GEOTECHNICAL INVESTIGATION REPORT
PROPOSED RESIDENTIAL DEVELOPMENT
1075 WEST FOOTHILL BOULEVARD

Rialto, California

Prepared for:
KEYSTONE DCS

Prepared by:
GEOBODEN INC.
Irvine, CA 92620

April 24, 2020

Project No. Rialto-1-01

GEOBODEN INC.

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1075 WEST FOOTHILL BOULEVARD
RIALTO, CALIFORNIA

KEYSTONE DCS

Prepared by:

GEOBODEN INC.
5 Hodgenville
Irvine, California 92620

April 24, 2020

J.N. Rialto-1-01

GEOBODEN, INC.
Geotechnical Consultants

April 24, 2020 Project No. Rialto-1-01

Attention: Keystone DCS

Subject: Geotechnical Investigation Report
Proposed Residential Development
1075 West Foothill Boulevard
Rialto, California

Geoboden, Inc. is pleased to submit herewith our geotechnical investigation report for the proposed Residential Development located at 1075 West Foothill Boulevard in the City of Rialto, California.

This report presents the results of our field investigation, laboratory testing and our engineering judgment, opinions, conclusions and recommendations pertaining to geotechnical design aspects of the proposed site development.

It has been a pleasure to be of service to you on this project. Should you have any questions regarding the contents of this report, or should you require additional information, please do not hesitate to contact us.

Respectfully submitted,
GEOBODEN, INC.

REGISTERED PROFESSIONAL ENGINEER
SHAHROKH E. RADVAR
2742
GEOTECHNICAL
STATE OF CALIFORNIA

Cyrus Radvar, G.E.#2742
Principal Engineer

Copies: 4/Addressee

5 Hodgenville | Irvine, CA 92620 | Off 949-872-9565 | Fax 949-743-2935

GEOTECHNICAL INVESTIGATION REPORT

PROPOSED RESIDENTIAL DEVELOPMENT
1075 West Foothill Boulevard
RIALTO, CALIFORNIA

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1075 WEST FOOTHILL BOULEVARD
Rialto, California

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation performed by Geoboden, Inc. (Geoboden) for the proposed Residential Development located at 1075 West Foothill Boulevard in the City of Rialto, California. The general location of the project is shown on Figure 1.

The purposes of this investigation were to determine the geotechnical properties of subsurface soil conditions, to evaluate their in-place characteristics, evaluate site seismicity, and to provide geotechnical recommendations with respect to site grading and for design and construction of building foundations and other site improvements.

The scope of the authorized investigation included performing a site reconnaissance, conducting field exploration and laboratory testing programs, performing engineering analyses, and preparing this Geotechnical Investigation Report. Evaluation of environmental issues or the potential presence of hazardous materials was not within the scope of services provided.

This report has been prepared for Keystone Contractor and their other project team members, to be used solely in the site development of facility described herein. This report may not contain sufficient information for other uses or the purposes of other parties.

2.0 SITE AND PROPOSED DESCRIPTION

The subject property is located at 1075 West Foothill Boulevard in the City of Rialto, California. At the time of our field exploration, the subject property was vacant.

Based on our review of the Conceptual Site Plan, Figure 2, the project will include Residential Development, and other associated site improvements. Other associated site improvements within the site will include surface parking, and various underground utilities.

It is also our understanding that the proposed buildings will be of wood-frame structures with the slabs-on-grade floor. No basements are planned for the buildings.

3.0 GEOTECHNICAL INVESTIGATION

Our geotechnical investigation included a field exploration program and a laboratory testing programs. The field exploration and laboratory testing programs are briefly described below. A more detailed description of the field exploration and laboratory testing programs are provided in Appendix A and B, respectively.

3.1 FIELD EXPLORATION PROGRAM

A total of seven (7) exploratory borings were drilled using a truck-mounted drilling rig equipped with 8-inch diameter hollow stem augers. The borings were advanced to depths 11.5 to 21.5 feet (below ground surface). The approximate locations of the borings within the area of the proposed construction are shown on Figure 2.

Logs of subsurface conditions encountered in the borings were prepared in the field by the undersigned geotechnical engineer. Soil samples consisting of relatively undisturbed brass ring samples and Standard Penetration Tests (SPT) samples were collected at approximately 2 to 5-foot depth intervals and were returned to the laboratory for testing. One bulk sample was collected at depths of 1 to 5 feet below ground surface (bgs). The SPTs were performed in accordance with ASTM D 1586. Final boring logs were prepared from the field logs and are presented in Appendix A.

3.2 LABORATORY TESTING

Selected samples collected during drilling activities were sent to the laboratory to assist in evaluating controlling engineering properties of subsurface materials at the site. Physical tests performed included moisture and density determination, Atterberg, No. 200 Wash sieve, expansion, direct shear, consolidation, and chemical analyses. Chemical analysis included pH, soluble sulfates and soluble chlorides. Copies of the laboratory testing results are presented in Appendix B.

4.0 DISCUSSION OF FINDINGS

The following discussion of findings for the site is based on the results of the field exploration and laboratory testing programs.

4.1 SITE AND SUBSURFACE CONDITIONS

Generally, the subsurface conditions encountered in the seven borings consisted of silty sand, sandy silt and poorly graded sand with silt and gravel to the depths of 21.5 feet bgs.

The near surface soils consisted of silty sand and sandy silt. Based on sampler blowcounts, the near surface soils were found to be medium dense. Deeper granular soil layers were found to be very dense in relative density. Within our borings, fine to coarse gravel were encountered throughout the borings. For more detailed descriptions of the subsurface materials refer to the boring logs in Appendix A.

4.2 GROUNDWATER CONDITIONS

Groundwater was not encountered within our exploratory borings to the maximum depth of exploration (21.5 feet below ground surface). Groundwater is expected to be present at depths as shallow as 50 feet or greater below the ground surface.

Fluctuations of the groundwater table, localized zones of perched water, and rise in soil moisture content should be anticipated during the rainy season. Irrigation of landscaped areas can also lead to an increase in soil moisture content and fluctuations of intermittent shallow perched groundwater levels.

4.3 SOIL ENGINEERING PROPERTIES

Physical tests were performed on the relatively undisturbed samples to characterize the engineering properties of the native soils. Moisture content and dry unit weight determinations were performed on the samples to evaluate the in-situ unit weights of the different materials. Moisture content and dry unit weight results are shown on the boring logs in Appendix A.

4.4 CONSOLIDATION CHARACTERISTICS

Consolidation test was performed on sample of the existing native overburden soils recovered from the boring. Results of the consolidation test indicate that the overburden material will have low compressibility under the anticipated loads. These characteristics are compatible with the allowable bearing capacity values and corresponding settlement estimates presented in section 7.5 (Foundations).

4.5 COLLAPSE POTENTIALS

Results of consolidation test on a sample of native soil indicate that the native soil will have low collapse potential. The potential for hydro-collapse, in general, decreases with depth for the site materials. Removal and recompaction of the surficial soils is expected to reduce the anticipated amount of total differential settlement within the site.

