Appendix 5

Geotechnical Feasibility Report

April 24, 2019

M. Alexander DeGood
Cox, Castle & Nicholson
2029 Century Park East, Suite 2100
Los Angeles, California 90067

Subject: **Geotechnical Feasibility Report**
New Curtis School Additions
15871 Mulholland Drive
Los Angeles, California
Partner Project No. 17- 196035.1

Dear M. DeGood:

Per our conversation, Partner Assessment Corporation (Partner) prepared the attached Geotechnical Feasibility Report. This report is listed as a Feasibility Report because prior to submittal of a Geotechnical Design Report to the Los Angeles Building Department, we must comply with the requirements set forth in their memo "Contents of Reports for Submittal to the Grading Section" dated 04/2003.

Los Angeles Building Department will not issue approval of our report without adhering to Section 2 "Contents of Soils and Geology Reports" of the referenced document, particularly Part B and Part F. Part B is copied below for reference, and given the length of Part F, it can be found in the referenced document attached:

> *MAP AND CROSS SECTION*
> *Provide a scaled site map or plot plan with a north arrow showing the location and extent of the project. The map shall be based upon a topographic base map prepared by a licensed land surveyor when the site is not flat. Cross sections are usually required where a slope, basement, retaining wall, or temporary/permanent excavations greater than 5ft high or below a 1:1 from the property line is present. The map and cross sections shall clearly show the site boundaries, location and size of all existing and proposed buildings, walls, elevated decks, and pools, the location of all exploratory pits/borings, material contacts, and the extent of the proposed grading work. Cross sections shall also include depictions of ground water, temporary excavations, grades, foundations, retaining walls, sub drains, property boundaries, and slope setbacks. Topographic data and cross sections shall extend beyond the site to demonstrate that adjacent or offsite slopes do not affect the stability of the site. A geologic map and cross sections shall be provided where bedrock formations are involved. The geologic map shall present all the features required on a geotechnical map and the distribution of geologic units, faults, landslides, slumps, bedding attitudes, etc.*

Given that the design drawings for the new buildings are not available, pertinent site layout and elevation data is not finalized, and loading for settlement and other calculations are not available, we cannot obtain approval from the grading division at this time. Once design drawings are completed or at least completed to 90% accuracy, we can begin to prepare a submittal that will be able to pass through grading division review.

We appreciate the opportunity to be of service during this phase of the work.

Sincerely,

Matthew Marcus, PE
Technical Director – Geotechnical Engineering

Fran Chan EI
Project Engineer

Attachments: Los Angeles Department of Building and Safety "Contents of Reports for Submittal to the Grading Section"

Partner Geotechnical Feasibility Report

City of Los Angeles

DEPARTMENT OF BUILDING AND SAFETY

CONTENTS OF REPORTS FOR SUBMITTAL TO THE GRADING SECTION

REV.: 04/03 GGI -13

1. INTRODUCTION

Pursuant to Los Angeles Municipal Code Sec. 91.7006.2, geologic and soils reports are required to be submitted to the Department of Building and Safety (LADBS) for review and approval. These guidelines for geology and soils reports submitted to the City of Los Angeles are developed from four sources:

1. The Los Angeles Municipal Code (LAMC), Section 91 of the LAMC, known as the "Los Angeles Building Code" provides regulations affecting design and construction of grading and structures. The 2002 Building Code became effective on 11/01/2002.

2. The Department of Building and Safety Information Bulletins (IB), which document LADBS requirements and guidelines for specific topics in greater detail than the Building Code. Information Bulletins are available at the Department internet home page www.ladbs.org

3. Publications of the California Geologic Survey (CGS), including CGS Notes 42, 44 and 49 which provide the guidelines to geologic report format and content and CGS Special Publication 117 (SP117) which provides guidelines for evaluating and mitigating seismic hazards in California. CGS publication are available at: www.consrv.ca.gov

4. The Southern California Earthquake Center's (SCEC) "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California" (SCEC-Recommended Procedures) which provides more detail for implementing SP117. The SCEC-Recommended Procedures are available at www.scec.org.

Those preparing reports should first identify if the project site is to be subdivided and if it is within areas of the City that require special studies. A Parcel Profile Report available at www.ladbs.org may help in identifying whether the site is in a special study area. Those areas are:

a) Hillside Grading Areas (HGA's) per LAMC Sect. 91.7000, requiring geologic and soil investigation,

b) State Mapped Zones requiring Liquefaction and Landsliding investigation/mitigation per Seismic Hazard Mapping Act, State of California Public Resources Code, Section 2690 et seq.,

c) Earthquake Fault Rupture (Alquist-Priolo) Hazard Zones per State of California Public Resources Code, Section 2620 et seq., requiring fault studies per I.B.P/BC2001-49 & CGS Note 49,

d) Methane Seepage Districts per LAMC Sect. 91.7100. Methane report requirements may also include areas adjoining landfills, having hydrocarbon contamination, and near oil and gas wells.

