

Hydrology Report

For

Desert Valley Hospital – Emergency Department Expansion

16850 Bear Valley Road,
Victorville, California 92395
Project No. 22006870.00
December 1st, 2023

Prepared for:

Desert Valley Hospital
16850 Bear Valley Road,
Victorville, California 92395

Prepared by:



IMEG Corp

Engineer: John Mark Thompson, PE
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909-942-5540

Prepared: December 7th, 2023



A handwritten signature in black ink, appearing to read "John M. Thompson".

John M. Thompson, P. E.

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Introduction and Purpose

This drainage study provides an analysis of the existing and proposed hydrology improvements of the Prime Desert Valley Hospital – Emergency Department Expansion located at 16850 Bear Valley Road, Victorville, CA 92395. The project site is bounded by Bear Valley Road on the South, First Avenue on the west, an existing surface parking lot on the north, and an existing 2-story stucco Medical Office Building on the east.

The project site (Total Area = 367,055 SF = 8.43 AC.) proposes one 2-story emergency department building (Area = 37,820 SF) on east side of the existing 2-story stucco Medical Office Building (MOB); a new fire lane access road from Bear Valley Rd. connecting to the existing road; a new surface parking lot including 83 parking stalls, and a new service yard.

The report will analyze 2-year, 10-year, and 100-year storm events (1, 6, and 24 hour) design storm frequency for the hydraulics of on-site drainage areas per the requirements in the Hydrology Manual prepared by San Bernardino County (August 1986).

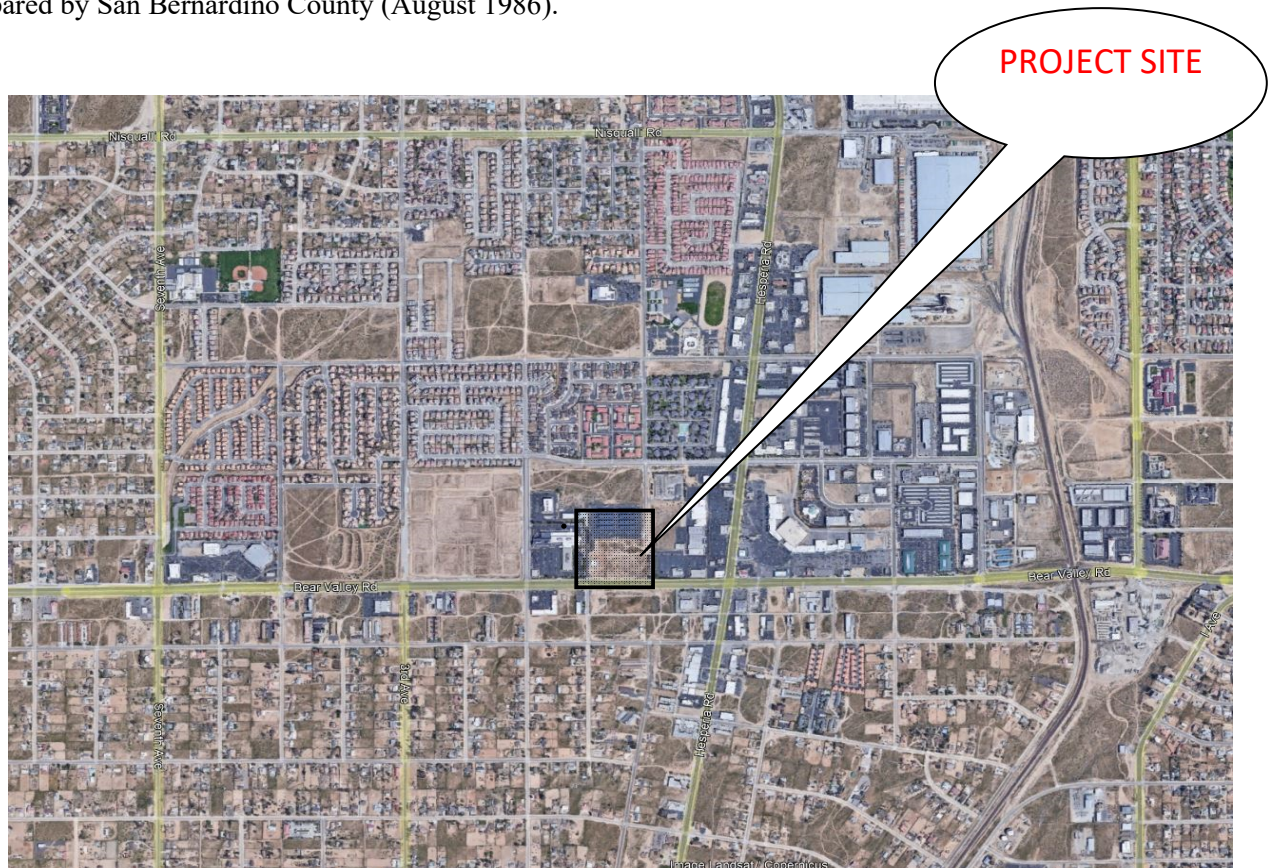


Figure 1: Location Map
(Source: Google Maps)



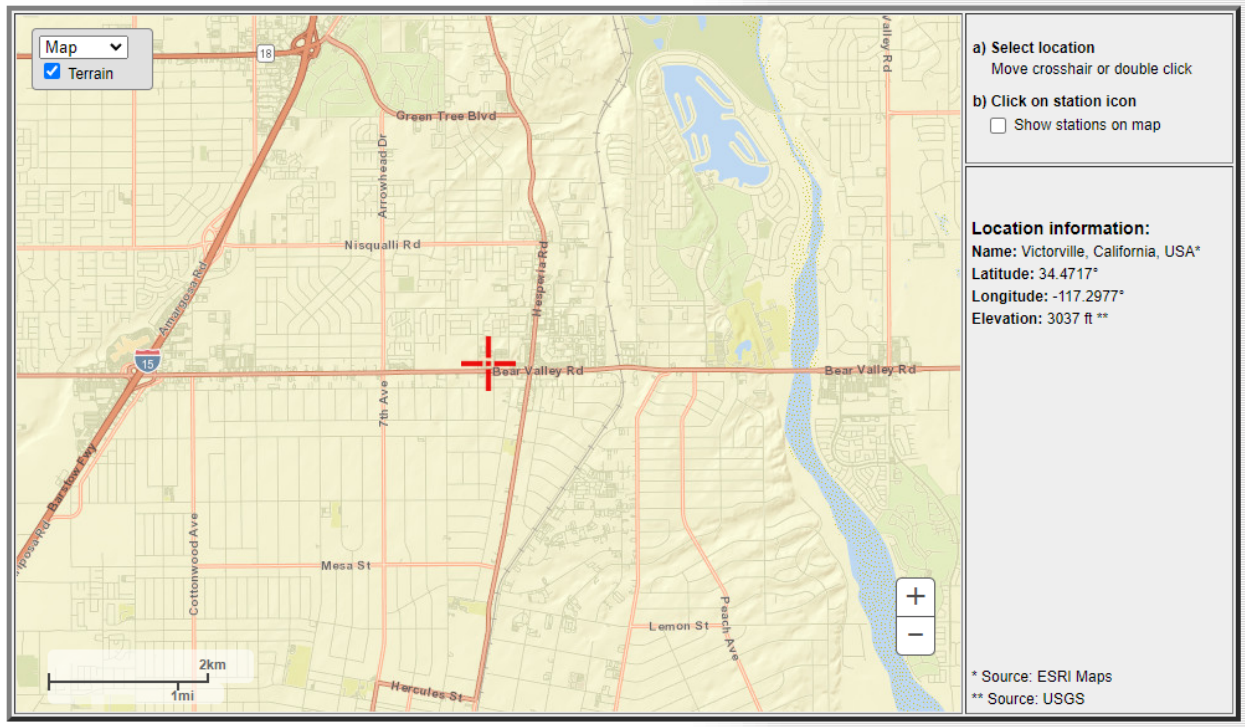


Figure 2: Site Coordinates
(Source: USGS)

Existing Conditions

The project site is approximately 8.43 acres with approximately 21.35% consisting of impervious cover.

The as-built records for the existing development do not provide evidence of existing water quality features onsite. Therefore, the existing condition (See Appendix A) is based on the current state, which was surveyed on October 7, 2022. The existing site grading is relatively flat and slopes average to 1.5% from south to north. The existing asphalt concrete surface parking lot which is on the east of the existing Medical Office Building slopes toward the access road, and the access road slopes north toward to an existing catch basin next to the oxygen tank. Next to the access road is the existing heliport which currently is about 6 feet higher than the existing grade. The heliport is surrounded by iron fence and decorative sloped landscape with rocks. The remaining land on the site is vacant land with shrubs and surface flow toward the north westerly. Existing Hydrology conditions for the total site are comprised of one Drainage Area (DA) which directs runoff flows northerly across the site towards Jasmine Street.

Project Description

Proposed Hydrology Drainage Area (DA) is divided into 3 areas. DA A is approximately 2.47 acres with approximately 75.81% consisting of impervious cover. The drainage in DA A including the proposed ED building, an access road, an ambulance drop off parking space in front of the ED building. DA B is approximately 2.89 acres with approximately 77.28% consisting of impervious cover. The drainage in DA B includes a service access road to access the equipment rooms and a parking lot. DA C is approximately 3.07 acres with approximately 15.76% consisting of impervious cover. The drainage in DA C includes the proposed surface parking lot, a detention basin and vacant landscape area. The proposed hydrology map (See Appendix A) illustrates the proposed hydrology conditions for the project site.

The proposed emergency department building is located 40 feet east of existing Medical Office Building. The storm water from the proposed building and surrounding landscape will be collected by roof drain inlets which will connect to underground storm drainpipes. The storm water from asphalt concrete pavement of the proposed surface parking lot will sheet flow into a proposed 24" catch basin that are then conveyed underground in pipes flowing towards another 24" catch basin at north end of access road. Water runoff will continue flowing easterly to the proposed on-site aboveground infiltration basin. The basin is sized to capture and mitigate the runoff volume before it exits the site.

Methodology

The peak flow rates for each drainage area were calculated using the Rational Method consistent with the requirements in the San Bernadino County Hydrology Manual. The NOAA Atlas 14 was used to provide precipitation intensity values for 2-year, 10-year, and 100-year storm events. A copy of the precipitation values for the project site can be found attached to this report (Appendix B). The runoff coefficients were determined using the coefficient table and the peak discharges were determined using the equation $Q = CIA$ (D.1) shown in page D-1 of the San Bernadino County Hydrology Manual.

Report Summary

The Rational method was used to compute the peak flows for 2-year, 10-year, and 100-year, 1-hr, 6-hr- and 24-hr storm events. The following tables summarize the results found for each drainage area and 1-hr storm event which is the worst-case scenario. The rest of the calculations are included in Appendix C.

Total Site Area = 367,055 sq. ft. ~ 8.43 acres

DA 1 = 2.47 acres

DA 2 = 2.89 acres

DA 3 = 3.07 acres

Flowrate Equation: $Q_n = CiA$

The total runoff of the existing development given a 100yr, 1hr storm event is 2.83 cfs. A summary of the existing condition hydrology results are provided in Table 1 below.

Table 1: Existing Hydrology Summary				
	Area (ac)	2-yr Q1-hr (cfs)	10-yr Q1-hr (cfs)	100-yr Q1-hr (cfs)
DA 1	8.43	0.68	1.63	2.83
Total (cfs)	8.43	0.68	1.63	2.83

* Values from Precipitation Frequency estimates table.

The total runoff of the proposed development given a 100yr, 1hr storm event is 7.81 cfs. A summary of the proposed condition hydrology results are provided in Table 2 below.

Table 2: Proposed Hydrology Summary				
	Area (ac)	2-yr Q1-hr (cfs)	10-yr Q1-hr (cfs)	100-yr Q1-hr (cfs)

DA 1	2.47	0.60	1.44	2.49
DA 2	2.89	0.70	1.68	2.91
DA 3	3.07	0.58	1.39	2.41
Total (cfs)	8.43	1.88	4.51	7.81

* Values from Precipitation Frequency estimates table.

A comparison of the Pre-and Post-Development conditions show there is an increase in peak flow under the post-development conditions. The increase in flow of 4.98 cfs is due to the increase in impervious groundcover.

Conclusion

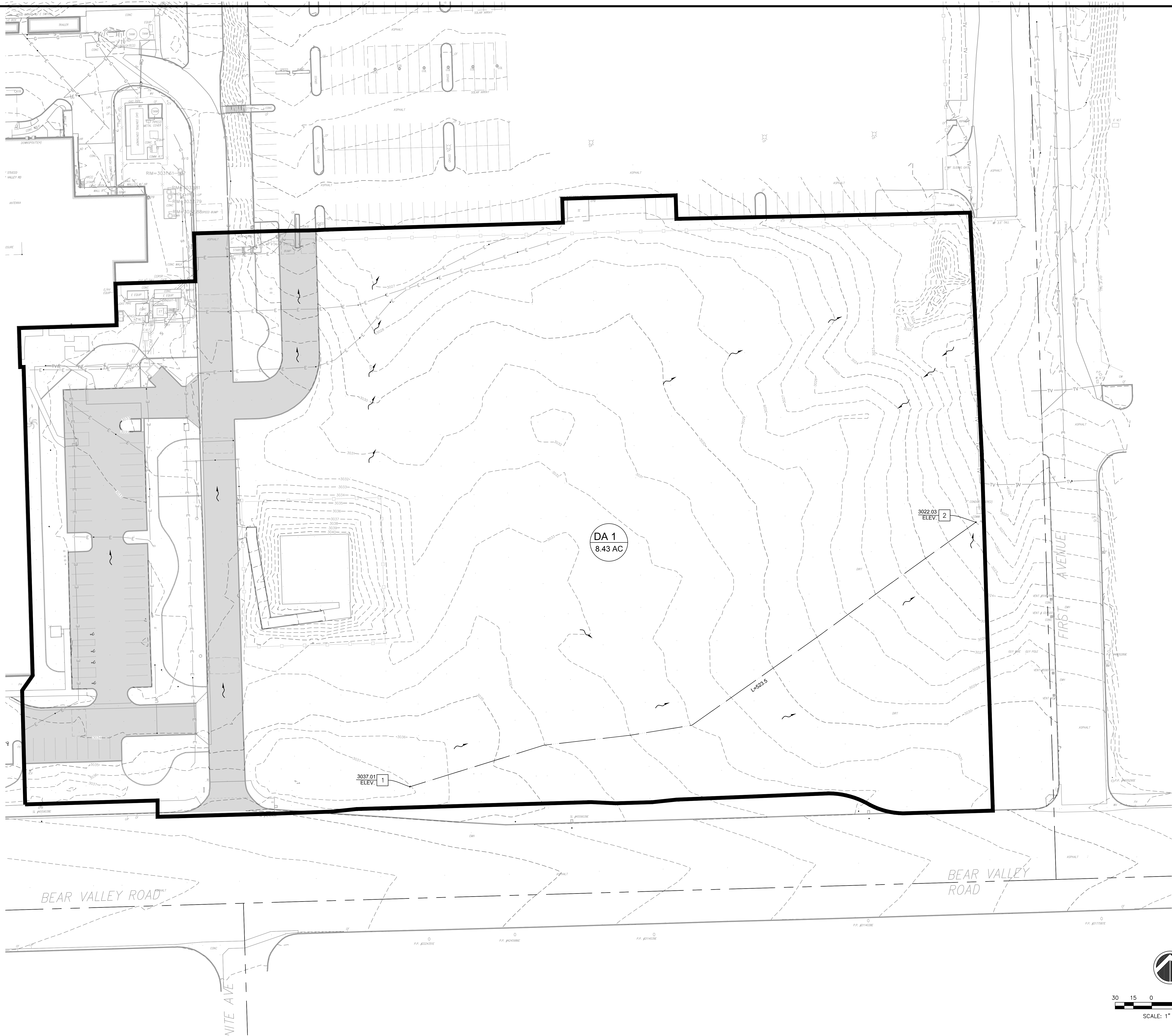
The Desert Valley Hospital – Emergency Department Expansion project located in city of Victorville is approximately 8.43 acres. Proposed improvements to the undeveloped land increase impervious cover. Hydrologic calculations were prepared using San Bernadino County’s Rational Method to compare pre- and post-development peak flows for 2-year, 10-year, and 100-year storm events. Results show that peak runoff increases under proposed conditions. The increase runoff is managed with additional storm drain inlets, pipes and will continue to flow to the proposed on-site retention system.

Per the findings of this study, the proposed storm facilities for the development can accommodate the requirements of the City of Victorville, County of San Bernardino. Stormwater will not inundate the project site and the building will be protected from the 100-year storm event.