4.6 EXPANSION POTENTIAL

Preliminary laboratory testing of representative sample of onsite soils indicate that these materials exhibit LOW expansion potentials.

5.0 STRONG GROUND MOTION POTENTIAL

The project site is located in a seismically active area typical of Southern California and likely to be subjected to a strong ground shaking due to earthquakes on nearby faults.

5.1 CBC DESIGN PARAMETERS

To accommodate effects of ground shaking produced by regional seismic events, seismic design can, at the discretion of the designing Structural Engineer, be performed in accordance with the 2019 edition of the California Building Code (CBC). Table below, 2019 CBC Seismic Parameters, lists (next) seismic design parameters based on the 2019 CBC methodology, which is based on ASCE/SEI 7-16:

2019 CBC Seismic Design Parameters	Value
Site Latitude (decimal degrees)	34.1062
Site Longitude (decimal degrees)	-117.3906
Site Class Definition (ASCE 7 Table 20.3-1)	D
Mapped Spectral Response Acceleration at 0.2s Period, S_s (Figure 1613.3.1(1))	1.904
Mapped Spectral Response Acceleration at 1s Period, S_1 (Figure 1613.3.1(2))	0.75
Short Period Site Coefficient at 0.2s Period, F_a (Table 1613.3.3(1))	1.2
Long Period Site Coefficient at 1s Period, F_v (Table 1613.3.3(2))	1.7
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS} (Eq. 16-37)	2.285
Adjusted Spectral Response Acceleration at 1s Period, S_{M1} (Eq. 16-38)	1.275
Design Spectral Response Acceleration at 0.2s Period, S_{DS} (Eq. 16-39)	1.523
Design Spectral Response Acceleration at 1s Period, S_{D1} (Eq. 16-40)	0.85

6.0 LIQUEFACTION POTENTIAL

For liquefaction to occur, all of seven key ingredients are required: liquefaction-susceptible soils, groundwater within a depth of 50 feet or less, and strong earthquake shaking. Soils susceptible to liquefaction are generally saturated loose to medium dense sands and non-plastic silt deposits below the water table.

The site is not located within a liquefaction hazard zone. Groundwater was not encountered within our exploratory borings to the maximum depth of exploration (21.5 feet below ground surface). High historic groundwater is anticipated to be deeper than 50 feet bgs. The onsite soils are dense to very dense and would not likely liquefy under earthquake loading.

6.1 LIQUEFACTION ASSOCIATED HAZARDS

Potential hazards associated with liquefaction include global landsliding, (lateral spreading and flow slides), foundation bearing failure, and ground surface settlement. Considering the upper 50 feet of the onsite soils are not likely to liquefy, these hazards are not considered to be design factors for this project.

7.0 DESIGN RECOMMENDATIONS

Based upon the results of our investigation, the proposed site development are considered geotechnically feasible provided the recommendations presented herein are incorporated into the design and construction. If changes in the design of the structures are made or variations or changed conditions are encountered during construction, Geoboden should be contacted to evaluate their effects on these recommendations. The following geotechnical engineering recommendations for the proposed building are based on observations from the field investigation program and the physical test results.

7.1 EARTHWORK

All earthworks, including excavation, backfill and preparation of subgrade, should be performed in accordance with the geotechnical recommendations presented in this report and applicable portions of the grading code of local regulatory agencies. All earthwork should be performed under the observation and testing of a qualified geotechnical engineer.

7.2 SITE AND FOUNDATION PREPARATION

The construction area should be cleared of any vegetation and stripped of miscellaneous debris and other deleterious material. Organic matter and all other material that may interfere with the completion of the work should be removed from the limits of the construction area. Vegetation, construction debris, and organic matter should not be incorporated into engineered fill.

All existing low-density, near-surface soils will require removal to competent material from areas to receive newly compacted fill. The basis for establishing a competent exposed surface on which to place fill should consist of competent materials exhibiting an in-place relative compaction of at least 85 percent. Prior to placing structural fill, exposed bottom surfaces in each removal area approved for fill should first be scarified to a depth of at least 6 inches, water or air dried as necessary to achieve near optimum moisture conditions, and then recompacted in place to a minimum relative compaction of 90 percent. For construction of the new buildings, the upper 3 feet of existing grades should be removed and recompacted. For pavement areas, we recommend that the upper 18 inches of the existing subgrade be removed and replaced with properly compacted fill.

7.3 FILL PLACEMENT AND COMPACTION REQUIREMENTS

Material for engineered fill should be select free of organic material, debris, and other deleterious substances, and should not contain fragments greater than 3 inches in maximum dimension. On-site excavated soils that meet these requirements may be used to backfill the excavated building pad area.

All fill should be placed in 6-inch-thick maximum lifts, watered or air dried as necessary to achieve near optimum moisture conditions, and then compacted in place to a maximum relative compaction of 90 percent. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with Test Method ASTM D 1557. A representative of the project consultant should be present on-site during grading operations to verify proper placement and compaction of all fill, as well as to verify compliance with the other geotechnical recommendations presented herein.

7.4 IMPORTED SOILS

If imported soils are required to complete the planned grading, these soils should consist of clean materials devoid of rock exceeding a maximum dimension of 8 inches, as well as organics, trash and similar deleterious materials. Imported soils should also exhibit an expansion potential no greater than LOW, as classified in accordance with UBC Table 18-I-B. Prospective import soils should be observed, tested and approved by this firm prior to importing the soils to the site.

7.5 SHALLOW FOUNDATIONS

Following the site and foundation preparation recommended above, foundation for load bearing walls and interior columns may be designed as discussed below.

7.5.1 Bearing Capacity and Settlement

Load bearing walls and interior columns may be supported on continuous spread footings and isolated spread footings, respectively, and should bear entirely upon properly engineered fill. Continuous and isolated footings should have a minimum width of 14 inches and 24 inches, respectively. All footings should be embedded a minimum depth of 18 inches measured from the lowest adjacent finish grade. Continuous and isolated footings placed on such materials may be designed using an allowable (net) bearing capacity of 2,000 pounds per square foot (psf). Allowable increases of 250 psf for each additional 1 foot in width and 250 psf for each additional 6 inches in depth may be utilized, if desired. The maximum allowable bearing pressure should be 3,000 psf. The maximum bearing value applies to combined dead and sustained live loads. The allowable bearing pressure may be increased by one-third when considering transient live loads, including seismic and wind forces.

Based on the allowable bearing value recommended above, total settlement of the shallow footings are anticipated to be less than one inch, provided foundation preparations conform to the recommendations described in this report. Differential settlement is anticipated to be approximately half the total settlement for similarly loaded footings spaced up to approximately 30 feet apart.

