Geotechnical Engineering Report

Proposed ALDI Building

North of Imperial Hwy, 360 feet West of South Harbor Blvd

La Habra, California

September 1, 2015

Terracon Project No. 60155058

Prepared for:

ALDI, Inc.
Riverside, California

Prepared by:

Terracon Consultants, Inc.
Irvine, California

September 1, 2015

Terracon

ALDI, Inc.
1770 Iowa Avenue, Suite 240
Riverside, CA 92507

Attn: Mr. Matthew Baca
Director of Real Estate
E: Matthew.Baca@aldi.us

Re: Geotechnical Engineering Report
Proposed ALDI Building
North of Imperial Highway, 360 feet West of South Harbor Boulevard
La Habra, California
Terracon Project No. 60155085

Dear Mr. Baca:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in general accordance with the Task Order dated July 7, 2015.

This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical engineering recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

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

Sincerely,
Terracon Consultants, Inc.

REGISTERED PROFESSIONAL ENGINEER
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EXECUTIVE SUMMARY

A geotechnical exploration has been performed for the Proposed ALDI Building project to be located at north of Imperial Highway approximately 360 feet west of the intersection with South Harbor Boulevard in La Habra, California. Terracon's geotechnical scope of work included the advancement of seven (7) test borings to approximate depths of 6½ feet to 51½ feet below the ground surface (bgs). In addition, three (3) borings were drilled to approximate depths of 5 to 10 feet bgs and utilized for percolation testing.

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings and provided our recommendations contained in this report are properly implemented in the design and construction. Based on the information obtained from our engineering analyses of the field and laboratory data, the following geotechnical considerations were identified:

- The surface cover at the site generally consisted of 4 to 6 inches of asphalt concrete over 2 to 4 inches aggregate base. Surface soils at the site generally consisted of sandy lean clay overlying sand with variable amounts of silt and clay. Laboratory test results indicate the near surface soils have medium to high expansion characteristics.

- Due to the low bearing capacity of the near surface soils, the foundation system should bear on engineered fill. Engineered fill should extend to a minimum depth of 3 feet below the bottom of foundations, or 5 feet below existing grades, whichever is greater. Slab on grade may be utilized for the interior floor, provided that care is taken in the placement and compaction of the subgrade soil. On-site soils are not suitable for use as engineered fill for this project. Engineered fill should consist of low volume change imported materials.

- Automobile parking areas – 3" AC over 9" AB or 5" PCC over 4" AB; On-site driveways – 4" AC over 10" AB or 6" PCC over 4" AB. All pavement subgrades should be scarified, moisture conditioned and compacted to a minimum depth of 10 inches.

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

This geotechnical executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED ALDI BUILDING
NORTH OF IMPERIAL HIGHWAY, 360' WEST OF SOUTH HARBOR BOULEVARD
LA HABRA, CALIFORNIA

Terracon Project No. 60155058
September 1, 2015

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the Proposed ALDI Building project located on the north side of Imperial Highway, approximately 360 feet west of the intersection with South Harbor Boulevard in La Habra, California. The Site Location Plan (Exhibit A-1) is included in Appendix A of this report. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- seismic considerations
- infiltration systems
- groundwater conditions
- floor slab design and construction
- foundation design and construction

Our geotechnical engineering scope of work included the advancement of seven (7) test borings to approximate depths of 6½ feet to 51½ feet below the ground surface (bgs). In addition, three (3) borings were drilled to approximate depths of 5 to 10 feet bgs and utilized for percolation testing. Laboratory testing on representative samples of the subsurface materials, engineering analyses, and development of engineering recommendations for design and construction of foundations and floor slabs.

Logs of the borings along with a Boring Location Diagram (Exhibit A-2) are included in Appendix A of this report. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B of this report. Descriptions of the field exploration and laboratory testing are included in their respective appendices.

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	Refer to the Boring Location Diagram, Exhibit A-2.

ITEM	DESCRIPTION
Structures	It is our understanding that the project will consist of a single-story ALDI store encompassing an area of approximately 18,500SF.
Finished floor elevation	Within one foot of existing grade (assumed).
Maximum loads (assumed)	Columns: 40 to 80 kips; Walls: 1 to 2 klf; Slabs: 150 psf.
Grading	Minimal cut/fill – estimated at less than 2 feet.
Traffic loading	Assumed Design Traffic Index (TI's): Automobile Parking Areas: 4.5 On-site Driveways and Delivery Areas: 5.5
Paving	Based on the proposed site layout, it is our understanding that new pavements are planned for the project site.

2.2 Site Location and Description

Item	Description
Location	The proposed ALDI building will be located at the north side of Imperial Highway, 360 feet west of South Harbor Boulevard in La Habra, Orange County, California.
Existing Improvements	The site consists of an asphalt parking area with an existing fast food restaurant building and a concrete pad for a recently demolished building.
Anticipated Seismic Hazards	Based on our review of California Geologic Survey maps, the project site is located within a mapped liquefaction hazard potential zone. However, based on our review of the State Fault Hazard Maps, the project site is not located within an Alquist-Priolo Earthquake Fault Zones.
Current ground cover	The ground is currently covered with asphalt and concrete surfaces with minor landscape areas.
Existing topography	The existing topography at the site is relatively flat.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The site is situated within the Peninsular Ranges Geomorphic Province in Southern California. Geologic structures within this Province trend mostly northeast, in contrast to the prevailing east-west trend in the neighboring Transverse Ranges Geomorphic Province to the north. The Peninsular Range Province extends into lower California, and is bounded by the Colorado

Desert to the east, the Pacific Ocean to the west and the San Gabriel and San Bernardino mountains to the north.[1,2] Surficial geologic units mapped at the site consist of alluvium of recent Quaternary age and non-marine deposits of Pleistocene age[3].

3.2 Typical Subsurface Profile

Specific conditions encountered at the boring locations are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for the borings can be found on the boring logs included in Appendix A. Based on the results of the borings, the subsurface conditions on the project site can be generalized as follow:

Description	Approximate Depth to Bottom of Stratum	Material Encountered	Consistency/Density
Surface Materials	2 to 6 inches AC over 2 to 4 inches AB		--
Stratum 1	5 to 25 feet[1]	Sandy Lean Clay	Soft to Very Stiff
Stratum 1a[2]	15 to 20 feet	Sand with variable amounts of silt and clay	Medium Dense to Dense
Stratum 2	30 feet	Silty Sand	Dense
Stratum 3	51½ (maximum depth of exploration)	Silty Clayey Sand	Medium Dense to Very Dense

[1] Borings B-2 through B-5 and P-1 through P-3 were terminated within this stratum.
[2] An interbedded layer encountered only in B-2 and B-3.

Laboratory tests were conducted on selected soil samples and the test results are presented in Appendix B and on the boring logs. Laboratory tests indicate that on-site near surface materials have medium to high plasticity. The results of a consolidation/collapse test performed at a depth of 2½ and 5 feet bgs indicate the subsurface materials encountered at an approximate depth of 2½ feet and 5 feet bgs exhibit a medium to low swell potential when saturated under a confining pressure of 2,000 psf. Expansion index testing performed on near surface materials shows that near surface lean clay soils have an expansion index of 57.

3.3 Groundwater

Groundwater was observed at an approximate depth of 14 feet bgs in B-1 boring at the time of field exploration. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations.

[1] Harden, D. R., "*California Geology, Second Edition*," Pearson Prentice Hall, 2004.
[2] Norris, R. M. and Webb, R. W., *"Geology of California, Second Edition,"* John Wiley & Sons, Inc., 1990.
[3] *State of California – Division of Mines and Geology, Geologic Map of California, Olaf P. Jenkins Edition, Santa Ana, Compiled in 1965.*

In clayey soils with low permeability, the accurate determination of groundwater level may not be possible without long term observation. Long term observation after drilling could not be performed as borings were backfilled immediately upon completion due to safety concerns. Groundwater levels can best be determined by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater monitoring wells, and periodic measurement of groundwater levels over a sufficient period of time.

Based on ground water data recorded from a nearby monitoring well, the highest groundwater measurement was approximately 15 feet bgs.[4]

3.4 Seismic Considerations

3.4.1 CBC Seismic Site Class and Parameters

DESCRIPTION	VALUE
2013 California Building Code Site Classification (CBC) [1]	E
Site Latitude	N 33.91810º
Site Longitude	W 117.93459
S_s Spectral Acceleration for a Short Period	2.009g
S_1 Spectral Acceleration for a 1-Second Period	0.732g
F_a Site Coefficient for a Short Period	0.9
F_v Site Coefficient for a 1-Second Period	2.4

[1]Note: The 2013 California Building Code (CBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the required 100 foot soil profile determination. Borings extended to a maximum depth of 51½ feet, and this seismic site class definition considers that similar soils continue below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be necessary to confirm and/or modify the above site class.

3.4.2 Faulting and Estimated Ground Motions

The site is located in Southern California, which is a seismically active area. The type and magnitude of seismic hazards affecting the site are dependent on the distance to causative faults, the intensity, and the magnitude of the seismic event. The table below indicates the distance of the fault zones and the associated maximum credible earthquake that can be produced by nearby seismic events, as calculated using the USGS Earthquake Hazard Program 2002 interactive disaggregation. The Elsinore-15 Fault, which is located approximately 4.2 kilometers from the site, is considered to have the most significant effect at the site from a design standpoint.

