APPENDIX E1
GEOTECHNICAL EVALUATION (APN 0167-061-01)

September 10, 2021
J.N. 21-315

MERITAGE HOMES
5 Peters Canyon Road, Suite 310
Irvine, California 92606

Attention: Ms. Johanna Crooker

Subject: Due-Diligence/Feasibility Geotechnical Assessment, Approximately 10±-Acre Property at 1160 W. Pioneer Avenue, East of 210 Freeway and North of Domestic Avenue, City of Redlands, San Bernardino County, California

Dear Ms. Crooker:

In accordance with your request, **Petra Geosciences, Inc. (Petra)** has performed a geotechnical due-diligence evaluation of the subject site for development of residential lots and related utility and street improvements. This report presents our findings and professional opinions with respect to the geotechnical feasibility of the proposed development, geotechnical constraints that should be taken into consideration during development of the site and potential mitigation measures to bring the site to compliance from a geotechnical engineering viewpoint.

It must be emphasized that that this report is intended as a feasibility-level geotechnical assessment only and is based solely on a review of the referenced background geologic literature and our limited subsurface exploration and laboratory testing. As such, the contents of this report are not suitable for submittal to regulatory agencies, nor should the findings or conclusions provided herein be relied upon for earthwork, quantity calculation or procedure, or structural engineering design. This geotechnical evaluation does not address soil contamination or other environmental issues affecting the property which will be provided under separate cover.

SITE GENERAL OVERVIEW

The subject site is located at 1160 W. Pioneer Avenue in the city of Redlands, San Bernardino County, California. According to the California Department of Conservation, Geologic Energy Management Division (CalGEM) Online Mapping System (2021), the site is located within Township 01 South, Range 03 West, Section 16, San Bernardino Base and Meridian. A site location map is included as Figure 1.

The rectangular shaped site is comprised of approximately 10±-acres of vacant land with Assessor Parcel Number (APN) 0167-061-01. Access to the subject property is via W. Pioneer Avenue along the south or

W. Domestic Avenue which is an unimproved dirt road along the northern boundary of the site. A drainage bounds the western edge of the subject property, with the 210 Freeway easement beyond. Vacant land and an orchard bound the site along the east with Citrus Valley High School beyond.

The site slopes gently to the north with existing elevations on the order of approximately 1,276± feet above mean sea level (msl) along the south portion of the site, to 1,267± feet above msl along the north portion of the site. Light to moderate vegetation covers the site with several mature trees along the south and east boundaries of the site.

DUE DILIGENCE ASSESSMENT

Literature Review

Petra has reviewed available published and unpublished geologic/geotechnical maps and literature, as well as online aerial imagery in the general area of the project site, see references. No geotechnical reports are known to exist for this site.

Site Reconnaissance and Subsurface Investigation

A preliminary subsurface exploration program was conducted within the site by representatives of Petra on August 6, 2021. The field investigation included the excavation of 6 exploratory borings (B-1 through B-6) to approximate depths ranging from 10.5 to 56.5 feet below existing ground surface (bgs) utilizing a conventional rubber-tired drill rig. One Boring, Boring B-1, was converted to a percolation test well. Following drilling, logging and percolation testing, the borings were loosely backfilled with the soil cuttings and logs of the borings are shown in Appendix A. The approximate locations of the exploratory borings are shown on Figure 2. The purpose of our preliminary investigation was to evaluate the subsurface surface soil materials to determine the unsuitable soil removal depths (remedial grading).

Laboratory Testing

The preliminary laboratory program consisted of testing select undisturbed and/or bulk samples of onsite native soil materials for in-situ moisture and dry density, expansion index, maximum dry density and optimum moisture content, and general corrosion potential (sulfate, chloride, pH, resistivity). The laboratory data is tabulated in Appendix B and the results are included in the conclusions and recommendations section herein.

FINDINGS

Proposed Development

Although there are no preliminary grading plans, the current conceptual development is expected to consist of building pads for single-family residences with other site improvements consisting of new in-tract streets and underground utility lines (sewer, water, storm drain and dry utilities), an offsite sewer line, masonry block screen walls, concrete sidewalks and landscaping etc.

Site Reconnaissance

A representative of Petra conducted a site reconnaissance and performed photo documentation during the field investigation on August 6, 2021 to observe the current surface conditions at subject site. The property is situated in an area of residential, commercial and open space/undeveloped land use.

The site surrounding areas consist of W. Domestic Avenue, with agricultural fields and the Santa Ana River beyond to the north; a drainage channel and the 210 Foothill Freeway, with commercial development beyond to the west; Pioneer Avenue, with vacant land beyond to the south and; Citrus Valley High School, with Texas Street, vacant land and residential development beyond to the east.

Based on information obtained during a parallel study, the site appears to have been used for cultivated orchards since at least 1930 until sometime between/during 1994 and 2002. Sometime between/during 1994 and 2002 the orchards have been removed from the site and the site has remained vacant land to present.

Dumped household trash was observed in several areas of the site and included plastic bags, plastic bottles, cans, pans, wood, cardboard and other miscellaneous household trash along with windblown trash. One water well was observed near the southwest portion of the subject property; however, it is unclear if this well is within the subject property. The well pumps water to a concrete underground irrigation distribution box which then distributes the water to underground concrete irrigation lines. A second concrete irrigation structure was observed within the southeast portion of the site. There was no evidence of sumps, pits, pools, or lagoons identified during our site reconnaissance. Three wooden power poles with overhead lines were located along the southwest portion of the subject property. Three pole-mounted transformers are located on the last pole adjacent to the water well.