7.5.2 Lateral Load Resistance

Lateral load resistance for the spread footings will be developed by passive soil pressure against sides of footings below grade and by friction acting at the base of the concrete footings bearing on compacted fill. An allowable passive pressure of 250 psf per foot of depth may be used for design purposes. An allowable coefficient of friction 0.30 may be used for dead and sustained live load forces to compute the frictional resistance of the footings constructed directly on compacted fill. Safety factors of 2.0 and 1.5 have been incorporated in site improvements of allowable passive and frictional resistance values, respectively. Under seismic and wind loading conditions, the passive pressure and frictional resistance may be increased by one-third.

7.5.3 Footing Reinforcement

Reinforcement for footings should be designed by the structural engineer based on the anticipated loading conditions. Footings for lightly loaded wood-frame structures that are supported in low expansive soils should have No. 4 bars, two top and two bottom.

7.6 CONCRETE SLAB ON-GRADE

Concrete slabs will be placed on properly compacted fill as outlined in Section 7.2. Moisture content of subgrade soils should be maintained near the optimum moisture content. At the time of the concrete pour, subgrade soils should be firm and relatively unyielding. Any disturbed soils should be excavated and then replaced and compacted to a minimum of 90 percent relative compaction.

Slabs should be designed to accommodate very low to low expansive fill soils. The structural engineer should determine the minimum slab thickness and reinforcing depending upon the expansive soil condition intended use. Unless a more stringent design is recommended by the structural engineer, we recommend a minimum slab thickness of 4 inches, and reinforcement consisting of No. 3 bars spaced a maximum of 18 inches on centers, both ways. All slab reinforcement should be supported on concrete chairs or brick to ensure the desired placement near mid depth.

If moisture-sensitive floor covering is planned, a layer of open-graded gravel, at least 4 inches thick, should be placed below the concrete slab to form a capillary break. Alternately, moisture-proof membrane (such as 10-mil) may be utilized. The vapor barrier should be placed between sand layers (2 inches above and below) to protect the membrane from damage during construction. Gravel for use under a concrete floor slab should be clean, crushed rock that meets the gradation requirements presented below.

Sieve Size	Percentage
1 inch	100
¾ inch	90-100
No. 4	0-10

7.7 PRELIMINARY PAVEMENT DESIGN

Pavement design should be confirmed at the completion of site grading when the subgrade soils are in-place. This should include sampling and R-Value testing of the actual subgrade soils and an analysis based upon the anticipated traffic loading.

For a preliminary pavement design, recommendations for pavement design section of asphalt parking areas are provided below. These values are based on an assumed R-value of 40.

For pavement design, Traffic indexes (TI) of 4.0 and 5.5 were used for the parking areas and auto driveways, respectively. The preliminary flexible pavement layer thickness is as follows:

RECOMMMENDED ASPHALT PAVEMENT SECTION LAYER THICKNESS

Pavement Material	Recommended Thickness	
	TI = 4.0	**TI = 5.5**
Asphalt Concrete Surface Course	3 inches	4 inches
Class II Aggregate Base Course	4 inches	6 inches
Compacted Subgrade Soils	12 inches	12 inches

Asphalt concrete should conform to Sections 203 and 302 of the latest edition of the Standard Specifications for Public Works Construction ("Greenbook").

Class II aggregate base should conform to Section 26 of the Caltrans Standard Specifications, latest edition. The aggregate base course should be compacted to at least 95 percent of the maximum dry density as determined by ASTM Method D 1557.

Portland cement concrete paving sections were determined in accordance with procedures developed by the Portland Cement Association. Concrete paving sections for three Traffic Indices are presented below. We have assumed that the portland cement concrete will have a compressive strength of at least 3,000 pounds per square inch.

Assumed Traffic Index	Asphaltic Paving (Inches)	Base Course (Inches)
4½ (Automobile Parking)	6	4
5½ (Driveways and Light Track Traffic)	6½	4
6½ (Roadways and Heavy Truck Traffic)	7	4

7.8 SOLUBLE SULFATES AND SOIL CORROSIVITY

Concrete subject to exposure to sulfates shall comply with the requirements set forth in ACI 318, Section 4.3. Based on the available water-soluble sulfate results the corrosion potential to buried concrete should be considered "low", i.e., exposure Class S_0, per ACI 318, Table 4.2.1. Consequently, injurious sulfate attack is not a concern with a minimum 28-day compressive strength of 2,500 psi.

Concrete reinforcement should be protected from corrosion and exposure to chlorides in accordance with ACI 318, Section 4.4.

The corrosion potential of the on-site materials to buried steel was evaluated in accordance with Caltrans corrosive environment evaluation criteria. Caltrans considers a site corrosive, if at least one of the following conditions exists:

- Chloride content ≥ 500 ppm;
- Soluble sulphate content ≥ 2,000 ppm;
- pH ≤ 5.5.

Observations and laboratory tests indicate that based on the Caltrans' criteria the soils at the site are considered non-corrosive. If additional recommendations are desired, it is recommended that a corrosion specialist be consulted regarding suitable types of piping and necessary protection for underground metal conduits.

7.9 UTILITY TRENCH BACKFIL

All utility trench backfill should be compacted to a minimum relative compaction of 90 percent. Trench backfill materials should be placed in lifts no greater than approximately 6 inches in thickness, watered or air-dried as necessary to achieve near optimum moisture conditions, and then mechanically compacted in place to a minimum relative compaction of 90 percent. A representative of the project geotechnical consultant should probe and test the backfills to verify adequate compaction.

As an alternative for shallow trenches where pipe or utility lines may be damaged by mechanical compaction equipment, such as under building floor slabs, imported clean sand exhibiting a sand equivalent (SE) value of 30 or greater may be utilized. The sand backfill materials should be watered to achieve near optimum moisture conditions and then tamped into place. No specific relative compaction will be required; however, observation, probing, and if deemed necessary, testing should be performed by a representative of the project geotechnical consultant to verify an adequate degree of compaction and that the backfill will not be subject to settlement.

Where utility trenches enter the footprints of the building, they should be backfilled through their entire depths with on-site fill materials, sand-cement slurry, or concrete rather than with any sand or gravel shading. This "Plug" of less- or non-permeable materials will mitigate the potential for water to migrate through the backfilled trenches from outside of the building to the areas beneath the foundations and floor slabs.

8.0 CONSTRUCTION CONSIDERATIONS

Based on our field exploration program, earthwork can be performed with conventional construction equipment.

8.1 TEMPORARY DEWATERING

Groundwater was not encountered within our exploratory borings. Based on the anticipated excavation depths, it is unlikely that dewatering will be required during construction.

8.2 CONSTRUCTION SLOPES

An Excavation during construction should be conducted so that slope failure and excessive ground movement will not occur. The short-term stability of excavation depends on many factors, including slope angle, engineering characteristics of the subsoils, height of the excavation and length of time the excavation remains unsupported and exposed to equipment vibrations, rainfall and desiccation.

Where space permits, and providing that adjacent facilities are adequately supported, open excavations may be considered. In general, unsupported slopes for temporary construction excavations should not be expected to stand at an inclination steeper than 1:1 (horizontal:vertical). The temporary excavation side walls may be cut vertically to a height of 3 feet and then laid back at a 1:1 slope ratio above a height of 3 feet.