Additional requirements for special reports are discussed in Section 4 of these guidelines. Information, analyses, and recommendations provided in the reports shall be developed and reported under the responsible charge of professional signatories registered with the State of California to practice the subject discipline. Common report types and licensed professionals typically preparing them include:

City of Los Angeles

CITY LA DBS DEPARTMENT OF BUILDING AND SAFETY

CONTENTS OF REPORTS FOR SUBMITTAL TO THE GRADING SECTION

REV.: 04/03 GGI -13

Report Type	Engr. Geologist		Soils Engineer		Other
Hillside Grading Area (HGA)Investigation	✔	and	✔		
Soils Investigation			✔		
Fault Investigation	✔				
Compaction Report			✔		
Final Geology "As-Graded"	✔				
Monthly Progress Report for Grading	✔	and	✔		
Liquefaction Report	✔	and/or	✔		
Private Sewage Disposal	✔	and/or	✔		
Mudflow Analysis	✔	and/or	✔	and/or	✔
Responsibility Letter	✔	and/or	✔		
Methane Gas					✔

Geologic reports are generally required for:

a) all proposed subdivisions, construction, and grading in hillside areas,
b) during and/or at the completion of tract grading,
c) private sewage disposal systems in hillside areas,
d) sites located in Alquist-Priolo Earthquake Fault-Rupture Hazard Zones.

The engineering geology report shall include:

a) description of the general setting with respect to major geologic and geographic features,
b) description of the geology of the site accompanied with geologic maps and cross-sections,
c) description of natural materials and structural features,
d) conclusions and recommendations regarding the effect of geologic conditions on the proposed development, and
e) an opinion as to whether the site is suitable for the intended use.

Geologic reports for Hillside Grading Areas are commonly provided in a Combined Geology and Soils report.

As stipulated in LAMC Sec. 91.7006.3.1, the soils engineering report shall include:

1. data regarding the nature, distribution, and strength of existing soils,
2. conclusions and recommendations for grading procedures and design criteria for corrective measures, including buttress fills, when necessary, and
3. opinion as to whether the site is suitable for the intended use.

Reports shall be submitted in triplicate, including one unbound original for microfilming, at the downtown office or at a district office. A fourth copy of the report shall be submitted if the project is a subdivision or within State Mapped Zones for seismically induced liquefaction or land sliding investigation/mitigation. To ensure sufficient information and data are provided in these reports so that it can be reviewed in an expeditious manner, they should include, but not be limited to, the items listed below. The suggested formats and information required are intended to be relatively complete, and not all items would be applicable to small projects or low risk sites. In addition, some items would be covered in separate reports by soil engineers, geologists, seismologists, civil or structural engineers.

2. CONTENTS OF SOILS AND GEOLOGY REPORTS

A. SITE AND PROJECT DESCRIPTION

Identify the site address and legal descriptors (Tract, Block, Lots, Arb) for the site, this information may be checked with a Parcel Profile Report (available at www.ladbs.org). Discuss the type, size, and scope of the project, with a brief description of the proposed structures including number of floor levels and maximum anticipated design loads, existing site topography, and the extent of grading work proposed. Specify the proximity of the proposed development to any relevant ascending and descending slopes and indicate slope heights and inclinations. Identify whether the site is located in areas requiring special analyses or reports as described in Section 1 above.

B. MAP AND CROSS SECTION

Provide a scaled site map or plot plan with a north arrow showing the location and extent of the project. The map shall be based upon a topographic base map prepared by a licensed land surveyor when the site is not flat. Cross sections are usually required where a slope, basement, retaining wall, or temporary/permanent excavations greater than 5ft high or below a 1:1 from the property line is present. The map and cross sections shall clearly show the site boundaries, location and size of all existing and proposed buildings, walls, elevated decks, and pools, the location of all exploratory pits/borings, material contacts, and the extent of the proposed grading work. Cross sections shall also include depictions of ground water, temporary excavations, grades, foundations, retaining walls, sub drains, property boundaries, and slope setbacks. Topographic data and cross sections shall extend beyond the site to demonstrate that adjacent or offsite slopes do not affect the stability of the site. A geologic map and cross sections shall be provided where bedrock formations are involved. The geologic map shall present all the features required on a geotechnical map and the distribution of geologic units, faults, landslides, slumps, bedding attitudes, etc.

C. FIELD EXPLORATION

Describe the method of exploration including sampling and testing of the soil and bedrock. Detailed logs of test pits and borings shall show the locations of all samples and sampling resistance (blow counts, etc.). Ground water and seeps with observed fluctuations should be noted on the logs. For specific guidelines and requirements on hillside exploration and reporting of the results, refer to I.B. P/BC2001-68.

D. LABORATORY TESTING

All laboratory testing must be performed by a City of Los Angeles approved testing agency. Field density tests are considered to be laboratory tests. If data from previous reports are used, copies of the reports and their approval letters shall be included. If testing was done by others, provide a complete laboratory report signed and stamped by the licensed engineer, together with a responsibility statement by the new soils engineer.

