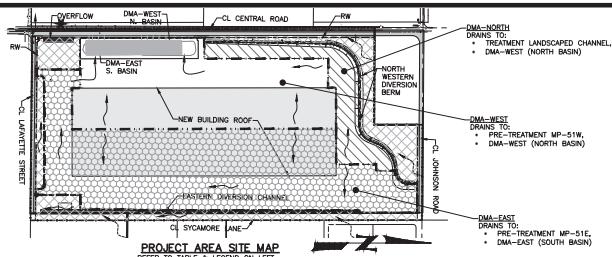
PROJECT AREAS

	4. Site property perimeter CL to CL (sq.ft)	3,271,838	75.11 acre(s)
	5. Exterior Road Improvements (sq.ft)	187,051	4.29 acre(s)
	6. Portions Used to Divert Run-on (sq.ft)	513,754	11.79 acre(s)
	7. Existing Paved Road (not disturbed) (sq.ft)	25,093	0.58 acre(s)
	8. Facility Operations Area (On-site going to BMP)	2,545,940	58.45 acre(s)
	9. Disturbance Total (sq.ft.) (Sum of Items 5 + 6 + 8) (sq.ft)	3,246,745	74.54 acre(s)
	WQMP Project Area (sq.ft) (On-site going to BMP)	**2,545,940**	**58.45 acre(s)**

1 DRAINAGE AREA:

DMAs are to determine size of pre-treatment in Forms 4.2

	DMA - East	1,320,122	30.31 acre(s)
	DMA - West	963,892	22.13 acre(s)
	DMA - North	261,926	6.01 acre(s)



PROJECT AREA SITE MAP

REFER TO TABLE & LEGEND ON LEFT, FORM 1-1, & FORMS 4.2-3 THRU 4.2-5

WQMP EXHIBIT LEGEND:

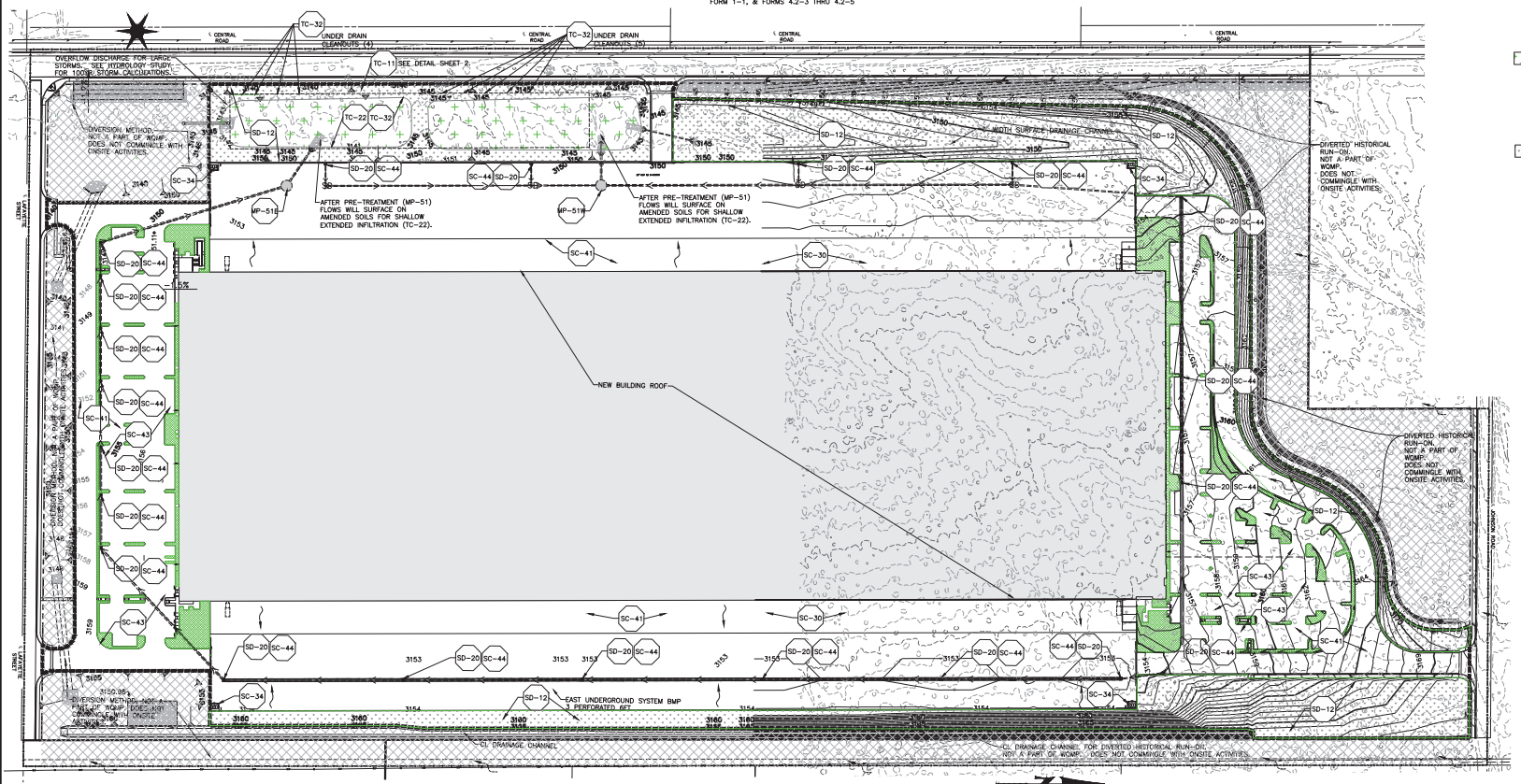
- INDICATES EXISTING CONTOUR
- INDICATES PROPOSED CONTOUR
- INDICATES ROAD CENTERLINE
- INDICATES PROPOSED UG STORM PIPE DIRECTION
- INDICATES EXISTING SURFACE FLOW DIRECTION
- INDICATES PROPOSED SURFACE FLOW DIRECTION
- R/W INDICATES RIGHT-OF-WAY
- SD-20 INDICATES BMPS CALLOUT (SEE BMP LEGEND TABLE)
- INDICATES BMP OVERFLOW

SIC CODE: 4225: WAREHOUSE & STORAGE

NEW-PROPOSED CONDITIONS

Proposed Impervious Surface:	**New Roof**		
DMA - East	540,000	12.40	acre(s)
DMA - West	540,000	12.40	acre(s)
DMA - North	-	0.00	acre(s)
TOTAL NEW ROOF AREA	**1,080,000**	**24.79**	**acre(s)**
Proposed Impervious Surface:	**New Impervious Paved Surfaces**		
DMA - East	599,376	13.76	acre(s)
DMA - West	330,485	7.59	acre(s)
DMA - North	99,785	2.29	acre(s)
TOTAL NEW PAVED SURFACE AREA	**1,029,646**	**23.64**	**acre(s)**
Proposed Pervious Surface:	**New Curbed Landscape (Self-treating)**		
DMA - East	32,493	0.75	acre(s)
DMA - West	-	0.00	acre(s)
DMA - North	20,681	0.47	acre(s)
TOTAL CURBED LANDSCAPED AREA	**53,174**	**1.22**	**acre(s)**
Proposed Pervious Surface:	**Bioretention Basin**		
DMA-East (South Basin)	29,400	0.67	acre(s)
DMA-West (North Basin)	35,257	0.81	acre(s)
DMA-North (North Channel)	-	0.00	acre(s)
TOTAL AMENDED SOILS (BASIN BOTTOM)	**64,657**	**1.48**	**acre(s)**
Proposed Pervious Surface:	**Landscaped sloped area**		
DMA - East	118,853	2.73	acre(s)
DMA - West	58,150	1.33	acre(s)
DMA - North	141,460	3.25	acre(s)
TOTAL LANDSCAPED SLOPED AREA	**318,463**	**7.31**	**acre(s)**
TOTAL WQMP AREA	**2,545,940**	**58.45**	**ACRES**