[4] Data collected from Well No 03S10W10N002S, approximately 0.7 mile East from the project site measured between December 1969 and November 1995 (http://www.water.ca.gov/)

Characteristics and Estimated Earthquakes for Regional Faults		
Fault Name	**Approximate Distance to Site (kilometers)**	**Maximum Credible Earthquake (MCE) Magnitude**
Elsinore-15	4.2	6.8
Puente Hills blind thrust	4.7	7.0
Puente Hills blind thrust GR	5.2	6.8

Based on the ASCE 7-10 Standard, the peak ground acceleration (PGA) at the subject site approximately 0.775g. Based on the USGS 2002 interactive deaggregations, the project site has a PGA with 2% return period in 50 years of 0.977g and a mean magnitude of 6.68.

The site is not located within an Alquist-Priolo Earthquake Fault Zone based on our review of the State Fault Hazard Maps.[5]

3.4.3 Liquefaction Potential

Liquefaction is a mode of ground failure that results from the generation of high pore water pressures during earthquake ground shaking, causing loss of shear strength. Liquefaction is typically a hazard where loose sandy soils exist below groundwater. The California Geologic Survey (CGS) has designated certain areas within Southern California as potential liquefaction hazard zones. These are areas considered at a risk of liquefaction-related ground failure during a seismic event, based upon mapped surficial deposits and the presence of a relatively shallow water table. The project site is located within a mapped liquefaction hazard zone as evaluated by the CGS.

The on-site materials generally consisted of clayey soils with various amounts of sand overlying sandy soils with variable amounts of silt and clay encountered at a depth of 25 feet below existing grades. Groundwater was encountered at an approximate depth of 14 feet bgs during the field exploration.

A liquefaction analysis for the site was performed in general accordance with the DMG Special Publication 117. The liquefaction study utilized the software “LiquefyPro” by CivilTech Software. This analysis was based on the soil data from the boring B-1. A Peak Ground Acceleration (PGA) of 0.977g and mean magnitude of 6.68 was used based on the USGS deaggregations. Calculations utilized the shallowest groundwater depth which is anticipated at 14 feet bgs. Settlement analysis used the Tokimatsu M-correction method. Fines were corrected using the Modify Stark/Olson method in the liquefaction analysis.

[5] California Department of Conservation Division of Mines and Geology (CDMG), “Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Southern Region”, CDMG Compact Disc 2000-003, 2000.

Liquefaction potential analysis was calculated from a depth of 0 to 50 feet below the ground surface. The site was represented by boring B-1. Liquefaction potential analysis is attached to this letter.

A factor of safety of 1.3 was used for the analysis. Based on the calculation results, total and differential seismically-induced settlement is estimated to be less than approximately ¼ of an inch.

3.5 Corrosion Potential

Results of soluble sulfate testing indicate that ASTM Type I/II Portland cement may be used for all concrete on and below grade. Foundation concrete may be designed for low sulfate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

Laboratory test results indicate the on-site soils have a pH of 8.1, a minimum resistivity of 1,261 ohm-centimeters, a water soluble sulfates content of 0.02%, Red-Ox potential of 622 mV, a chloride content of 75 ppm, and negligible sulfides as shown on the attached Results of Corrosivity Analysis sheet. These values should be used to evaluate corrosive potential of the on-site soils to underground ferrous metals.

Refer to the Results of Corrosivity Analysis sheet in Appendix B for the complete results of the corrosivity testing conducted in conjunction with this geotechnical exploration.

3.6 Percolation Test Results

Three (3) in-situ percolation tests (constant head borehole permeability) were performed to approximate depths of 5 to 10 feet bgs. A 2-inch thick layer of gravel was placed in the bottom of each boring after the borings were drilled to investigate the soil profile. A 3-inch diameter perforated pipe was installed on top of the gravel layer in each boring. Gravel was used to backfill between the perforated pipes and the boring sidewall. The borings were then filled with water for a pre-soak period. At the beginning of each test, the pipes were refilled with water and readings were taken at 30-minute time intervals. Percolation rates are provided in the following table:

TEST RESULTS

Test Location (depth)	Soil Classification	Percolation Rate, in/hr	Correlated Infiltration Rate*, in/hr	Water Head, in
P-1 (5 ft)	Sandy Lean Clay	0.5	<0.1	57
P-2 (5 ft)	Sandy Lean Clay	0.5	<0.1	57
P-3 (10 ft)	Sandy Lean Clay	1.5	<0.1	116

*If the proposed infiltration systems will mainly rely on vertical downward seepage, the correlated infiltration rates should be used. The correlated infiltration rates were calculated using the Porchet Method.

The field test results are not intended to be design rates. They represent the result of our tests, at the depths and locations indicated, as described above. The design rate should be determined by the designer by applying an appropriate factor of safety. The designer should take into consideration the variability of native soils when selecting appropriate design rates. With time, the bottoms of infiltration systems tend to plug with organics, sediments, and other debris. Long term maintenance will likely be required to remove these deleterious materials to help reduce decreases in actual percolation rates.

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

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

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings provided the recommendations provided in this report are implemented during design and construction. Based on the geotechnical engineering analyses, subsurface exploration and laboratory test results, a spread footing foundation system bearing on engineered fill is recommended for support of the proposed building.

Due to the low bearing capacity of the near surface soils, the foundation system should bear on engineered fill. Engineered fill should extend to a minimum depth of 3 feet below the bottom of foundations, or 5 feet below existing grades, whichever is greater. Slab on grade may be utilized for the interior floor, provided that care is taken in the placement and compaction of the subgrade soil.

Expansive soils are present on this site. This report provides recommendations to help mitigate the effects of soil shrinkage and expansion; however, even if these procedures are followed, some movement and at least minor cracking in the structure should be anticipated. The severity of cracking and other cosmetic damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and cosmetic distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request.

Estimated movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained. Exposed ground, extending at least 10 feet from the perimeter, should be sloped a minimum of 5% away from the building to provide positive drainage away from the structure. Grades around the structure should be periodically inspected and adjusted as part of the structure's maintenance program.

Surface and near surface soils consisted of clayey materials with medium expansion potential. These soils should are not considered suitable for use as engineered fill, and their use as engineered fill beneath foundation or slabs is not recommended. Onsite soils may be used as fill material for general site grading, backfill for utilities, and beneath pavements.

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

4.2 Earthwork

The following sections present recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for the design and construction of earth supported elements including, foundations and slabs are contingent upon following the recommendations outlined in this section. All grading for the proposed building should incorporate the limits of the building plus a lateral distance of 3 feet beyond the outside edge of perimeter footings.

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

4.2.1 Site Preparation

Strip and remove existing pavement, demolition debris, and other deleterious materials from proposed building and pavement areas. Exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.

Demolition of the existing building and concrete pad should include complete removal of all foundation systems and remaining underground utilities within the proposed construction area. This should include removal of any loose backfill found adjacent to existing foundations. All materials derived from the demolition of existing structures and pavements should be removed from the site and not be allowed for use as on-site fill, unless processed to conform to the standard specifications and fill materials characteristics included in section 4.2.3 of this report.

Multiple utilities including sewer pipes and electrical lines were observed onsite. Evidence of underground facilities such as septic tanks, cesspools, and basements, was not observed during the site reconnaissance, such features could be encountered during construction. If underground facilities and utilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

4.2.2 Subgrade Preparation

Due to the low bearing capacity of near surface soils, foundations and floor slabs should bear on engineered fill extending to a minimum depth of 3 feet below the bottom of the foundation bearing level, or 5 feet below existing grades, whichever is greater. Engineered fill should extend horizontally a minimum distance of 3 feet beyond the outside edge of perimeter footings.

Subgrade soils beneath exterior slabs and pavements should be scarified, moisture conditioned, and compacted to a minimum depth of 10 inches. The moisture content and compaction of subgrade soils should be maintained until slab or pavement construction.

Exposed areas which will receive fill, once properly cleared and benched where necessary, should be scarified to a minimum depth of 10 inches, moisture conditioned, and compacted per the compaction requirements in Section 4.2.5.

4.2.3 Fill Materials and Placement

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

Near surface soils consisted of clayey materials with medium expansion potential. These soils are not considered suitable for use as engineered fill, beneath foundation or slabs. Onsite soils may be used as fill material for general site grading, utility backfill, and pavements.

Imported soils for use as fill material within proposed building and structure areas should conform to low volume change materials as indicated in the following recommendations:

Gradation	**Percent Finer by Weight (ASTM C 136)**
3"	100
No. 4 Sieve	50-100
No. 200 Sieve	15-40

- Liquid Limit .... 30 (max)

- Plasticity Index .... 15 (max)
- Maximum expansive index* .... 20 (max)

*Tested per ASTM method D 4829.