Provide descriptions of all testing procedures and sample preparation and ASTM designations. Graphical presentations are required for grain size analyses, maximum density, consolidation, and shear tests. Shear graphs shall include: sample location, soil description, moisture content and dry density at the time of shearing, and shearing rate, type of test/sample preparation (undisturbed or remolded), and if the results are peak, ultimate, or residual. The graphs shall show all test points (minimum 3), the shear strength envelope, resulting cohesion and friction angle. The approximate degree of saturation during testing shall be provided on the graph or an accompanying table. Material testing for slope stability analyses shall be in accordance with I.B. P/BC 2001-49.

E. RESPONSIBILITY STATEMENT

If previous exploration data, laboratory testing, calculations, recommendations, or conclusions by others are relied upon in the investigation, the soils engineer (and geologist if applicable) shall provide a statement of responsibility indicating that the data by others was reviewed and concurred with.

F. ANALYSES

Where more than three analyses cases are evaluated a summary table shall be provided. Analyses and justifications are required for any recommendations less conservative than Code values and for the following:

a) STATIC SLOPE STABILITY ANALYSES.

For slopes steeper than 2:1 or where adverse geologic conditions are encountered, the soils report shall provide slope stability analyses in accordance with I.B. P/BC2001-49: Slope Stability Evaluation and Acceptance Standard, and I.B. P/BC2001-50: Construction Upon Slopes Steeper Than Two Horizontal to One Vertical. Provide cross sections with X & Y coordinates for all calculations, along with the input and output data from computer analyses. Where the site is near or on a known landslide, a back-calculated shear strength of that known landslide shall be provided to verify the material strength. The analyses shall provide a complete search to demonstrate that the worst case condition has been determined. Temporary and permanent slopes require a minimum factor of safety of 1.25 and 1.5, respectively. Temporary cuts require stability analyses if the cut is more than 5-foot vertical; steeper than 1:1 above a 5-foot vertical cut; surcharged by off-site structures, for slot cuts, or adverse geologic conditions. All stability analyses must use saturated shear test data.

b) SEISMIC SLOPE STABILITY ANALYSES.

Seismic slope stability analyses shall be performed for new construction at sites having landslides, and those sites adjoining or within State of California Seismically Induced Landslide Seismic Hazard Zones for all new construction except: one or two floor level single-family dwellings (when not part of a development of four or more dwellings) and alterations or additions not exceeding either 50 percent of either the value of the existing structure or 50 percent of the existing floor area of the structure. Seismic stability analyses shall be in accordance with CGS SP117, I.B. P/BC2001-49, and I.B. P/BC2001-50.

c) LIQUEFACTION ANALYSES.

Liquefaction analysis is required at sites located within State of California Liquefaction Seismic Hazard Zones for all new construction except: one or two floor level single-family dwellings (when not part of a development of four or more dwellings), and alterations or additions not exceeding either 50 percent of either the value of the existing structure or 50 percent of the existing floor area of the structure. When such analysis is required, it shall be based on the maximum historic groundwater level in accordance with CGS Special Publication 117, the SCEC Recommended Procedures, and LAMC 91.1804.5. Seismically induced total and differential settlements and lateral spreading shall be evaluated and reported.

d) LATERAL EARTH PRESSURE ANALYSES.

Retaining walls surcharged by slopes, structures, or adverse geology require lateral earth pressure calculations. Retaining walls over 15-foot high require lateral earth pressure calculations. Calculations shall show minimum factors of safety on mobilized shear strength of 1.5 for static lateral earth pressures and 1.25 for temporary cases. Design lateral pressures shall be equal to or greater than both: those from Table No.1 of IB P/BC2001-83: Retaining Wall Design, and those from limit equilibrium analyses (free-body diagram and vectors). Subdrains shall be provided, or walls shall be designed for full hydrostatic pressure. Walls founded in adverse geologic conditions, or on descending slope will require passive pressure analysis.

e) SETTLEMENT ANALYSES.

Settlement calculations are required where the estimated total and differential settlement of foundations exceed 2 inch and 1 inch, respectively over a 40ft span, and as deemed necessary. Estimated differential settlement between an existing structure and a proposed addition should be reported also.

f) MUDFLOW ANALYSES.

Where the site is located in the path of concentrated drainage or is in an area with a history of debris flows, recommendations conforming with the minimum guidelines of Section 91.7014.3 of the Los Angeles Municipal Code, I.B. P/BC2001-49, and I.B. P/BC2001-64 shall be provided.