Surcharge loads should be kept away from the top of temporary excavations a horizontal distance equal to at least one-half the depth of excavation. Surface drainage should be controlled along the top of temporary excavations to preclude wetting of the soils and erosion of the excavation faces. Even with the implementation of the above recommendations, sloughing of the surface of the temporary excavations may still occur, and workmen should be adequately protected from such sloughing.

Special care should be exercised when excavating adjacent to the property boundaries. Excavation along the property boundaries should be performed in a repeating "ABC" sequence to prevent exposing significant lengths of the existing building foundation at any one time. First, all the slots designated as "A" should be excavated, backfilled and recompacted. The procedure should continue with the "B" slots and end with the "C" slots. The width of each slot should not exceed 5 feet. If any evidence of potential instability is observed, revised recommendations such as narrower slot cuts may be necessary. All slot excavation and backfilling procedures should be performed under the observation and testing of a qualified geotechnical engineer.

8.3 POST INVESTIGATION SERVICES

Final project plans and specifications should be reviewed prior to construction to confirm that the full intent of the recommendations presented herein have been applied to design and construction. Following review of plans and specifications, observation should be performed by the geotechnical engineer during construction to document that foundation elements are founded on/or penetrate onto the recommended soils, and that suitable backfill soils are placed upon competent materials and properly compacted at the recommended moisture content.

9.0 CLOSURE

The conclusions, recommendations, and opinions presented herein are: (1) based upon our evaluation and interpretation of the limited data obtained from our field and laboratory programs; (2) based upon an interpolation of soil conditions between and beyond the borings; (3) are subject to confirmation of the actual conditions encountered during construction; and, (4) are based upon the assumption that sufficient observation and testing will be provided during construction.

If parties other than Geoboden are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or providing alternate recommendations.

If pertinent changes are made in the project plans or conditions are encountered during construction that appear to be different than indicated by this report, please contact this office.

Significant variations may necessitate a re-evaluation of the recommendations presented in this report.

10.0 REFERENCES

2019 California Building Code, Volume 2.

FIGURES

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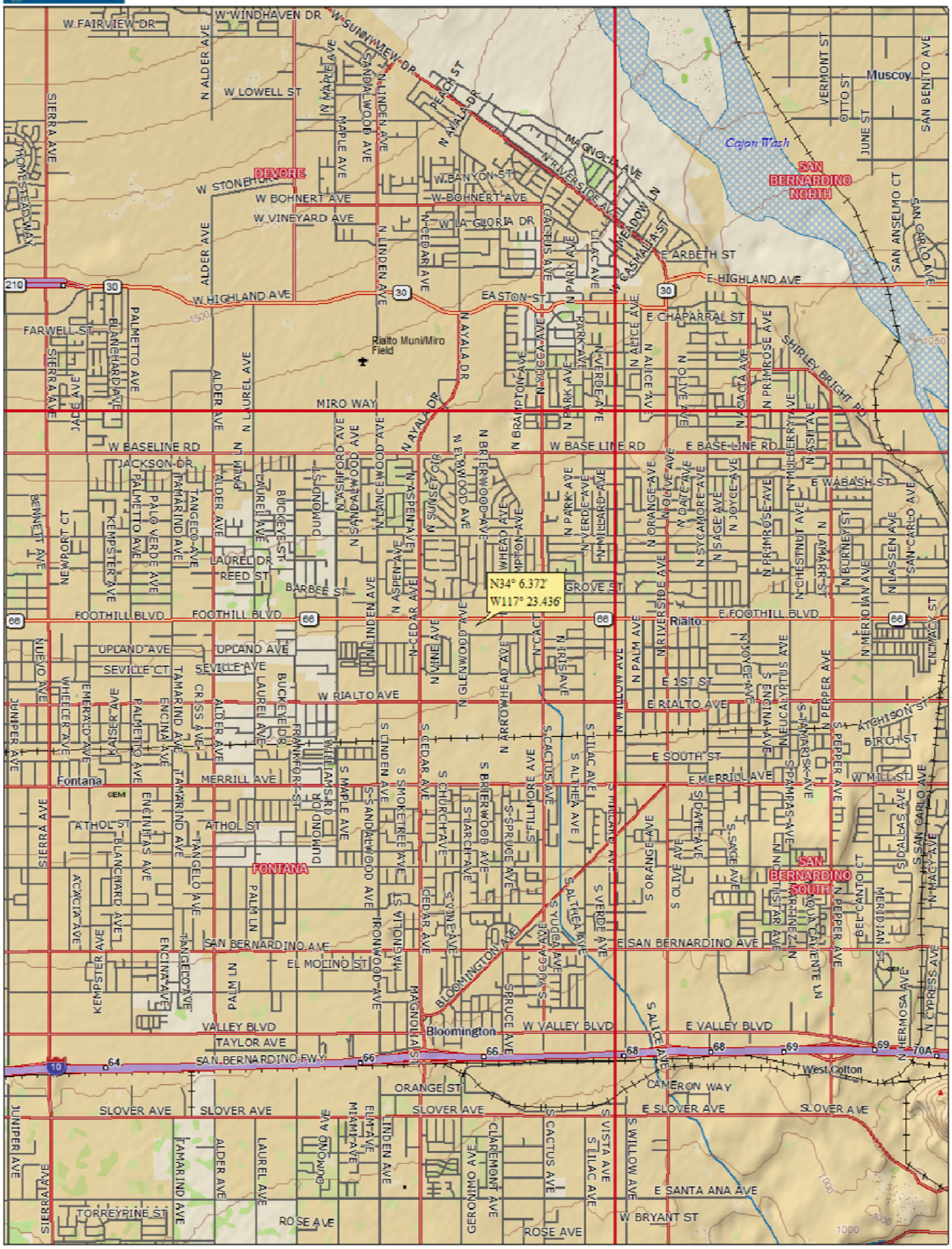