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

4.2.4 Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

Material Type and Location	Per the Modified Proctor Test (ASTM D 1557)		
	Minimum Compaction Requirement	Range of Moisture Contents for Compaction Above Optimum	
		Minimum	Maximum
Approved imported fill:			
Beneath foundations and interior floor slabs:	90%	0%	+4%
On-site native soils or approved imported fill:			
Beneath exterior slabs:	90%	0%	+4%
Beneath pavements:	95%	0%	+4%
Utility trenches (not structural areas)* :	90%	0%	+4%
Miscellaneous backfill:	90%	0%	+4%
Aggregate base (beneath pavements):	95%	-2%	+2%

*Upper 12 inches of utility trenches should be compacted to a minimum of 95% of relative compaction per ASTM D1557 within pavement areas.

4.2.5 Grading and Drainage

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

Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration. We recommend a minimum horizontal setback distance of 10 feet from the perimeter of any building and the high-water elevation of the nearest storm-water retention basin.

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

4.2.6 Exterior Slab Design and Construction

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

- exterior slabs should be supported directly on subgrade fill (not ABC) with no, or very low expansion potential;
- strict moisture-density control during placement of subgrade fills;
- maintain proper subgrade moisture until placement of slabs;
- placement of effective control joints on relatively close centers and isolation joints between slabs and other structural elements;
- provision for adequate drainage in areas adjoining the slabs;
- use of designs which allow vertical movement between the exterior slabs and adjoining structural elements.

4.2.7 Construction Considerations

At the time of our geotechnical exploration of the site, moisture contents of the surface and near-surface native soils ranged from about 11 to 23 percent. Based on these moisture contents, some moisture conditioning of the soils will likely be needed during construction of the project.

Although the exposed subgrades are anticipated to be relatively stable upon initial exposure, on-site clay soils may pump and unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. The use of light construction equipment would aid in reducing subgrade disturbance. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance. Should unstable subgrade conditions develop stabilization measures will need to be employed.

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

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

If unstable subgrade conditions develop during construction, suitable methods of stabilization will be dependent upon factors such as schedule, weather, size of area to be stabilized, and the nature of the instability. If soil stabilization is needed, Terracon should be consulted to evaluate the situation as needed.

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations (including utility trenches) as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

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

4.3 Foundations

DESCRIPTION	RECOMENDATION
Foundation Type	Conventional Shallow Spread Footings
Bearing Material	Engineered fill extending to a minimum depth of 3 feet below the bottom of the footing or 5 feet below existing grades, whichever is greater.
Allowable Bearing Pressure	2,000 psf
Minimum Dimensions	Walls: 18 inches; Columns: 24 inches
Maximum Dimension	Columns: 7 feet*
Minimum Embedment Depth Below Finished Grade	18 inches
Total Estimated Static Settlement	1-inch
Estimated Differential Static Settlement	½ inch in 40 feet.

*Based on settlement analysis. Terracon should be contacted if foundation widths of more than 7 feet are necessary.

Finished grade is defined as the lowest adjacent grade within 5 feet of the foundation for perimeter (or exterior) footings. The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations.

Foundations should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of control joints at openings or other discontinuities in masonry walls is recommended.

Foundation excavations should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

4.4 Floor Slab

DESCRIPTION	VALUE
Interior floor system	Slab-on-grade concrete.
Subbase	4-inches of Class II Aggregate Base materials.
Floor slab support	Engineered fill extending to a minimum depth of 3 feet below the bottom of the footing or 5 feet below existing grades, whichever is greater, as outlined 4.2.2 of this report.
Modulus of subgrade reaction	200 pounds per square inch per inch (psi/in) (The modulus was obtained based on engineered fill beneath floor slabs, and estimates obtained from NAVFAC 7.1 design charts). This value is for a small loaded area (1 Sq. ft or less) such as for forklift wheel loads or point loads and should be adjusted for larger loaded areas.

In areas of exposed concrete, control joints should be saw cut into the slab after concrete placement in accordance with ACI Design Manual, Section 302.1R-37 8.3.12 (tooled control joints are not recommended). Additionally, dowels should be placed at the location of proposed construction joints. To control the width of cracking (should it occur) continuous slab reinforcement should be considered in exposed concrete slabs.

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

4.5 Lateral Earth Pressures

For on-site near surface soils or imported low volume change materials used as engineered fill above any free water surface, recommended equivalent fluid pressures for foundation elements are:

CONDITION	On-site Soils	Import Engineered Fill[a]
Active Case	45 psf/ft	32 psf/ft
Passive Case	320 psf/ft	480 psf/ft
At-Rest Case	65 psf/ft	51 psf/ft
Coefficient of Friction	0.25	0.40[b]
[a] Note: The values are based on the low volume change import engineered fill materials used as backfill.		
[b] Note: The coefficient of base friction should be reduced to 0.30 when used in conjunction with passive pressure		

The lateral earth pressures herein do not include any factor of safety and are not applicable for submerged soils/hydrostatic loading. Additional recommendations may be necessary if such conditions are to be included in the design.

Fill against foundation and retaining walls should be compacted to densities recommended in the Earthwork section of this report. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors.

4.6 Pavements

4.6.1 Design Recommendations

An estimated design R-Value was used to calculate the asphalt concrete pavement thickness sections and the portland cement concrete pavement sections. R-value testing should be completed prior to pavement construction to verify the design R-value.

Assuming the pavement subgrades will be prepared as recommended within this report, the following pavement sections should be considered minimums for this project for the traffic indices assumed in the table below. As more specific traffic information becomes available, we should be contacted to reevaluate the pavement calculations.

	Recommended Pavement Section Thickness (inches)*	
	Light (Automobile) Parking Assumed Traffic Index (TI) = 4.5	On-site Driveways and Delivery Areas Assumed TI = 5.5
Section I Portland Cement Concrete (600 psi Flexural Strength)	5.0" PCC over 4" Class II Aggregate Base over 10" of scarified, moisture conditioned, and compacted materials	6.0" PCC over 4" Class II Aggregate Base over 10" of scarified, moisture conditioned, and compacted materials

	Recommended Pavement Section Thickness (inches)*	
	Light (Automobile) Parking Assumed Traffic Index (TI) = 4.5	**On-site Driveways and Delivery Areas Assumed TI = 5.5**
Section II Asphaltic Concrete	3" AC over 9" Class II Aggregate Base over 10" of scarified, moisture conditioned, and compacted materials	4" AC over 10" Class II Aggregate Base over 10" of scarified, moisture conditioned, and compacted materials
* All materials should meet the CALTRANS Standard Specifications for Highway Construction.		

These pavement sections are considered minimal sections based upon the assumed traffic and the existing subgrade conditions. However, they are expected to function with periodic maintenance and overlays if good drainage is provided and maintained.

All concrete for rigid pavements should have a minimum flexural strength of 600 psi, and be placed with a maximum slump of four inches. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

Preventative maintenance should be planned and provided for through an on-going pavement management program in order to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment.

Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

4.6.2 Construction Considerations

Materials and construction of pavements for the project should be in accordance with the requirements and specifications of the State of California Department of Transportation, or other approved local governing specifications.

Base course or pavement materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

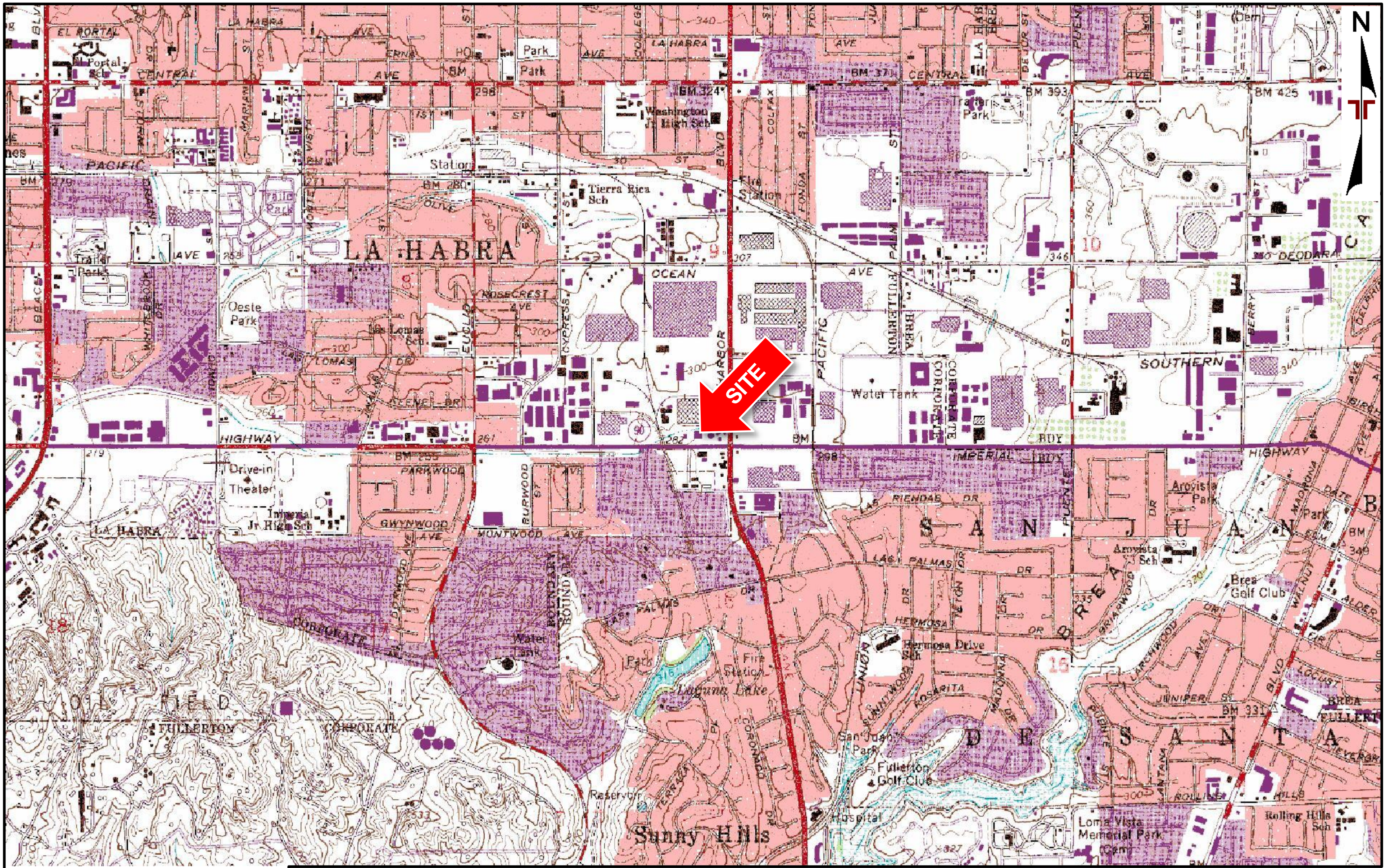
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