G. RECOMMENDATIONS

The recommendations should cover mitigation of the effects of liquefaction and adverse geologic conditions; address the temporary and permanent cut, fill, and natural slopes; provide design parameters for shoring, foundations, retaining walls, pavement, setbacks from ascending and descending slopes; stipulate measures to handle expansive soil conditions; and specify any inspection requirements to be performed by the consulting engineer and/or geologist. Recommendations concerning sub drains, lateral deflection, and sequence of excavation/backfill shall be provided for retaining structures, as appropriate. Recommended minimum earthquake design parameters, soil profile type for use in the static lateral force procedure (LAMC Section 91, Table 16-J), or parameters for dynamic analysis procedures (LAMC Sect.91.1631) shall be provided.

3. CONTENTS OF COMPACTION REPORTS

Pursuant to Los Angeles Municipal Code Sec. 91.7006.2, which stipulates that all fills shall be compacted to a minimum of 90% of the maximum dry density as determined by ASTM D-1557, compaction reports are required to be submitted to this Department for review and approval prior to the placement of foundations. The report shall include, but not limited to, the following:

A. Site address, legal description, and the grading permit under which the work is authorized. The address shall be in the report title. The report, Certificate of Compliance, and grading permit shall all use the same address and legal description for the site.

B. Drawn to scale plot plan with north arrow, showing location, extent, and depth of fill; location and depth of compaction tests; location and height of retaining walls; location and outlets of sub drains; toe and top of slopes; property boundaries; and adjacent structures and streets. Note: Subsurface geologic/geotechnical cross sections and elevations of sub drains may be required if deemed necessary.

C. Statement of:
   a) Purpose and use of fill: for supporting footings, floor slabs, and new fill, for supporting walkways/paving, for non-structural use (landscaping, etc.).
   b) Inspection and approval of the bottom of the excavation prior to placing fill.
   c) Inspection and approval of the sub drain pipes prior to placing gravel.

D. Description of each of the following:
   a) Materials encountered at the bottom of the excavation.
   b) Preparation of the bottom prior to placement of fill.
   c) Fill placement, and preparation.
   d) Moisture content control method and results.
   e) Thickness of the fill layers (typically 6-8 inches) prior to compaction.
   f) Types of compaction equipment and method of mechanical compaction.
   g) Identify fill materials used with Unified Soil Classification, maximum dry density and optimum moisture content.

E. Field density testing results. Field tests should be taken at every two vertical feet or for every 500 cubic yards of fill placed, whichever is more restrictive. Test results showing less than required relative compaction are not acceptable. Description of removal and re-compaction of the unacceptable fill and its retesting shall be included.

F. Nuclear testing results. If used, it shall be performed in conformance with I.B. P/BC2001-28: At least one sandcone test (A.S.T.M. 1556) shall be taken for each five nuclear tests (A.S.T.M. 2922 and 3017). The sand cone test shall be taken at the general location and elevation as one of the five nuclear tests to verify accuracy of the nuclear test results.

G. Laboratory Testing (See Item 2.D above.)
Results of all laboratory tests with applicable ASTM or UBC standard designation numbers and graphical presentation of maximum dry density and optimum moisture content testing. All soil testing shall be performed by a laboratory licensed by the Department's Materials Control Section. Engineers may employ an approved laboratory to perform the testing provided they furnish the Department with a letter of responsibility. A copy of the laboratory report signed and stamped by a licensed engineer shall also be provided.

H. Recommended maximum bearing capacities and minimum embedment of footings in compacted fill. Where the supporting material is Class of Material No.5 in LABC Table 18-I-A, expansion index testing shall be provided or recommendations for special design for highly expansive soil. Where design values exceed those shown in Table 18-1-A and are not recommended in an approved soils investigation report, additional tests for maximum dry density, moisture content, direct shear tests, and consolidation may be required. Shear tests are required for any import soils.

I. For buttress fills and slopes steeper than 2:1, as-built geologic cross sections and shear test results conducted on undisturbed samples are required.

J. A Certificate of Compliance that is completed, signed, and sealed by the Soils Engineer.

4. CONTENTS OF SPECIAL REPORTS

A. SUBDIVISION OF LAND

a. The reports shall conform with I.B. P/BC2001-68 and include the contents of soils and geology reports (Item 2 above).

b. The geologic/geotechnical map shall be based upon the proposed subdivision map and show all proposed property lines.

c. A geologic report is generally not required if the site is not located; on a hillside or in a State Mapped Hazard Zone.

B. FINAL REPORT AND PROGRESS REPORTS FOR TRACT GRADING

a. The report shall conform with the guidelines in LAMC 91.7008.

b. The final geology map must be based upon the "As-Graded" plan prepared and certified by the design engineer or land surveyor. Sub drain locations shall be depicted on the plan.

C. PRIVATE SEWAGE DISPOSAL SYSTEMS

a. The report shall conform with the guidelines of I.B. P/BC2001-27.

D. FAULT-RUPTURE HAZARD ZONE INVESTIGATION

a. The report shall conform with the guidelines of I.B. P/BC2001-44 and CGS Note 49.

E. METHANE GAS REPORT

a. The report shall be prepared by a Civil Engineer experienced in the design of subsurface gas- control systems and conform with LAMC 91.7100 and MGD-92 (I.B. P/BC2001-77 when released).