APPENDIX A

Hydrology Maps

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LEGEND

- ASPHALT PAVEMENT
- UNDEVELOPED AREA
- WATERSHED BOUNDARY
- SUBDRAINAGE AREA
- PROPERTY LINE
- STORM DRAIN LINE
- LONGEST PATH
- FLOW DIRECTION

DA 1
1.00 AC

DA NUMBER
AREA (ACRES)

REVISIONS		DATE
No	DESCRIPTION	

4300 N. MILLER ROAD
SUITE 122
SCOTTSDALE, ARIZONA 85251
PH: 480.371.1333
www.imeg.com

DESERT VALLEY HOSPITAL
16860 BEAR VALLEY ROAD VICTORVILLE, CA 92386

EXISTING CONDITION HYDROLOGY EXHIBIT

IMEG Project No: 22006870

File Name: 6870 Hydrology Exhibit

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Field Book No:

Drawn By: AF

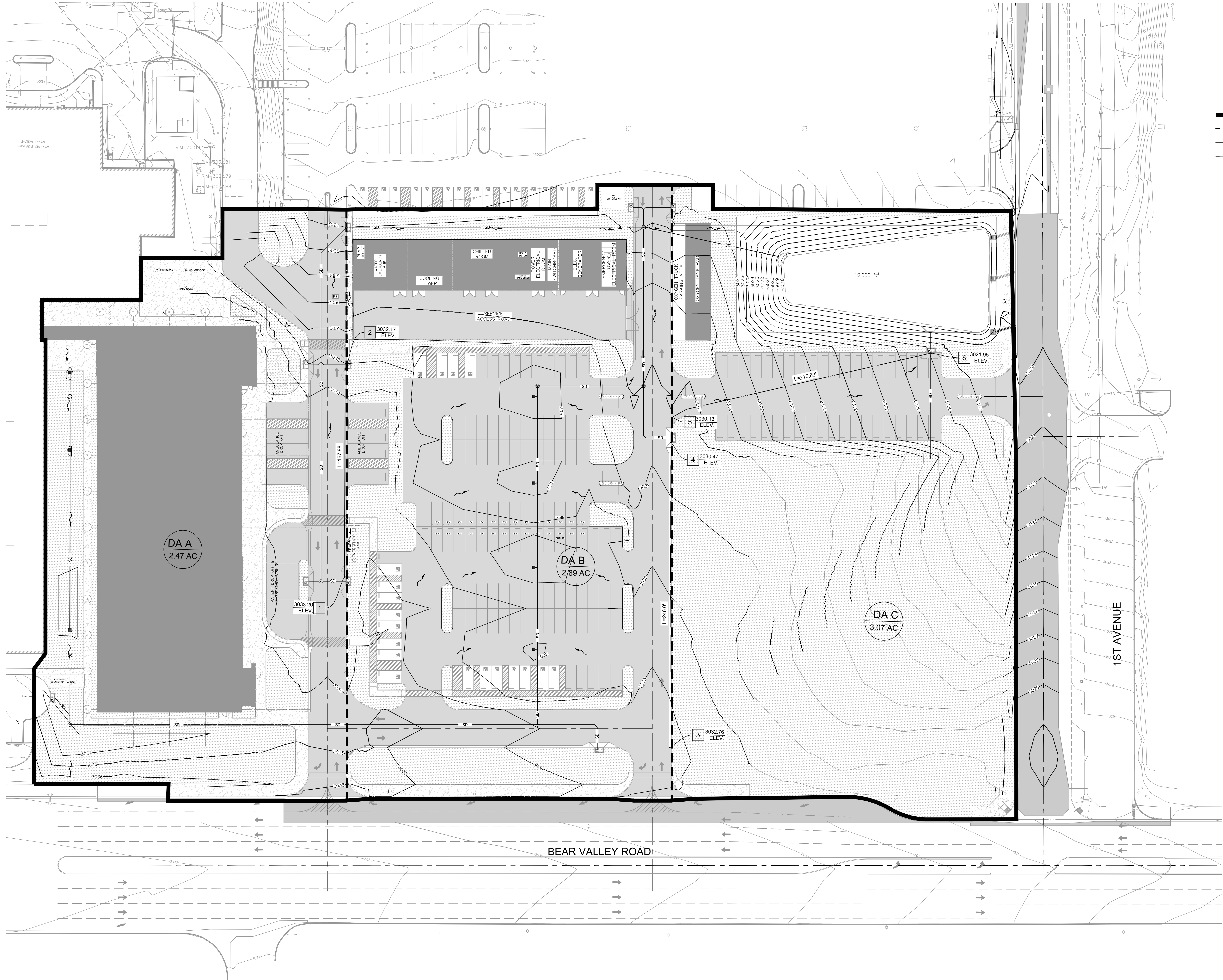
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Sheet 1 of 2

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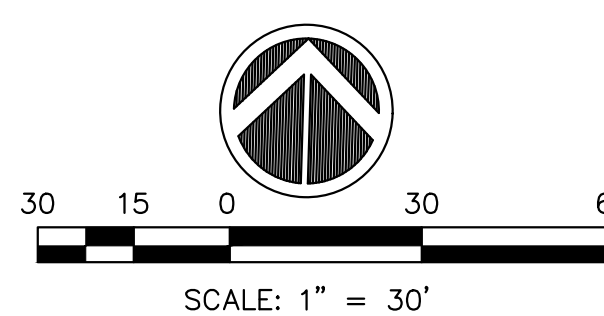


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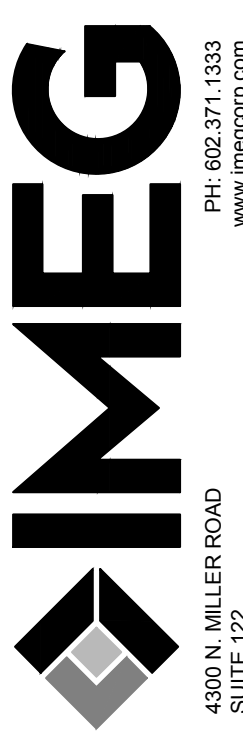
- ROOF
- ASPHALT PAVEMENT
- WATERSHED BOUNDARY
- SUBDRAINAGE AREA
- STORM DRAIN LINE
- LONGEST PATH
- FLOW DIRECTION

DA 1
1.00 AC

DMA NUMBER
AREA (ACRES)



REVISIONS		DATE
No	DESCRIPTION	



4300 N. MILLER ROAD
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PH: 480.371.1333
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DESERT VALLEY HOSPITAL
18850 BEAR VALLEY ROAD VICTORVILLE, CA 92386

PROPOSED CONDITION HYDROLOGY
EXHIBIT

IMEG Project No:
22006870

File Name:
6870 Hydrology Exhibit

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Field Book No:

Drawn By: AF

Checked By: KM

Date: ----

EXH

Sheet 2 of 2

APPENDIX B

NOAA Atlas



NOAA Atlas 14, Volume 6, Version 2
Location name: Victorville, California, USA*
Latitude: 34.4717°, Longitude: -117.2977°
Elevation: 3037 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 & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.07 (0.876-1.30)	1.49 (1.22-1.82)	2.06 (1.70-2.54)	2.57 (2.09-3.17)	3.26 (2.58-4.18)	3.83 (2.96-5.00)	4.43 (3.35-5.93)	5.08 (3.72-6.98)	5.99 (4.21-8.58)	6.73 (4.57-9.98)
10-min	0.762 (0.630-0.930)	1.07 (0.882-1.30)	1.48 (1.22-1.82)	1.84 (1.50-2.27)	2.34 (1.85-2.99)	2.75 (2.12-3.59)	3.17 (2.40-4.25)	3.64 (2.67-5.00)	4.29 (3.02-6.15)	4.82 (3.28-7.15)
15-min	0.612 (0.508-0.752)	0.860 (0.708-1.05)	1.20 (0.984-1.47)	1.48 (1.21-1.83)	1.89 (1.49-2.41)	2.22 (1.71-2.89)	2.56 (1.93-3.43)	2.93 (2.15-4.04)	3.46 (2.44-4.96)	3.89 (2.64-5.77)
30-min	0.428 (0.354-0.522)	0.598 (0.494-0.732)	0.832 (0.686-1.02)	1.03 (0.842-1.28)	1.31 (1.04-1.68)	1.54 (1.19-2.01)	1.78 (1.35-2.39)	2.04 (1.50-2.81)	2.41 (1.70-3.45)	2.71 (1.84-4.02)
60-min	0.268 (0.221-0.327)	0.375 (0.309-0.459)	0.522 (0.429-0.640)	0.646 (0.527-0.799)	0.823 (0.650-1.05)	0.966 (0.747-1.26)	1.12 (0.843-1.50)	1.28 (0.939-1.76)	1.51 (1.06-2.16)	1.70 (1.15-2.52)
2-hr	0.189 (0.156-0.231)	0.254 (0.210-0.312)	0.345 (0.284-0.423)	0.421 (0.344-0.521)	0.531 (0.419-0.679)	0.619 (0.478-0.808)	0.711 (0.537-0.952)	0.811 (0.595-1.12)	0.951 (0.670-1.36)	1.06 (0.725-1.58)
3-hr	0.153 (0.127-0.188)	0.204 (0.168-0.250)	0.274 (0.225-0.336)	0.333 (0.272-0.412)	0.417 (0.330-0.534)	0.486 (0.375-0.635)	0.557 (0.421-0.746)	0.634 (0.465-0.873)	0.743 (0.523-1.06)	0.830 (0.565-1.23)
6-hr	0.105 (0.087-0.129)	0.139 (0.115-0.170)	0.185 (0.152-0.227)	0.224 (0.183-0.278)	0.280 (0.221-0.358)	0.325 (0.251-0.424)	0.372 (0.281-0.498)	0.422 (0.310-0.581)	0.493 (0.347-0.708)	0.551 (0.375-0.818)
12-hr	0.067 (0.055-0.082)	0.090 (0.074-0.110)	0.121 (0.099-0.148)	0.147 (0.120-0.182)	0.184 (0.145-0.235)	0.213 (0.165-0.279)	0.244 (0.184-0.327)	0.277 (0.203-0.381)	0.323 (0.227-0.463)	0.360 (0.245-0.534)
24-hr	0.044 (0.039-0.051)	0.061 (0.054-0.070)	0.083 (0.074-0.096)	0.102 (0.089-0.119)	0.128 (0.109-0.155)	0.149 (0.124-0.183)	0.171 (0.138-0.215)	0.193 (0.152-0.251)	0.225 (0.170-0.305)	0.251 (0.183-0.351)
2-day	0.025 (0.022-0.029)	0.035 (0.031-0.040)	0.048 (0.042-0.056)	0.059 (0.052-0.069)	0.075 (0.063-0.090)	0.087 (0.072-0.107)	0.100 (0.081-0.126)	0.114 (0.090-0.148)	0.133 (0.101-0.180)	0.149 (0.109-0.208)
3-day	0.018 (0.016-0.021)	0.025 (0.022-0.029)	0.035 (0.031-0.040)	0.043 (0.038-0.050)	0.055 (0.046-0.066)	0.064 (0.053-0.079)	0.073 (0.059-0.093)	0.084 (0.066-0.108)	0.098 (0.074-0.133)	0.110 (0.080-0.153)
4-day	0.014 (0.012-0.016)	0.020 (0.018-0.023)	0.028 (0.025-0.032)	0.034 (0.030-0.040)	0.044 (0.037-0.053)	0.051 (0.042-0.063)	0.059 (0.048-0.074)	0.067 (0.053-0.087)	0.079 (0.059-0.106)	0.088 (0.064-0.123)
7-day	0.009 (0.008-0.010)	0.012 (0.011-0.014)	0.017 (0.015-0.020)	0.021 (0.018-0.024)	0.027 (0.022-0.032)	0.031 (0.026-0.038)	0.036 (0.029-0.045)	0.041 (0.032-0.053)	0.047 (0.036-0.064)	0.053 (0.039-0.074)
10-day	0.006 (0.006-0.007)	0.009 (0.008-0.010)	0.012 (0.011-0.014)	0.015 (0.013-0.018)	0.019 (0.016-0.023)	0.023 (0.019-0.028)	0.026 (0.021-0.033)	0.030 (0.023-0.039)	0.035 (0.026-0.047)	0.039 (0.028-0.054)
20-day	0.003 (0.003-0.004)	0.005 (0.004-0.006)	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.011 (0.009-0.014)	0.013 (0.011-0.016)	0.015 (0.012-0.019)	0.017 (0.014-0.023)	0.020 (0.015-0.028)	0.023 (0.017-0.032)
30-day	0.003 (0.002-0.003)	0.004 (0.003-0.004)	0.005 (0.005-0.006)	0.007 (0.006-0.008)	0.009 (0.007-0.010)	0.010 (0.008-0.013)	0.012 (0.009-0.015)	0.014 (0.011-0.018)	0.016 (0.012-0.022)	0.018 (0.013-0.025)
45-day	0.002 (0.002-0.002)	0.003 (0.002-0.003)	0.004 (0.004-0.005)	0.005 (0.004-0.006)	0.007 (0.006-0.008)	0.008 (0.007-0.010)	0.009 (0.007-0.012)	0.011 (0.008-0.014)	0.013 (0.010-0.018)	0.015 (0.010-0.020)
60-day	0.001 (0.001-0.002)	0.002 (0.002-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.007)	0.007 (0.005-0.008)	0.008 (0.006-0.010)	0.009 (0.007-0.012)	0.011 (0.008-0.015)	0.012 (0.009-0.017)

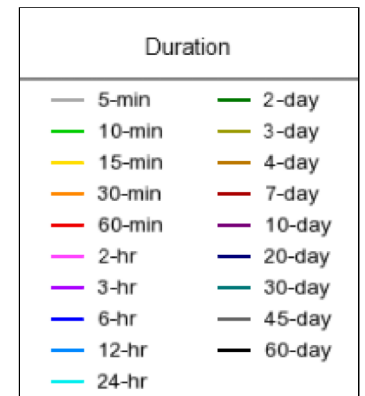
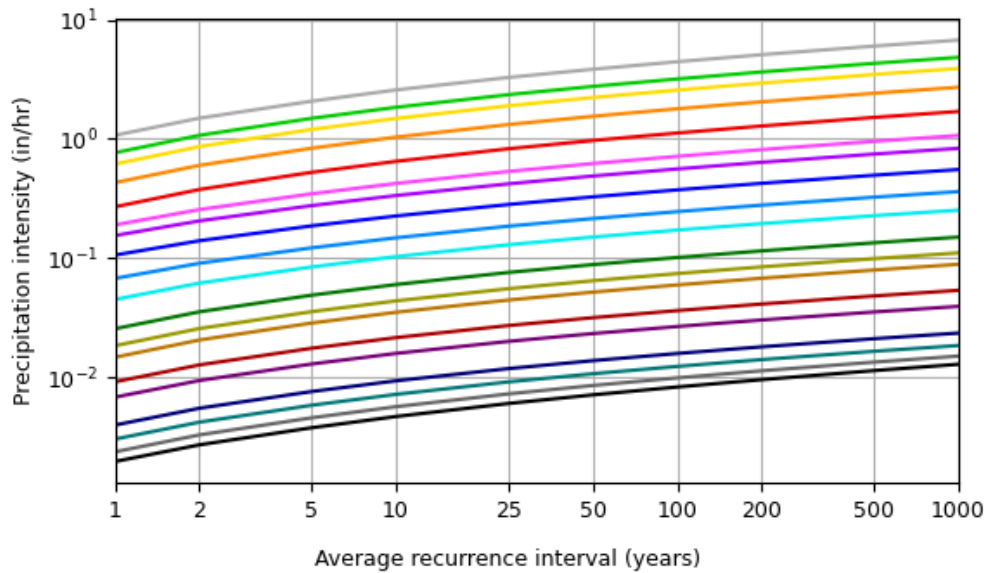
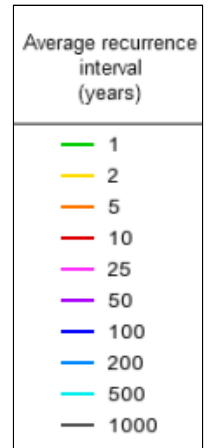
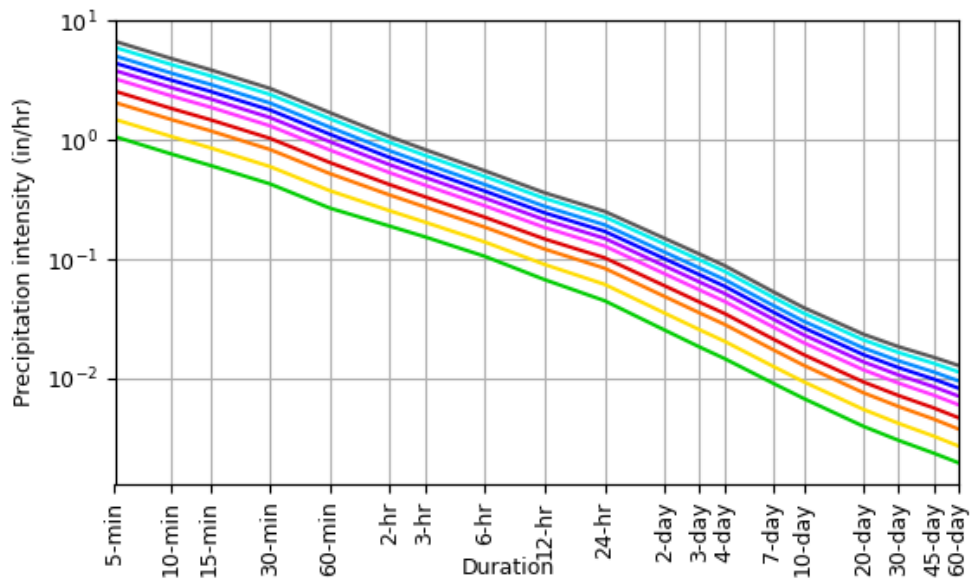
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average 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 intensity-duration-frequency (IDF) curves

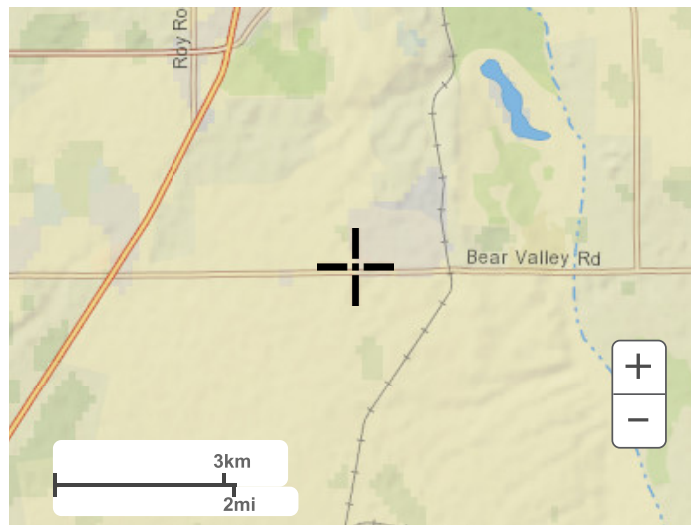
Latitude: 34.4717°, Longitude: -117.2977°