Post Impervious			
DMA - East	1,139,376	26.16 acre(s)	86% % TO DA
DMA - West	870,485	19.98 acre(s)	90% % TO DA
DMA - North	99,785	2.29 acre(s)	38% % TO DA
TOTAL IMPERVIOUS	**2,109,646**	**48.43 acre(s)**	**83% % TO SITE**
Post Pervious			
DMA - East	180,746	4.15 acre(s)	14% % TO DA
DMA - West	93,407	2.14 acre(s)	10% % TO DA
DMA - North	162,141	3.72 acre(s)	62% % TO DA
TOTAL PERVIOUS	**436,295**	**10.02 acre(s)**	**17% % TO SITE**



COMMERCIAL/INDUSTRIAL BMP LEGEND

CALLOUT	FACT SHEET DESCRIPTION	APPLICATION
SD-12	EFFECTIVE IRRIGATION AND PLANNING	REFER TO APPROVED LANDSCAPE PLANS
SD-20	STORM DRAIN SIGNAGE	PRE-STAMPED INLET GRATES OR EPOXY EMBLEM
SC-30	OUTDOOR LOADING AND UNLOADING	GROUNDS MAINTENANCE INCLUDING PAVEMENT SWEEPING, SPILL CLEAN-UP AND STAIN REMOVAL
SC-34	TRASH STORAGE MAINTENANCE	REGULAR INSPECTION AND CLEANING AS NECESSARY.
SC-41	BUILDING/GROUNDS MAINTENANCE	REGULAR UPKEEP, INCLUDING PERIMETER FENCING AND WIND-BLOWN DEBRIS.
SC-43	PARKING AREA MAINTENANCE	REGULAR PARKING SWEEPING/VACUUMING. REMOVE OIL/GREASES STAINS/LEAKS PRIOR TO ENTERING ANY INLETS
SC-44	DRAINAGE AREA MAINTENANCE	ENSURE INLETS ARE PROTECTED FROM POLLUTANTS ENTERING AND REMAIN FREE OF BLOCKAGE
TC-11	INFILTRATION BASIN (UNDERGROUND GRAVEL, AND PIPES)	CLEAN OUTS PROVIDED ALONG BERM WITH SWEEP CONNECTION TO FLUSH UNDER DRAINS AS NEEDED, OR BIANNUALLY.
TC-22	EXTENDED DETENTION BASIN (SURFACE LANDSCAPED BASIN AND SURFACE WEIRS / OVERFLOW)	PART OF GROUND MAINTENANCE. ENSURE AMENDED SOILS AND HEALTHY VEGETATION WILL PROPERLY INFILTRATE FLOWS FROM PRETREATMENT DEVICES. REMOVE WEEDS, OVERGROWTH, TRASH/DEBRIS. NO STANDING WATER LONGER THAN 48 HOURS AFTER RAIN FALL.
TC-32	BIORETENTION (AMENDED SOILS, UNDERGROUND GRAVEL, PIPES, AND CLEAN OUT ACCESSES)	PART OF GROUND MAINTENANCE. ENSURE AMENDED SOILS AND HEALTHY VEGETATION WILL PROPERLY INFILTRATE. NO STANDING WATER LONGER THAN 48 HOURS AFTER RAIN FALL. POOR INFILTRATION WILL REQUIRE REMOVE OF FINES (CLAY LAYER) AND REPLACEMENT OF AMENDED SOILS. MAINTAIN DEPTHS OF SOILS MEDIA, AND DEPTHS FROM SURFACE BOTTOM TO INLETS AND OVERFLOWS AS SHOWN ON PLANS.
MP-51	PRE-TREATMENT HYDRODYNAMIC SEPARATOR, OR APPROVED EQUIVALENT THRU DIFFERED SUBMITTAL	REFER TO MANUFACTURE'S SPECIFICATIONS. PROFESSIONAL CONTRACTED MAINTENANCE VACUUM TRUCK & HAULER