5. SELECTED DEPARTMENT REFERENCES

BUILDING CODE

LAMC Sect.91.0100	ADMINISTRATION
LAMC Sect.91.1600	STRUCTURAL DESIGN REQUIREMENTS
LAMC Sect.91.1800	FOUNDATIONS AND RETAINING WALLS
LAMC Sect.91.3300	SITE WORK, DEMOLITION, AND CONSTRUCTION
LAMC Sect.91.7000	GRADING, EXCAVATION, AND FILLS
LAMC Sect.91.7100	METHANE SEEPAGE DISTRICT REGULATIONS

INFORMATION BULLETINS

I.B. No.	FORMER RGA/MGD	TITLE
P/BC2001-01		FOOTINGS ON OR ADJACENT TO SLOPES
P/BC2001-14	(RGA 14-67)	DESIGN AND CONSTRUCTION OF SWIMMING POOLS
P/BC2001-27	(MGD#54)	PRIVATE SEWAGE DISPOSAL SYSTEMS-GRADING HILLSIDE AREAS
P/BC2001-28	(MGD#61)	NUCLEAR DEVICES SOIL DENSITY AND MOISTURE DETERMINATION
P/BC2001-30	(RGA 2-66)	INTERCONNECTION TIES FOR INDIVIDUAL PILE CAPS AND CAISSONS
P/BC2001-34	(MGD#87)	EMPLOYMENT AND DUTIES OF A REGISTERED DEPUTY INSPECTOR
P/BC2001-35	(MGD#86)	DEPUTY INSPECTOR CERTIFICATE OF REGISTRATION
P/BC2001-39	(RGA 1-73)	DEMOLITION OF BUILDINGS
P/BC2001-44	(RGA 1-77)	IMPLEMENTATION OF THE ALQUIST-PRIOLO EARTHQUAKE FAULT ZONING ACT
P/BC2001-47	(MGD#81)	SPECIAL REQUIREMENTS FOR FOOTINGS ON EXPANSIVE SOILS
P/BC2001-49	(RGA 1-84)	SLOPE STABILITY EVALUATION AND ACCEPTANCE STANDARDS
P/BC2001-50	(RGA 2-84)	CONSTRUCTION UPON SLOPES STEEPER THAN TWO HORIZONTAL TO ONE VERTICAL
P/BC2001-57	(MGD#102)	DRAINAGE ACROSS LOT/PROPERTY LINE
P/BC2001-58	(MGD#93)	GUIDELINES FOR RECOGNITION OF TESTING AGENCIES
P/BC2001-64	(MGD#63)	FLOOD HAZARD MANAGEMENT SPECIFIC PLAN GUIDELINES
P/BC2001-68	(RGA 5-67)	RULES AND REGULATIONS FOR HILLSIDE TRACT EXPLORATORY WORK
(P/BC2001-77)	MGD#92	METHANE POTENTIAL HAZARD ZONES
P/BC2001-83		RETAINING WALL DESIGN
P/G I2001-18	(RGA6-68)	COMPUTER SOFTWARE PROGRAM SOLUTIONS

NOTE: RGA and MGD numbers enclosed in parenthesis are obsolete. The above references are periodically revised and may be supplemented or replaced by future Information Bulletins. Information Bulletin P/BC2001-77 is applicable when released.

Revision Date 12/18/2002 -tg

PARTNER

GEOTECHNICAL FEASIBILITY REPORT

New Curtis School Additions
15871 Mulholland Drive
Los Angeles, California

April 24, 2019
Partner Project Number: 17-196035.1

Prepared for:

Cox, Castle & Nicholson
2029 Century Park East, Suite 2100
Los Angeles, California 90067

Engineers who understand your business

April 24, 2019

M. Alexander M. DeGood
Cox, Castle & Nicholson
2029 Century Park East, Suite 2100
Los Angeles, California 90067

Subject: **Geotechnical Feasibility Report**
New Curtis School Additions
15871 Mulholland Drive
Los Angeles, California
Partner Project No. 17- 196035.1

Dear M. DeGood:

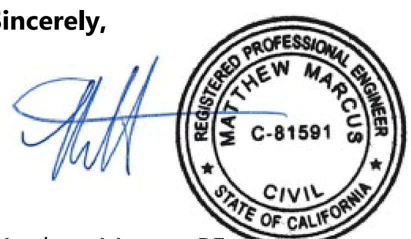
Partner Assessment Corporation (Partner) presents the following general opinion regarding the geotechnical conditions at the subject site, based on the information contained within this geotechnical evaluation and our general experience with construction practices and geotechnical conditions on other sites. This opinion does not constitute our engineering recommendations; our engineering recommendations are contained in Sections 1 and 5 of this geotechnical report.

- The geotechnical conditions on the site related to the planned construction should be similar to other similar sites* located within the project vicinity.