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Maps & aerials

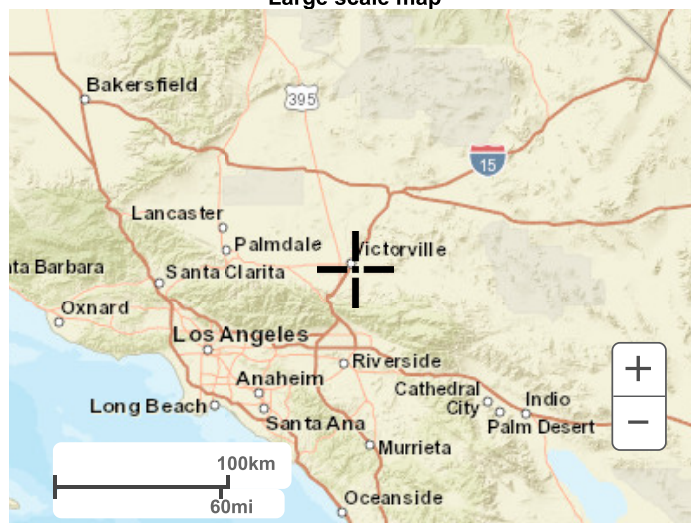
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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APPENDIX C

Calculations

EXISTING CONDITION CALCULATIONS				
2YR-DA-1: EXISTING HYDROLOGY SUMMARY (IMPERVIOUS 21.35%)				
HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	0.268	8.43	0.30	0.68
6	0.105	8.43	0.30	0.27
24	0.044	8.43	0.30	0.11
10YR-DA-1: EXISTING HYDROLOGY SUMMARY (IMPERVIOUS 21.35%)				
HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	0.646	8.43	0.30	1.63
6	0.224	8.43	0.30	0.57
24	0.102	8.43	0.30	0.26
100 YR-DA-1: EXISTING HYDROLOGY SUMMARY (IMPERVIOUS 21.35%)				
HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	1.12	8.43	0.30	2.83
6	0.372	8.43	0.30	0.94
24	0.171	8.43	0.30	0.43

DA-A PROPOSED CONDITION CALCULATIONS				
2YR-DA-A: PROPOSED HYDROLOGY SUMMARY (IMPERVIOUS 75.81%)				
HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	0.268	2.47	0.90	0.60
6	0.105	2.47	0.90	0.23
24	0.044	2.47	0.90	0.10
10YR-DA-A: PROPOSED HYDROLOGY SUMMARY (IMPERVIOUS 75.81%)				
HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	0.646	2.47	0.90	1.44
6	0.224	2.47	0.90	0.50
24	0.102	2.47	0.90	0.23
100 YR-DA-A: PROPOSED HYDROLOGY SUMMARY (IMPERVIOUS 75.81%)				
HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	1.12	2.47	0.90	2.49
6	0.372	2.47	0.90	0.83
24	0.171	2.47	0.90	0.38

DA-B PROPOSED CONDITION CALCULATIONS**2YR-DA-B: PROPOSED HYDROLOGY SUMMARY (IMPERVIOUS 77.28%)**

HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	0.268	2.89	0.90	0.70
6	0.105	2.89	0.90	0.27
24	0.044	2.89	0.90	0.11

10YR-DA-B: PROPOSED HYDROLOGY SUMMARY (IMPERVIOUS 77.28%)

HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	0.646	2.89	0.90	1.68
6	0.224	2.89	0.90	0.58
24	0.102	2.89	0.90	0.27

100 YR-DA-B: PROPOSED HYDROLOGY SUMMARY (IMPERVIOUS 77.28%)

HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	1.12	2.89	0.90	2.91
6	0.372	2.89	0.90	0.97
24	0.171	2.89	0.90	0.44

DA-C PROPOSED CONDITION CALCULATIONS**2YR-DA-C: PROPOSED HYDROLOGY SUMMARY (IMPERVIOUS 15.76%)**

HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	0.268	3.07	0.70	0.58
6	0.105	3.07	0.70	0.23
24	0.044	3.07	0.70	0.09

10YR-DA-C: PROPOSED HYDROLOGY SUMMARY (IMPERVIOUS 15.76%)

HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	0.646	3.07	0.70	1.39
6	0.224	3.07	0.70	0.48
24	0.102	3.07	0.70	0.22

100 YR-DA-C: PROPOSED HYDROLOGY SUMMARY (IMPERVIOUS 15.76%)

HR	PRECIPITATION INTENSITY (i)-in/hr	SITE AREA (A)	RUNOFF COEFF. (C)	FLOWRATE (Qn)-cfs
1	1.12	3.07	0.70	2.41
6	0.372	3.07	0.70	0.80
24	0.171	3.07	0.70	0.37

APPENDIX D

Soils Report



Geotechnical Engineering Report

**Proposed Desert Valley Hospital Addition
Victorville, San Bernardino County, California**

March 6, 2023

Terracon Project No. CB225235

Prepared for:

Prime Healthcare Management, Inc.
Ontario, CA

Prepared by:

Terracon Consultants, Inc.
Colton, California



March 6, 2023

Prime Healthcare Management, Inc.
3300 E. Guasti Road, 3rd Floor
Ontario, CA 91761

Attn: Mr. Robert T. Escareno
P: (760) 713 0021
E: REscareno@primehealthcare.com

Re: Geotechnical Engineering Report
Proposed Desert Valley Hospital Addition
16850 Bear Valley Rd.
Victorville, San Bernardino County, California
Terracon Project No. CB225235

Dear Mr. Escareno:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PCB225235 dated December 21, 2022. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.


Ali Tabatabaei, Ph.D., G.E. 3159
Geotechnical Project Engineer



Keith P. Askew, P.E., G.E.
Geotechnical Department Manager

John S. McKeown, E.G. 2396
Senior Geologist

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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the [GeoReport](#) logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report
Proposed Desert Valley Hospital Addition
16850 Bear Valley Road
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Terracon Project No. CB225235
March 6, 2023

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed new building to be located at 16850 Bear Valley Road in Victorville, San Bernardino County, California. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions and historic high groundwater
- 2022 California Building Code (CBC) seismic design parameters
- Liquefaction analysis
- Subgrade preparation/earthwork recommendations
- Foundation design and concrete slabs-on-grade
- Preliminary pavement section design
- Infiltration and drainage

The geotechnical engineering Scope of Services for this project included the advancement of eleven test borings to depths ranging from approximately 5 to 51½ feet below existing site grades, percolation testing, laboratory testing, and preparation of this report.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and/or as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

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Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California

March 6, 2023 ■ Terracon Project No. CB225235

Item	Description
Parcel Information	The project is located at the 16850 Bear Valley Road in Victorville, San Bernardino County, California. The addition is planned at the east side of an existing 2-story stucco building. The footprint (per plans provided to us) for the new structure is approximately 39,280 square feet. Center of the proposed structure is Latitude 34.4717° N / Longitude 117.2973° W (approximate) See Site Location
Existing Improvements	Site for the new building is currently an asphalt concrete parking lot.
Current Ground Cover	Asphalt concrete parking, trees and shrubs and concrete flatwork.
Existing Topography	The site is relatively flat with approximately elevations ranging from 280 to 298 feet and generally slopes down towards the southeast.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Proposed Development	Project plans include an approximate footprint measuring 39,280 square feet. The existing building is described as a two-story stucco building. We assume a similar configuration for the planned addition. We understand that the proposed construction is classified as an HCAI project and will be subject to review by the California Geological Survey (CGS).
Building Construction	Not provided. A likely construction would be steel moment frame with a slab on grade, using spread footings or a mat foundation.
Finished Floor Elevation	Unknown, assumed to be close to existing grade.
Structural Loads (assumed)	■ Columns: 100-200 kips ■ Walls: 2 to 4 kips per linear foot (klf) ■ Slabs: 150 pounds per square foot (psf)
Grading Requirements	Up to 5 feet of cut and fill may be required to develop final grade, excluding remedial grading. Permanent slopes are not anticipated.
Below Grade Structures	Not specified.
Infiltration Systems	An on-site stormwater retention/infiltration system is planned; therefore, we have included infiltration testing in this current scope of work and report.
Free-Standing Retaining Wall	Not anticipated

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Item	Description
Pavements	Paved driveway and parking will be constructed on site. We assume both rigid (concrete) and flexible (asphalt) pavement sections should be considered. Please confirm this assumption.
	Anticipated traffic indices (TIs) are as follows for asphalt pavement:
	■ Auto Parking Areas: TI=5.0
	■ Drive Lanes TI=5.5
	■ Truck Delivery Areas: TI=7.0
	■ The pavement design period is 20 years.
	Anticipated average daily truck traffic (ADTT) is as follows for concrete pavement:
	■ Light Duty: ADTT=1 (Category A)
	■ Medium Duty: ADTT=25 (Category B)
	■ Heavy Duty: ADTT=700 (Category C)

GEOTECHNICAL CHARACTERIZATION

Site Geology

The site is located in the Mojave Desert on an alluvial plain formed along the northern flank of the San Bernardino Mountains. The Mojave River is approximately 2.4 miles east of the site. The Mojave Desert Province is an interior region characterized by isolated mountains and hills separated by broad alluvial plains. Playa lakes are common in the lower basins and faults trend east-west and northwest to southeast.

Based on geologic mapping by Dibblee and Minch (2008), the site is underlain by older alluvium. As encountered in our site explorations, these materials include interlayered mixtures of silt and sand.

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The table below summarizes our geotechnical characterization.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on

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Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California

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the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description ¹	Consistency/Density
Surface Cover	---	Asphalt Concrete (AC), approximately 1.5" to 2" thick	---
	----	Aggregate Base (AB), approximately 6" thick	---
Stratum I	51 ½ (maximum depth of the explorations)	Interbedded layers of poorly graded sand, silty sand, brown	Medium dense to very dense

^{1.} Aggregate base was encountered in borings B-1, B-3 and B-7 only.

Hydroconsolidation

To evaluate the potential deformation that may be caused by the addition of water to subsurface soils, hydroconsolidation testing was performed on two selected, representative relatively undisturbed samples. The results are provided in the Exploration Results section. The test results indicate a collapse potential of 0.4% and 1.2% for B-1 at 5 feet, and B-8 at 5 feet, respectively. The soil sample was saturated under an axial pressure of 2,000 psf.

Groundwater Conditions

The following table summarizes groundwater depth information for a well located near the site.

Well No.	Reference Point Elevation (feet)	Date of Measurement	Depth to Water (feet)	Distance to Site	Direction
05N04W34N001S	3003	8/1/1992	239	1440 feet	NE
		3/1/2006	250		
		2/2/2011	240		
		5/12/2014	252		

Groundwater was not encountered within the maximum 51½ foot depth of borings drilled for the project.

The borings were advanced using continuous flight auger drilling techniques that allow short-term groundwater observations to be made while drilling. Groundwater seepage was not observed within the maximum depths of exploration during or at the completion of drilling.

Groundwater level fluctuations can occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. We do not anticipate groundwater to impact construction.

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Regional Faulting

The tectonics of the Southern California area are dominated by the interaction of the North American and Pacific tectonic plates, which are sliding past each other in transform motion. Although some of the motion may be accommodated by rotation of crustal blocks such as the western Transverse Ranges (Dickinson, 1996), the San Andreas fault zone represents the major surface expression of the tectonic boundary and accommodates a significant portion of the slip between the Pacific and North American plates. Some of the slip is accommodated by other northwest-trending strike-slip faults that are related to the San Andreas system, such as the San Jacinto and Elsinore faults. The Mojave Desert region contains a portion of the Eastern California Shear Zone, a system of northwest-southeast trending faults that extend across the eastern Mojave region. Active faults in this zone include the Helendale-South Lockhart, Lenwood-Lockhart, and Johnson Valley faults. Several of the ECSZ faults ruptured during the Landers earthquake in 1992 forming a broad zone of surface rupture distributed across multiple fault stands. The Hector Mine earthquake of 1999 similarly ruptured along several mapped fault strands. A Regional Fault Map is presented in [Supplemental Figures](#).

Fault Rupture Potential: The site is not located within an Alquist-Priolo Earthquake Fault Zone (APZ) designated by the State of California for active faults (Hart, 1999). The closest APZ boundary, designated for the San Jacinto North Frontal fault zone, is located approximately 6.8 miles southeast of the site. Known faults or fault-related features are not located within the site; therefore, the potential for fault rupture within the site is considered low.

North Frontal Fault Zone: The North Frontal fault zone of the San Bernardino Mountains is located approximately 11 kilometers southeast of the site. The North frontal zone is an east-west trending fault system made up of a number of separate structural elements, each of which accommodates range-front uplift/deformation. This fault zone is characterized by a broad, complex zone of discontinuous, generally south-dipping thrust, reverse, and, locally, strike-slip faults with latest Pleistocene to Holocene offset. The western section includes the Ord Mountains fault zone which is the closest element of the zone to the site. Additional elements in the Western section include the Ocotillo Ridge fold, Sky High Ranch fault, and White Mountains Thrust. The Ord Mountains section is included in a State-designated fault hazard zone.

Helendale Fault: The northwest-striking Helendale-South Lockhart fault zone is located approximately 22 kilometers northeast of the site, is the westernmost of a series of sub-parallel right-lateral strike-slip faults in the central Mojave Desert, and is part of the eastern California shear zone. The Helendale-South Lockhart fault zone extends from its presumed junction with the Lockhart fault zone near Highway 395 to about 15 km northwest of Highway 15. The Helendale fault trends along the southwest side of the Sidewinder Mountains, through the Lucerne Valley and into the northern San Bernardino Mountains.

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San Andreas Fault Zone: The San Andreas fault zone (SAFZ), a prominent geologic feature of California, traverses the Cajon Pass region and northern flank of the San Gabriel Mountains approximately 26 kilometers southwest of the site. The San Andreas fault is characterized by youthful fault scarps, aligned vegetation, topographic troughs, springs and offset drainage channels.

The greater San Andreas fault system is composed of multiple named segments extending through California that are postulated to rupture singly or together with other segments. The SAFZ is capable of producing magnitude 7.5 to 8 earthquakes under multi-segment rupture scenarios. The ShakeOut Scenario (USGS, 2008) is a study aimed at identifying the physical, social and economic effects of a major earthquake in southern California and preparing Californians before such an event occurs. The scenario earthquake selected for ShakeOut is a magnitude 7.8 event on the southern SAFZ, postulated to generate similar events on average every 150 years. Lateral slip for the scenario event is estimated as 9 to 30 feet. Fault rupture and strong ground shaking from the SAFZ present hazards to be mitigated for developments in the southern California region. Southwestward decrease in slip rates along the SAFZ northwest of its junction with the San Jacinto fault zone is suggested in studies by McGill and others (2021) and attests to the complexity of fault systems in southern California.

Cucamonga Fault : The southern margin of the San Gabriel Mountains is coincident with a series of east-west trending, predominantly reverse and thrust faults known as the Transverse Ranges frontal fault system. The San Fernando fault of this system ruptured during the 1971 magnitude 6.7 San Fernando earthquake. The Cucamonga fault of this system is located at the base of the San Gabriel Mountains, approximately 35 kilometers southwest of the site. Evidence of recent activity on this fault includes fresh scarps, sag ponds and disrupted Holocene alluvium (Dutcher and Garrett, 1963; Yerkes, 1985; Morton and Yerkes, 1987).

Historical Earthquakes

A search of the USGS earthquake catalog for earthquakes of magnitude 4.5 or greater within 150 kilometers of the site returned 340 results including 4 events of magnitude 7 or greater, 19 events of magnitude 6 to 6.9, 104 events of magnitude 5 to 6 and 248 events of magnitude 4.5 to 5. A Regional Seismicity Map based on these data is attached.

The following table summarizes selected earthquakes recorded in the site region.

Event ID	Date	Magnitude	Distance (km)	Direction
NW of San Bernardino	12-8-1812	7.5	34	WSW
Palmdale	1-16-1857	6.3	68	W
Devore area	12-16-1858	6.0	31	S
NW of San Bernardino	7-30-1894	6.2	34	SW
Cajon Pass area	7-22-1899	6.4	29	SW
Barstow Heights	7-16-1916	4.5	37	NE
SSE of Fort Irwin	4-10-1947	6.5	88	NE
Tehachapi	7-21-1952	7.3	165	W

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Sylmar	2-9-1971	6.6	99	W
Landers	6-28-1992	7.3	85	ESE
Big Bear	6-28-1992	6.4	53	SE
Northridge	1-17-1994	6.7	11	WSW
Hector Mine	10-16-1999	7.1	96	E
ENE Running Springs	10-19-1999	5.6	35	SE
Searles Valley	7-6-2019	7.1	145	N

Mitigation of seismic shaking hazard includes design and construction of buildings and improvements according to applicable codes. The following section provides seismic design information specific to this project site.

SEISMIC CONSIDERATIONS

Seismic Design Parameters

The seismic design parameters, according to the ASCE 7-16 are provided in the following section based on the **site-specific method** of Section 21.2. Site Classification (soil profile type) for seismic design is based on the upper 100 feet of a site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7. We used $V_{s30} = 260$ meters/second, consistent with the Site Class 'D' condition, based on blow counts measured in site borings. The site-specific V_{s30} value was used in deterministic models and the 'D' category was applied in probabilistic spectral values using the USGS Hazard Tool. Basin factors $Z_{1.0} = 60$ meters and $Z_{2.5} = 220$ meters were derived from data compiled by Graves (2011) for CDMG seismic station 23321 located in a similar geologic setting approximately 3.7 kilometer southwest of the site. The site does not lie within a deep structural basin.

Subsurface explorations at this site were extended to a maximum depth of 51½ feet. The site properties to a profile depth of 100 feet (30 meters) were estimated based on our experience and knowledge of geologic conditions of the general area. The seismic design parameters are summarized in the following table according to site-specific method of ASCE 7-16, Chapter 21.

Description	Value
Site Classification ¹	D
Site Latitude	34.4717
Site Longitude	-117.2973
Mapped Spectral Acceleration Parameters ²	$S_s = 1.251$ and $S_1 = 0.482$
Site Coefficients	$F_a = 1.0^2$ and $F_v = 1.82^3$
Site-specific Spectral Response Acceleration Parameters ⁴	$SM_s = 1.47$ and $SM_1 = 0.963$

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Description	Value
Design Spectral Acceleration Parameters ⁴	$SD_s = 0.98$ and $SD_1 = 0.642$
Peak Ground Acceleration ⁴	0.538g
De-aggregated Magnitude ⁵	7.9

^{2.} Seismic site classification in general accordance with ASCE 7-16, Chapter 20.
^{3.} These values were obtained using online seismic design tools provided by Structural Engineers Association of California - <https://www.seaoc.org/page/seismicdesignmaptool>.
^{4.} ASCE 7-16 11.4.4
^{5.} Site-specific values based on ASCE 7-16, 21.4 and 21.5
^{6.} USGS Unified Hazard Tool <https://earthquake.usgs.gov/hazards/interactive>.