Preliminary Geotechnical Field and Laboratory Results

As noted, our preliminary field investigation included the excavation of six exploratory test borings (B-1 through B-6) to depths between approximately 10.5 to 51.5 feet bgs. Boring B-6 was converted to a field

percolation well to evaluate the infiltration rate of the alluvial deposits underlying the site. The following presents the results of subsurface and laboratory investigations.

Hollow Stem Auger Borings

Based on our six borings, the site is generally underlain by native younger alluvial soil deposits that were observed to the maximum depth explored of 56.5 feet bgs. These alluvial soils generally consisted of thinly to thickly interbedded sequences of dry to slightly moist sand and silty sand with low to medium density in the upper 20 to 25 feet and increasing in density with greater depth. Thin interbeds of sandy silt were occasionally encountered, as well as thin gravel layers. Logs of the borings are included as Appendix A.

The result of our analysis indicates that the site is not susceptible to seismically induced liquefaction settlements; however, is considered susceptible to seismically induced dry sand/dynamic settlements. Based on our analysis, total dry sand settlement can range from 4 to 6 inches at the location studied with a potential for differential settlement of 2 inches.

In the literature, prediction of the seismic settlement for unsaturated sandy soils, referred to as "dry sand" settlement, is based on observation of performance of 5 sites that were comprised of clean sands (i.e., sands with 5 percent fines or less). However, the shallow site soils, above the assumed historic high ground water level, are comprised of sands with substantial amounts of fines. This influences (reduces) the settlement potential under a seismic event. To overcome this, the measured parameters of soils with fines are first converted to clean sand values and then will be used in the predictive routines. This is an indirect approach and, therefore, lacks the performance-based verification requirements. For this reason, some review agencies do not require "dry sand" settlement calculations as a part of their approval process.

For the subject site, the total seismic settlement is considered to be within the tolerable range and mitigation of the adverse impact of 1 to 2 inches of differential settlement on proposed structures may include post tensioned slabs along with the structural engineer's design calculations.

Percolation Test Results

The falling-head percolation test was performed at Boring B-6 location to determining the shallow site infiltration rate, I_t [expressed in units of inches/hour, utilizing the Porchet Method (RCFCWCD, 2011)]. Following a presoaking period, field testing was conducted in a perforated-cased borehole (with ¾-inch gravel surrounding the pipe) at 10-minute intervals for a period of approximately 1 hour. Test data are attached in Appendix C. The infiltration rate, I_t, was calculated by determining the volumetric water flow rate through the wetted borehole surface area, expressed in terms of inches per hour. An un-factored

infiltration rate of 2.8 inches per hour is obtained. A Reduction Factor of 1.25 should be considered for Site Suitability considerations to the value of Infiltration Rate provided herein.

Laboratory Tests

Limited laboratory testing was conducted on various representative fill samples collected from drill rig locations for engineering and classification properties. The in-situ moisture and dry density results are indicated on the boring logs in Appendix A. The native soils in the upper 5 feet across the site was found to generally consist of very dry to slightly moist sand to silty sand that have a very low expansion potential (EI of 0). Lab testing found site soils to have a negligible corrosion potential to concrete materials (soluble sulfate of 0.0009 percent), very low exposure to chlorides (108 mg/L), moderately alkaline (soil pH of 8.4) and are considered mildly corrosive to buried metallic elements and (minimum resistivity of 10,000 ohm-cm). Maximum dry density and optimum moisture content had a value of 125.0 pcf at 9.0 percent optimum moisture content. [Collapse testing of the native alluvium soils in an adjacent site to the north indicated a collapse potential generally on the order of 0.15 to 0.45 percent indicating a relatively low collapse potential.] The tabulated laboratory data is also included in Appendix B.

Compressible/Collapsible Soils

Based on our borings and laboratory testing, the existing soils, including all topsoil and the upper portions of low-density and dry alluvial soils, are considered unsuitable for support of proposed fills, structures, pavement or other improvements and should be removed to underlying competent alluvial soils and replaced as properly compacted fill. Based on our boring data, the upper 6 feet of site soils should be uniformly removed to competent alluvium and then the bottom excavation should be tested in the field. If the natural bottom excavation is found to have a minimum of 85 percent in-situ relative density, then the bottom surface may be properly processed to at least 12 inches in depth by moisture content to at least 2 percent above optimum moisture content and recompacted to at least 90 percent relative compaction. Then engineered fill placement may commence to design grades. Localized areas of deeper excavation/removal of unsuitable soils may be necessary and contingencies should be planned for.

Groundwater

Groundwater was not encountered in our borings to the maximum explored depth of approximately 56.5 feet below grade. In addition, California Department of Water Resources website indicated that recent groundwater levels since 1990 in the nearby area are greater than 130 feet bgs. Groundwater may have been as shallow as 55 feet back in the 1940's however it is highly unlikely groundwater levels would rise to those previous elevations in the future. Groundwater is not anticipated to impact the proposed development.

Faulting

Based on our review of published geologic maps, no faults are known to project through the property, and no portion of the site lies within an Earthquake Fault Hazard Zone as designated by the State of California pursuant to the Alquist-Priolo Earthquake Zoning Act. Therefore, it is our opinion that surface-rupturing will not affect the site.