The descriptions and findings of our geotechnical feasibility report are presented for your use in this electronic format, for your use as shown in the hyperlinked outline below. To return to this page after clicking a hyperlink, hold "alt" and press the "left arrow key" on your keyboard.

We appreciate the opportunity to be of service during this phase of the work.

Sincerely,



Matthew Marcus, PE
Technical Director – Geotechnical Engineering

**This refers to sites with similar planned and existing uses, where we have recently performed work, and is a general statement not based on statistical analysis*

1.0 GEOTECHNICAL EXECUTIVE SUMMARY

Geologic Zones and Site Hazards:

According to the report*: The subject property is located in the city of Los Angeles in the Transverse Ranges Geomorphic Providence of California. The Transverse Ranges are east to west trending mountain ranges and valleys. The site is within the Santa Monica Mountains, bounded by San Fernando Basin to the north and Santa Monica and Hollywood basins to the south. Native site soils consist of upper Miocene Modelo Formation – sedimentary rock. This portion of Southern California is considered to have high seismic activity, and it is near the earthquake induced landslide zones however is not in the Alquist-Priolo Seismic Hazard Zones of Required Investigation.

Excavation Conditions

According to the report*: The site is an existing private school with many classrooms, buildings, athletic courts, fields and landscaping areas. The new construction is planned for both the northwest side of campus and the southeast side of campus. Site soils are a mixture of silty sands and weathered rock and bedrock that ranges from 20 to 40 feet below ground surface. We anticipate that excavation of soil for foundations will be possible with construction equipment in good working order. We do anticipate excavations deeper than 4 feet on the site, and recommend native soils to be graded no steeper than 1.5:1 (H:V) for excavations up to 10 feet in depth. It is also recommended that excavated soils be placed a minimum lateral distance from top of slope equal to the height of slope. Groundwater was not encountered and is not anticipated on the site. Groundwater levels fluctuate over time.

Foundation/Slab Support

According to the report*: Spread foundations should be considered for the new building foundations. The foundations can be supported on engineered fill and/or competent, clean native soil compacted in-place, as described in the report. Slabs-on-grade areas should be supported on non-expansive engineered fill or native soils. All grass, roots and other plant materials should be removed from structural areas of the site. In new fill areas more than 2 feet below planned slabs or in new pavement areas, cleaned subgrade should be proofrolled and evaluated by the engineer. Soft or unstable areas should be repaired per the direction of the engineer. The approved subgrade should be scarified, moisture conditioned and recompacted to a depth of 12 inches prior to the placement of new fills, slabs or pavements.

Soil Reuse

According to the report*: Site clayey soils that are moderately expansive are not usable as engineered fill below new slabs on grade (within the upper 2 feet). It is recommended to use non-expansive structural fill that is free of deleterious materials, and is properly moisture conditioned and compacted to 95% of the modified proctor (ASTM D 1557) is recommended.

Pavement Design: According to the report*:

Roadway Type	*Subgrade Preparation*	*Pavement Section*
Parking Area Light Duty	Proofrolled Subgrade*	3-in asphalt / 6-in aggregate base
Parking Area Heavy Duty	Proofrolled Subgrade*	3-in asphalt / 9-in aggregate base
Parking Area Heavy Duty	Proofrolled Subgrade*	6-in concrete / 4-in aggregate base

This summary in no way replaces or overrides the detailed sections of the report*

2.0 REPORT OVERVIEW AND LIMITATIONS

2.1 Report Overview

To develop this report, Partner accessed existing information and obtained site specific data from our exploration program. Partner also used standard industry practices and our experience on previous projects to perform engineering analysis and provide recommendations for construction along with construction considerations to guide the methods of site development. The opinions on the cover letter of this report do not constitute engineering recommendations, and are only general, based on our recent anecdotal experiences and not statistical analysis. Section 1.0, Geotechnical Executive Summary, compiles data from each of the report sections, while each of sections in the report presents a detailed description of our work. The detailed descriptions in Section 5.0 and Appendix C constitute our engineering recommendations for the project, and they supersede the Geotechnical Executive Summary.

The report overview, including a description of the planned construction and a list of references, as well as an explanation of the report limitations is provided in Section 2.0. The findings of Partner's geologic review are included in Section 3.0 Geologic Conditions and Hazards. The descriptions of our methods of exploration and testing, as well as our findings are included in Section 4.0 Geotechnical Exploration and Laboratory Results. In addition, logs of our exploration excavations are included in Appendix A of the report, and laboratory testing is included in Appendix B of the report. Site Location and Site Plan maps are included as Figures in the report.

2.2 Assumed Construction

Partner's understanding of the planned construction was based on information provided by the project team. The proposed site plan is included as Figure 2. Partner's assumptions regarding the new construction are presented in the below table.