Site-Specific Ground Motions

A site-specific ground motion study for the project was performed and included a ground motion hazard analysis. We performed this analysis in general conformance with Chapter 21 of ASCE 7-16.

The procedures outlined in ASCE 7-16 Chapters 11, 20 and 21 were utilized for preparation of site-specific spectra for the proposed project. The site is approximately 11 kilometers northwest of the mapped trace of the North Frontal fault zone and 26 kilometers northeast of the San Andreas fault zone. We prepared deterministic and probabilistic spectra and associated limiting spectra. We used $V_{s30} = 260$ meters/second. Basin factors $Z_{1.0}$ and $Z_{2.5}$ were adapted from Southern California Earthquake Center (SCEC) Community Velocity Models (CVM H11) as compiled by Graves (2011). The site-specific response spectra in tabular and graphic forms and a discussion of methodology are included in this section.

Deterministic Spectrum: Deterministic MCE spectra based on scenario events on nearby faults and consistent with the Next Generation West 2 (NGA-West 2) attenuation relations (GMPEs) used for the 2014 USGS seismic source models were calculated. Basin factors were applied as defined for each GMPE. The fault properties used are summarized in the following table and are consistent with deterministic scenario values presented in BSSC (2015) <https://earthquake.usgs.gov/scenarios/catalog/bssc2014>.

Fault	Magnitude	Distance (km)	Direction	Type
North Frontal	7.2	11	SE	reverse
Helendale	7.4	22	NE	Strike slip
San Andreas	8.2	26	SW	Strike slip
Cucamonga	6.9	35	SW	reverse

We evaluated the deterministic spectral values from scenario fault sources that resulted in the highest amplitude at any spectral period and compiled them for the deterministic spectrum. The resulting deterministic spectrum is controlled by the North Frontal fault at periods from PGA to 2.0 seconds and the San Andreas fault at periods from 3 to 5 seconds.

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The equally-weighted spectral values from the attenuation relations of Abrahamson and others (ASK 2014), Boore and others (BSSA 2014), Campbell and Borzognia (CB 2014) and Chiou and Youngs (CY 2014) were used for the deterministic MCE spectra. The MCE spectrum represents 84th-percentile, 5-percent-damped spectral response acceleration in the direction of maximum horizontal response (maximum rotated) for each spectral period. Maximum rotated values were obtained using the scaling factors of Shahi and Baker (2014). The deterministic MCE_R spectrum and associated spectra are attached in tabular and graphic forms.

Probabilistic MCE_R Spectrum: An MCE_R spectrum was developed as a probabilistic spectrum using site class D values obtained with the USGS Hazard Tool (<https://earthquake.usgs.gov/hazards/interactive/>) web-based software application consistent with the Next Generation West 2 (NGA-West 2) attenuation relations (GMPEs). The equally-weighted spectral values from the attenuation relations of Abrahamson and others (ASK 2014), Boore and others (BSSA 2014), Campbell and Borzognia (CB 2014) and Chiou and Youngs (CY 2014) were used for the probabilistic spectrum. Basin factors were applied as defined for each GMPE. The values so obtained were scaled from geomean to maximum rotated values using the factors of Shahi and Baker (2014). Gridded seismic sources are included in the probabilistic model. The probabilistic MCE spectrum was converted to a risk-targeted spectrum (MCE_R) using the USGS Risk Targeted Ground Motion Calculator tool (<https://code.usgs.gov/ghsc/hazdev/earthquake-rtgm-calculator>).

Site-Specific MCE_R Spectrum: The lesser of the spectral values at any period from the deterministic MCE_R and probabilistic MCE_R spectra form the site-specific MCE_R spectrum per ASCE 7-16 21.2.3. For the subject site, the deterministic spectrum controls the design spectrum at all periods.

Design Spectrum: A design response spectrum was determined according to the procedure outlined in ASCE 7-16, Section 21.3, and is equal to two-thirds of the response spectral accelerations of the site-specific MCE_R. The design spectrum is limited by a 'floor' at 80 percent of spectral acceleration determined according to ASCE 7-16, Section 11.4.6. For this site, the 'floor' condition was applied for period from 1 to 5 seconds. The recommended site-specific design response spectrum is attached in tabular and graphic forms.

Peak Ground Acceleration (PGA)

According to ASCE 7-16, Section 11.4.8, the site-specific geometric mean (MCE_G) PGA used for evaluation of soil effects is based on the lesser of the site-specific deterministic and probabilistic PGA values with an adjustment to 80% of the code value if needed. The following table summarizes the PGA values considered for the project.

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Site-Specific PGA Values	
Code-Based Geometric Mean PGA	0.55g
80 Percent of Code-Based PGA	0.44g
Probabilistic Geometric Mean PGA	0.69g
Deterministic Geometric Mean PGA	0.54g
Recommended Site-Specific PGA	0.54g

For the site-specific (MCE_G) PGA, the deterministic value is the lesser of the probabilistic and deterministic values and is greater than 80 percent of the code-based geometric mean PGA value. Therefore, we recommended a site-specific PGA value of 0.54g for evaluation of soil effects such as liquefaction or seismic settlement.

Tsunamis, Inundation, and Seiche and Flooding Potential

The site is not located within a 100-year flood zone or 500-year flood zone (FEMA, 2016). No evidence of recent significant flooding of the site was observed during the geologic field reconnaissance or on the aerial photographs reviewed. An evaluation of the storm-induced flood potential of the site falls under the purview of others.

The site is not located within a potential inundation zone for seismically-induced dam/reservoir failure (County of San Bernardino General Plan, 2010).

The site is not located in a coastal area. No large water storage facilities are known to exist within the area of the site. Therefore, the potential for seismically-induced flooding due to seiche or tsunami to affect the site is considered very low.

Subsidence Potential

The site is not within an area of defined subsidence hazard. Structures susceptible to subsidence include gravity sewers, surface drainage and storm drains. The proposed development is unlikely to be significantly affected should subsidence occur.

Erosion Potential

Most of the subject site will be covered with structures or flatwork. Erosion by wind and water is not considered to be a hazard at the site.

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Slope Stability and Landslide Potential

The site is not located in an area identified as having a potential for landslides or lateral spreading. The site is relatively flat and level, and significant natural or manmade slopes are not located within the project boundaries. Therefore, the potential for landsliding or lateral spreading is considered very low.

Based on the relatively flat-lying site surface and planned development, significant temporary cut slopes are not expected during the proposed construction. For purposes of construction, the soils encountered in our explorations are considered type "C" materials. Accordingly, temporary slopes in near surface native soil should conform to applicable standards as outlined by Cal/OSHA for construction excavations (https://www.dir.ca.gov/title8/1541_1a.html).

LIQUEFACTION AND SEISMIC SETTLEMENT

Liquefaction is a mode of ground failure that results from the generation of high pore-water pressures during earthquake ground shaking, causing loss of shear strength, and is typically a hazard where loose sandy soils exist below groundwater. San Bernardino County has designated certain areas as potential liquefaction hazard zones. These are areas considered at a risk of liquefaction-related ground failure during a seismic event, based upon mapped surficial deposits and the presence of a relatively shallow water table.

The subsurface materials generally consist of Interbedded layers of poorly graded sand, sandy silt, and silty sand with varying amounts of silt extending to the maximum depth of the explorations approximately 51½ feet bgs. Groundwater seepage was not observed within the maximum depths of exploration during or at the completion of drilling and has historically been greater than 100 feet bgs.

According to the County of San Bernardino (2010), the site is not located within an area identified as having a liquefaction potential. Historic groundwater levels are not within 50 feet of the ground surface; therefore, liquefaction is not anticipated.

Seismic Settlement

To determine the amount of seismic settlement (dry sand), we utilized the software "LiquefyPro" by CivilTech Software, seismic settlement was estimated using the soil profile from exploratory borings B-1 and B-4. A Peak Ground Acceleration (PGA) of 0.54g and the de-aggregated mode magnitude of 7.9 were utilized as input into the liquefaction analysis program. Settlement analysis used the Ishihara / Yoshimine method and the fines percentage were corrected for liquefaction using the Modify Stark/Olson method.

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We performed a seismic settlement analysis to determine the dry seismic settlement using data from boring B-1 and B-4. Based on data from these borings, seismically induced settlement (dry sand) is estimated to be less than 1-inch. Differential seismic settlement is estimated to be on the order of 2/3 of total seismic settlement over a distance of 40 feet.

GEOTECHNICAL OVERVIEW

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings, provided that the recommendations provided in this report are implemented in the design and construction phases of this project.

Geotechnical engineering recommendations for foundation systems and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, and our current understanding of the proposed project.

On-site soils generally consisted of Interbedded layers of poorly graded sand, sandy silt, and silty sand with varying amounts of silt extending to the maximum depth of the explorations approximately 51½ feet bgs.

Based on the conditions encountered, the proposed building can be supported on shallow foundations, such as spread footings.

Groundwater was not encountered in the borings within the drilling depths at the time of drilling. Groundwater is not expected to affect shallow foundation construction on this site.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

The following recommendations include site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements including foundations, slabs, and pavements are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

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Site Preparation

Strip and remove existing vegetation, debris, pavements and other deleterious materials from proposed building and pavement areas. Exposed surfaces should be free of mounds and depressions which could prevent uniform compaction. The site should be initially graded to create a relatively level surface to receive fill and provide for a relatively uniform thickness of fill beneath proposed building structures.

All materials derived from the demolition of existing structures and pavements should be removed from the site and not be allowed for use as on-site fill, unless processed in accordance with the fill requirements included in this report.

Existing utility lines were noted across the site. However, although no evidence of other underground facilities such as septic tanks, cesspools, and basements, was observed during the site reconnaissance, such features could be encountered during construction. If unexpected fills, utilities, or underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

Subgrade Preparation

We recommend that the proposed structures be supported on engineered fill extending to a minimum depth of 2 feet below the bottom of foundations, or 5 feet below existing grades, whichever is greater. Engineered fill placed beneath the entire footprint of the structures should extend horizontally a minimum distance of 3 feet beyond the outside edge of perimeter footings.

Subgrade soils beneath exterior slabs and pavements should be removed to a depth of 1 foot below the proposed pavement section, or 18 inches below the existing grade, whichever is deeper.

Exposed areas which will receive fill, once properly cleared and benched where necessary, should be scarified to a minimum depth of 10 inches, moisture conditioned, and compacted per the compaction requirements in this report. Compacted fill soils should then be placed to the design grades, and the moisture content and compaction of soils should be maintained until slab, pavement, or proposed improvements are constructed.

Based upon the subsurface conditions determined from the geotechnical exploration, subgrade soils exposed during construction are anticipated to be relatively workable. However, the workability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unworkable conditions develop, workability may be improved by scarifying and drying.

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Excavation

We anticipate that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or construction.

Individual contractors are responsible for designing and constructing stable, temporary excavations. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

Fill Material Types

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than three inches in size. Pea gravel or other similar non-cementitious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer.

Clean on-site soils or approved imported materials may be used as fill material for the following:

■ general site grading	■ foundation backfill
■ foundation areas	■ pavement areas
■ interior floor slab areas	■ exterior slab areas

If imported soils are used as fill materials to raise grades, these soils should conform to low volume change materials and should conform to the following requirements:

<u>Gradation</u>	<u>Percent Finer by Weight (ASTM C 136)</u>
3"	100
No. 4 Sieve	50 - 100
No. 200 Sieve	20 - 50
■ Liquid Limit	30 (max)
■ Plasticity Index	15 (max)
■ Maximum Expansive Index*	20 (max)

*ASTM D 4829

The contractor shall notify the Geotechnical Engineer of import sources sufficiently ahead of their use so that the sources can be observed and approved as to the physical characteristic of the import material. For all import material, the contractor shall also submit current verified reports from a recognized analytical laboratory indicating that the import has a "not applicable" (Class S0) potential for sulfate attack based upon current ACI criteria. The reports shall be accompanied by a written statement from the contractor that the laboratory test results are representative of all import material that will be brought to the job.

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Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed 10 inches loose thickness.

Compaction Requirements

Material Type and Location	Per the Modified Proctor Test (ASTM D 1557)		
	Minimum Compaction Requirement (%)	Range of Moisture Contents for Compaction Above Optimum	
		Minimum	Maximum
On-site soils and/or low volume change imported fill:			
Beneath foundations:	90	0%	+3%
Beneath interior slabs:	90	0%	+3%
Miscellaneous backfill:	90	0%	+3%
Beneath pavements:	95	0%	+3%
Utility Trenches*:	90	0%	+3%
Bottom of excavation receiving fill:	90	0%	+3%
Aggregate base (beneath pavements):	95	0%	+3%

* Upper 12 inches should be compacted to 95% within pavement and structural areas. Low-volume change imported soils should be used in structural areas.

Utility Trenches

We anticipate that the on-site soils will provide suitable support for underground utilities and piping that may be installed. Any soft and/or unsuitable material encountered at the bottom of excavations should be removed and be replaced with an adequate bedding material. A non-expansive granular material with a sand equivalent greater than 30 is recommended for bedding and shading of utilities, unless otherwise allowed by the utility manufacturer.

On-site materials are considered suitable for backfill of utility and pipe trenches from one foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

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Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the development. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. Planters and other surface features which could retain water in areas adjacent to the building or pavements should be sealed or eliminated. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with a minimum grade of approximately 5 percent for at least 10 feet from perimeter walls. Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration.

We recommend a minimum horizontal setback distance of 10 feet from the perimeter of any building and the high-water elevation of the nearest storm-water retention basin.

Roof drainage should discharge into splash blocks or extensions when the ground surface beneath such features is not protected by exterior slabs or paving. Sprinkler systems and landscaped irrigation should not be installed within 5 feet of foundation walls.

Exterior Slab Design and Construction

Exterior slabs-on-grade, exterior architectural features, and utilities founded on, or in backfill may experience some movement due to the volume change of the backfill. To reduce the potential for damage caused by movement, we recommend:

- minimizing moisture increases in the backfill;
- controlling moisture-density during placement of backfill;
- using designs which allow vertical movement between the exterior features and adjoining structural elements;
- placing effective control joints on relatively close centers.

Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompact prior to floor slab and pavement construction.

Onsite soils consist of cohesionless sandy soils. Such soils have the tendency to cave and slough during excavations. Therefore, formwork may be needed for foundation excavations.

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We recommend that the earthwork portion of this project be completed during extended periods of dry weather if possible. If earthwork is completed during the wet season (typically November through April) it may be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork operations may require additional mitigative measures beyond that which would be expected during the drier summer and fall months. This could include diversion of surface runoff around exposed soils and draining of ponded water on the site. Once subgrades are established, it may be necessary to protect the exposed subgrade soils from construction traffic.

Construction Observation and Testing

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proof-rolling, placement and compaction of controlled compacted fills, backfilling of excavations to the completed subgrade.

The exposed subgrade and each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Item	Description
Foundation Support	Engineered fill extending 2 feet below the bottom of foundations, or 5 feet below existing grades, whichever is greater.
Net Allowable Bearing pressure^{1, 2} (On-site soils or structural fill)	2,500 psf

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Item	Description
Foundation Support	Engineered fill extending 2 feet below the bottom of foundations, or 5 feet below existing grades, whichever is greater.
Minimum Foundation Dimensions	Columns: 24 inches Continuous: 18 inches
Minimum Footing Depth	24" below finish grade
Increments of Net Allowable Bearing Pressure	400 psf for each additional foot of width 800 psf for each additional foot of depth
Ultimate Passive Resistance ⁴	350 pcf
Ultimate Coefficient of Sliding Friction ⁵	0.32
Estimated Total Static Settlement from Structural Loads ²	about 1 inch
Estimated Differential Settlement ^{2, 6}	About 1/2 of total settlement
1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. 2. Values provided are for maximum loads noted in Project Description. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations. The above settlement estimates have assumed that the maximum footing size is 6 feet for column footings and 3 feet for continuous footings. 3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the Earthwork. 4. Use of passive earth pressures requires the footing forms be removed and compacted structural fill be placed against the vertical footing face. A factor of safety of 2.0 is recommended. 5. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions. A factor of safety of 1.5 is recommended. 6. Differential settlements are as measured over a span of 40 feet.	

Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

To ensure foundations have adequate support, special care should be taken when footings are located adjacent to trenches. The bottom of such footings should be at least 1 foot below an imaginary plane with an inclination of 1.5 horizontal to 1.0 vertical extending upward from the nearest edge of adjacent trenches.

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FLOOR SLABS

DESCRIPTION	RECOMMENDATION
Interior floor system	Slab-on-grade concrete
Floor slab support	Engineered fill extending 3 feet below the bottom of foundations, or 5 feet below existing grades, whichever is greater.
Subbase	Minimum 4-inches of Aggregate Base
Modulus of subgrade reaction	150 pounds per square inch per inch (psi/in) (The modulus was obtained based on estimates obtained from NAVFAC 7.1 design charts). This value is for a small loaded area (1 Sq. ft or less) such as for forklift wheel loads or point loads and should be adjusted for larger loaded areas.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs noted in this section must be applied to the site which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

Design of asphalt concrete (AC) pavements is based on the procedures outlined in the Caltrans "Highway Design Manual for Safety Roadside Rest Areas" (Caltrans, 2016). Design of Portland

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cement concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330R-08; "Guide for Design and Construction of Concrete Parking Lots."

A correlated design R-value of 35 was used for the AC pavement design. A modulus of rupture of 600 psi was used for pavement concrete. The structural sections are predicated upon proper compaction of the utility trench backfills and the subgrade soils as prescribed by in **Earthwork**, with the upper 12 inches of subgrade soils and all aggregate base material brought to a minimum relative compaction of 95 percent in accordance with ASTM D 1557 prior to paving. The aggregate base should meet Caltrans requirements for Class 2 base.