Strong Ground Motions

The site is located in a seismically active area of Southern California and will likely be subjected to very strong seismically-related ground shaking during the anticipated life span of the project. Structures within the site should therefore be designed and constructed to resist the effects of strong ground motion in accordance with the 2019 California Building Code (CBC).

Liquefaction and Dynamic Settlement Potential

Based on review of the San Bernardino County geologic hazard maps the site is not specifically located within a mapped the liquefaction hazard zone, however the site is in close proximity to an area mapped as high liquefaction potential. Regional groundwater depths from nearby in the area indicate recent depths of over 130 feet bgs or more, however historic high groundwater in the 1940's was as high as 55 feet± bgs. Our boings didn't not encountered groundwater to a depth of 56.5 feet bgs, therefore liquefaction does not appear to be a hazard at this site.

Based on the youth and low density of the underlying alluvium we also performed a seismic or "dry sand" settlement analysis. Based on our preliminary analysis, the potential for seismic (dynamic) settlement at this site was determined to be between 4 to 6 inches. It is our professional opinion that the adverse impacts of this additional settlement on structural behavior could be mitigated by a placement of an engineered fill layer and a foundation design using a differential settlement of 2 inches in 40 feet.

CONCLUSIONS AND RECOMMENDATIONS

Based on our site reconnaissance, limited field investigation and laboratory testing, the development of the subject project site is considered feasible from a geotechnical engineering standpoint. It is recommended that the following geotechnical issues be considered by the Client during this due diligence period.

Primary Geotechnical Issues

Our professional opinion, from a geotechnical engineering viewpoint, regarding various aspects of site condition and/or proposed development is presented herein. The following presents the salient points of our due diligence assessment that we recommend be considered for future site development.

- Design Level Geotechnical Report and Grading Plan Review Report: The City of Redlands will require a formal geotechnical report during the review and approval process and may also require a geotechnical review of the final grading plans. Any formal geotechnical reports should include recommendations for site rough grading, post-grading improvements, and preliminary building foundation design based on the current 2019 California Building Code.

- Demolition, Clearing and Grubbing: All existing site improvements, underground utility lines and/or structures will need to be demolished are removed from the site. In addition, due the past site usage, the possibility does exist that other unknown underground structures may be found below current grades. It is recommended that all vegetation (including the root ball), debris and trash encountered on the site be removed and disposed in accordance with current local regulations.

  One water well was observed near the southwest portion of the subject property, however, it is unclear if this well is within the subject property. In the event the well is not intended for future use, it is recommended that the well be abandoned in accordance with the California Well Standards as published by the California Department of Water Resources (Bulletin 74-81 and 74-90), with oversight provided by the appropriate agencies.

  The well pumps water to a concrete underground irrigation distribution box which then distributes the water to underground concrete irrigation lines. If these are encountered during clearing and grubbing or future grading and development, they should be left in place until an experienced environmental professional (such as Petra) has had the opportunity to evaluate the conditions and provide recommendations if needed. In the event concrete irrigation lines are encountered, caution should be taken to not crush the lines until it can be ascertained that they do not contain asbestos.

  Three pole mounted transformers were adjacent the well. No staining was observed on or in the soils below the transformers. If the transformers are to be removed, it is recommended that the removal be completed by a licensed contractor or the utility company responsible for the transformer.

  It is unknown if there are any septic tanks or leach fields on the site. If any are encountered during site development, it is recommended that they be removed in accordance with current regulations.

- Removal of Unsuitable Soil Materials: Based on our boring data, the upper 6 feet of native site were generally loose and dry and generally unsuitable for support of proposed fills or structures and should be removed to competent alluvium exhibiting at least 85 percent in-situ relative density. Additionally, any cut lots should be further overexcavated at least 3 feet below finish pad grades if not already accomplished by the remedial removals. Remedial grading removals in street and non-structural areas may be reduced to 2 feet below design grades or at least 3 feet below existing site grades, whichever is deeper. The bottom of all remedial excavations should be properly processed in-place prior to fill placement.

- Suitability of Onsite Soils for Fill: All onsite soils consisting of "clean" native alluvium are considered suitable for use in engineering fill provided they are free of organics or other deleterious materials. The near-surface site soils (upper 5± feet) may be in a very dry condition and may to be pre-watered for an extended period to bring the site soils to near optimum conditions at the onset of grading.

- Shrinkage/Importing of Fill: Although grading plans and preliminary grading quantities are not currently available, all earthwork calculations should take into account soil shrinkage and site subsidence during remedial alluvial removals and replacement as compacted fill. Estimated shrinkage of native alluvium could be on the order of 15 to 17± percent when removed and compacted as engineered fill and site subsidence could be on the order of 0.1 to 0.2 feet. It should also be noted that the removal and exporting of the existing trees and their underground root ball system may affect the upper 1 to 1.5 feet across the site that should also be taken into account with preliminary earthwork calculations.

  In the event that import is needed to complete grading of the site, the potential source(s) should be evaluated prior to importing to the site such that non-expansive, low corrosive soils that are free of deleterious materials will be used.

- Deep Utility Trenching: Based on the observed soil types, sands and silty sands with generally low fines content, these soils types are prone to caving and any deep trenching for utility lines may need to be laid back at a slope excavation flatter than normal or shoring may need to be employed.