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

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: LA HABRA, CA (1/1/1981).

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

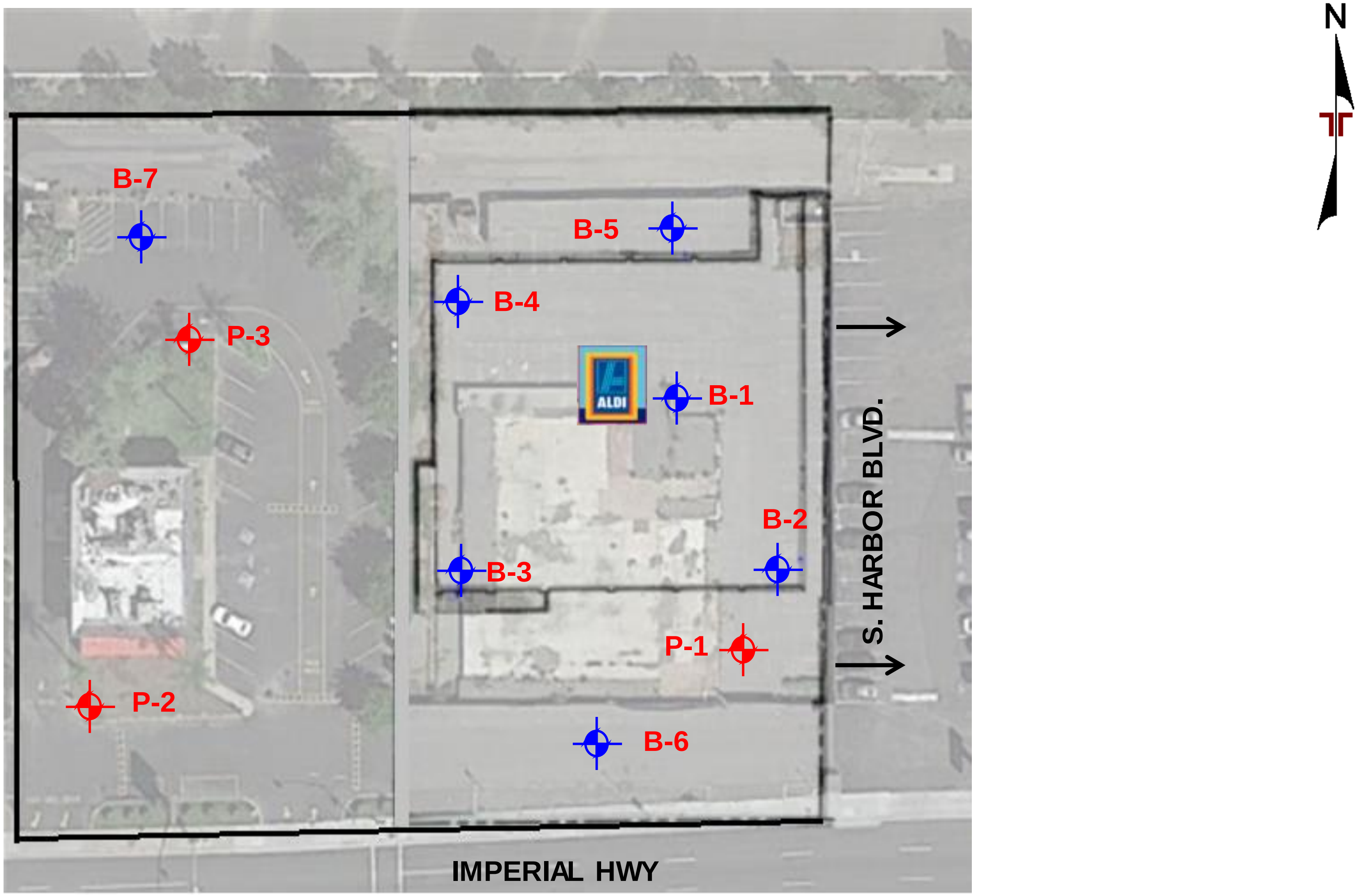
Project Manager: FH	Project No. 60155058
Drawn by SZ	Scale: 1"=2,000 SF
Checked by JM	File Name: A-1
Approved by FH	Date: 08/14/2015

Terracon
2817 McGaw Ave.
Irvine, CA 92614

SITE LOCATION

Proposed ALDI Building
North of Imperial Hwy approximately 360' W. of Harbor
La Habra, CA

Exhibit
A-1



LEGEND

B-1 APPROXIMATE BORING LOCATION

P-1 APPROXIMATE PERCOLATION TEST LOCATION

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

Project Manager: FH	Project No. 60155058
Drawn by: SZ	Scale: 1 in. ~ 70 ft.
Checked by: JM	File Name: A-2
Approved by: FH	Date: 08/31/15

Terracon
Consulting Engineers & Scientists
2817 McGaw Avenue Irvine, CA 92614
PH. (949) 261-0051 FAX. (949) 261-6110

BORING LOCATION DIAGRAM

Proposed ALDI Building

North of Imperial Hwy approximately 360' W. of Harbor
La Habra, CA

Exhibit

A-2

Field Exploration Description

A total of ten (10) test borings were advanced to an approximate depth of 5 to 51½ feet bgs on August 11, 2015. Three (3) of the borings were utilized for percolation testing. The borings were drilled at the approximate locations shown on the attached Boring Location Diagram, Exhibit A-2. The test borings were advanced with a truck-mounted drill rig utilizing 6-inch diameter hollow-stem augers. Groundwater was encountered at approximately 14 feet bgs at the time of the field exploration.

The borings were located in the field by using the proposed site plan, aerial photographs of the site, and measuring distances from existing site features. The accuracy of boring locations should only be assumed to the level implied by the method used.

Continuous lithologic logs of the borings were recorded by the field engineer during the drilling operations. At selected intervals, samples of the subsurface materials were taken by driving split-spoon or ring-barrel samplers. Bulk samples of subsurface materials were also obtained. Groundwater conditions were evaluated in the borings at the time of site exploration.

Penetration resistance measurements were obtained by driving the split-spoon and ring-barrel samplers into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency or relative density of materials encountered.

An automatic hammer was used to advance the split-barrel sampler in the borings performed on this site. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings prior to the drill crew leaving the site.

BORING LOG NO. B-1

PROJECT: Proposed ALDI Building

CLIENT: ALDI Inc.
Riverside, CA

SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA

LOCATION See Exhibit A-2

Latitude: 33.917947° Longitude: -117.934611°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT CONCRETE**, 3" thickness											
0.6	**AGGREGATE BASE COURSE**, 4" thickness											
	SANDY LEAN CLAY (CL), dark brown to reddish-brown, medium stiff	0.5–2.5		Auger								
		2.5–4		SPT	2-2-3 N=5							
		5–6.5		SPT	2-3-4 N=7							81
		7.5–9		SPT	3-3-4 N=7							
	medium stiff to stiff	10–11.5		SPT	2-3-5 N=8							
		14	▽									
	soft to medium stiff	15–16.5		SPT	2-2-2 N=4						23-15-8	55
		20–21.5		SPT	WOH-2-2							

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered @ 14'*

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-4

BORING LOG NO. B-1

PROJECT: Proposed ALDI Building

CLIENT: ALDI Inc.
Riverside, CA

SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA

LOCATION See Exhibit A-2

Latitude: 33.917947° Longitude: -117.934611°

DEPTH	GRAPHIC LOG / DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), dark brown to reddish-brown, medium stiff *(continued)*											
25.0	**SILTY SAND (SM)**, light gray to brown, dense	25		X	12-18-20 N=38						NP	15
30.0	**SILTY CLAYEY SAND (SC-SM)**, light gray to brown, medium dense	30		X	2-8-12 N=20							
	light gray to brown, very dense	35		X	10-20-33 N=53						21-15-6	23
		40		X	12-20-32 N=52							

