Appendix D
Geotechnical Study

BERGAMOT SPECIFIC PLAN
INITIAL STUDY

March 13, 2019
J.N. 18-345

MLC HOLDINGS, INC.
5 Peters Canyon Road, Suite 310
Irvine, California 92606

Attention: Mr. Matt Maehara

Subject: **Due-Diligence/Feasibility Geotechnical Assessment, Approximately 46-Acre± Property Off West Domestic Avenue, City of Redlands, San Bernardino County, California**

Dear Mr. Maehara:

In accordance with your request, **Petra Geosciences, Inc. (Petra)** has performed a geotechnical due-diligence evaluation of the subject site for development of 178 residential lots and related utility and street improvements within two undesignated tracts. 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 46±-acre property is comprised of two separate blocks of parcels, a westerly, rectangular site comprised of APN's 016-703-116 and 016-703-102, and a nearly square site approximately 150 feet± to the east, comprised of APN's 016-703-104, 106-703-105, 016-703-106 and 016-703-107; see Figures 1 and 2. Both blocks are located north of West Domestic Drive and east of Highway 210, in the city of Highland. West Domestic Drive is an unimproved dirt drive along the southern boundary of the site. The site is essentially covered by a former citrus orchard which is also located to the north and east and a high school campus is located south of West Domestic Drive.

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Petra has reviewed available published and unpublished geologic/geotechnical maps and literature, as well as online aerial imagery in the general area of the project site, see references.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 October 12, 2018. The field investigation included the excavation of 6 exploratory borings (B-1 through B-6) to approximate depths ranging from 21.5 to 51.5 feet below existing ground surface (bgs) utilizing a conventional rubber-tired drill rig. Following drilling and logging, the borings were loosely backfilled with the soil cuttings and logs of the borings are shown in Appendix A. In addition, five Cone Penetrometer Test soundings (CPT-1 through CPT-5) were advanced to depths of between approximately 53 and 65 feet below existing grade. The approximate locations of the exploratory borings and CPT soundings 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) and to evaluate the potential for dynamic settlement to affect the site.

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, collapse potential, 200 wash analysis 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 map as shown on Figure 2 indicates the development will consist of 178 building pads for single-family residences and based on the layout of the project, two tract designations are likely. 59 Lots will be located in the westerly parcel and 119 lots will be located in the easterly parcel. Other site improvements are expected to consist of WQMP facilities such as basins, improvements to West Domestic Avenue, 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 October 12, 2018 to observe the current surface conditions at subject site. The two project sites are accessed by either West Domestic Avenue, an unimproved dirt drive along the south, or by a dirt path along the northern boundary. Highway 215 is located just to the west and a drainage channel is located between the highway right-of-way and a natural descending slope at the project's westernmost boundary. A small drainage ditch is also located in the very northwest corner of the site. A high school campus is located further to the south of Domestic Avenue.

The subject site is essentially covered by an active or recently abandoned citrus grove that include related improvements such as irrigation or water lines and windmill-type structures. It is possible that a well supporting the grove is located within the site although not observed. The parcel in between the two sites is in a similar condition as well as the property to the north and east. Several dirt paths extend thru the grove. A mature stand of trees is located within the drainage in the northwest as well as along the descending natural slope of the western boundary. The natural descending slope at the westerly site boundary appears to be heavily eroded in some areas.

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 21.5 to 51.5 feet bgs; and five CPT tests (CPT-1 through CPT-5) to depths ranging from 53 to 65 bgs. The following presents the results of subsurface and laboratory investigations.

Hollow Stem Auger Borings

Based on our six borings, the surface of the site is generally underlain by a thin veneer of very loose topsoil on the order of 1 to 2 feet in depth. Below the surficial topsoil, native younger alluvial soil deposits were observed to the maximum depth explored of 51.5 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.

CPT Field Testing and Analysis

CPT's 1, 4 and 5 were advanced to the target depth of 65 feet and CPT's 2 and 3 encountered refusal at 53 to 61 feet likely on concentrated gravel layers. Based on the CPT field data, the site is generally underlain by sequences of thinly to thickly bedded deposits consisting predominantly of sand and silty sand with minor thin beds of sandy silt. Density appeared to be generally low in the upper 35 to 40 feet with greater density below. Analysis of the CPT results was performed using Cliq liquefaction analysis software by GeoLogismiki following the guidelines contained in Special Publication 117A published by the California Geological Survey (1997, Revised 2008).