- Expansion and Corrosion Potential of Site Soils: Our laboratory testing indicated site soils to be very low in expansion potential and have a negligible exposure to sulfates. Additionally, site soils are considered moderately corrosive to buried metallic elements. As site grading remains to be completed, additional sampling and laboratory testing should be performed during grading operations for expansion and general corrosion potential for the purposes of providing final foundation and other design recommendations.

- Building Foundation Design: Based on the observed soils types and anticipated engineered grading, conventional foundations are expected to be feasible, however based on our dynamic settlement analysis that indicated 2 inches of potential settlement, we recommend a post-tensioned slab on-grade for the proposed dwellings. Final foundation design would be provided at the completion of site grading depending on the as-graded conditions and expansion potential of soils at or near finish grades. Very low expansion soils are anticipated across the site at this time.

- Pavement Design: Based on the observed soil types, sands and silty sands, a preliminary pavement design of 3 inches of asphalt over 6 inches of base for in-tract streets may be utilized for budgeting purposes only. A thicker pavement section may be needed for West Domestic Avenue depending on the traffic index. Final pavement design should be provided at the completion of site and street grading based on final sampling and testing of subgrade soils for R-value.

- Onsite Stormwater Infiltration: Based on the observed soil types, sands and silty sands with generally low fines content, we expect to have reasonable percolation or infiltration rates, as indicated by our pilot test, and onsite storm water infiltration systems may be effective for transmitting water into the subsurface. Once basin locations and depths are known, supplemental field infiltration testing should be performed and the required setback established.

REPORT LIMITATIONS

This report is based on the existing conditions of the subject property and the geotechnical observations made during our site reconnaissance and preliminary field investigation and limited laboratory testing. The soil conditions observed in our field investigation are believed to be representative of the general area conditions; however, soil conditions can vary in characteristics between excavations, both laterally and vertically and we recommend supplemental test pits for further evaluation during the design phase of the project. The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and in the same time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This opportunity to be of service is sincerely appreciated. If you have any additional questions or concerns, please feel free contact this office.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

9/10/2021

Siamak Jafroudi, PhD
Senior Principal Engineer
GE 2024

REGISTERED PROFESSIONAL ENGINEER
SIAMAK JAFROUDI
No. GE002024
GEOTECHNICAL
STATE OF CALIFORNIA

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Attachments: References
Figure 1 – Site Location Map
Figure 2 – Boring Location Map
Appendix A – Boring Logs
Appendix B – Laboratory Test Data
Appendix C – Percolation Test Data

Distribution: Addressee (electronic)

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REFERENCES

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Huitt-Zoliars, 2018, Conceptual Site Plan, dated October 16.

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Matti, J. C. et. al., 2003, Geologic Map of the Redlands 7.5' Quadrangle, San Bernardino and Riverside Counties, California; USGS Open-file Report 03-302.

San Bernardino County Land Use Plan, 2010, General Plan Geologic Hazard Overlays, Figure FH31 C, Redlands.

Base Map Reference: Google Earth (2021) Map

PETRA GEOSCIENCES, INC.
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COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

SITE LOCATION MAP

1160 W. Pioneer Avenue Project
Redlands, California

PETRA GEOSCIENCES INC.

DATE: Sept, 2021

J.N.: 21-315

Figure 1

EXPLANAION

Approximate Location of Site Boundary

Approximate Location of Geotechnical Borings
B-6

P-1 Percolation Test Location

N

Reference: Goolge Earth Image, 2021

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BORING LOCATION MAP

1160 W. Pioneer Avenue Project
Redlsnds, California

PETRA GEOSCIENCES INC.

DATE: Sept, 2021

J.N.: 21-315

Figure 2

APPENDIX A

BORING LOGS

Soil Classification

PETRA

4 Moisture Content

Dry
Slightly Moist
Moist
Very Moist
Wet (Saturated)

Modifiers

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

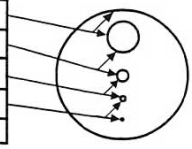
Soil Classification Should Include:

PREFERRED ORDER

1. Group Name
2. Group Symbol
3. Color
4. Moisture Content
5. Relative Density / Consistency
6. Grain Size Range
7. Structure
8. Odor
9. Additional comments indicating soil characteristics which might affect engineering properties

6 Grain Size

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



1 2 Unified Soil Classification System

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

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

5 Consistency - Fine Grained Soils

Apparent Density	SPT (# blows/foot)	Modified CA Sampler (# blows/foot)	Field Test
Very Soft	<2	<3	Easily penetrated by thumb; exudes between thumb and fingers when squeezed in hand
Soft	2-4	3-6	Easily penetrated one inch by thumb; molded by light finger pressure
Firm	5-8	7-12	Penetrated over 1/2 inch by thumb with moderate effort; molded by strong finger pressure
Stiff	9-15	13-25	Indented about 1/2 inch by thumb but penetrated only with great effort
Very Stiff	16-30	26-50	Readily indented by thumbnail
Hard	>30	>50	Indented with difficulty by thumbnail

5 Relative Density - Coarse Grained Soils

Apparent Density	SPT (# blows/foot)	Modified CA Sampler (# blows/foot)	Field Test
Very Loose	<4	<5	Easily penetrated with 1/2-inch reinforcing rod pushed by hand
Loose	4-10	5-12	Easily penetrated with 1/2-inch reinforcing rod pushed by hand
Medium Dense	11-30	13-35	Easily penetrated 1-foot with 1/2-inch reinforcing rod driven with a 5-lb hammer
Dense	31-50	36-60	Difficult to penetrated 1-foot with 1/2-inch reinforcing rod driven with a 5-lb hammer
Very Dense	>50	>60	Penetrated only a few inches with 1/2-inch reinforcing rod driven with a 5-lb hammer