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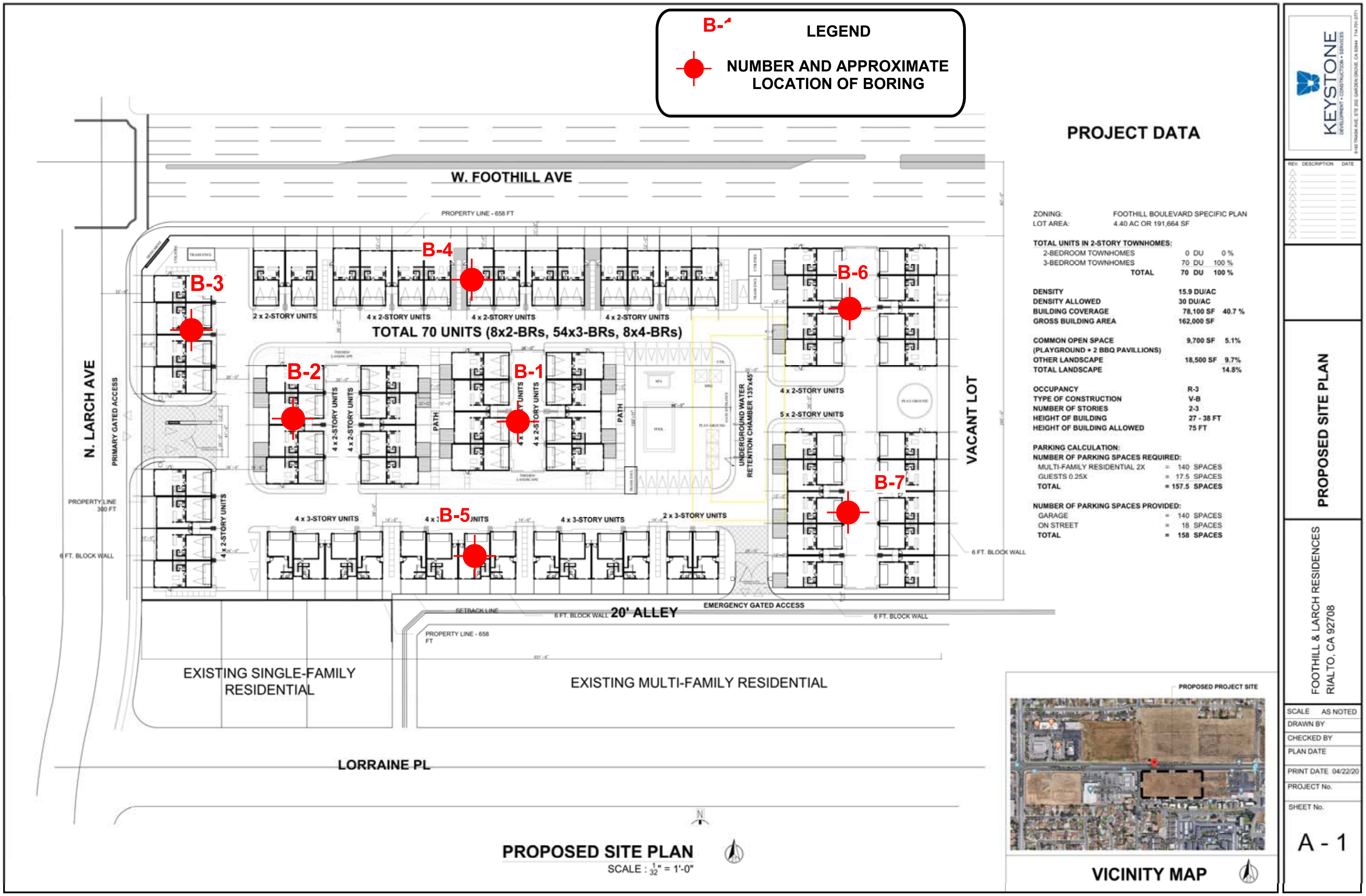
GEOBODEN INC.	**SITE VICINITY MAP** **Proposed Residential Development** **1075 West Foothill Boulevard** **Rialto, California**	Figure By S.R.	Project No. Rialto-1-01
		Map No. XX	Figure No. 1
		Date 04-24-20	



GEOBODEN INC.

BORING LOCATION MAP
Proposed Residential Development
1075 West Foothill Boulevard
Rialto, California

Figure By S.R.	Project No. Rialto-1-01
Map No. XX	Figure No. 2
Date 04-24-20	

APPENDIX A
SUBSURFACE
EXPLORATION PROGRAM

APPENDIX A
SUBSURFACE EXPLORATION PROGRAM

PROPOSED RESIDENTIAL DEVELOPMENT
1075 West Foothill Boulevard
RIALTO, CALIFORNIA

Prior to drilling, the proposed borings were located in the field by measuring from existing site features.

A total of 7 exploratory borings (B-1 through B-7) were drilled using a CME-75 drill rig equipped with 8-inch outside diameter (O.D.) hollow-stem augers. The approximate locations of borings are shown on Figure 2.

Depth-discrete soil samples were collected at selected intervals from the exploratory borings using a 2 ½ -inch inside diameter (I.D.) modified California Split-barrel sampler fitted with 12 brass ring of 2 ½ inches in O.D. and 1-inch in height and one brass liner (2 ½ -inch O.D. by 6 inches long) above the brass rings. The sampler was lowered to the bottom of the boreholes and driven 18 inches into the soil with a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the lower 12 inches is shown on the blow count column of the boring logs.

After removing the sampler from the boreholes, the sampler was opened and the brass rings and liner containing the soil were removed and observed for soil classification. Brass rings containing the soil were sealed in plastic canisters to preserve the natural moisture content of the soil. One bulk sample of near surface soil was collected from selected exploratory borings and placed in plastic bags. Soil samples and bulk sample collected from exploratory borings were labeled, and submitted to the Cal Land Engineering laboratory for physical testing.

Standard Penetration Tests (SPTs) were also performed at selected depths. The SPT consists of driving a standard sampler, as described in the ASTM 1586 Standard Method, using a 140-pound hammer falling 30 inches. The number of blows required to drive the SPT sampler the lower 12 inches of the sampling interval is recorded on the blow count column of the boring logs.

The field staff recorded and logged the soil classifications and descriptions on field logs using the Unified Soil Classification System as described by the American Society for Testing and

Materials (ASTM) D 2488-90, “Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).” The final boring logs were prepared from the field logs and are presented in this Appendix.

The exploratory borings were backfilled with drilled cuttings after drilling and sampling.

GEOBODEN, INC.

CLIENT Keystone
PROJECT NAME Proposed Residential Development
PROJECT NUMBER Rialto-1-01
PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA
DATE STARTED 4/20/20 **COMPLETED** 4/20/20
GROUND ELEVATION **HOLE SIZE** 8"
DRILLING CONTRACTOR Geoboden, Inc
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY S.R. **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		SILTY SAND (SM): olive brown, moist, ~60% fine sand, ~40% fines										
5			MC R-1		20		109	8				
		SAND w. SILT & GRAVEL (SP-SM): olive gray, moist, ~30% fine gravel, ~10% fines, ~60% sand										
10			MC R-2		62		121	6				
		SILTY SAND (SM): olive brown, moist, ~30 fines, ~70% fine sand										
15			SS S-3		16							
20		~10% fine gravel	SS S-4		29							

Bottom of borehole at 21.5 feet below ground surface. No groundwater was encountered. Boring was backfilled with cuttings.
Bottom of borehole at 21.5 feet.

GEOBODEN, INC.