THE CONTRACTOR IS REQUIRED BY GOVERNMENT CODE 4216 "CALIFORNIA ONE CALL LAW" TO CALL DIG ALERT AT LEAST TWO (2) WORKING DAYS BEFORE DIGGING. CONTRACTOR IS REQUIRED BY SAME CODE TO HAND-EXPOSE TO THE POINT OF NO CONFLICT 24" ON EITHER SIDE OF THE UNDERGROUND FACILITY SO YOU CAN DETERMINE ITS EXACT LOCATION BEFORE USING POWER EQUIPMENT.

811 Know what's below. Call before you dig.

BENCHMARK AND BASIS OF BEARING

OPUS STATIC GPS OBSERVATION
BASE POINT COORDINATES:
NORTHING: 2047019.0907
EASTING: 681199.3300 - CALIFORNIA STATE PLANE COORDINATE SYSTEM ZONE V NAD 83

ELEVATION: 3234.10' - NAVD 88

NO.	REVISION	DATE	BY

NOTE:

IF THIS PLAN IS NOT SIGNED AND DATED BY THE ENGINEER OF RECORD AND ALSO BY THE CITY ENGINEER OR UTILITY COMPANY OFFICIAL IN THE APPROVAL BLOCKS OF THIS PLAN THEN THIS PLAN IS PRELIMINARY AND NOT FOR CONSTRUCTION.

REGISTERED PROFESSIONAL ENGINEER E. CARY PACKER No. C-51752 CIVIL STATE OF CALIFORNIA

MERRELL JOHNSON

DRAWN BY:	EKJ/JMC
DATE:	08/23/23
DESIGNED BY:	ECP/EKJ
DATE:	08/23/23
APPROVED BY:	ECP
DATE:	08/23/23

TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:

MICHAEL P. PODEGRACZ, TOWN ENGINEER DATE

RCE 33445, EXP. DATE:

THESE PLANS ARE SIGNED BY THE TOWN OF APPLE VALLEY FOR CONCEPT ADHERENCE TO TOWN STANDARDS AND REQUIREMENTS ONLY. THE TOWN OF APPLE VALLEY IS NOT RESPONSIBLE FOR DESIGN, ASSUMPTIONS AND ACCURACY.

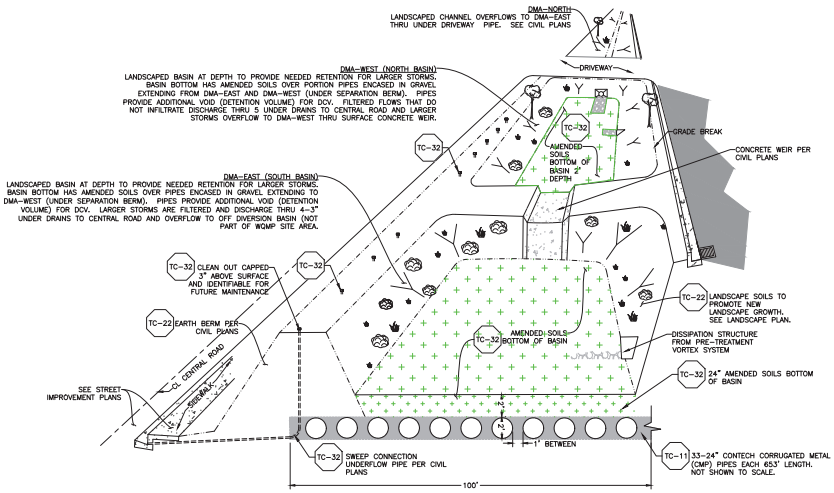
Town of Apple Valley

TOWN OF APPLE VALLEY WQMP EXHIBIT PLAN WAREHOUSE FACILITY SITE EXHIBIT PLAN

APPLE VALLEY, CA

SCALE: AS SHOWN
JOB NO. 3675.007
SHEET 1 OF 2

PDF 8:30am 28 August 2023 P:\3675.007 Uncommon Dev\WQMP Exhibit\3675.007.01.dwg - WQMP Exhibit (1) Merrell-Johnson Companies