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**		Boring No.: **B-1**
Location:	**Redlands, California**		Elevation: **1268ft (msl)**
Job No.:	**21-315**	Client: **Meritage**	Date: **August 6, 2021**
Drill Method:	**CME-75 Hollowstem**	Driving Weight: **140lbs**	Logged By: **BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Young Axial Valley Deposits (Qya) Silty Sand (SM): Gray brown, dry, loose, fine to medium-grained sand, porous with scattered rootlets.							Max, Corrosion, Atterberg, Sieve, Expansion
		Gray brown, dry, medium dense, fine to medium-grained sand.		12 9 11			2.0	106.1	
5		Gray brown, dry, medium dense, fine to medium-grained sand.		5 7 8			1.1	105.8	
		Interbedded Silty Sand and Silt (SM-ML): Olive gray, damp, loose, interbedded silty fine to medium-grained sand and slightly clayey silt, with <5% sub-rounded fine-grained gravel.		3 5 7			6.5	94.9	
10		Silty Sand (SM): Olive brown, moist, medium dense, silty fine-grained sand.		8 12 12			6.4	91.9	
15		Poorly Graded Sand (SP): Olive brown, moist, medium dense, poorly graded fine-grained sand.		5 8 13			5.0	101.8	
20		Gray brown, moist, medium dense, poorly graded fine to medium-grained sand.		9 12 17			2.2		
25		Gray brown, moist, medium dense, poorly graded fine to medium-grained sand, with <5% sub-rounded fine grained gravel.		7 8 12					
30		Silty Sand (SM): Olive brown, moist, medium dense, fine-grained sand.		8 12 20			7.2	98.4	
35		Olive brown, moist, medium dense, fine-grained sand.		7					