BORING NUMBER B-2

CLIENT Keystone

PROJECT NAME Proposed Residential Development

PROJECT NUMBER Rialto-1-01

PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA

DATE STARTED 4/20/20 **COMPLETED** 4/20/20

GROUND ELEVATION **HOLE SIZE** 8"

DRILLING CONTRACTOR Geoboden, Inc

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

AT TIME OF DRILLING ---

LOGGED BY S.R. **CHECKED BY**

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		SANDY SILT (ML): olive brown, moist, ~30% fine sand, ~70% fines										
5			MC R-1		46		109	14	42	26	16	67
		POORLY-GRADED GRAVEL (GP): olive gray, dry, ~5% fines, ~95% gravel up to 2 inches										
10		SILTY SAND w. GRAVEL (SM): olive gray, moist, ~20% fine to coarse gravel, ~30 fines, ~50% sand	MC R-2		28							
15			MC R-3		65							
		SAND w. SILT (SP-SM): olive gray, moist, ~5% fine gravel, ~10% fines, ~85% sand										
20			SS S-4		50							

Bottom of borehole at 21.5 feet below ground surface. No groundwater was encountered. Boring was backfilled with cuttings.

Bottom of borehole at 21.5 feet.

GEOBODEN, INC.

BORING NUMBER B-3

CLIENT Keystone
PROJECT NAME Proposed Residential Development
PROJECT NUMBER Rialto-1-01
PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA
DATE STARTED 4/20/20 **COMPLETED** 4/20/20
GROUND ELEVATION **HOLE SIZE** 8"
DRILLING CONTRACTOR Geoboden, Inc
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY S.R. **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		SANDY SILT (ML): light olive, moist, ~30% fine sand, ~70% fines										
5		light olive brown	MC R-1		29		101	12	45	28	17	70
10			MC R-2		29							
		SAND w. SILT (SP-SM): olive gray, moist, ~5% fine to coarse gravel, ~10% fines, ~85% fine sand										
15			MC R-3		71							12
20			MC R-4		75							

Bottom of borehole at 21.5 feet below ground surface. No groundwater was encountered. Boring was backfilled with cuttings.
Bottom of borehole at 21.5 feet.

GEOBODEN, INC.

BORING NUMBER B-4

CLIENT Keystone

PROJECT NAME Proposed Residential Development

PROJECT NUMBER Rialto-1-01

PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA

DATE STARTED 4/20/20 **COMPLETED** 4/20/20

GROUND ELEVATION **HOLE SIZE** 8"

DRILLING CONTRACTOR Geoboden, Inc

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

AT TIME OF DRILLING ---

LOGGED BY S.R. **CHECKED BY**

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		SILTY SAND (SM): olive brown, moist, ~60% fine sand, ~40% fines										
5			MC R-1		21							36
		SILTY SAND w. GRAVEL (SM): olive gray, moist, ~20% fine to coarse gravel, ~30 fines, ~50% sand										
10			MC R-2		27							
		SAND w. SILT (SP-SM): olive gray, moist, ~5% fine gravel, ~10% fines, ~85% sand										
15			MC R-3		56							
20			MC R-4		67							

Bottom of borehole at 21.5 feet below ground surface. No groundwater was encountered. Boring was backfilled with cuttings

Bottom of borehole at 21.5 feet.

GEOBODEN, INC.

BORING NUMBER B-5

CLIENT Keystone
PROJECT NAME Proposed Residential Development
PROJECT NUMBER Rialto-1-01
PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA
DATE STARTED 4/20/20 **COMPLETED** 4/20/20
GROUND ELEVATION **HOLE SIZE** 8"
DRILLING CONTRACTOR Geoboden, Inc
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY S.R. **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		SANDY SILT (ML): light olive gray, moist, ~30% fine sand, ~70% fines										
5		light olive brown	MC R-1		23		104	16				
10			MC R-2		29							
		SILTY SAND (SM): olive brown, moist, ~30 fines, ~70% fine sand										
15			MC R-3		67							
		SAND w. SILT (SP-SM): olive gray, moist, ~5% fine to coarse gravel, ~10% fines, ~85% fine sand										
20			MC R-4		76							

Bottom of borehole at 21.5 feet below ground surface. No groundwater was encountered. Boring was backfilled with cuttings.
Bottom of borehole at 21.5 feet.

GEOBODEN, INC.

BORING NUMBER B-6

CLIENT Keystone
PROJECT NAME Proposed Residential Development
PROJECT NUMBER Rialto-1-01
PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA
DATE STARTED 4/20/20 **COMPLETED** 4/20/20
GROUND ELEVATION **HOLE SIZE** 8"
DRILLING CONTRACTOR Geoboden, Inc
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY S.R. **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0	SANDY SILT (ML): olive brown, moist, ~30% fine sand, ~70% fines										
	SILTY SAND w. GRAVEL (SM): olive gray, moist, ~20% fine to coarse gravel, ~30 fines, ~50% sand										
5		MC R-1		19		114	8				
	SAND w. SILT (SP-SM): olive grayish brown, moist, ~5% fine to coarse gravel, ~10% fines, ~85% fine sand										
10		MC R-2		21							

Bottom of borehole at 11.5 feet below ground surface. No groundwater was encountered. Boring was backfilled with cuttings.
Bottom of borehole at 11.5 feet.

GEOBODEN, INC.

BORING NUMBER B-7

CLIENT Keystone

PROJECT NAME Proposed Residential Development

PROJECT NUMBER Rialto-1-01

PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA

DATE STARTED 4/20/20 **COMPLETED** 4/20/20

GROUND ELEVATION **HOLE SIZE** 8"

DRILLING CONTRACTOR Geoboden, Inc

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger

AT TIME OF DRILLING ---

LOGGED BY S.R. **CHECKED BY**

AT END OF DRILLING ---

NOTES

AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0		SILTY SAND (SM): olive brown, moist, ~60% fine sand, ~40% fines										
5			MC R-1		28		106	9				
		SILTY SAND w. GRAVEL (SM): olive gray, moist, ~20% fine to coarse gravel, ~30 fines, ~50% sand										
10			MC R-2		34							

Bottom of borehole at 11.5 feet below ground surface. No groundwater was encountered. Boring was backfilled with cuttings.

Bottom of borehole at 11.5 feet.

APPENDIX B
LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

PROPOSED RESIDENTIAL DEVELOPMENT
1075 West Foothill Boulevard
RIALTO, CALIFORNIA

Laboratory tests were performed on selected samples to assess the engineering properties and physical characteristics of soils at the site. The following tests were performed:

- moisture content and dry density
- No. 200 Wash Sieve
- Atterberg
- consolidation
- expansion index
- corrosion potential

Test results are summarized on laboratory data sheets or presented in tabular form in this appendix.

Moisture Density Tests

The field moisture contents, as a percentage of the dry weight of the soils, were determined by weighing samples before and after oven drying. The dry density, in pounds per cubic foot, was also determined fir all relatively undisturbed ring samples collected. These analyses were performed in accordance with ASTM D 2937. The results of these determinations are shown on the boring logs in Appendix A.

No. 200 Wash Sieve

A quantitative determination of the percentage of soil finer than 0.075 mm was performed on selected soil samples by washing the soil through the No. 200 sieve. Test procedures were performed in accordance with ASTM Method D1140. The results of the tests are shown on the boring logs in Appendix A.