The pavement designs were based upon the results of preliminary sampling and testing and should be verified by additional sampling and testing (specifically R-value testing) during construction when the actual subgrade soils are exposed. Additionally, the preliminary sections provided are minimums based on procedures previously referenced. The project civil engineer should confirm minimum Traffic Indices and sections required by local agencies or jurisdictions if applicable.

Pavement Section Thicknesses

The following table provides options for AC and PCC Sections:

Asphalt Concrete Design		
Usage	Assumed Traffic Index	Recommended Structural Section
Auto Parking Areas	5.0	3" HMA ¹ /5" Class 2 AB ²
Drive lanes	5.5	3" HMA ¹ /6" Class 2 AB ²
Truck Delivery Areas	7.0	3.5" HMA ¹ /10" Class 2 AB ²
^{1.} HMA = hot mix asphalt ^{2.} AB = aggregate base		

Portland Cement Concrete Design			
Layer	Thickness (inches)		
	Light Duty ¹	Medium Duty ²	Heavy Duty ³
PCC	5.0	6.0	7.5
Aggregate Base ⁴	--	--	--
^{1.} Car Parking and Access Lanes, Average Daily Truck Traffic (ADTT) = 1 (Category A). ^{2.} Truck Parking Areas, Multiple Units, ADTT = 25 (Category B)			

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Portland Cement Concrete Design			
Layer	Thickness (inches)		
	Light Duty ¹	Medium Duty ²	Heavy Duty ³
3. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g., dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles, ADTT = 700 (Category C). 4. Aggregate base is not required. Compacted on-site material is considered competent.			

Recommended structural sections were calculated based on assumed TIs and our preliminary sampling and testing.

Terracon does not practice traffic engineering. We recommend that the project civil engineer or traffic engineer verify that the TIs and ADTT traffic indices used are appropriate for this project.

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles. A maintenance program including surface sealing, joint cleaning and sealing, and timely repair of cracks and deteriorated areas will increase the pavement's service life. As an option, thicker sections could be constructed to decrease future maintenance.

Concrete for rigid pavements should have a minimum 28-day compressive strength of 4,000 psi, and be placed with a maximum slump of 4 inches. Although not required for structural support, a minimum 4-inch-thick base course layer is recommended to help reduce potential for slab curl, shrinkage cracking, and subgrade pumping through joints. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. Joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer.

Where practical, we recommend early-entry cutting of crack-control joints in PCC pavements. Cutting of the concrete in its "green" state typically reduces the potential for micro-cracking of the pavements prior to the crack control joints being formed, compared to cutting the joints after the concrete has fully set. Micro-cracking of pavements may lead to crack formation in locations other than the sawed joints, and/or reduction of fatigue life of the pavement.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system, longitudinal subdrains, or other suitable

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outlets and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Dishing in parking lots surfaced with ACC is usually observed in frequently-used parking stalls (such as near the front of buildings), and occurs under the wheel footprint in these stalls. The use of higher-grade asphalt cement, or surfacing these areas with PCC, should be considered. The dishing is exacerbated by factors such as irrigated islands or planter areas, sheet surface drainage to the front of structures, and placing the ACC directly on a compacted clay subgrade.

PCC pavement details for joint spacing, joint reinforcement, and joint sealing should be prepared in accordance with ACI 330 and ACI 325. PCC pavements should be provided with mechanically reinforced joints (doweled or keyed) in accordance with ACI 330.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2 percent.
- Subgrade and pavement surfaces should have a minimum 2 percent slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.

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- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

STORM WATER MANAGEMENT

Three in-situ infiltration tests (falling head borehole permeability) were performed at approximate depths of 5 and 10 feet bgs. The objective of the infiltration testing is to provide infiltration rates for designing the proposed infiltration system. A 2-inch thick, 3/8-inch gravel layer was placed in the bottom of each boring after the borings were drilled to investigate the soil profile.

Three-inch diameter perforated pipes were installed on top of the gravel layer. Gravel was used to backfill between the perforated pipes and the boring sidewall. The borings were then filled with water for a pre-soak period.

At the beginning of each test, the pipes were refilled with water and readings were taken at periodic time intervals as the water level dropped. The soil at the percolation test locations was classified in the field using a visual/manual procedure. The infiltration velocity is presented as the infiltration rate and is summarized in the following table. The infiltration rates provided do not include safety factors.

Test Location	Boring Depth (ft.) ¹	Test Depth Range (ft.) ¹	Soil Type	Percolation Rate (in./hr.)	Correlated Infiltration Rate (in./hr.) ²
P-1	5	0 to 5	SM	37.0	1.5
P-2	5	0 to 5	SM	67.8	3.4
P-3	10	5 to 10	SW-SM	316.0	16.8

The above infiltration rates determined by the shallow percolation test method are based on field test results utilizing clear water. Infiltration rates can be affected by silt buildup, debris, degree of soil saturation, site variability and other factors. The rate obtained at specific location and depth is representative of the location and depth tested and may not be representative of the entire site. Application of an appropriate safety factor is prudent to account for subsoil inconsistencies, possible compaction related to site grading, and potential silting of the percolating soils, depending on the application.

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The design engineer should also check with the local agency for the limitation of the infiltration rate allowed in the design. If the maximum allowable design infiltration rate is lower than the above recommended rate, the maximum allowable design infiltration rate should be used. The designer of the basins should also consider other possible site variability in the design.

The percolation test was performed with clear water, whereas the storm water will likely not be clear, but may contain organics, fines, and grease/oil. The presence of these deleterious materials will tend to decrease the rate that water percolates from the infiltration systems. Design of the storm water infiltration systems should account for the presence of these materials and should incorporate structures/devices to remove these deleterious materials.

Based on the soils encountered in our borings, we expect the percolation rates of the soils could be different than measured in the field due to variations in fines and gravel content. The design elevation and size of the proposed infiltration system should account for this expected variability in infiltration rates.

Infiltration testing should be performed after construction of the infiltration system to verify the design infiltration rates. It should be noted that siltation and vegetation growth along with other factors may affect the infiltration rates of the infiltration areas. The actual infiltration rate may vary from the values reported here. Infiltration systems should be located at least 10 feet from any existing or proposed foundation system.

CORROSIVITY

The following table lists the laboratory electrical resistivity (standard and as-received), chlorides, soluble sulfates, and pH testing results. These values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Boring	Depth (feet)	Soluble Sulfate (mg/kg)	Soluble Chloride (mg/kg)	Total Salts (mg/kg)	pH	Resistivity (as-received) (Ohm-cm)	Resistivity (saturated) (Ohm-cm)
B-3	0 to 5	22	23	327	9.37	29,100	2,813

Results of soluble sulfate testing indicate samples of the on-site soils tested possess negligible sulfate concentrations when classified in accordance with Table 4.3.1 of the ACI Design Manual. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

For protection against corrosion to buried metals, Terracon recommends that an experienced corrosion engineer be retained to design a suitable corrosion protection system for underground metal structures or components.

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If corrosion of buried metal is critical, it should be protected using a non-corrosive backfill, wrapping, coating, sacrificial anodes, or a combination of these methods, as designed by a qualified corrosion engineer.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

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Geotechnical Engineering Report

Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California

March 6, 2023 ■ Terracon Project No. CB225235

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Aerial Imagery Examined

Google Earth, 2023, web-based software application, aerial imagery dated May 28, 1994; June 4, 2003; November 13, 2003; December 31, 2004; December 31, 2005; May 24, 2009; March 21, 2013; January 1, 2015; September 4, 2016; June 13, 2017; August 25, 2018; May 30, 2022.

Fairchild Imagery Collection (UCSB Library), black and white aerial photograph no. AXL 6W-27, dated June 23, 1959.

Fairchild Imagery Collection (UCSB Library), black and white aerial photograph no. AXL 3JJ-149 dated May 28, 1968.

ATTACHMENTS

Geotechnical Engineering Report

Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California

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EXPLORATION AND TESTING PROCEDURES

Field Exploration

Terracon conducted eleven soil-testing borings. These borings were planned to the following extended depths below existing grades.

Number of Borings	Boring Depth (feet) ¹	Location
2 (B-1 and B-4)	51 ½	Planned building footprint
2 (B-2 and B-3)	31 ½	Planned building footprint
4 (B-5 to B-8)	26 ½	Planned building footprint
3(P-1 to P-3)	5 and 10	Infiltration system

1. Below ground surface.

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from the Google Earth. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advance the borings with a truck-mounted drill rig using 8-inch-diameter hollow-stem augers. Both a standard penetration test (SPT) sampler (2-inch outer diameter and 1-3/8-inch inner diameter) and a modified California ring-lined sampler (3-inch outer diameter and 2-3/8-inch inner diameter) are utilized in our investigation. The penetration resistance is recorded on the boring logs as the number of hammer blows used to advance the sampler in 6-inch increments (or less if noted). The samplers are driven with an automatic hammer that drops a 140-pound weight 30 inches for each blow. After the required seating, samplers are advanced up to 18 inches, providing up to three sets of blowcounts at each sampling interval. The sampling depths, penetration distances, and other sampling information are recorded on the field boring logs. The recorded blows are raw numbers without any corrections for hammer type (automatic vs. manual cathead) or sampler size (ring sampler vs. SPT sampler). Relatively undisturbed and bulk samples of the soils encountered are placed in sealed containers and returned to the laboratory for testing and evaluation.

We observe and record groundwater levels during drilling and sampling. For safety purposes, all borings are backfilled with auger cuttings after their completion.

Our exploration team prepares field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs are prepared from the field logs. The

Geotechnical Engineering Report

Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California

March 6, 2023 ■ Terracon Project No. CB225235

final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- Water (Moisture) Content of Soil by Mass
- Laboratory Determination of Density (Unit Weight) of Soil Specimens
- Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- Hydro Consolidation test
- Modified Proctor test
- Plasticity Index test
- Corrosivity suite test

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

SITE LOCATION

Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California

March 6, 2023 ■ Terracon Project No. CB225235

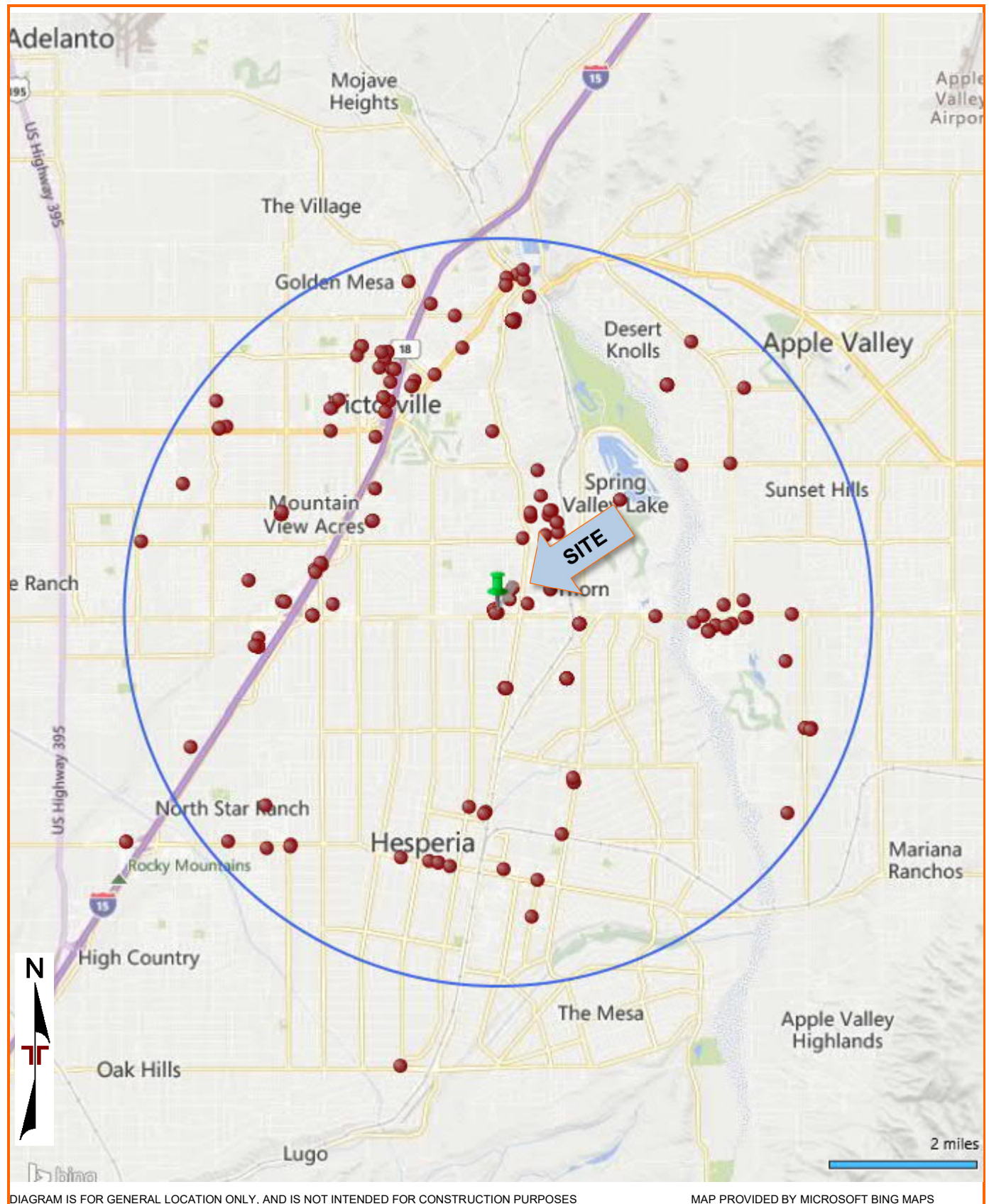


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California

March 6, 2023 ■ Terracon Project No. CB225235



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

GEOLOGIC MAP

Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California

March 6, 2023 ■ Terracon Project No. CB225235

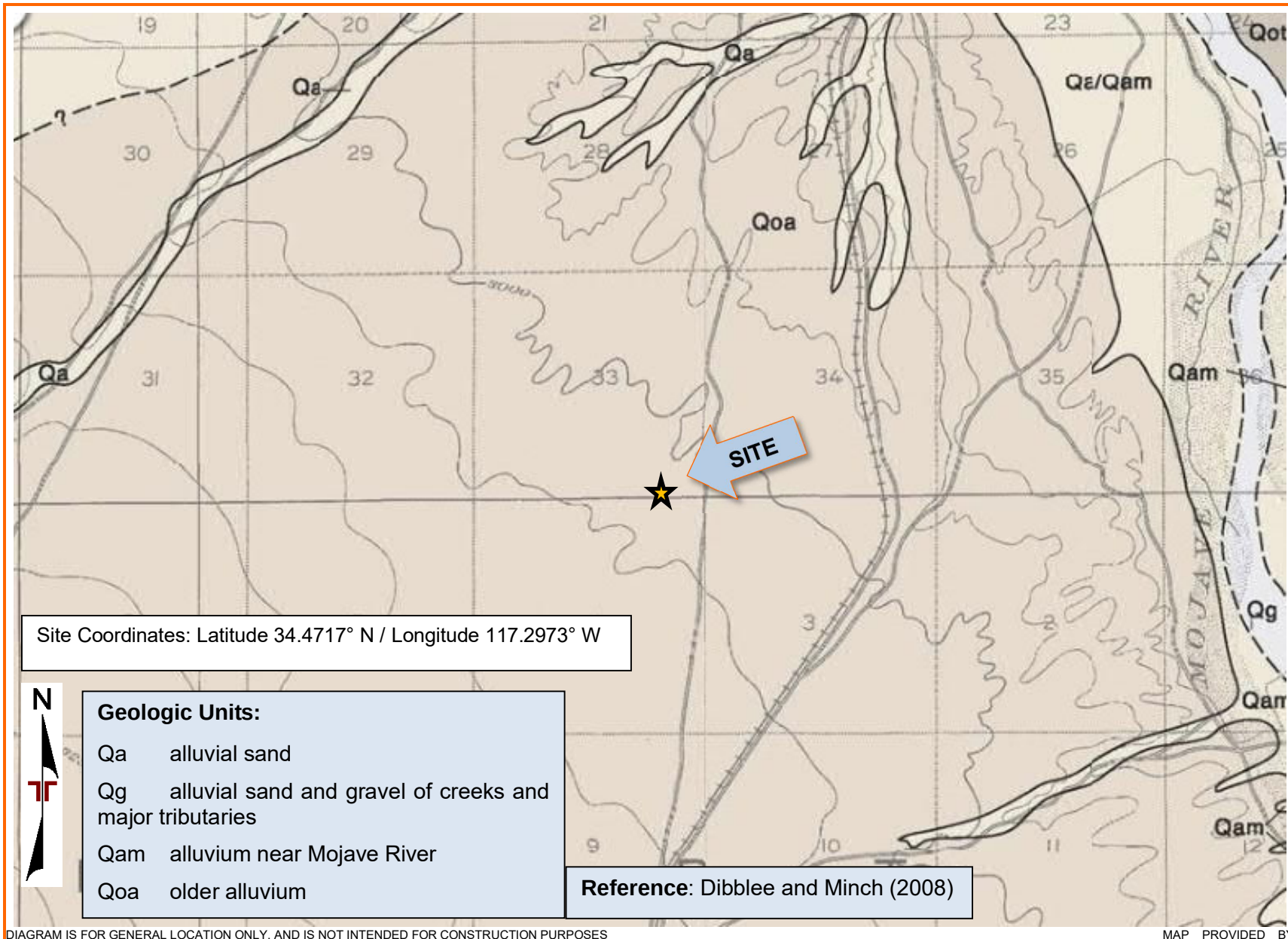


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY

REGIONAL FAULT MAP

Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California
March 6, 2023 ■ Terracon Project No. CB225235