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered @ 14'*

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-4

BORING LOG NO. B-1

PROJECT: Proposed ALDI Building

CLIENT: ALDI Inc. Riverside, CA

SITE: N. of Imperial Hwy Approx 360' W. of Harbor La Habra, CA

LOCATION See Exhibit A-2

Latitude: 33.917947° Longitude: -117.934611°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY CLAYEY SAND (SC-SM), light gray to brown, medium dense *(continued)*											
	reddish-brown to brown, medium dense	45		X	7-10-19 N=29							
	51.5	50		X	4-12-15 N=27							
	Boring Terminated at 51.5 Feet											

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater encountered @ 14'

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-4

BORING LOG NO. B-2

PROJECT: Proposed ALDI Building

CLIENT: ALDI Inc. Riverside, CA

SITE: N. of Imperial Hwy Approx 360' W. of Harbor La Habra, CA

LOCATION See Exhibit A-2

Latitude: 33.917758° Longitude: -117.934502°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT CONCRETE**, 4" thickness											
0.5	**AGGREGATE BASE COURSE**, 2" thickness											
	SANDY LEAN CLAY (CL), light brown to reddish-brown, very stiff				4-8-11				14	111		
		5			7-13-14				19	110		
7.5	**CLAYEY SAND (SC)**, reddish-brown to tan, medium dense				5-9-9 N=18							
		10			3-9-10				12	106		
15.0	**POORLY GRADED SAND WITH SILT (SP-SM)**, reddish-brown, medium dense	15			10-7-10 N=17							
20.0	**SANDY LEAN CLAY (CL)**, reddish-brown, very stiff	20			5-12-17				23	101		
21.5	***Boring Terminated at 21.5 Feet***											

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-5

BORING LOG NO. B-3

PROJECT: Proposed ALDI Building

CLIENT: ALDI Inc.
Riverside, CA

SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA

LOCATION See Exhibit A-2

Latitude: 33.917757° Longitude: -117.93493°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT CONCRETE**, 4" thickness											
0.5	**AGGREGATE BASE COURSE**, 2" thickness											
	SANDY LEAN CLAY (CL), trace gravel, dark brown to reddish-brown, very stiff										46-16-30	68
					10-12-13				16	114		
		5			4-9-18				16	110		
					3-8-17				11	116		
10.0	**SILTY SAND (SM)**, reddish-brown, medium dense	10			4-7-9 N=16							
15.0	**SANDY LEAN CLAY (CL)**, yellowish-brown, very stiff	15			6-12-27				19	108		
	brown	20			3-8-13 N=21							
21.5	***Boring Terminated at 21.5 Feet***											

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015 | Boring Completed: 8/11/2015

Drill Rig: CME-75 | Driller: Jet Drilling

Project No.: 60155058 | Exhibit: A-6

BORING LOG NO. B-4

PROJECT: Proposed ALDI Building

CLIENT: ALDI Inc.
Riverside, CA

SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA

LOCATION See Exhibit A-2

Latitude: 33.918045° Longitude: -117.934919°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ASPHALT CONCRETE**, 4" thickness											
0.5	**AGGREGATE BASE COURSE**, 2" thickness											
	SANDY LEAN CLAY (CL), dark brown to gray, stiff				5-8-9				15	111		
	very stiff	5			7-11-11				22	100		
	medium stiff				4-4-5				23	94		
	soft	10			WOH-WOH-2							
	very soft	15			WOH-WOH-2				31	93		
21.5	soft	20			WOH-WOH-2							
	Boring Terminated at 21.5 Feet											

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-7

BORING LOG NO. B-5

PROJECT: Proposed ALDI Building

**CLIENT: ALDI Inc.
Riverside, CA**

**SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA**

LOCATION See Exhibit A-2

Latitude: 33.918101° Longitude: -117.934588°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.4	**ASPHALT CONCRETE**, 5" thickness											
	5.0	**SANDY LEAN CLAY (CL)**, brown to dark brown	5										
		Boring Terminated at 5 Feet											

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-8

BORING LOG NO. B-6

PROJECT: Proposed ALDI Building

**CLIENT: ALDI Inc.
Riverside, CA**

**SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA**

LOCATION See Exhibit A-2

Latitude: 33.917592° Longitude: -117.934678°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.5	**ASPHALT CONCRETE**, 6" thickness											
	0.8	**AGGREGATE BASE COURSE**, 4" thickness											
	5.0	**SANDY LEAN CLAY (CL)**, brown	5										
		Boring Terminated at 5 Feet											

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-9

BORING LOG NO. B-7

PROJECT: Proposed ALDI Building

CLIENT: ALDI Inc.
Riverside, CA

SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA

LOCATION See Exhibit A-2

Latitude: 33.918129° Longitude: -117.935325°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3	**ASPHALT CONCRETE**, 4" thickness											
	0.5	**AGGREGATE BASE COURSE**, 2" thickness											
	5.0	**SANDY LEAN CLAY (CL)**, brown	5										

Boring Terminated at 5 Feet

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-10

BORING LOG NO. P-1

PROJECT: Proposed ALDI Building

**CLIENT: ALDI Inc.
Riverside, CA**

**SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA**

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.917699° Longitude: -117.934519° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3 **ASPHALT CONCRETE**, 4" thickness											
	0.6 **AGGREGATE BASE COURSE**, 3" thickness											
	SANDY LEAN CLAY (CL), brown											
	5.0	5										
	Boring Terminated at 5 Feet											

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-11

BORING LOG NO. P-2

PROJECT: Proposed ALDI Building

CLIENT: ALDI Inc. Riverside, CA

SITE: N. of Imperial Hwy Approx 360' W. of Harbor La Habra, CA

LOCATION See Exhibit A-2

Latitude: 33.917645° Longitude: -117.935428°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.2 **ASPHALT CONCRETE**, 2" thickness											
	0.4 **AGGREGATE BASE COURSE**, 3" thickness											
	SANDY LEAN CLAY (CL), brown											
	5.0	5										
	Boring Terminated at 5 Feet											

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-12

BORING LOG NO. P-3

PROJECT: Proposed ALDI Building

**CLIENT: ALDI Inc.
Riverside, CA**

**SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA**

LOCATION See Exhibit A-2

Latitude: 33.918036° Longitude: -117.935284°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3	**ASPHALT CONCRETE**, 4" thickness											
	0.5	**AGGREGATE BASE COURSE**, 2" thickness											
		SANDY LEAN CLAY (CL), brown											
			5										
	10.0		10										
		Boring Terminated at 10 Feet											

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

Hammer Type: Automatic SPT Hammer

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
2817 McGaw Avenue
Irvine, California

Boring Started: 8/11/2015	Boring Completed: 8/11/2015
Drill Rig: CME-75	Driller: Jet Drilling
Project No.: 60155058	Exhibit: A-13

APPENDIX B

LABORATORY TESTING

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix C. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

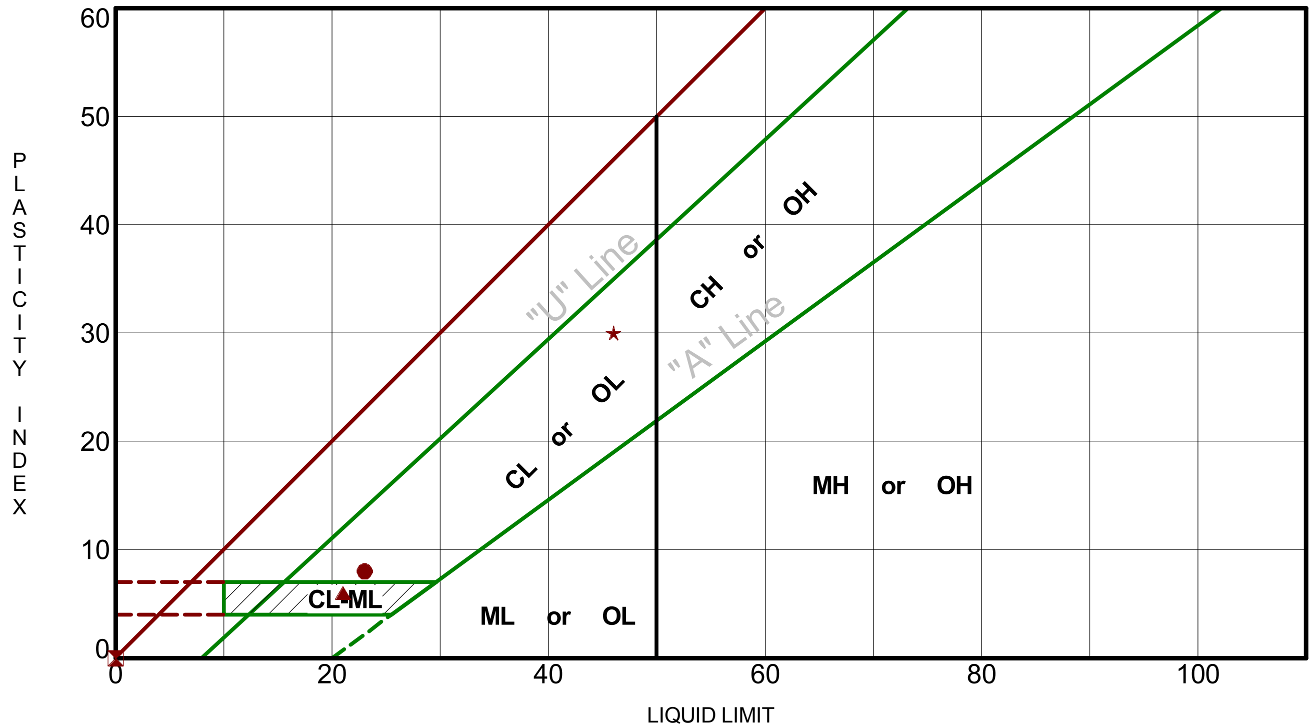
Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- In-situ Dry Density
- Soluble Chlorides
- pH
- Percent Passing #200 Sieve
- Atterberg Limits
- In-situ Water Content
- Soluble Sulfates
- Minimum Resistivity
- Consolidation/Swell Potential