Property Data	
Planned Use	New School Buildings, Athletic Fields & Parking Lots
New Footprint/Height	89940 sf of new school buildings, max height of 40 feet, 2 new athletic fields, 13 retaining walls 5-10 ft high, surface parking/driveway
Site Area	Roughly 25 ac
Type of Construction	Concrete slab-on-grade and lightweight framing
Foundations Type/Loading	Spread foundations, 3,000 psf
Site Setting	Developed as a school with approx. 12 buildings, base of a large slope, near landslide hazard zone
Soil Exploration Plan:	9 SPT borings from 5 to 50 feet in depth, use of previous report

2.3 References

The following references were used to generate this report:

California Department of Transportation, ARS Online, accessed 9/25/17
http://dap3.dot.ca.gov/ARS_Online/

California Geological Survey, Note 36, *California Geomorphic Provinces*, 2002.

Federal Emergency Management Agency, FEMA Flood Map Service Center (online), accessed 9/25/2017

Google Earth Pro (Online), accessed 9/25/2017

United States Geological Survey, Lower 48 States 2014 Seismic Hazard Map, accessed online 9/25/2017, http://earthquake.usgs.gov/hazards/products/conterminous/2014/HazardMap2014_lg.jpg

United States Geological Survey Topographic Map 2015, 7.5 minute series, *Van Nuys, California*, accessed via internet, accessed 9/25/2017

United States Geologic Survey, Earthquake Hazards Program (Online), http://earthquake.usgs.gov/designmaps/us/application.php, accessed 9/25/2017

2.4 Limitations

The conclusions, recommendations, and opinions in this report are based upon soil samples and data obtained in widely spaced borings, and are subject to field confirmation that the samples we obtained were representative of site conditions. If conditions on the site are different than what was encountered in our borings, the report recommendations should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed. It should be noted that geotechnical subsurface evaluations are not capable of predicting all subsurface conditions, and that our evaluation was performed to industry standards at the time of the study, no other warranty or guarantee is made.

Likewise, our document review and geologic research study made a good-faith effort to review readily available documents that we could access and were aware of at the time, as listed in this letter. We are not able to guarantee that we have discovered, observed, and reviewed all relevant site documents and conditions. If new documents or studies are available following the completion of the report, the recommendations herein should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed.

This report is intended for the use of the client in its entirety for the proposed project as described in the text. Information from this report is not to be used for other projects or for other sites. All of the report must be reviewed and applied to the project or else the report recommendations may no longer apply. 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 for review. Significant variations may necessitate a re-evaluation of the recommendations presented in this report. The findings in this report are valid for one year from the date of the report

If parties other than Partner 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.

Our statements regarding geotechnical conditions listed on our cover letter are based on this study and our previous anecdotal experience, and do not constitute engineering recommendations. We expect that exceptions to our opinions can be found and no guarantee or warranty is implied by our statement. The opinion footnotes are explained below:

3.0 GEOLOGIC CONDITIONS AND HAZARDS

This section presents the results of a geologic review performed by Partner, for a proposed 4 modular classroom buildings. The general location of the project is shown on Figure 1.

3.1 Site Location and Project Information

The planned construction of the proposed retaining walls and arts, library and house buildings will be on the northwest part of the campus. Proposed parking lot, 2 fields, gymnasium and classroom building is planned on the southeast part of the campus. The site is located at 15871 Mulholland Drive, Los Angeles, California. Figure 2 presents the project site and the locations of our site exploration. Based on our review of available documents, the site has had the following previous uses:

Historical Use Information		
Period/Date	**Source**	**Description/Use**
Unknown to 1981	Online Records	Undeveloped hillside
1994 to present	Online Records	School Campus

3.2 Geologic Setting

The subject property is located in the city of Los Angeles in the Transverse Ranges Geomorphic Providence of California. The Transverse Ranges are east to west trending of steep mountain ranges and valleys resulting from north-south tectonic compression and extends from the San Bernardino Mountains in the east to the offshore Channel Islands to the west. The site is within the Santa Monica Mountains, bounded by San Fernando Basin to the north and Santa Monica and Hollywood basins to the south. The mountains, as such, are not considered water bearing formations; however, groundwater can exist in within fractures within the bedrock, and may be manifest as localized seeps and springs. No seeps or springs were noted within the property boundaries.

Native site soils consist of upper Miocene Modelo Formation. The formation is described as: a silty shale or soft earthy siltstone and interbedded fine- to coarse-grained lithic or arkosic wacke. The maximum thickness is approximately 1350 meters. Additionally, some of the prominent ridges were mapped as massive, fine- to coarse-grained sandstone sequences. These sandstones can be a much as 175 meters thick. The bedrock as mapped was depicted as striking approximately N80W and dipping between 16 and 20 degrees to the north. This portion of Southern California is considered to have high seismic activity, and it is near the earthquake induced landslide zones however is not in the Alquist-Priolo Seismic Hazard Zones of Required Investigation.