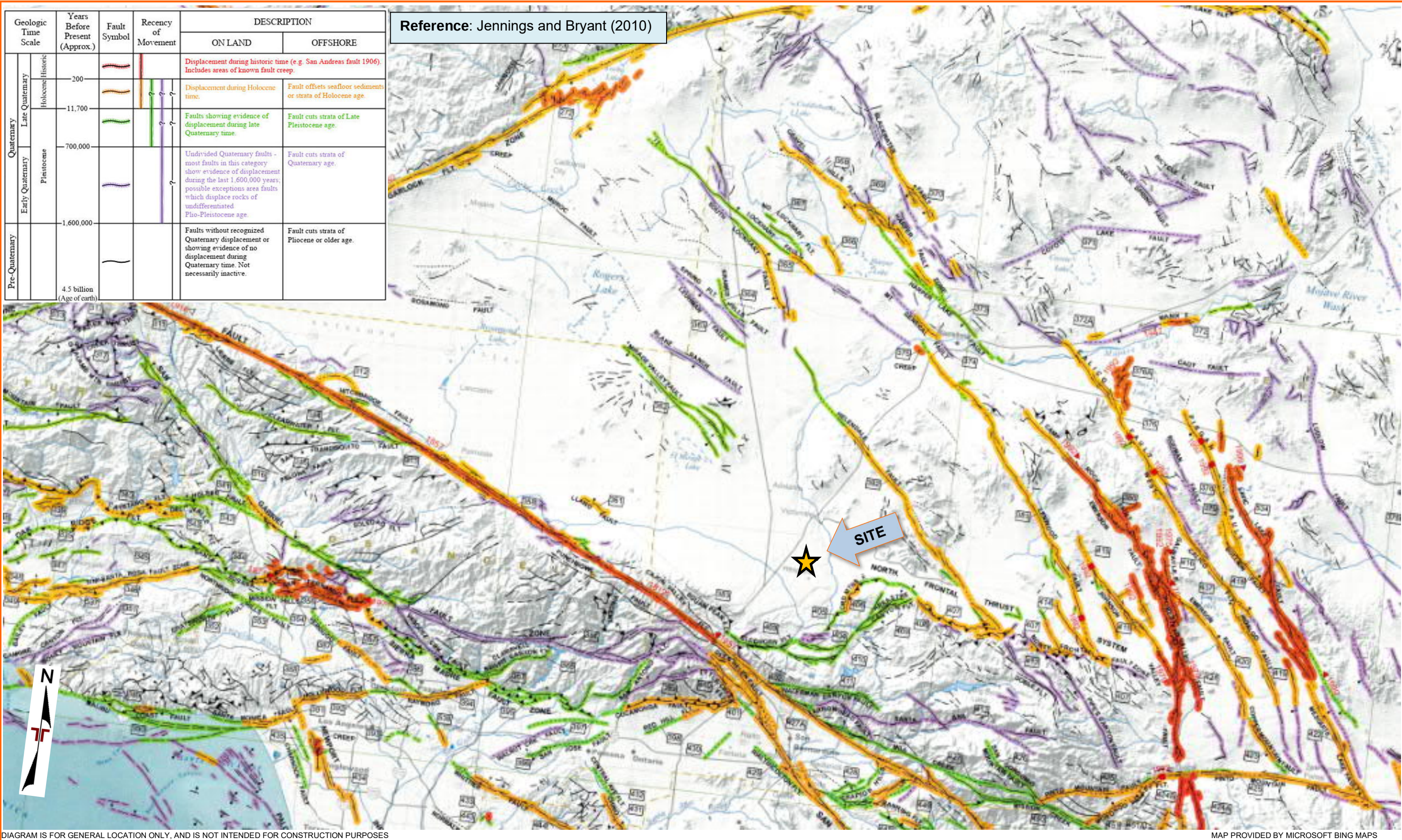


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

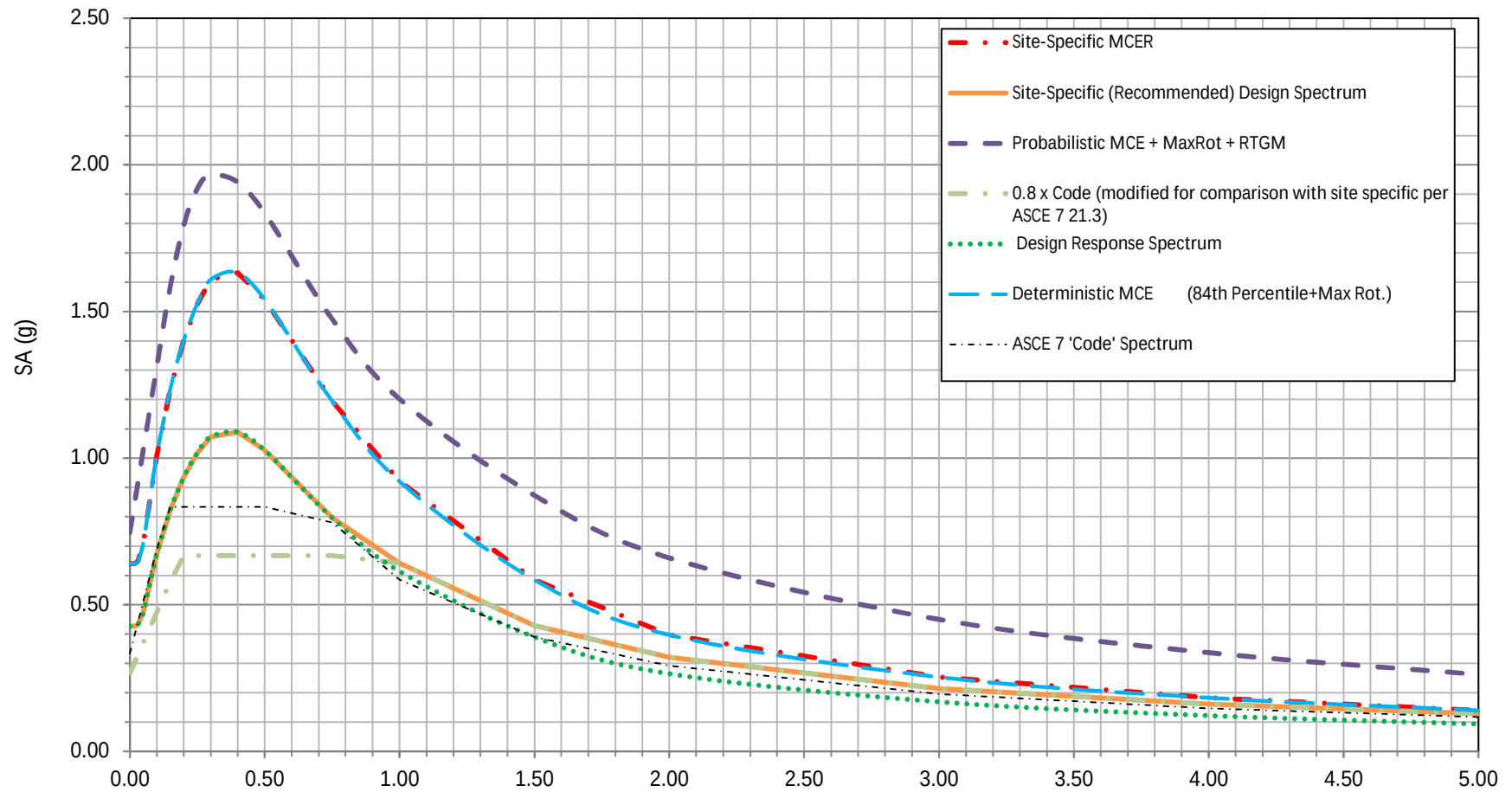
MAP PROVIDED BY MICROSOFT BING MAPS

REGIONAL SEISMICITY

Proposed Desert Valley Hospital Addition ■ Victorville, San Bernardino County, California
March 6, 2023 ■ Terracon Project No. CB225235



Desert Valley Hospital Addition Project- 5% Damped Horizontal Response Spectra ASCE 7-16



Desert Valley Hospital Addition Project - Site-Specific Response Spectra ASCE 7-16							
Period (sec)	Deterministic MCE (84th Percentile+Max Rot.)	Probabilistic MCE + MaxRot + RTGM	Site-Specific MCE _R	0.8 x Code (modified for comparison with site specific per ASCE 7 21.3)	Design Response Spectrum	Site-Specific (Recommended) Design Spectrum	ASCE 7 'Code' Spectrum
0.000	0.640	0.746	0.640	0.267	0.427	0.427	0.334
0.010	0.641	0.803	0.641	0.288	0.427	0.427	0.369
0.020	0.641	0.859	0.641	0.308	0.427	0.427	0.405
0.030	0.648	0.916	0.648	0.329	0.432	0.432	0.441
0.050	0.711	1.029	0.711	0.371	0.474	0.474	0.512
0.075	0.864	1.171	0.864	0.423	0.576	0.576	0.601
0.100	1.010	1.313	1.010	0.475	0.673	0.673	0.690
0.150	1.235	1.585	1.235	0.579	0.823	0.823	0.834
0.200	1.403	1.794	1.403	0.667	0.935	0.935	0.834
0.250	1.526	1.919	1.526	0.667	1.017	1.017	0.834
0.300	1.609	1.965	1.609	0.667	1.073	1.073	0.834
0.400	1.633	1.941	1.633	0.667	1.088	1.088	0.834
0.500	1.541	1.836	1.541	0.667	1.027	1.027	0.834
0.750	1.195	1.474	1.195	0.667	0.797	0.797	0.780
1.000	0.921	1.202	0.921	0.642	0.614	0.642	0.585
1.500	0.585	0.873	0.585	0.428	0.390	0.428	0.390
2.000	0.397	0.660	0.397	0.321	0.265	0.321	0.293
3.000	0.253	0.450	0.253	0.214	0.169	0.214	0.195
4.000	0.183	0.336	0.183	0.161	0.122	0.161	0.146
5.000	0.140	0.262	0.140	0.128	0.093	0.128	0.117

Shahi & Baker (2014) Coefficients

Period	$S_{a_{RotD10g}}/S_{a_{RotD50}}$
0.01	1.19
0.02	1.19
0.03	1.19
0.04	1.19
0.05	1.19
0.075	1.19
0.10	1.19
0.15	1.20
0.20	1.21
0.25	1.22
0.30	1.22
0.40	1.23
0.50	1.23
0.75	1.24
1.00	1.24
1.50	1.24
2.00	1.24
3.00	1.25
4.00	1.26
5.00	1.26

BORING LOG NO. B-1

Page 1 of 2

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CA

SITE: 16850 Bear Valley Rd
Victorville, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS.GPJ TERRACON DATATEMPLATE.GDT 3/1/23

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.472° Longitude: -117.2974°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
	DEPTH								
	0.2' ASPHALT , 2" thickness								
	0.7' AGGREGATE BASE COURSE , 6" thickness								
	POORLY GRADED SAND (SP) , trace silt, brown								
	5.0' SILTY SAND (SM) , light brown, medium dense	5			16-17-13	12	102		33
	loose				5-6-11	14	108		
	10.0' POORLY GRADED SAND WITH SILT (SP-SM) , light brown, medium dense	10			11-17-27	4	116		
		15			5-10-9 N=19				6
	20.0' SILTY SAND (SM) , brown, dense	20			5-12-18 N=30				
	medium dense	25			6-7-9 N=16				29
	medium dense	30			8-13-16 N=29				
		35							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
8-inch Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon

1355 E Cooley Dr, Ste C
Colton, CA

Boring Started: 01-12-2023

Boring Completed: 01-12-2023

Drill Rig: CME 75

Driller: 2R Drilling

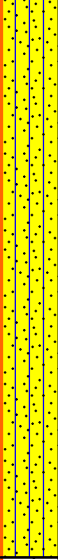
Project No.: CB225235

BORING LOG NO. B-1

Page 2 of 2

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CASITE: 16850 Bear Valley Rd
Victorville, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.472° Longitude: -117.2974°	DEPTH (Ft)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
	DEPTH SILTY SAND (SM) , brown, dense (<i>continued</i>) medium dense			X	7-10-16 N=26				
		40		X	9-18-31 N=49				29
		45		X	16-17-21 N=38				
		50		X	12-19-20 N=39				
	Boring Terminated at 51.5 Feet								
Stratification lines are approximate. In-situ, the transition may be gradual.									
Hammer Type: Automatic									
Advancement Method: 8-inch Hollow Stem Auger		See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).			Notes:				
Abandonment Method: Boring backfilled with auger cuttings upon completion.		See Supporting Information for explanation of symbols and abbreviations.							
		Elevations were interpolated from a topographic site plan							
WATER LEVEL OBSERVATIONS		 1355 E Cooley Dr, Ste C Colton, CA			Boring Started: 01-12-2023		Boring Completed: 01-12-2023		
No free water observed					Drill Rig: CME 75		Driller: 2R Drilling		
					Project No.: CB225235				

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS GPJ TERRACON DATATEMPLATE GDT 3/1/23

BORING LOG NO. B-2

Page 1 of 1

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CA

SITE: 16850 Bear Valley Rd
Victorville, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.4721° Longitude: -117.297°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
	DEPTH								
	SILTY SAND (SM) , brown, dense								
						8	125		
	reddish brown	5			16-34-50	6	110		28
	brown				13-25-39	15	109		
	10.0	10							
	POORLY GRADED SAND WITH SILT (SP-SM) , light brown, medium dense								
					16-21-26	1	119		12
		15			7-11-14 N=25				
		20			7-9-11 N=20				
	25.0	25			5-8-15 N=23				35
	SILTY SAND (SM) , brown, medium dense								
		30			3-6-9 N=15				
	31.5								
	Boring Terminated at 31.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
8-inch Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon

1355 E Cooley Dr, Ste C
Colton, CA

Boring Started: 01-12-2023

Boring Completed: 01-12-2023

Drill Rig: CME 75

Driller: 2R Drilling

Project No.: CB225235

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS.GPJ TERRACON DATATEMPLATE.GDT 3/1/23

BORING LOG NO. B-3

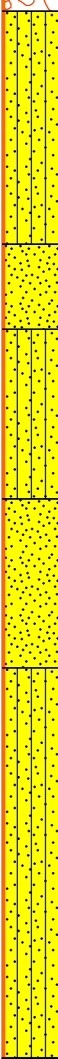
Page 1 of 1

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CA

SITE: 16850 Bear Valley Rd
Victorville, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS.GPJ TERRACON DATATEMPLATE GDT 3/1/23

GRAPHIC LOG	LOCATION See Exploration Plan		DEPTH (FL)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
	Latitude: 34.4716° Longitude: -117.2974°								LL-PL-PI	
DEPTH										
	0.1	ASPHALT , approximately 1.5" thick								
	0.6	AGGREGATE BASE COURSE , approximately 6" thick								
		SILTY SAND (SM) , brown very dense				6-50/6"				
		dense	5			27-33-30	4	122		
	7.5	POORLY GRADED SAND (SP) , trace silt, reddish brown, medium dense				11-18-21	8	125		
	10.0	SILTY SAND (SM) , brown, medium dense	10			12-20-29	9	120		31
	15.0	POORLY GRADED SAND (SP) , trace silt, tan, medium dense	15			7-11-13 N=24				
	20.0	SILTY SAND (SM) , brown, medium dense	20			5-6-11 N=17				
		dense	25			10-14-18 N=32				26
		dense	30			10-15-19 N=34				
	31.5	Boring Terminated at 31.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method: 8-inch Hollow Stem Auger	See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).	Notes:
Abandonment Method: Boring backfilled with auger cuttings upon completion.	See Supporting Information for explanation of symbols and abbreviations.	
	Elevations were interpolated from a topographic site plan.	
WATER LEVEL OBSERVATIONS No free water observed	 1355 E Cooley Dr, Ste C Colton, CA	Boring Started: 01-12-2023
		Boring Completed: 01-12-2023
		Drill Rig: CME 75
		Driller: 2R Drilling
		Project No.: CB225235

BORING LOG NO. B-4

Page 1 of 2

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CASITE: 16850 Bear Valley Rd
Victorville, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.4717° Longitude: -117.2972°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
	DEPTH								
	SILTY SAND (SM) , brown, medium dense								31
		5			20-16-26	8	113		
	reddish brown, dense				25-32-36	6	130		23
	brown, medium dense				16-16-14	24	101		
	10.0	10			7-6-8				7
	POORLY GRADED SAND WITH SILT (SP-SM) , reddish brown, loose, soft								
	dense	15			13-15-15 N=30				
	20.0	20			7-8-9 N=17				21
	SILTY SAND (SM) , brown, medium dense				3-5-8 N=13				
	30.0	30			3-12-12 N=24				
	POORLY GRADED SAND (SP) , trace silt, brown, medium dense								
	35.0	35							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
8-inch Hollow Stem AugerAbandonment Method:
Boring backfilled with auger cuttings upon completion.See [Exploration and Testing Procedures](#) for a
description of field and laboratory procedures used
and additional data (if any).See [Supporting Information](#) for explanation of
symbols and abbreviations.Elevations were interpolated from a topographic site
plan.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon1355 E Cooley Dr, Ste C
Colton, CA

Boring Started: 01-12-2023

Boring Completed: 01-12-2023

Drill Rig: CME 75

Driller: 2R Drilling

Project No.: CB225235

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS.GPJ TERRACON DATATEMPLATE.GDT 3/1/23

BORING LOG NO. B-4

Page 2 of 2

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CA

SITE: 16850 Bear Valley Rd
Victorville, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.4717° Longitude: -117.2972°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
	DEPTH								
	WELL GRADED SAND WITH SILT (SW-SM) , tan, dense			X	10-20-27 N=47				11
	40.0 SANDY SILT (ML) , brown, stiff	40		X	3-5-9 N=14				
	very stiff	45		X	4-7-11 N=18				68
	50.0 POORLY GRADED SAND (SP) , trace silt, brown, medium dense	50		X	13-11-15 N=26				
	51.5 Boring Terminated at 51.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
8-inch Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon

1355 E Cooley Dr, Ste C
Colton, CA

Boring Started: 01-12-2023

Boring Completed: 01-12-2023

Drill Rig: CME 75

Driller: 2R Drilling

Project No.: CB225235

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS.GPJ TERRACON DATATEMPLATE GDT 3/1/23

Page 1 of 1

CLIENT: Prime Healthcare Management Inc
Ontario, CA

[illegible]

Hammer Type: Automatic

Project No.: CB225235

BORING LOG NO. B-6

Page 1 of 1

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CA

SITE: 16850 Bear Valley Rd
Victorville, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS GPJ TERRACON DATATEMPLATE GDT 3/1/23