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**		Boring No.: **B-1**
Location:	**Redlands, California**		Elevation: **1268ft (msl)**
Job No.:	**21-315**	Client: **Meritage**	Date: **August 6, 2021**
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				8 12					
40		Interbedded Silty Sand and Clean Sand (SP-SM): Olive brown, moist, dense, interbedded sandy silt and clean fine to medium-grained sand.		15 14 23			3.2	103.5	
45		Silty Sand (SM): Olive brown, moist, medium dense, fine grained-sand.		9 11 17					
50		Poorly Graded Sand (SP): Gray, damp, very dense, poorly graded fine to medium-grained sand.		29 32 50			2.0	105.8	
55		Silty Sand (SM): Olive gray, damp, very dense, fine to medium-grained sand.		30 30 37					
		Total depth 56.5-feet. No groundwater or seepage. Backfilled with cuttings.							
60									
65									
70									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**		Boring No.: **B-2**
Location:	**Redlands, California**		Elevation: **1264ft (msl)**
Job No.:	**21-315**	Client: **Meritage**	Date: **August 6, 2021**
Drill Method:	**CME-75 Hollowstem**	Driving Weight: **140lbs**	Logged By: **BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Young Axial Valley Deposits (Qya) Silty Sand (SM): Olive gray, dry, loose, fine-grained sand.							
		Olive gray, dry, loose, fine-grained sand, porous, with rootlets.		4 5 6	■		0.8	98.9	
5		Light gray, dry, medium dense, fine to medium-grained sand.		4 7 7	■		1.3		
		Poorly Graded Sand (SP): Light gray, dry, medium dense, poorly graded fine to medium-grained sand.		4 8 10	■		0.7		
10		Silty Sand (SM): Light gray, dry, medium dense, fine-grained sand, with <5% sub-rounded fine-grained gravel.		5 6 9	■		4.2	95.5	
15		Olive gray, damp, medium dense, fine-grained sand.		7 8 12	■		2.3	100.2	
		Olive brown, damp, loose, fine-grained sand, micaceous.		3 3 5	◢				
20				6 7 9	■		1.9	103.0	
25		Olive gray to olive brown, moist, medium dense, fine-grained sand.		7 9 15	■		11.4	93.4	
		Total Depth 26.5 feet. No groundwater or seepage. Backfilled with cuttings.							
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**		Boring No.: **B-3**
Location:	**Redlands, California**		Elevation: **1264ft (msl)**
Job No.:	**21-315**	Client: **Meritage**	Date: **August 6, 2021**
Drill Method:	**CME-75 Hollowstem**	Driving Weight: **140lbs**	Logged By: **BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Younger Axial Valley Deposits (Qya) Silty Sand (SM): Olive brown, dry, loose, fine to medium-grained sand.							
		Olive brown, dry, loose, fine to medium-grained sand.		5 5 6	■		1.4	105.9	
5		Gray to olive gray, dry, medium dense, fine to medium-grained sand.		4 5 8	■		2.1	107.0	
		Poorly Graded Sand (SP): Gray, dry, medium dense, poorly graded fine-grained sand.		4 6 10	■		6.3	89.9	
10		Gray, dry, medium dense, poorly graded fine to medium-grained sand, with >5% sub-rounded fine-grained gravel.		5 7 13	■		2.3		
15		Silty Sand (SM): Olive brown, dry, medium dense, fine-grained sand.		6 6 12	■		6.8	100.2	
20		Poorly Graded Sand (SP): Gray, dry, dense, poorly graded fine to medium-grained sand, with <5% sub-angular fine-grained gravel.		7 18 25	■		2.0	107.1	
		Gray, dry, medium dense, poorly graded fine to medium-grained sand, with <5% sub-sub rounded fine-grained gravel.		6 11 13	◪				
25		Gray, dry, dense, poorly graded fine to medium-grained sand, with >10% coarse sand grains.		13 22 22	■		1.3		
		Total Depth 26.5-feet. No groundwater or seepage. Backfilled with cuttings.							
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**		Boring No.: **B-4**
Location:	**Redlands, California**		Elevation: **1260ft (msl)**
Job No.:	**21-315**	Client: **Meritage**	Date: **August 6, 2021**
Drill Method:	**CME-75 Hollowstem**	Driving Weight: **140lbs**	Logged By: **BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Younger Axial Valley Deposits (Qya) Silty Sand (SM-ML): Light gray brown, dry, medium dense, fine-grained sand.		14 9 9	■		0.9	104.2	
		Light gray brown, dry, loose, fine to medium-grained sand.		4 6 6	■		1.4	97.4	
5									
		Silt (ML): Light gray, dry, medium dense, sandy silt.		5 9 9	■		0.9	105.3	
		Poorly Graded Sand (SP): Gray, loose, dry, poorly graded fine to medium-grained sand, with <5% coarse sand grains.		5 3 7	◢				
10		Total depth 10.5-feet. No groundwater or seepage. Converted to percolation test boring.							
15									
20									
25									
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**		Boring No.: **B-5**
Location:	**Redlands, California**		Elevation: **1262ft (msl)**
Job No.:	**21-315**	Client: **Meritage**	Date: **August 6, 2021**
Drill Method:	**CME-75 Hollowstem**	Driving Weight: **140lbs**	Logged By: **BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Younger Axial Valley Deposits (Qya) Silty Sand (SM): Light olive gray, dry, loose, fine-grained sand.		5 7 7	■		1.8	102.9	
		Light olive gray, dry, medium dense, fine-grained sand.		3 7 9	■		2.7	99.7	
5		Silt (ML): Gray brown, dry, firm, sandy silt.		3 5 7	■		2.8	96.8	
10		Interbedded Silty Sand and Poorly Graded Sand (SP-SM): Gray brown, dry, medium dense, interbedded silty fine to medium-grained sand and poorly graded fine to medium-grained sand.		5 6 10	■		2.8	102.0	
		Total depth 10.5-feet. No groundwater or seepage. Backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**1160 W. Pioneer Ave**		Boring No.: **B-6**
Location:	**Redlands, California**		Elevation: **1270ft (msl)**
Job No.:	**21-315**	Client: **Meritage**	Date: **August 6, 2021**
Drill Method:	**CME-75 Hollowstem**	Driving Weight: **140**	Logged By: **BR**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		Young Axial Valley Deposits (Qya) Silty Sand (SM): Gray brown, dry, medium dense, fine-grained sand.		8 7 7	■		0.7		
		Gray brown, dry, medium dense, fine-grained sand, with <5% sub-rounded fine- grained gravel.		5 6 9	■		1.7	106.9	
5		Olive gray brown, dry, medium dense, fine-grained sand.		4 6 7	■		0.8		
		Gray, dry, medium dense, fine to coarse-grained sand, with <10% sub-angular fine gravel.		7 9 11	■		1.3		
10		Total depth 10.5-feet. No groundwater or caving. Backfilled with cuttings.							
15									
20									
25									
30									
35									

PLATE

Petra Geosciences, Inc.

APPENDIX B

LABORATORY TEST DATA

Maximum Dry Density and Optimum Moisture Content Test Data

Boring/Depth (feet)	Soil Type	Optimum Moisture (%)	Maximum Dry Density (pcf)
B-1 @ 0-5	Silty Sand	9.0	125.0

Per ASTM Test Method ASTM D 1557

Expansion Index Test Data

Boring/Depth (feet)	Soil Type	Expansion Index	Expansion Potential
B-1 @ 0-5	Silty fine Sand	0	Very Low

Per ASTM Test Method ASTM D 4829

Corrosion Test Data

Boring/Depth (feet)	Sulfate (%)	Chloride (mg/L)	pH	Resistivity (ohm-cm)	Corrosivity Potential
B-1 @ 2	0.0009	108	8.4	10,000	Concrete: Negligible Steel: Moderate

Per California Test Method CTM 417, 422, 643

COMPACTION TEST REPORT

Project No.: 21-315 **Date:** 9/7/2021

Project: 1160 W. Pioneer Ave

Client: Meritage

Source of Sample: Phase 100 **Depth:** 0-5

Sample Number: B-1

Remarks: Expansion Index: 0 (Very Low)