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	**B-1**	**15.0**	**23**	**15**	**8**	**55**	**CL**	**SANDY LEAN CLAY**
⧗	**B-1**	**25.0**	**NP**	**NP**	**NP**	**15**	**SM**	**SILTY SAND**
▲	**B-1**	**35.0**	**21**	**15**	**6**	**23**	**SC-SM**	**SILTY CLAYEY SAND**
★	**B-3**	**1.0**	**46**	**16**	**30**	**68**	**CL**	**SANDY LEAN CLAY**

PROJECT: Proposed ALDI Building

SITE: N. of Imperial Hwy Approx 360' W. of Harbor
La Habra, CA

Terracon
2817 McGaw Avenue
Irvine, California

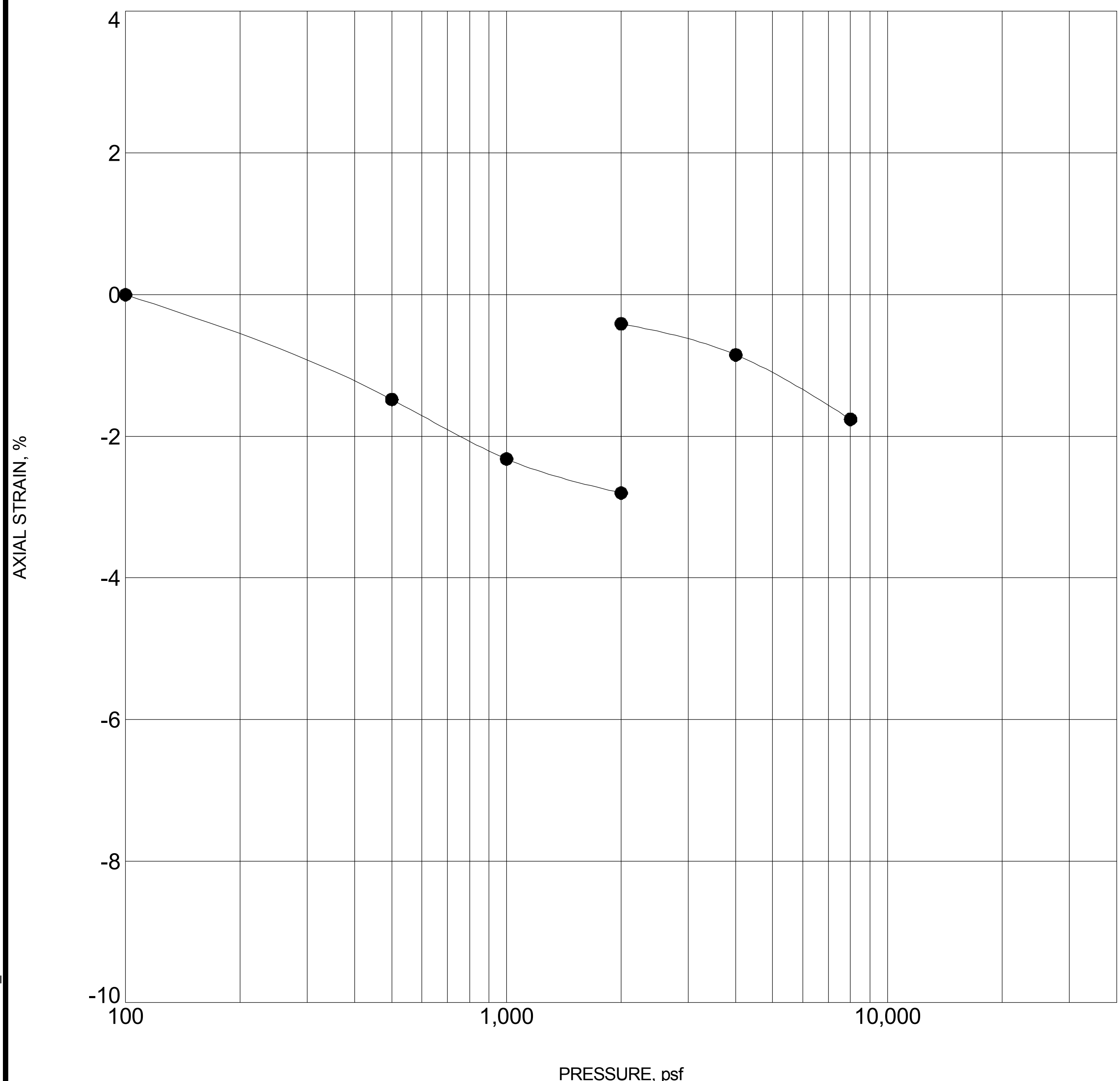
PROJECT NUMBER: 60155058

CLIENT: ALDI Inc.
Riverside, CA

EXHIBIT: B-2

SWELL CONSOLIDATION TEST

ASTM D4546



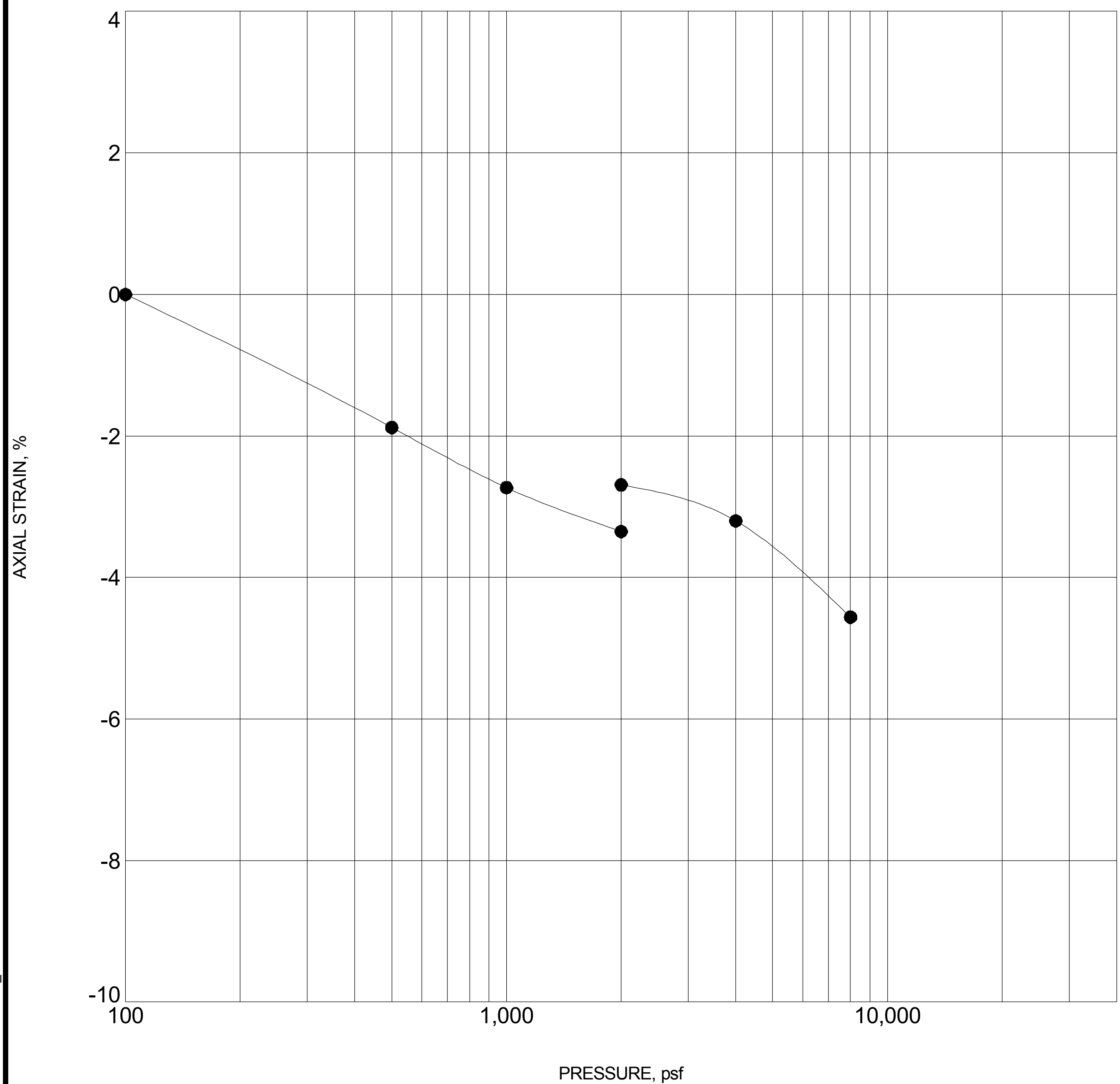
Specimen Identification		Classification	γ_d, pcf	WC, %
●	B-3 2.5 ft	SANDY LEAN CLAY	114	16