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.4715° Longitude: -117.2972°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
DEPTH									
	SILTY SAND (SM) , trace gravel, brown, dense								
5.0		5			14-37-50/6"				
	POORLY GRADED SAND WITH SILT (SP-SM) , brown, medium dense				15-18-20				
	trace silt and gravel, loose				5-8-9				
		10			6-8-11				
		15			9-11-13 N=24				
20.0		20			8-12-9 N=21				
	SILTY SAND (SM) , trace gravel, brown, medium dense								
26.5		25			5-7-9 N=16				
	Boring Terminated at 26.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
8-inch Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Started: 02-06-2023

Boring Completed: 02-06-2023

Drill Rig: CME 75

Driller: 2R Drilling

Project No.: CB225235

BORING LOG NO. B-7

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PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CA

SITE: 16850 Bear Valley Rd
Victorville, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS.GPJ TERRACON DATATEMPLATE GDT 3/1/23

GRAPHIC LOG	LOCATION See Exploration Plan		DEPTH (FL)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES	
	Latitude: 34.4714° Longitude: -117.2973°								LL-PL-PI		
	DEPTH										
	0.2	ASPHALT , approximately 1.5" thick									
	0.7	AGGREGATE BASE COURSE , approximately 6" thick									
	2.5	SILTY SAND (SM) , brown									
		POORLY GRADED SAND (SP) , reddish brown, medium dense									
			5			7-17-20	5	117			
						7-14-19	10	108			
						5-12-17	1	111			
			10			13-17-24	4	104			
		loose	15			6-8-7					
	20.0	SILTY SAND (SM) , brown, loose	20			4-6-8				44	
		medium dense	25			8-11-11					
	26.5	Boring Terminated at 26.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
8-inch Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Started: 01-12-2023

Boring Completed: 01-12-2023

Drill Rig: CME 75

Driller: 2R Drilling

Project No.: CB225235

BORING LOG NO. B-8

Page 1 of 1

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CA

SITE: 16850 Bear Valley Rd
Victorville, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.4713° Longitude: -117.2969°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
DEPTH									
	POORLY GRADED SAND WITH SILT (SP-SM) , trace gravel, light brown, medium dense								
					8-13-17	1			8
		5			9-11-16	2			
					10-18-23	1			
		10			13-21-29	2	109		7
		15			8-10-15				
		20			7-10-14				24
		25			6-11-15				
	SILTY SAND (SM) , brown, medium dense								
	CLAYEY SAND (SC) , dark brown, medium dense								
	Boring Terminated at 26.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
8-inch Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
1355 E Cooley Dr, Ste C
Colton, CA

Boring Started: 01-12-2023

Boring Completed: 01-12-2023

Drill Rig: CME 75

Driller: 2R Drilling

Project No.: CB225235

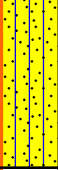
THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS GPJ TERRACON DATATEMPLATE GDT 3/1/23

BORING LOG NO. P-1

Page 1 of 1

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CASITE: 16850 Bear Valley Rd
Victorville, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.4723° Longitude: -117.2966°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
DEPTH									
	SILTY SAND (SM) , light brown	5							25
5.0	Boring Terminated at 5 Feet								
Stratification lines are approximate. In-situ, the transition may be gradual.									
Hammer Type: Automatic									
Advancement Method: 8-inch Hollow Stem Auger		See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).			Notes:				
Abandonment Method: Boring backfilled with auger cuttings upon completion.		See Supporting Information for explanation of symbols and abbreviations.							
WATER LEVEL OBSERVATIONS		 1355 E Cooley Dr, Ste C Colton, CA			Boring Started: 01-12-2023		Boring Completed: 01-12-2023		
No free water observed					Drill Rig: CME 75		Driller: 2R Drilling		
					Project No.: CB225235				

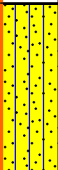
THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS.GPJ TERRACON_DATATEMPLATE.GDT 3/1/23

BORING LOG NO. P-2

Page 1 of 1

PROJECT: Desert Valley Hospital Addition

CLIENT: Prime Healthcare Management Inc
Ontario, CASITE: 16850 Bear Valley Rd
Victorville, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.4723° Longitude: -117.2958°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
	DEPTH								
	SILTY SAND (SM) , light brown								
	5.0	5							
Boring Terminated at 5 Feet									
Stratification lines are approximate. In-situ, the transition may be gradual.									
Hammer Type: Automatic									
Advancement Method: 8-inch Hollow Stem Auger			See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).			Notes:			
Abandonment Method: Boring backfilled with auger cuttings upon completion.			See Supporting Information for explanation of symbols and abbreviations.						
WATER LEVEL OBSERVATIONS			 1355 E Cooley Dr, Ste C Colton, CA			Boring Started: 01-12-2023		Boring Completed: 01-12-2023	
No free water observed						Drill Rig: CME 75		Driller: 2R Drilling	
						Project No.: CB225235			

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS.GPJ TERRACON_DATATEMPLATE.GDT 3/1/23

BORING LOG NO. P-3

Page 1 of 1

PROJECT: Desert Valley Hospital Addition

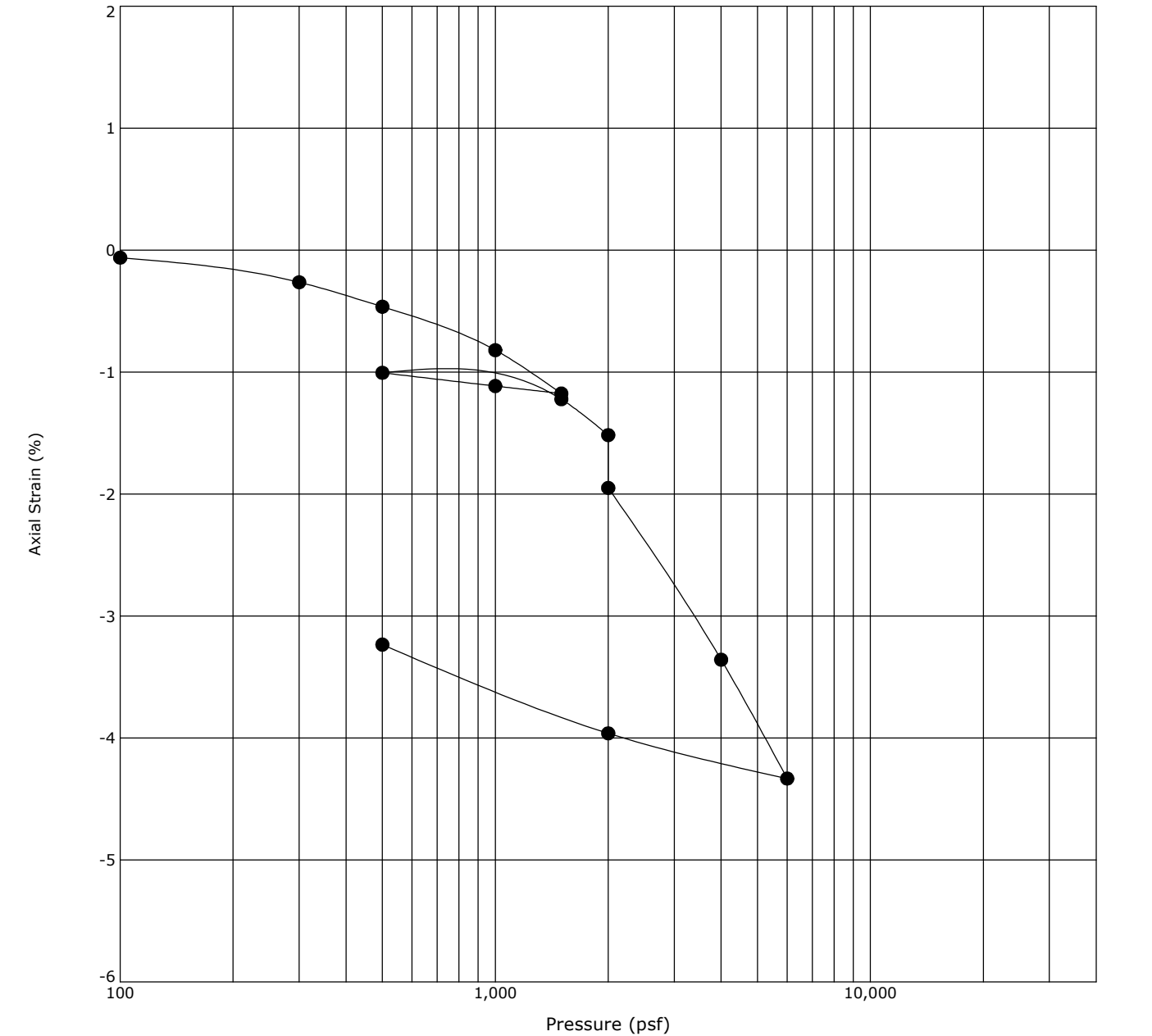
CLIENT: Prime Healthcare Management Inc
Ontario, CASITE: 16850 Bear Valley Rd
Victorville, CA

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 34.4723° Longitude: -117.2952°	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS	PERCENT FINES
								LL-PL-PI	
DEPTH									
	WELL GRADED SAND WITH SILT (SW-SM) , reddish brown	5							7
	10.0	10							
	Boring Terminated at 10 Feet								
Stratification lines are approximate. In-situ, the transition may be gradual.									
Hammer Type: Automatic									
Advancement Method: 8-inch Hollow Stem Auger			See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).			Notes:			
Abandonment Method: Boring backfilled with auger cuttings upon completion.			See Supporting Information for explanation of symbols and abbreviations.						
WATER LEVEL OBSERVATIONS			 1355 E Cooley Dr, Ste C Colton, CA			Boring Started: 01-12-2023		Boring Completed: 01-12-2023	
No free water observed						Drill Rig: CME 75		Driller: 2R Drilling	
						Project No.: CB225235			

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL CB225235 DESERT VALLEY HOS.GPJ TERRACON_DATATEMPLATE.GDT 3/1/23

Swell Consolidation Test

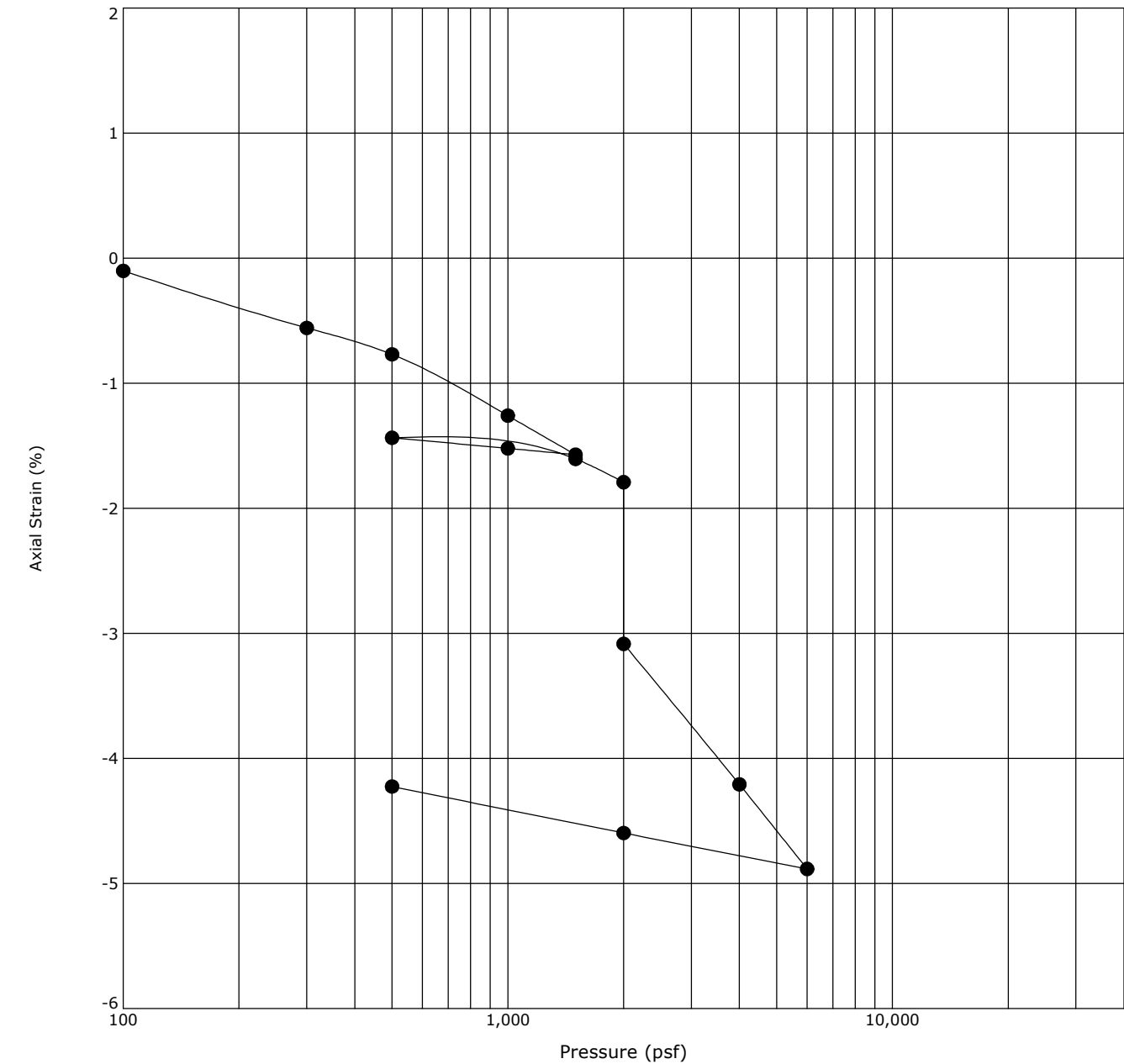
ASTM D2435



Boring ID		Depth (Ft)	Description	USCS	γ _d (pcf)	WC (%)
●	B-1	5 - 6.5			102	12.1
Notes:						