Atterberg Limits

Liquid limit, plastic limit, and plasticity index were determined for selected soil samples in accordance with ASTM D 4318. The soil sample was air-dried and passed through a No. 40 sieve and moisturized. The liquid and plastic limit tests were performed on the fraction passing the No. 40 sieve. Results of the Atterberg limits tests are shown graphically and presented in this Appendix.

Consolidation

The test was performed in accordance with ASTM Test method D-2345. The compression curve from the consolidation test is presented in this Appendix.

Direct Shear

Direct shear tests were performed on undisturbed samples of on-site soils. A different normal stress was applied vertically to each soil sample ring which was then sheared in a horizontal direction. The resulting shear strength for the corresponding normal stress was measured at a maximum constant rate of strain of 0.005 inches per minute. The direct shear results are shown graphically on a laboratory data sheet included in this appendix.

Expansion Potential

Expansion index test was performed on a representative bulk sample of the on-site soils in accordance with ASTM D4829. The result of expansion test is summarized in Table B-1.

TABLE B-1 (Expansion Index Test Data)

Boring Designation	**Depth (ft)**	Expansion Index (EI)
B-1	0-5	23

Corrosion

The test was performed on selected soil sample in the near surface to determine the corrosivity of the site soil to steel and concrete. The soil samples were tested for soluble sulfate (Caltrans 417), soluble chloride (Caltrans 422), and pH and minimum resistivity (Caltrans 643). The results of corrosion tests are summarized in Table B-2.

TABLE B-2 (Corrosion Test Results)

Boring No.	Depth (ft)	Chloride Content (Calif. 422) ppm	Sulfate Content (Calif. 417) % by Weight	pH (Calif. 643)	Resistivity (Calif. 643) Ohm*cm
B-1	0-5	79	0.0169	7.2	1,578

GEOBODEN, INC.

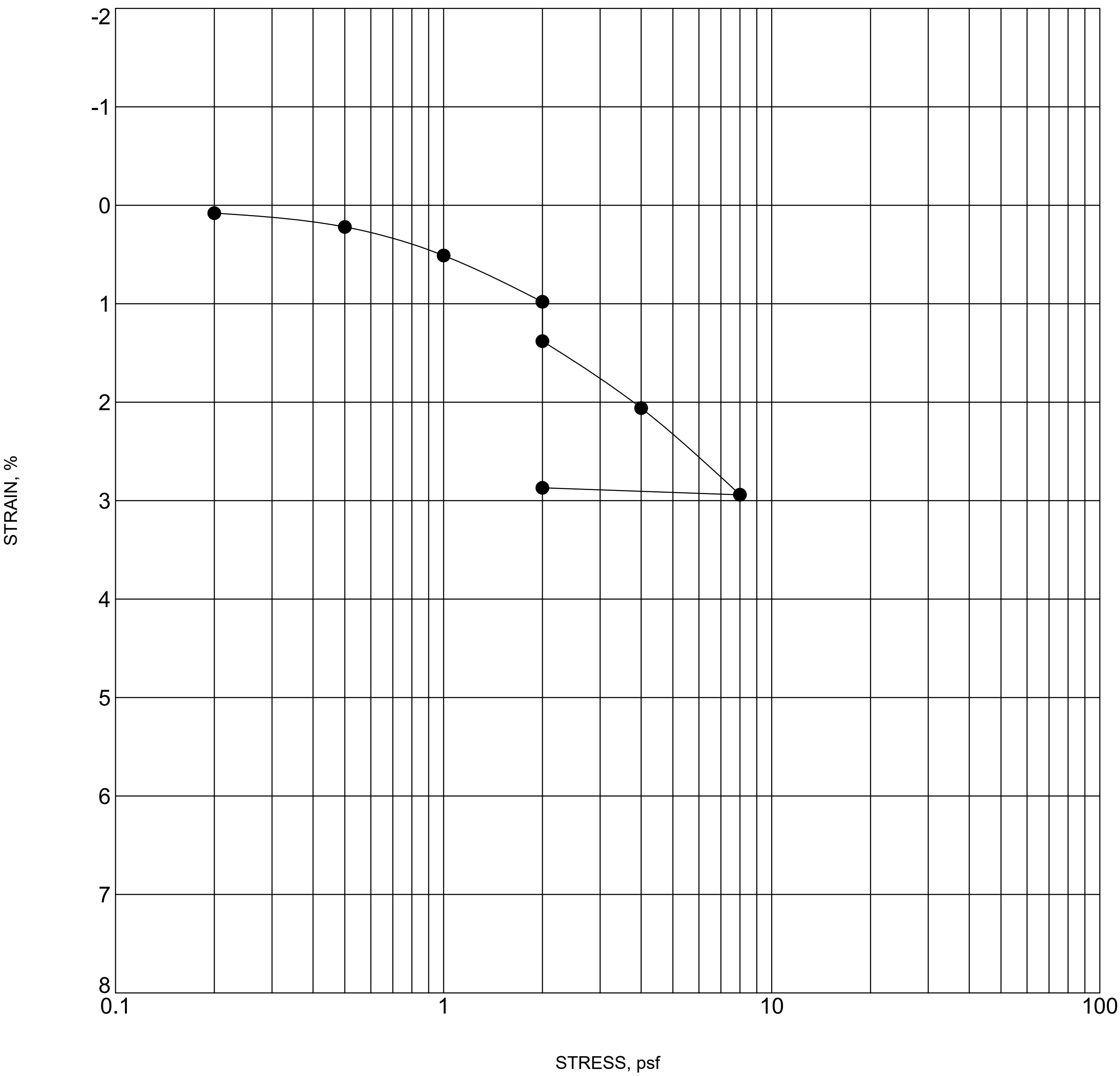
CONSOLIDATION TEST

CLIENT Keystone

PROJECT NAME Proposed Residential Development

PROJECT NUMBER Rialto-1-01

PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA



	Specimen Identification		Classification	γ_d	MC%
●	**B-1**	**5.0**	**SILTY SAND (SM): olive brown**	**109**	**8**