NOTES: Water added @ 2000psf

PROJECT: Proposed ALDI Building	Terracon 2817 McGaw Avenue Irvine, California	PROJECT NUMBER: 60155058
SITE: N. of Imperial Hwy Approx 360' W. of Harbor La Habra, CA		CLIENT: ALDI Inc. Riverside, CA
		EXHIBIT: B-3

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification		Classification	γ_d, pcf	WC, %
●	B-4 5.0 ft	SANDY LEAN CLAY	100	22

NOTES: Water added @ 2000psf

PROJECT: Proposed ALDI Building

SITE: N. of Imperial Hwy Approx 360' W. of Harbor La Habra, CA

Terracon
2817 McGaw Avenue
Irvine, California

PROJECT NUMBER: 60155058

CLIENT: ALDI Inc. Riverside, CA

EXHIBIT: B-4

EXPANSION INDEX - UBC 18-2 & ASTM D 4829-88

PROJECT Terracon # 60155058 JOB NO. 2011-0104

Sample	B-6 @ 0'		By	LD	Sample			By	
Sta. No.					Sta. No.				
Soil Type	Brown, Silty Clay				Soil Type				
Date	Time	Dial Reading	Wet+Tare	599.9	Date		Dial Reading	Wet+Tare	
8/18/2015	16:30	0.3597	Tare	218.9				Tare	
		H2O	Net Weight	381				Net Weight	
8/19/2015	9:00	0.3027	% Water	11.5				% Water	
			Dry Dens.	103.5				Dry Dens.	
			% Max					% Max	
			Wet+Tare	631.5				Wet+Tare	
			Tare	218.9				Tare	
			Net Weight	412.6				Net Weight	
INDEX	57	5.7%	% Water	20.7	**INDEX**			% Water	

Sample			By		Sample			By	
Sta. No.					Sta. No.				
Soil Type					Soil Type				
Date		Dial Reading	Wet+Tare		Date		Dial Reading	Wet+Tare	
			Tare					Tare	
			Net Weight					Net Weight	
			% Water					% Water	
			Dry Dens.					Dry Dens.	
			% Max					% Max	
			Wet+Tare					Wet+Tare	
			Tare					Tare	
			Net Weight					Net Weight	
INDEX			% Water		**INDEX**			% Water	

Geo-Logic ASSOCIATES

Exhibit :B-5

CHEMICAL LABORATORY TEST REPORT

Project Number: 60155058
Service Date: 08/17/15
Report Date: 08/17/15
Task:

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

Client

Project

Aldi: La Habra

Sample Submitted By: Terracon (60) **Date Received:** 8/14/2015 **Lab No.: 15-0629**

Results of Corrosivity Analysis

Sample Number	
Sample Location	B-1
Sample Depth (ft.)	0.0
pH Analysis, AWWA 4500 H	8.12
Water Soluble Sulfate (SO4), AWWA 4500 E (percent %)	0.02
Sulfides, AWWA 4500-S D, (mg/kg)	Nil
Red-Ox, AWWA 2580, (mV)	+622
Total Salts, AWWA 2510, (mg/kg)	1126
Chlorides, AWWA 4500 Cl B, (mg/kg)	75
Resistivity, ASTM G-57, (ohm-cm)	1261

Analyzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Shelby Tube	Split Spoon
Rock Core	Macro Core	Modified California Ring Sampler
Grab Sample	No Recovery	Modified Dames & Moore Ring Sampler

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
N	N value
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer
(WOH)	Weight of Hammer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

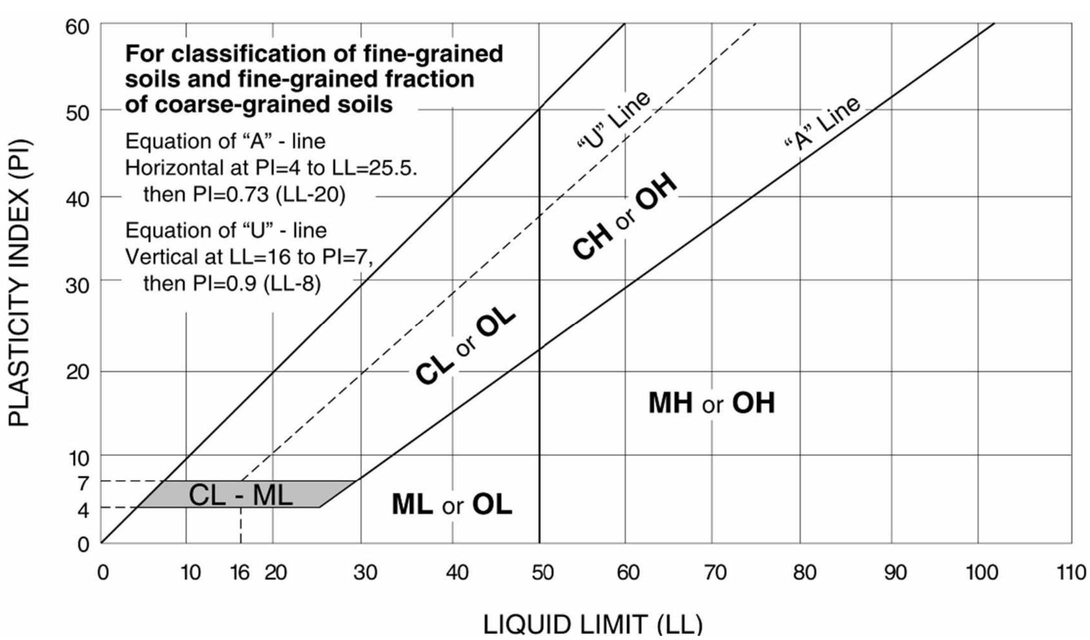
UNIFIED SOIL CLASSIFICATION SYSTEM

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

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

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

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



Design Maps Detailed Report

ASCE 7-10 Standard (33.9181°N, 117.93459°W)

Site Class E – “Soft Clay Soil”, Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1]	S_S = 2.009 g
From Figure 22-2 [2]	S_1 = 0.732 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class E, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_S$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index *PI* > 20, • Moisture content *w* ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = E and S_S = 2.009 g, F_a = 0.900

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = E and S_1 = 0.732 g, F_v = 2.400

Equation (11.4–1):	$S_{MS} = F_aS_S = 0.900 \times 2.009 = 1.808$ g
Equation (11.4–2):	$S_{M1} = F_vS_1 = 2.400 \times 0.732 = 1.757$ g

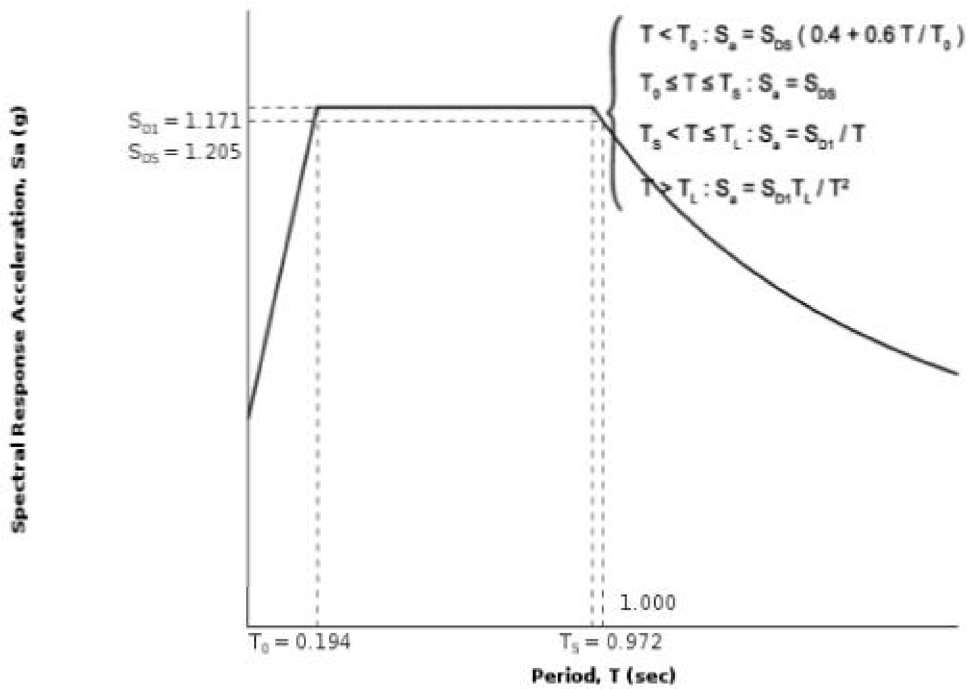
Section 11.4.4 — Design Spectral Acceleration Parameters