The result of our analysis indicates that the site is not susceptible to seismically induced liquefaction settlements; however, is susceptible to seismically induced dry sand/dynamic settlements. Based on our analysis, total liquefaction induced and dry sand settlement can range from 4 to 6 inches at the locations studied with a differential settlement of 2 inches. This represents a relatively uniform settlement potential across the site (see Table 1 below). It should be noted that the following results are for "free field" condition and the effects of the proposed structures and improvements may impact the predicted results.

TABLE 1

Free Field Seismic Settlement

CPT Number	Unsaturated Sandy Soil Settlement, in.	Liquefaction Settlement, in.	Total Settlement, in.
CPT-1	5 ½ - 6	< ½	≤ 6
CPT-2	5 ½ - 6	< ½	≤ 6
CPT-3	3 ½ - 4	< ½	≤ 4
CPT-4	4 ½ - 5	< ½	≤ 5
CPT-5	4 ½ - 5	< ½	≤ 5

The calculated liquefaction settlement is based on the occurrence of the design earthquake when groundwater is at its assumed historic high elevation. Typical tolerable level of total seismic settlement adopted by local and state codes varies from 4 to 6 inches. As such, our analysis shows that the site settlement is acceptable for liquefaction and dry sand settlement. It should be pointed out that the potential for concurrence of historic high groundwater level and design earthquake is low to moderate. As stated in the next section, the return to historic high ground water appears to be unlikely. Therefore, the total liquefaction settlement is anticipated to be less than those provided in the above table.

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.

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 fill 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 2). Lab testing found site soils to have a negligible corrosion potential to concrete materials (soluble sulfate of 0.006 percent), very low exposure to chlorides (84 mg/L) and are considered moderately corrosive to buried metallic elements (soil pH of 7.0 and a minimum resistivity of 6,700 ohm-cm). Maximum dry density and optimum moisture content had a value of 124.0 pcf at 7.0 percent optimum moisture content. Collapse testing of the native alluvium soils 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 or CPT's to the maximum explored depth of approximately 65 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 2016 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 51.5 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 2016 California Building Code, however the 2019 CBC will take effect on January 1, 2020.

- Demolition, Clearing and Grubbing: All existing site improvements, underground utility lines and/or structures related to the former grove 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. All existing trees, including the root ball, other vegetation, miscellaneous debris, trash and/or other deleterious materials will also require clearing and hauling offsite.

- 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.

- Western Descending Slope: We are unsure if the proposed site grading will extend to the existing natural descending slope at the western boundary of the project site. The design/construction of any new slopes at or near the existing natural descending slope may require specialized grading recommendations. Supplemental investigation, analysis and recommendations may be needed depending on the grading concept along the western property boundary.

- 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 and onsite storm water infiltration systems may be effective for transmitting water into the subsurface. However, any proposed basins near the top of the existing descending slope at the western boundary should be preliminarily setback of 15 feet. 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.

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

Distribution: Addressee (electronic)
Mr. Aaron Talarico (electronic)