BIORETENTION WITH AMENDED SOILS, UNDER PIPES, AND UNDER DRAIN OUTLETS

NOT TO SCALE

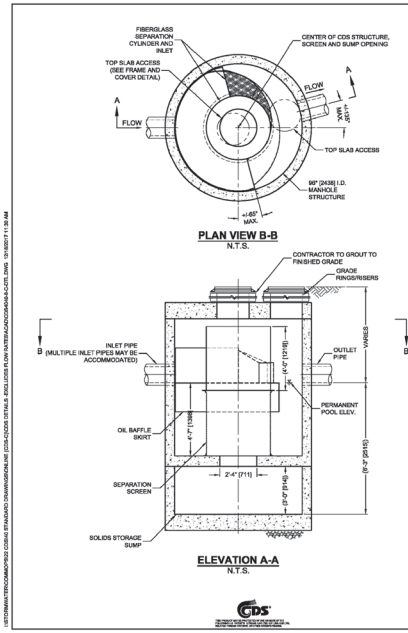
DMA EAST & WEST GENERAL VIEW

THIRTY-THREE CORRUGATED METAL PIPES ARE 725 LINEAR FEET EACH EXTENDING FROM DMA EAST AND WEST BASINS (UNDER WEIR). PIPES ARE TWO-FOOT DIAMETER AND SPACED ONE-FOOT APART WITH SURROUNDING 3/4-1 INCH MINUS CLEAN WASHED GRAVEL. GRAVEL IS TWO FEET DEPTH (BOTTOM TO TOP OF PIPES).

AMENDED SOILS EXTEND THE ENTIRE BOTTOM OF BASINS AND IS TWO-FEET DISPTH.

SLOPES ARE COMPACTED PER CIVIL PLANS WITH LANDSCAPE SOILS AND VEGETATION PER LANDSCAPE PLANS.

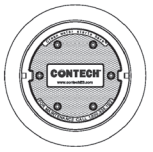
RIP RAP DISSIPATION FROM PRE-TREATMENT DEVICES PER CIVIL PLANS.



CDS4040-8-C DESIGN NOTES

THE STANDARD CDS4040-8-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

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



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

SITE SPECIFIC DATA REQUIREMENTS

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

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

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

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

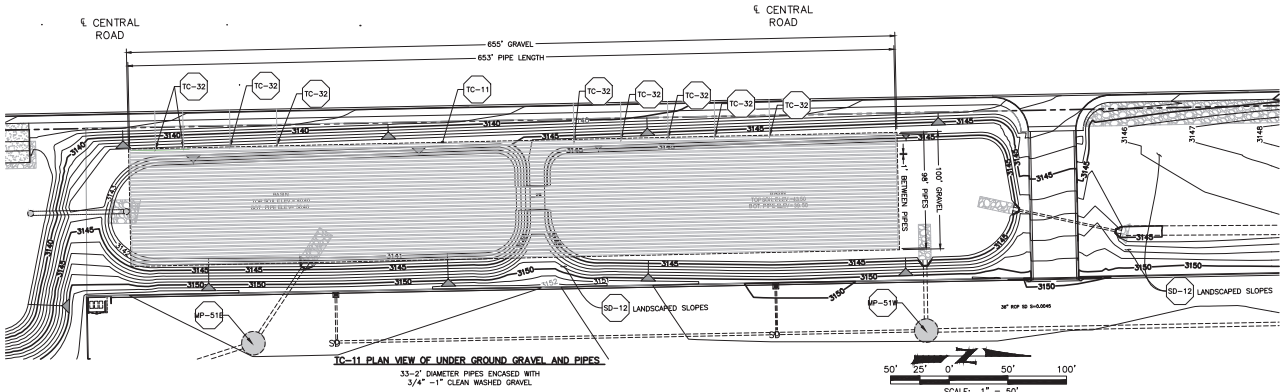
CONTECH ENGINEERED SOLUTIONS LLC
www.contech-cpi.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS4040-8-C
INLINE CDS
STANDARD DETAIL