MATERIAL DESCRIPTION

Description: Brown Silty fine to medium Sand

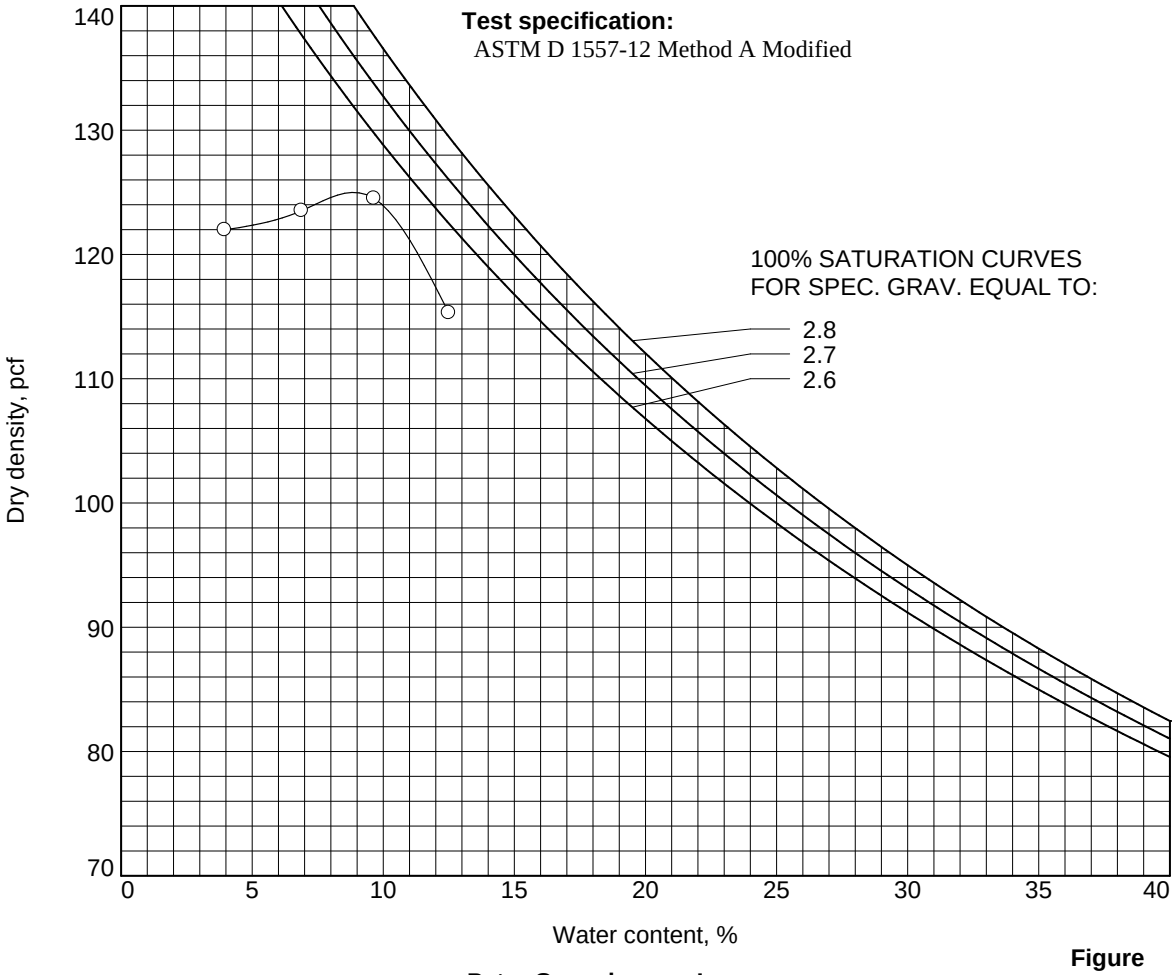
Classifications - **USCS:** **AASHTO:**

Nat. Moist. = **Sp.G. =**

Liquid Limit = **Plasticity Index =**

% < No.200 = 29.9 %

TEST RESULTS
Maximum dry density = 125.0 pcf
Optimum moisture = 9.0 %



Figure

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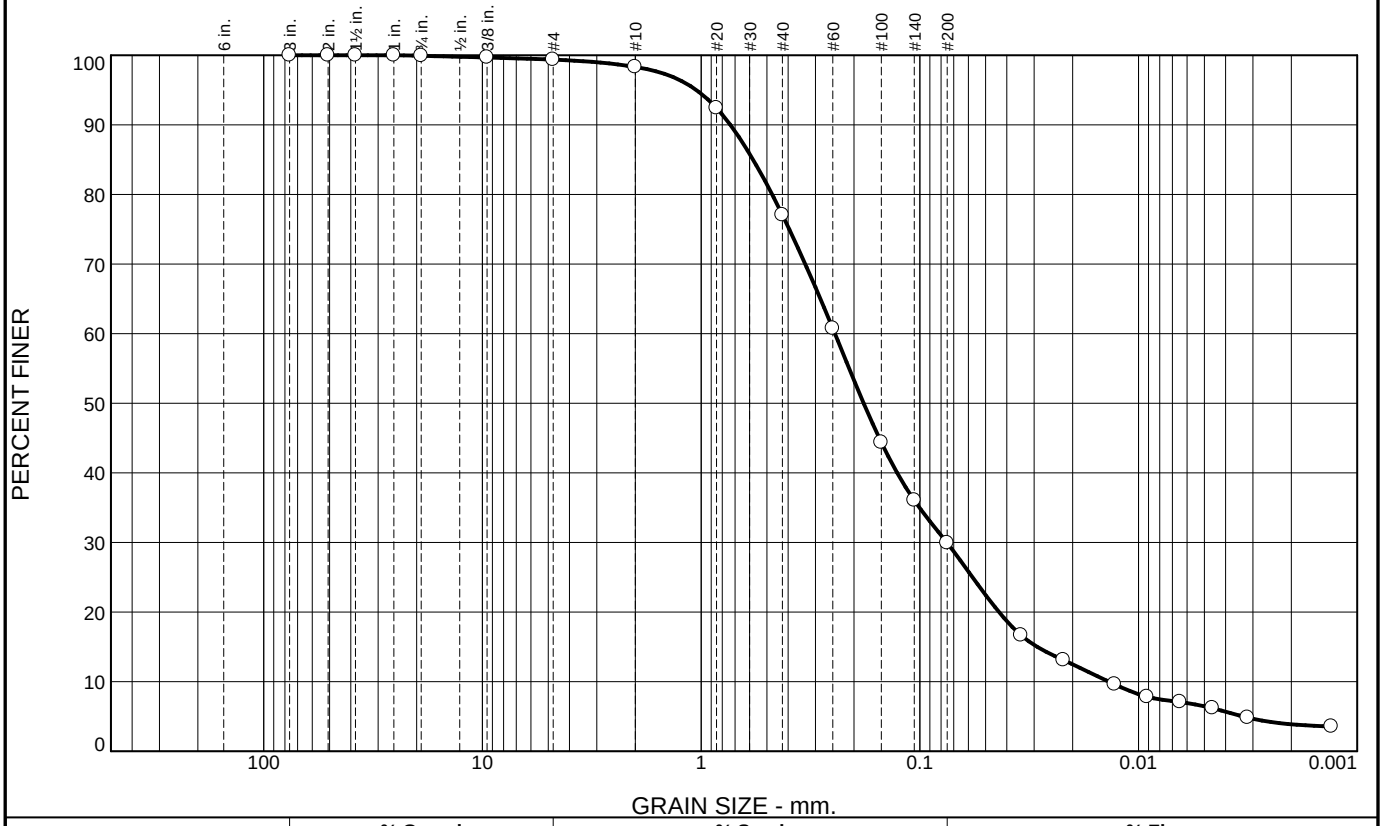
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.1	0.5	1.1	21.2	47.2	23.4	6.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100.0		
2	100.0		
1.5	100.0		
1	100.0		
.75	99.9		
.375	99.7		
#4	99.4		
#10	98.3		
#20	92.4		
#40	77.1		
#60	60.8		
#100	44.4		
#140	36.0		
#200	29.9		

* (no specification provided)

Material Description

Brown Silty fine to medium Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.7351 D_{85}= 0.5786 D_{60}= 0.2444
D_{50}= 0.1806 D_{30}= 0.0752 D_{15}= 0.0290
D_{10}= 0.0137 C_u= 17.90 C_c= 1.70

Classification

USCS= AASHTO=

Remarks

Source of Sample: Phase 100 **Depth:** 0-5
Sample Number: B-1

Date: 9/9/2021

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Client: Meritage
Project: 1160 W. Pioneer Ave

Project No: 21-315 **Figure**

APPENDIX C

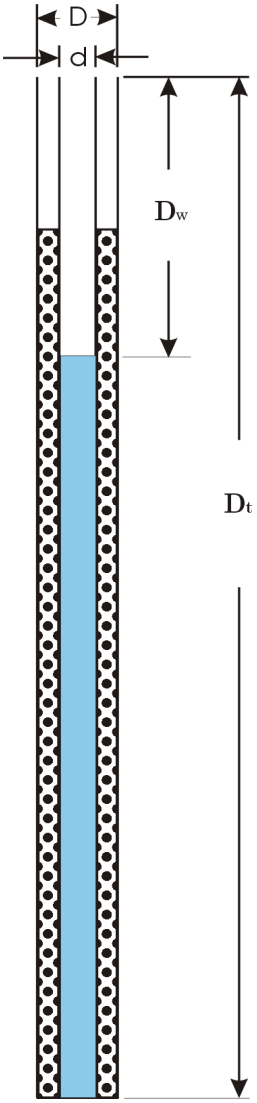