REFERENCES

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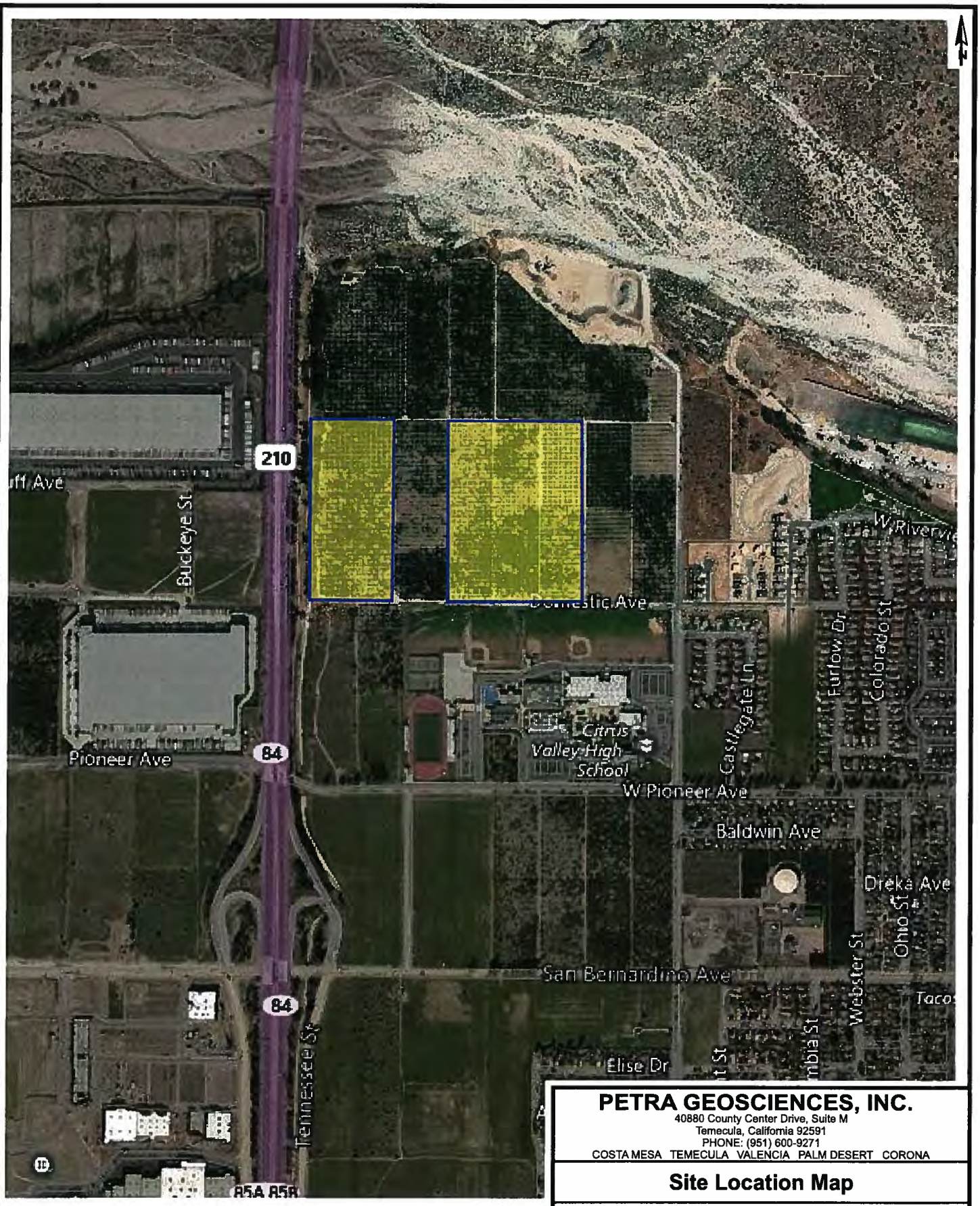

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COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

Site Location Map

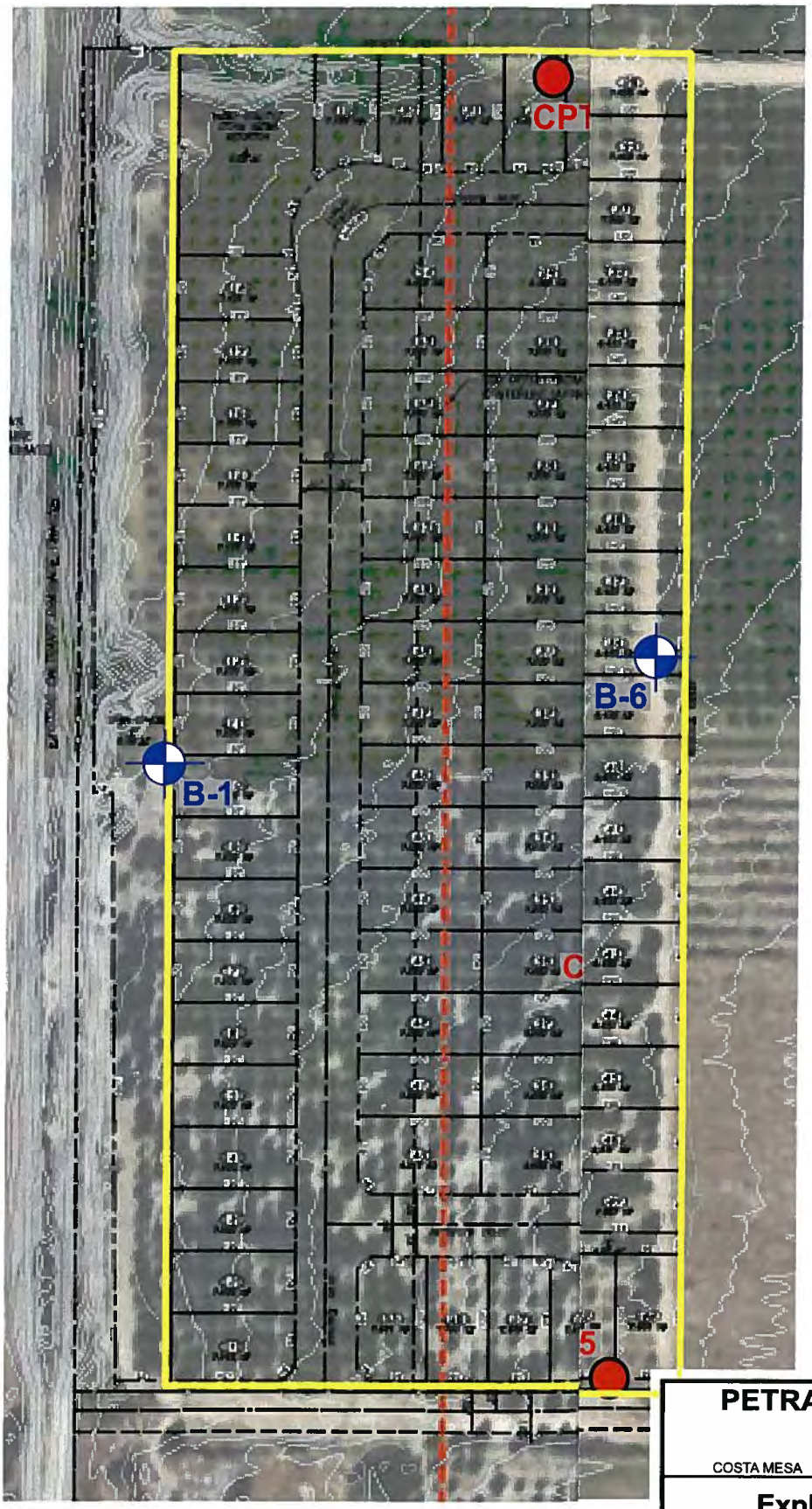
Redlands 46-acres Project
City of Redlands, California