MP–51 PRE–TREATMENT VORTEX SYSTEM

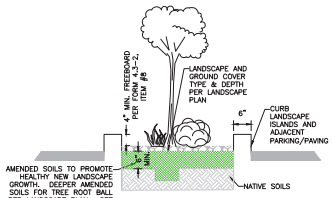
NOT TO SCALE

TWO UNITS UNDERGROUND ON THE WEST SIDE UNDER PAVED SURFACES.



TC–11 PLAN VIEW OF UNDER GROUND GRAVEL AND PIPES

33–2' DIAMETER PIPES ENCASED WITH 3/4" –1" CLEAN WASHED GRAVEL



LANDSCAPED ISLAND DETAIL

NOT TO SCALE

SEE FORM 4.3–2

LANDSCAPED ISLANDS SURROUNDED BY CURB WITH 4" FREEBOARD WILL NOT COMMINGLE WITH SURFACE FLOWS DURING THE 2YR–1HR STORM.

THE CONTRACTOR IS REQUIRED BY GOVERNMENT CODE 4216 "CALIFORNIA ONE CALL LAW" TO CALL DIG ALERT AT LEAST TWO (2) WORKING DAYS BEFORE DIGGING. CONTRACTOR IS REQUIRED BY SAME CODE TO HAND-EXPOSE TO THE POINT OF NO CONFLICT 24" ON EITHER SIDE OF THE UNDERGROUND FACILITY SO YOU CAN DETERMINE ITS EXACT LOCATION BEFORE USING POWER EQUIPMENT.

811 Know what's below. Call before you dig.

BENCHMARK AND BASIS OF BEARING

OPUS STATIC GPS OBSERVATION
BASE POINT COORDINATES:
NORTHING: 2047019.0907
EASTING: 6811199.3302 - CALIFORNIA STATE PLANE COORDINATE SYSTEM ZONE V NAD 83

ELEVATION: 3234.10' - NAVD 88

NO.	REVISION	DATE	BY

NOTE:

IF THIS PLAN IS NOT SIGNED AND DATED BY THE ENGINEER OF RECORD AND ALSO BY THE CITY ENGINEER OR UTILITY COMPANY OFFICIAL IN THE APPROVAL BLOCKS OF THIS PLAN THEN THIS PLAN IS PRELIMINARY AND NOT FOR CONSTRUCTION.

REGISTERED PROFESSIONAL ENGINEER E. CARY PACKER No. C-51752 CIVIL STATE OF CALIFORNIA

MERRELL JOHNSON

DRAWN BY: EKJ/JMC	DATE: 05/26/23
DESIGNED BY: ECP/EKJ	DATE: 05/26/23
APPROVED BY: ECP	DATE: 05/26/23

TOWN OF APPLE VALLEY
ENGINEERING DEPARTMENT

REVIEWED BY:

MICHAEL P. PODEGRACZ, TOWN ENGINEER DATE

RCE 33445, EXP. DATE:

THESE PLANS ARE SIGNED BY THE TOWN OF APPLE VALLEY FOR CONCEPT ADHERENCE TO TOWN STANDARDS AND REQUIREMENTS ONLY. THE TOWN OF APPLE VALLEY IS NOT RESPONSIBLE FOR DESIGN, ASSUMPTIONS AND ACCURACY.

Town of Apple Valley

TOWN OF APPLE VALLEY WQMP EXHIBIT PLAN WAREHOUSE FACILITY DETAILS SHEET

APPLE VALLEY, CA

SCALE:	AS SHOWN
JOB NO.	3675.007
SHEET	2 OF 2

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