PERCOLATION TEST DATA

Test Number: P-1

Shallow Percolation Test Method

Total Depth of Boring, D_t (ft): 10
Diameter of Hole, D (in): 8
Diameter of Pipe, d (in): 3
Agg. Correction (% Voids): 40
Pre-soak depth (ft): 5

Time Interval (min)	Depth to Water Surface D_w (ft)		Change in Head (in)	Perc. Rate (min/in)	Perc. Rate (gal/day/ft^2)
	1st Reading	2nd Reading			
25	5.05	9.42	52.44	0.48	51.86
25	5.50	9.26	45.12	0.55	46.94
10	5.02	6.55	18.36	0.54	30.37
10	5.05	6.70	19.80	0.51	33.44
10	5.20	6.72	18.24	0.55	31.43
10	5.05	6.68	19.56	0.51	32.96
10	5.22	6.78	18.72	0.53	32.57
10	5.15	6.73	18.96	0.53	32.51



Percolation Rate: 0.53 Minutes/Inch
39.62 gal/day/ft^2

Infiltration Rate: 2.79 Inches/Hour*
(Porchet Method)

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

$r = D / 2$
$H_o = D_t - D_o$
$H_f = D_t - D_f$
$\Delta H = \Delta D = H_o - H_f$
$H_{avg} = (H_o + H_f) / 2$

*Raw Number, Does Not Include a Factor of Safety

Testing by Bryan Rall 8/9/21

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

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COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA SAN DIEGO

PERCOLATION TEST SUMMARY

1160 W. Pioneer Ave
Redlands, California

PETRA GEOSCIENCES INC.
DATE: Sept. 2021
J.N.: 21-315

Figure 1