PETRA GEOSCIENCES INC

DATE: March 2019
J.N.: 18-345

Figure 1

Reference: Bing Maps



Reference: Huitt-Zoliars, Inc., Conceptual Site Plan date

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Exploration Location Map

Redlands 46-acre Projecct
City of Redlands, California

PETRA GEOSCIENCES INC.

DATE: March 2019

J.N.: 18-345

Figure 2

APPENDIX A

BORING LOGS

Key to Soil and Bedrock Symbols and Terms

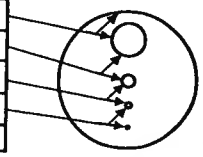
PETRA

Unified Soil Classification System

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

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



Laboratory Test Abbreviations

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

Modifiers

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

Sampler and Symbol Descriptions

- Approximate Depth of Seepage
- Approximate Depth of Standing Groundwater
- Modified California Split Spoon Sample
- Standard Penetration Test
- Bulk Sample
- Shelby Tube
- No Recovery in Sampler

Bedrock Hardness

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

Notes:

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

EXPLORATION LOG

Project:	**46± Acres**	Boring No.:	**B-1**
Location:	**City of Redlands**	Elevation:	**±1,265'**
Job No.:	**18-345**	Client: **MLC Holdings, Inc.**	Date: **10/12/18**
Drill Method:	**8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Gray to grayish-brown, dry, loose, very fine- to fine-grained.							
		ALLUVIUM (Qal) Sand (SP): Dark olive brown, dry, loose, fine- to coarse-grained sand, poorly graded.		2 3 5			3.3	103.3	MAX, EI, S04, pH, RES, CL
5		Same as above.		3 5 7			3.3	104.8	
		Gray, very dry, medium-dense, medium- to coarse-grained sand.		6 9 6			1.4	104.0	
		Sandy Silt (ML): Olive brown, slightly moist, medium-dense, fine-grained sand.		4 5 7			5.4	102.3	CON
10		Becomes gray.		5 7 10			10.1	100.7	#200
15		Sand (SP): Gray, moist, medium-dense, fine- to medium-grained, poorly graded.		7 12 20			5.2	106.3	
20		Silty Sand (SM): Dark gray, moist, medium-dense, fine-grained sand.		7 13 15			16.8	90.5	
25		Sand (SP): Olive brown, dry, medium-dense, fine- to coarse-grained sand.		8 15 25			4.8	107.4	
30		Becomes gray, medium- to coarse-grained and very dense.		11 24 37			4.3	94.9	