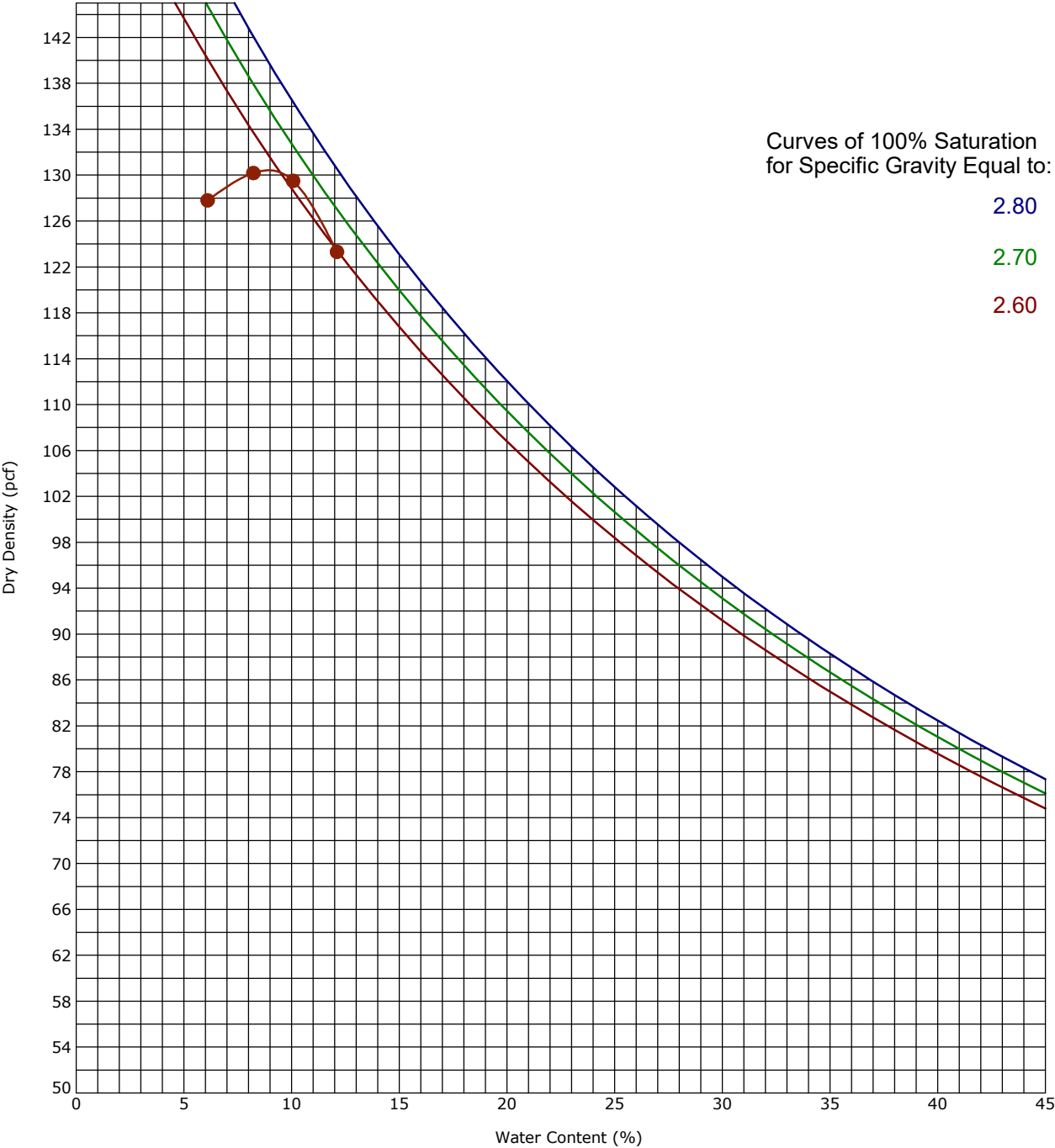
Swell Consolidation Test

ASTM D2435



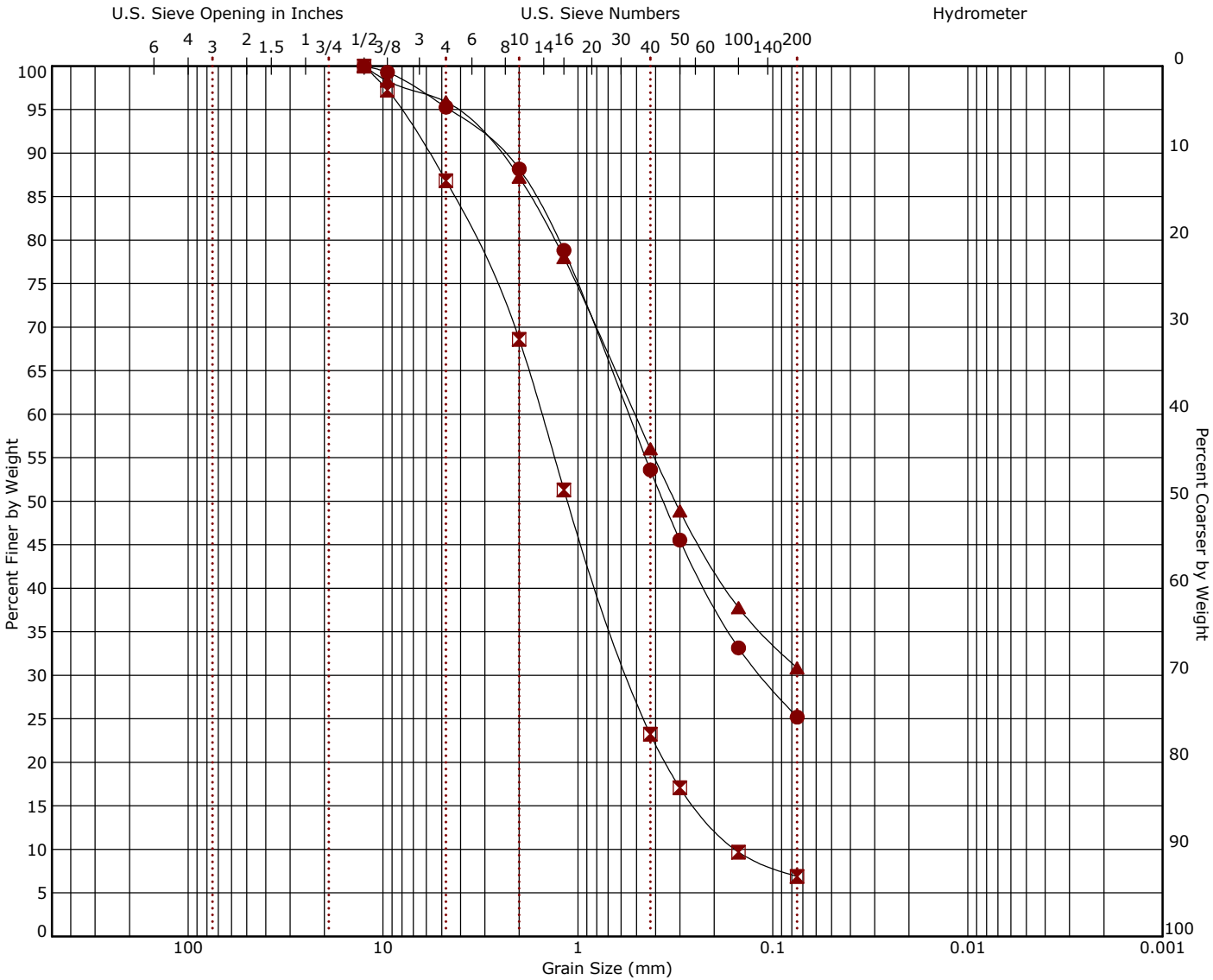
Boring ID		Depth (Ft)	Description	USCS	γ_d (pcf)	WC (%)
●	B-8	5 - 6.5				1.6
Notes:						

Moisture-Density Relationship
ASTM D1557-Method D



Boring ID		Depth (Ft)		Description of Materials			
B-1		0 - 5		POORLY GRADED SAND			
Fines (%)	Fraction > mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)
	0.0				ASTM D1557-Method D	130.4	8.9

Grain Size Distribution
ASTM D422 / ASTM C136



750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393



Client

Prime Healthcare Management Inc

Project

Desert Valley Hospital Addition

Sample Submitted By: Terracon (CB)

Date Received: 1/24/2023

Lab No.: 23-0069

Results of Corrosion Analysis

Sample Number	--
Sample Location	B-3
Sample Depth (ft.)	0.0-5.0
pH Analysis, ASTM G 51	9.37
Water Soluble Sulfate (SO ₄), ASTM C 1580 (mg/kg)	22
Sulfides, AWWA 4500-S D, (mg/kg)	Nil
Chlorides, ASTM D 512, (mg/kg)	23
Red-Ox, ASTM G 200, (mV)	+732
Total Salts, AWWA 2540, (mg/kg)	327
As-Received Resistivity, ASTM G 57, (ohm-cm)	29100
Resistivity, ASTM G 57, (ohm-cm)	2813

A handwritten signature in black ink, appearing to read 'N. Campo'.

Analyzed By: _____

Nathan Campo
Engineering Technician II

The tests were performed in general accordance with applicable ASTM and AWWA test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

Job No.: CB225235

PERCOLATION TEST DATA

BORING NUMBER: P-1
LOT No:
TRACT No:

CLIENT: Prime Healthcare Management Inc.
PROJECT: Desert Valley Hospital Addition

DATE OF DRILLING:	January 13, 2023
DATE OF PRESOAK:	January 13, 2023
DATE OF TEST:	January 13, 2023
TESTED BY:	

DEPTH BEFORE (ft.):	5.0
DEPTH AFTER (ft.):	5.0
PVC PIPE DIA. (in.):	3.0
PERC HOLE DIA. (in.):	8.0

Time Interval (min.)	Total Elapsed Time (min.)	Initial Water Level (in.)	Final Water Level (in.)	Change in Water Level (in.)	Initial Hole Depth (in.)	Final Hole Depth (in.)	Percolation Rate (in/hr)	Infiltration rate (Porchet Method) (in/hr)
15	15	2.5	22.0	19.5	60.0	60.0	78.0	3.14
15	30	4.0	13.0	9.0	60.0	60.0	36.0	1.35
10	40	9.0	17.0	8.0	60.0	60.0	48.0	1.96
10	50	9.0	15.0	6.0	60.0	60.0	36.0	1.44
10	60	9.0	15.0	6.0	60.0	60.0	36.0	1.44
10	70	9.0	15.5	6.5	60.0	60.0	39.0	1.57
10	80	9.0	15.0	6.0	60.0	60.0	36.0	1.44
Average of last 3 readings:							37.00	1.48

Job No.: CB225235

PERCOLATION TEST DATA

BORING NUMBER: P-2
LOT No:
TRACT No:

CLIENT: Prime Healthcare Management Inc.
PROJECT: Desert Valley Hospital Addition

DATE OF DRILLING:	January 13, 2023
DATE OF PRESOAK:	January 13, 2023
DATE OF TEST:	January 13, 2023
TESTED BY:	

DEPTH BEFORE (ft.):	5.0
DEPTH AFTER (ft.):	5.0
PVC PIPE DIA. (in.):	3.0
PERC HOLE DIA. (in.):	8.0

Time Interval (min.)	Total Elapsed Time (min.)	Initial Water Level (in.)	Final Water Level (in.)	Change in Water Level (in.)	Initial Hole Depth (in.)	Final Hole Depth (in.)	Percolation Rate (in/hr)	Infiltration rate (Porchet Method) (in/hr)
10	10	21.0	60.0	39.0	60.0	60.0	234.0	21.77
3	13	23.0	30.8	7.8	60.0	60.0	155.0	8.83
10	23	16.0	36.0	20.0	60.0	60.0	120.0	6.67
10	33	16.0	30.0	14.0	60.0	60.0	84.0	4.31
10	43	17.0	29.0	12.0	60.0	60.0	72.0	3.69
10	53	17.0	28.0	11.0	60.0	60.0	66.0	3.34
10	63	17.0	29.0	12.0	60.0	60.0	72.0	3.69
11	64	16.0	28.0	12.0	60.0	60.0	65.5	3.27
Average of last 3 readings:							67.82	3.44

Job No.: CB225235

PERCOLATION TEST DATA

BORING NUMBER: P-3
LOT No:
TRACT No:

CLIENT: Prime Healthcare Management Inc.
PROJECT: Desert Valley Hospital Addition

DATE OF DRILLING:	January 13, 2023
DATE OF PRESOAK:	January 13, 2023
DATE OF TEST:	January 13, 2023
TESTED BY:	

DEPTH BEFORE (ft.):	10.0
DEPTH AFTER (ft.):	10.0
PVC PIPE DIA. (in.):	3.0
PERC HOLE DIA. (in.):	8.0

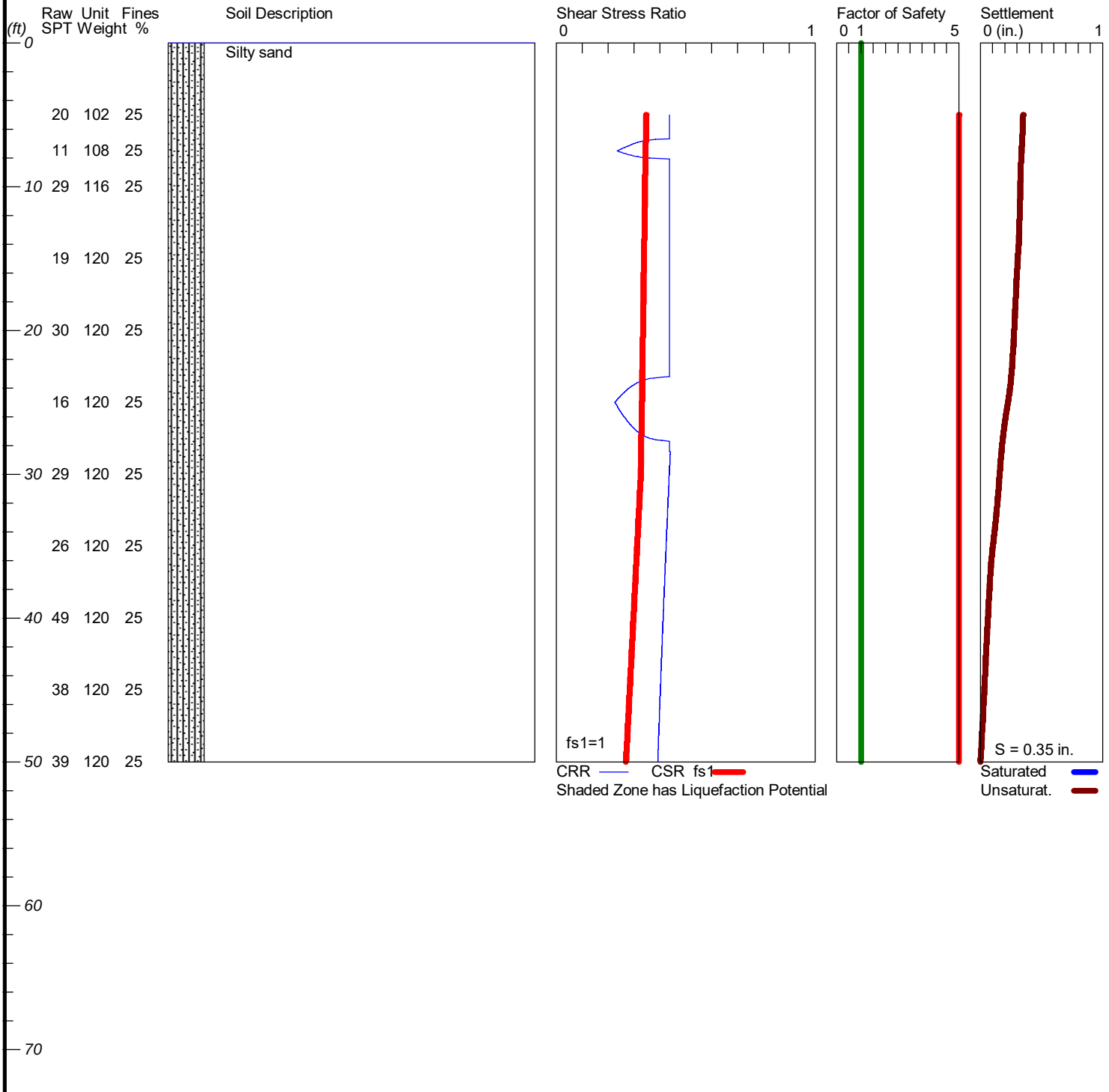
Time Interval (min.)	Total Elapsed Time (min.)	Initial Water Level (in.)	Final Water Level (in.)	Change in Water Level (in.)	Initial Hole Depth (in.)	Final Hole Depth (in.)	Percolation Rate (in/hr)	Infiltration rate (Porchet Method) (in/hr)
3	3	58.0	94.0	36.0	120.0	120.0	720.0	31.30
2	5	64.0	106.0	42.0	120.0	120.0	1260.0	68.11
10	15	58.0	113.0	55.0	120.0	120.0	330.0	18.08
10	25	58.0	112.0	54.0	120.0	120.0	324.0	17.51
10	35	58.0	112.0	54.0	120.0	120.0	324.0	17.51
10	45	58.0	110.0	52.0	120.0	120.0	312.0	16.42
10	55	58.0	111.0	53.0	120.0	120.0	318.0	16.96
10	62	58.0	111.0	53.0	120.0	120.0	318.0	16.96
Average of last 3 readings:							316.00	16.78

LIQUEFACTION ANALYSIS

Desert Valley Hospital Addition

Hole No.=B-1 Water Depth=100 ft

Magnitude=7.9
Acceleration=0.54g

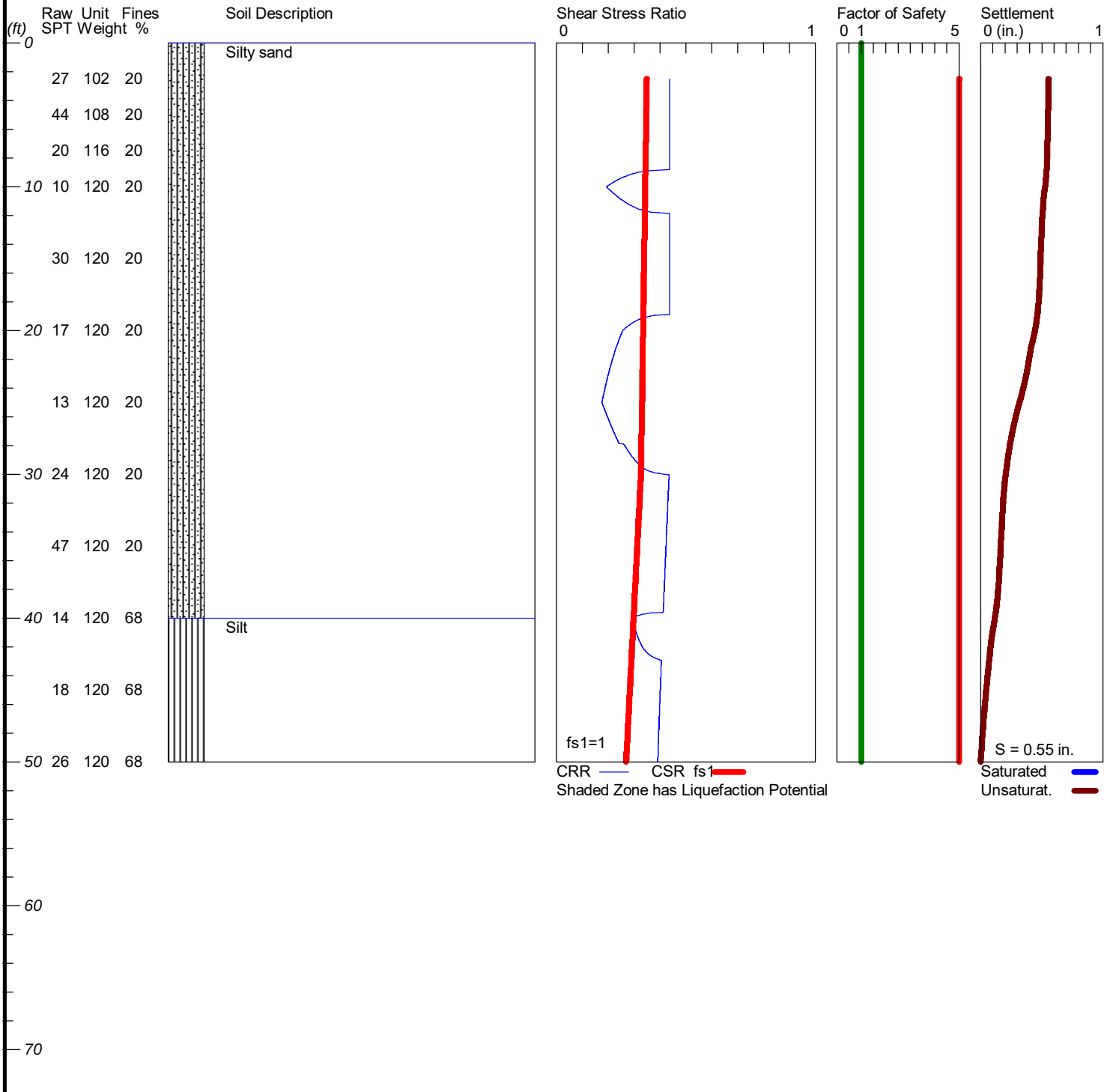


LIQUEFACTION ANALYSIS

Desert Valley Hospital Addition

Hole No.=B-4 Water Depth=100 ft

Magnitude=7.9
Acceleration=0.54g



SUPPORTING INFORMATION

Contents:

General Notes

Unified Soil Classification System

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING	WATER LEVEL	FIELD TESTS
 Auger Cuttings  Grab Sample  Modified California Ring Sampler  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See [Exploration and Testing Procedures](#) in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 0.25	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium Stiff	0.50 to 1.00	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18
Very Dense	> 50	> 99	Very Stiff	2.00 to 4.00	15 - 30	19 - 42
			Hard	> 4.00	> 30	> 42

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A					Soil Classification	
					Group Symbol	Group Name ^B
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above “A”	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below “A” line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above “A” line	CH	Fat clay ^{K, L, M}	
			PI plots below “A” line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat	

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$^E Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.