Equation (11.4–3):	$S_{DS} = ⅔\, S_{MS} = ⅔ \times 1.808 = 1.205$ g
Equation (11.4–4):	$S_{D1} = ⅔\, S_{M1} = ⅔ \times 1.757 = 1.171$ g

Section 11.4.5 — Design Response Spectrum

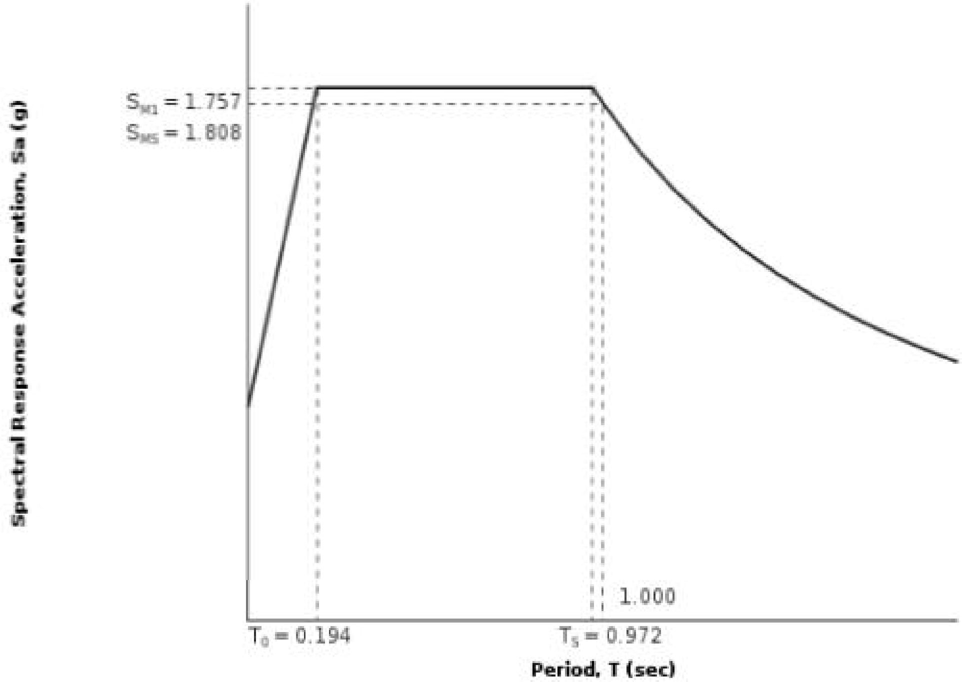
From Figure 22-12 [3]	T_L = 8 seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4]	PGA = 0.776
Equation (11.8–1):	$PGA_M = F_{PGA}PGA = 0.900 \times 0.776 = 0.699$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = E and PGA = 0.776 g, F_{PGA} = 0.900

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5]	C_{RS} = 0.947
From Figure 22-18 [6]	C_{R1} = 0.963

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
S_{DS} < 0.167g	A	A	A
0.167g ≤ S_{DS} < 0.33g	B	B	C
0.33g ≤ S_{DS} < 0.50g	C	C	D
0.50g ≤ S_{DS}	D	D	D

For Risk Category = I and S_{DS} = 1.205 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
S_{D1} < 0.067g	A	A	A
0.067g ≤ S_{D1} < 0.133g	B	B	C
0.133g ≤ S_{D1} < 0.20g	C	C	D
0.20g ≤ S_{D1}	D	D	D

For Risk Category = I and S_{D1} = 1.171 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is E for buildings in Risk Categories I, II, and III, and F for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

APPENDIX D

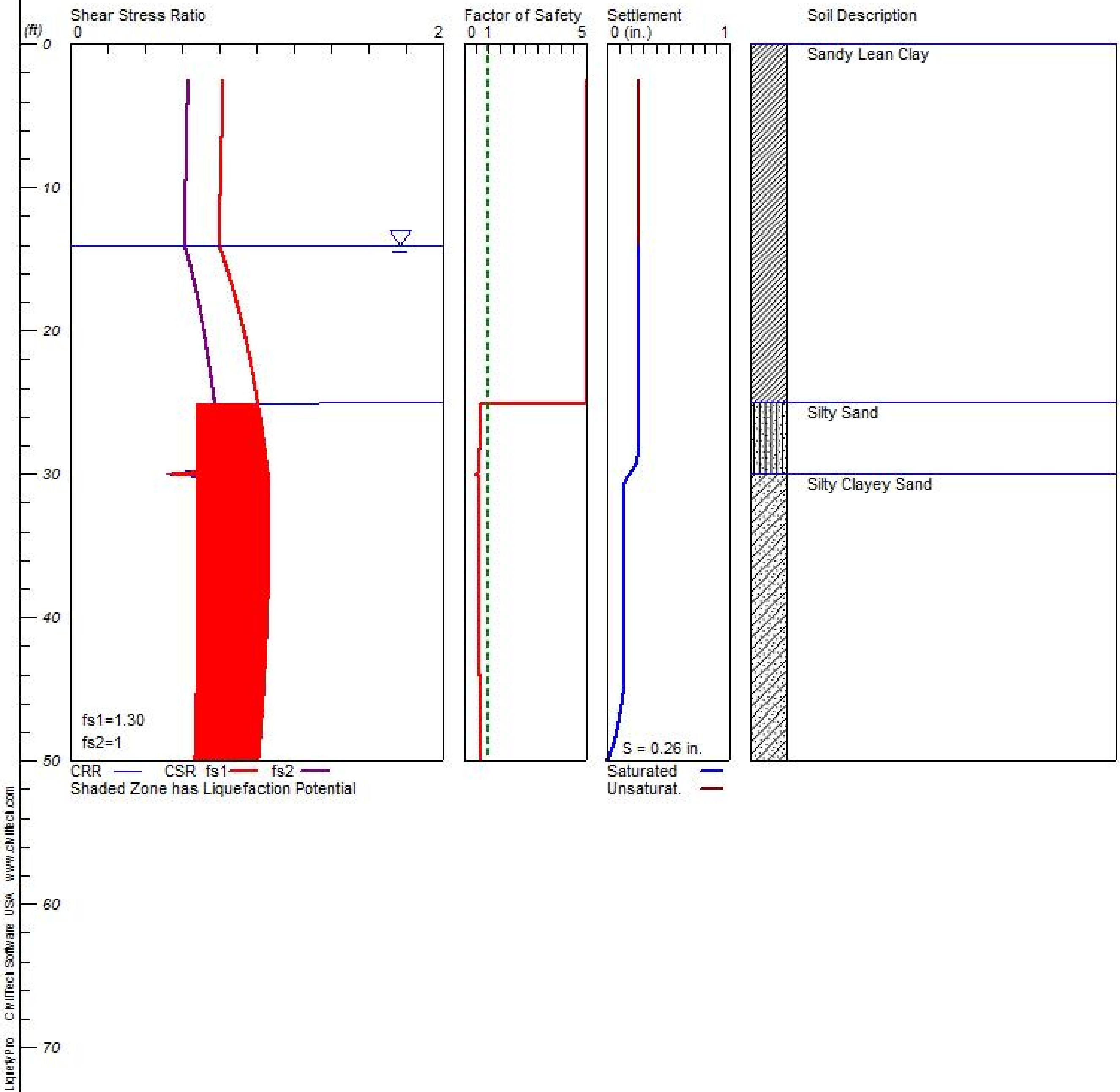
LIQUEFACTION ANALYSIS

LIQUEFACTION ANALYSIS

ALDI La Habra

Hole No.=B-1 Water Depth=14 ft Surface Elev.=100

Magnitude=6.68
Acceleration=0.977g



CivilTech Corporation

Exhibit D-1

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LIQUEFACTION ANALYSIS SUMMARY

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Surface Elev.=100
Hole No.=B-1
Depth of Hole= 50.00 ft
Water Table during Earthquake= 14.00 ft
Water Table during In-Situ Testing= 14.00 ft
Max. Acceleration= 0.98 g
Earthquake Magnitude= 6.68
No-Liquefiable Soils: CL, OL are Non-Liq. Soil

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Tokimatsu, M-correction
3. Fines Correction for Liquefaction: Modify Stark/Olson
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1
7. Borehole Diameter, Cb= 1.15
8. Sampling Method, Cs= 1.2
9. User request factor of safety (apply to CSR) , User= 1.3
   Plot two CSR (fs1=User, fs2=1)
10. Use Curve Smoothing: Yes*

* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
2.50	5.00	120.00	NoLiq
5.00	7.00	120.00	NoLiq
7.50	7.00	120.00	NoLiq
10.00	8.00	120.00	NoLiq
15.00	4.00	120.00	NoLiq
20.00	4.00	120.00	NoLiq
25.00	38.00	120.00	15.00
30.00	20.00	120.00	23.00
35.00	53.00	120.00	23.00
40.00	52.00	120.00	23.00
45.00	29.00	120.00	23.00
50.00	27.00	120.00	23.00

Output Results:

Settlement of Saturated Sands=0.26 in.
Settlement of Unsaturated Sands=0.00 in.
Total Settlement of Saturated and Unsaturated Sands=0.26 in.
Differential Settlement=0.128 to 0.169 in.