PLATE A-1

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**46± Acres**		Boring No.: **B-1**
Location:	**City of Redlands**		Elevation: **±1,265'**
Job No.:	**18-345**	Client: **MLC Holdings, Inc.**	Date: **10/12/18**
Drill Method:	**8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
35		Sand (SP): Brown, dry, medium-dense, fine- to coarse-grained sand, poorly graded.		13 16 17	■		4.6	111.9	
40		Silty Sand (SM): Olive brown, moist, very dense, fine-grained.		11 20 42	■		15.0	101.6	
45		Sand (SP): Olive brown, moist, very dense, fine- to medium-grained.		18 28 42	■		9.7	105.5	
50		Becomes gray with trace silt, very dense.		17 30 50	■		9.6	100.2	
		Total Depth= 51.5' No groundwater encountered Boring backfilled with cuttings and tamped.							
55									
60									
65									

PLATE A-1

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	46± Acres		Boring No.: B-2
Location:	City of Redlands		Elevation: ±1,274'
Job No.:	18-345	Client: MLC Holdings, Inc.	Date: 10/12/18
Drill Method:	8" Hollow Stem Auger	Driving Weight: 140lbs/30"	Logged By: KTM

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Gray, dry, loose, fine-grained sand.							
		ALLUVIUM (Qal) Sand (SP): Brown, moist, loose, fine-grained, poorly graded, with trace coarse-grained sand. Same as above.		3 3 5	■		6.2	99.5	
5		Silty Sand (SM): Dark gray, moist, loose, fine-grained.		3 5 7	■		7.1	97.3	
				4 5 6	■		7.1	100.3	CON
		Olive brown, moist, loose, fine-grained.		3 3 7	■		14.1	93.4	#200
10		Silt (ML): Olive brown, moist, soft to firm, 6" thick.							
		Silty Sand (SM): Olive brown, moist, medium-dense, fine-grained.							
15		Sand (SP): Gray, moist, medium-dense, fine-grained.		4 5 9	■		6.1	95.6	
20		Becomes fine- to coarse-grained.		6 8 10	■		5.9	96.8	
		Total Depth= 21.5' No groundwater encountered Boring backfilled with cuttings and tamped.							
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PLATE A-2

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	46± Acres		Boring No.: B-3
Location:	City of Redlands		Elevation: ±1,276'
Job No.:	18-345	Client: MLC Holdings, Inc.	Date: 10/12/18
Drill Method:	8" Hollow Stem Auger	Driving Weight: 140lbs/30"	Logged By: KTM

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Gray to brown, dry, loose, fine- to medium-grained.							
		ALLUVIUM (Qal) Sand (SP): Olive brown, dry, loose, fine- to medium-grained, poorly graded.		3 3 4	■		4.7	102.1	
		Same as above.		2 3 5	■		5.5	101.1	
5		Becomes gray, dry, and medium-dense.		5 11 12	■		3.0	99.2	
		Same as above, very dry.		7 7 7	■		1.9	97.3	
10		Silty Sand (SM): Olive brown, moist, loose, fine-grained.		3 4 6	■		11.8	97.2	CON, #200
15		Sand (SP): Gray, dry, medium-dense, medium-grained, poorly graded.		6 10 16	■		3.9	101.6	
20		Becomes dense and medium- to coarse-grained.		10 20 29	■		3.7	108.1	
		Total Depth= 21.5' No groundwater encountered Boringbackfilled with cuttings and tamped.							
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PLATE A-3

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**46± Acres**	Boring No.:	**B-4**
Location:	**City of Redlands**	Elevation:	**±1,281'**
Job No.:	**18-345**	Client: **MLC Holdings, Inc.**	Date: **10/12/18**
Drill Method:	**8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Gray, dry, loose, fine- to medium-grained sand.							
		ALLUVIUM (Qal) Sand (SP): Orangish-brown, dry, loose, fine- to coarse-grained. Same as above.		2 4 5	■		4.3	104.4	
5		Sand (SP): Gray, very dry, loose to medium-dense, fine- to coarse-grained.		4 7 10	■		2.2	107.6	CON
		Becomes medium-grained		7 11 11	■		1.8	101.2	
10		Olive brown, moist, medium-dense, fine- to medium-grained.		5 7 10	■		8.6	102.1	
15		Gray, dry, medium-dense, medium-grained, with trace gravel up to 2" in diameter.		11 16 20	■		3.1	103.0	
20		Silty Sand (SM): Olive brown, moist, medium-dense, fine-grained.		5 8 10	■		14.8	96.6	
25		Sand (SP): Gray, dry, medium-dense, medium-grained.		8 12 15	■		4.7	102.3	
30		Becomes slightly moist & fine-grained.		10 12 15	■		5.3	96.6	