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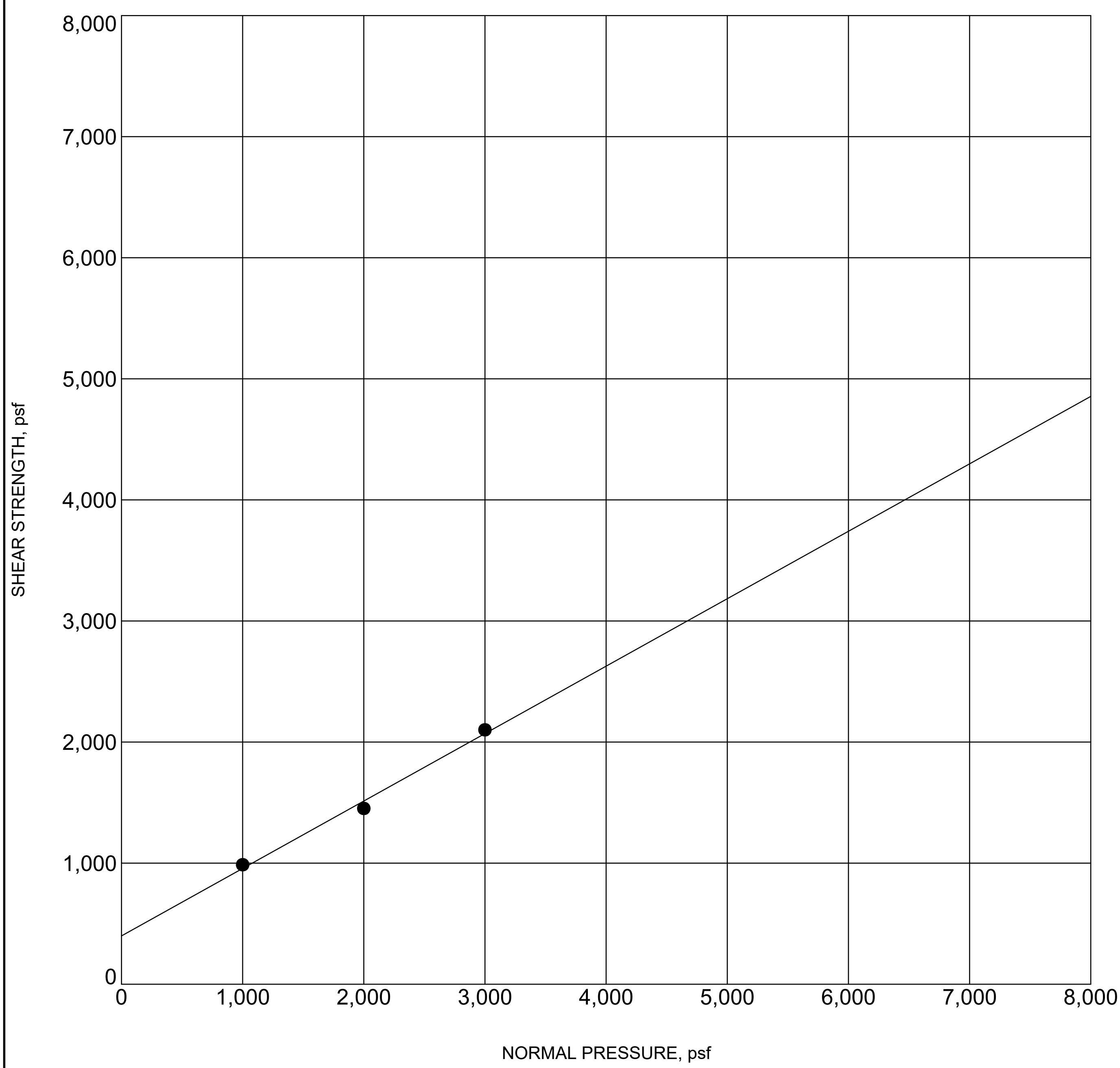
DIRECT SHEAR TEST

CLIENT Keystone

PROJECT NAME Proposed Residential Development

PROJECT NUMBER Rialto-1-01

PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA



	Specimen Identification		Classification	γ_d	MC%	c	ϕ
●	**B-2**	**5.0**	**SANDY SILT(ML)**	**109**	**14**	**399.3**	**29**

GEOBODEN, INC.

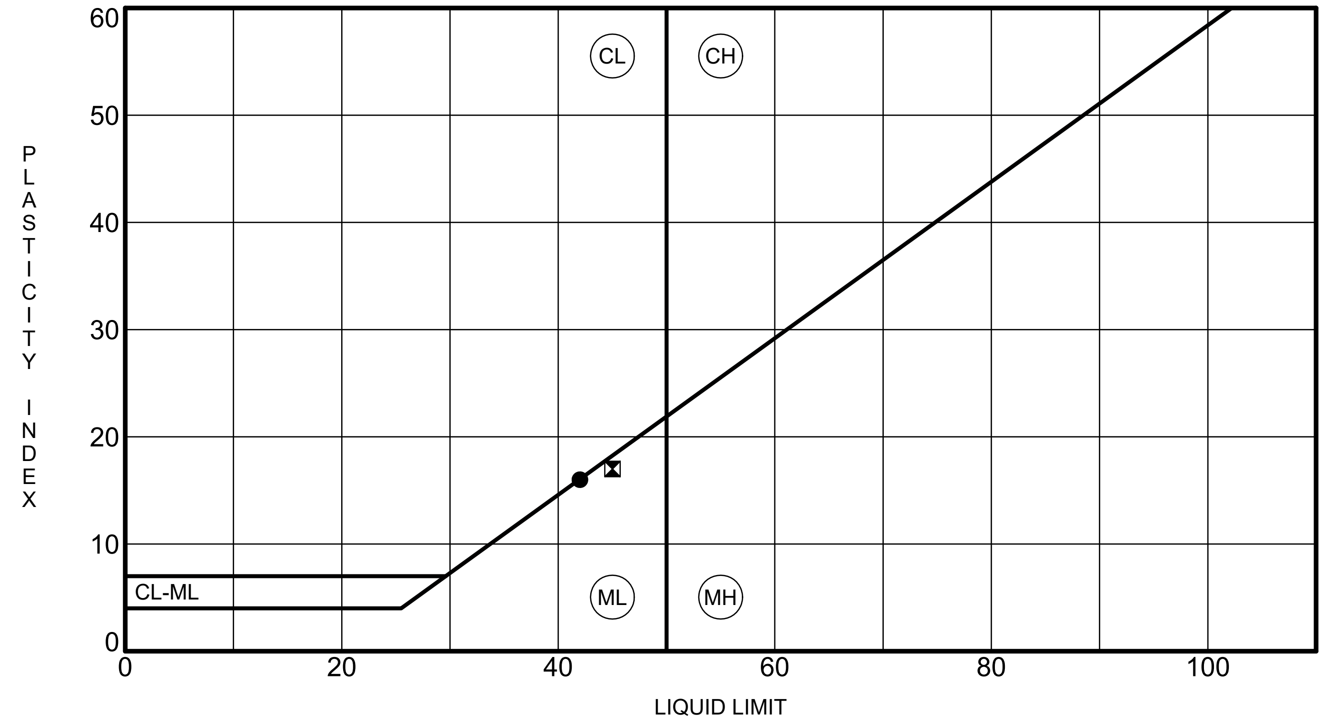
ATTERBERG LIMITS' RESULTS

CLIENT Keystone

PROJECT NAME Proposed Residential Development

PROJECT NUMBER Rialto-1-01

PROJECT LOCATION 1075 West Foothill Boulevard, Rialto, CA



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-2**	**5.0**	**42**	**26**	**16**	**67**	**SANDY SILT(ML)**
⊠	**B-3**	**5.0**	**45**	**28**	**17**	**70**	**SANDY SILT(ML)**