PLATE A-4

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**46± Acres**	Boring No.:	**B-4**
Location:	**City of Redlands**	Elevation:	**±1,281'**
Job No.:	**18-345**	Client: **MLC Holdings, Inc.**	Date: **10/12/18**
Drill Method:	**8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
35		Becomes medium- to coarse-grained and dense, trace cobbles increased blow counts.		13 50	■		4.2	102.1	
40		Becomes fine- grained.		13 18 25	■		6.5	99.7	
45		Same as above except very dense with trace coarse-grained sand and trace gravel.		20 35 40	■		5.3	102.2	
50		Same as above except medium-grained with no gravel.		20 33 45	■		3.8	109.8	
		Total Depth= 51.5' No groundwater encountered Boring backfilled with cuttings and tamped.							
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PLATE A-4

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**46± Acres**		Boring No.: **B-5**
Location:	**City of Redlands**		Elevation: **±1,285'**
Job No.:	**18-345**	Client: **MLC Holdings, Inc.**	Date: **10/12/18**
Drill Method:	**8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Gray, dry, loose, fine- to medium-grained.							
		ALLUVIUM (Qal) Sand (SP): Brown, dry, loose, fine- to coarse-grained.		4 5 6	■		2.3	110.3	
		Same as above.		4 5 4	■		3.6	104.0	
5		Silty Sand (SM): Gray to brown, moist, medium-dense, fine-grained.		3 7 9	■		8.3	95.7	CON
		Sand (SP): Gray, slightly moist, medium-dense, fine-grained.		5 6 9	■		6.7	98.4	
		Olive brown, fine- to coarse-grained.		5 7 11	■		5.7	108.8	
10									
		Gray, dry, dense, medium- to coarse-grained.		13 20 25	■		3.4	107.8	
		Same as above with few cobbles encountered.							
		Same as above with no cobbles.							
15									
		Silty Sand (SM): Olive brown, moist, medium-dense, fine-grained.		6 10 13	■		9.3	97.4	
		Total Depth= 21.5' No groundwater encountered Boring backfilled with cuttings and tamped.							
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PLATE A-5

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**46± Acres**		Boring No.: **B-6**
Location:	**City of Redlands**		Elevation: **±1,289'**
Job No.:	**18-345**	Client: **MLC Holdings, Inc.**	Date: **10/12/18**
Drill Method:	**8" Hollow Stem Auger**	Driving Weight: **140lbs/30"**	Logged By: **KTM**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**TOPSOIL** Silty Sand (SM): Brown, dry, loose, fine-grained.							
		ALLUVIUM (Qal) Sand (SP): Brown, dry, loose, fine- to coarse-grained.		3 4 5			5.5	106.1	MAX
5		Becomes gray, dry, medium-dense.		4 7 12			3.3	99.9	CON
		Becomes very dry, medium-grained.		8 18 20			2.6	93.9	
10		Sand (SP): Olive brown, dry, medium-dense, fine-grained.		3 5 8			4.0	110.9	
15		Sand (SP): Gray, dry, medium-dense, medium-grained.		10 16 21			4.6	104.4	
20		Becomes dense & medium- to coarse-grained.		10 20 30			5.4	110.4	
		Total Depth= 21.5' No groundwater encountered Boring backfilled with cuttings and tamped.							
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PLATE A-6

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	7.0	124.0
B-6 @ 0-5	Silty Sand	7.0	124.0

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	2	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	0.0006	84	7.0	6,700	Concrete: Negligible Steel: Moderate

Per California Test Method CTM 417, 422, 643

Collapse Potential

Boring/Depth (feet)	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	Collapse (%)
B-1 @ 8	102.3	5.4	0.20
B-2 @ 7	100.3	7.1	0.43
B-3 @ 10	97.2	11.8	0.15
B-4 @ 5	107.6	2.2	0.05
B-5 @ 6	95.7	8.3	0.16
B-6 @ 5	99.9	3.3	0.17

Per ASTM Test Method D 5333

No. 200 Wash

Boring/Depth (feet)	Percent Passing (%)
B-1 @ 10	59
B-2 @ 9	39
B-3 @ 10	45

Per California Test Method 202