Geologic Data		
Parameter	**Value**	**Source**
Geomorphic Zone	Traverse Ranges	California Department of Conservation
Ground Elevation	1270 feet above MSL	Google Earth
Seismic Hazard Zone	Medium	USGS Seismic Hazards Maps
Geologic Hazards	Landslides	California Department of Conservation
Surface Cover/Depth	Grass, Asphalt, Buildings	Google Earth
Site Modifications	School buildings	Google Earth; NETR Online
Surficial Geology	Mv-Miocene Formation	Los Angeles 30 x 60 Quadrangle

Geologic Data		
Parameter	**Value**	**Source**
Depth to Bedrock	40+ feet	Soil Borings
Groundwater Depth	Not Encountered	Soil Borings
Historic High GW depth	50+ feet bgs	California Department of Conservation

3.3 Geologic Hazards and Parameters

The Seismic design parameters based on the USGS Design Maps Detailed Report for ASCE 7-10 Standard Method are presented below.

Seismic Item	*Value*	*Seismic Item*	*Value*
Site Classification	D	Seismic Design Category	D
Fa	1.0	Fv	1.5
Ss	2.180	S_1	0.761
S_{MS}	1.618g	S_{M1}	1.142g
S_{DS}	1.453g	S_{D1}	0.761g
PGA Max (ASCE '10)	0.786g	67% PGA (ASCE '10)	0.5266

3.3.1 Liquefaction and Landslide Potential

Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soils most susceptible to liquefaction are clean, loose, saturated, and uniformly graded fine-grained sands. Four conditions are generally required before liquefaction can occur: 1) the soils must be saturated (relatively shallow groundwater less than 40 feet in depth); 2) the soils must be loosely packed (low to medium density); 3) the soils must be relatively cohesion less (not silty or clayey); and 4) ground shaking of sufficient intensity must occur as a trigger mechanism.

The site is not situated in a geologic hazard area with regards to areas of potential liquefaction. A portion of the property along the west side is indicated as having a potential for seismically induced landslides with slopes in excess of 30 feet in height, however this portion of the property is already included in the slope setback easement for the Mulholland Scenic Corridor, and the potential for seismically induced landslides affecting construction on the site is considered negligible.

3.3.2 Faulting

We consider the most significant geologic hazard to the project to be the potential for moderate to strong seismic shaking that is likely to occur during the design life of the proposed project. The project site is located in the highly seismic Southern California region within the influence of several faults that are considered to be active or potentially active. An active fault is defined by the State of California as a "sufficiently active and well-defined fault" that has exhibited surface displacement within the Holocene time (about the last 11,000 years). A potentially active fault is defined by the State as a fault with a history of movement within Pleistocene time (between 11,000 and 1.6 million years ago).

These active and potentially active faults are capable of producing potentially damaging seismic shaking at the site. It is anticipated that the project site will periodically experience ground acceleration as the result of small to moderate magnitude earthquakes. Other active faults without surface expression (blind faults) or other potentially active seismic sources are not currently zoned and may be capable of generating an earthquake are known to be locally present under the region.

There are a number of faults in the southern California area which are considered active and will have an effect on the site in the form of moderate to strong ground shaking, should they be the source of an earthquake. These include, but are not limited to: the Northridge fault, the Malibu Coast fault, the San Andreas fault, the Newport-Inglewood (Rose Canyon) fault, the Hollywood fault, the Palos Verdes fault, the Santa Monica fault, the Sierra Madre Fault, and the San Jose fault.

Based on our review of the referenced geologic maps, as well as on our geologic field reconnaissance, the subject site is not underlain by known active or potentially active faults (i.e., faults that exhibit evidence of ground displacement in the last 11,000 years and 1,600,000 years, respectively). Los Angeles is subject to strong seismic shaking from numerous active faults. The three most relevant faults to the site, based on the Caltrans ARS Online resource are: the Anacapa-Dume (4.9 miles from the site, MMax = 7.2), Santa Monica Fault (5.3 miles from the site, MMax = 7.0), Newport Inglewood Fault Zone (5.7 miles from site, MMax = 7.2).

4.0 GEOTECHNICAL EXPLORATION AND LABORATORY RESULTS

Our evaluation of soils on the site included field exploration and laboratory testing. The field exploration and laboratory testing programs are briefly described below. Data reports from the field exploration and laboratory testing are provided in Appendix A and Appendix B, respectively.

4.1 Soil Borings

The soil boring program was conducted on September 11-12, 2017. Borings were advanced by the use of a truck-mounted drill using hollow-stem auger drilling techniques. Several borings were placed in the new buildings envelope as well as in the proposed fields and parking lot. The approximate locations of exploratory borings are shown on Figure 2.

A log of subsurface conditions encountered in the borings was prepared in the field by a representative of our firm. Soil samples consisting of relatively undisturbed brass ring samples and Standard Penetration Tests (SPT) samples were collected at approximately 5-foot depth intervals and were returned to the laboratory for testing. The SPTs were performed in accordance with ASTM D 1586. Typed boring logs were prepared from the field logs and are presented in Appendix A. A summary table description is provided below:

Surficial Geology		
Strata	**Depth to Bottom of Layer (ft bgs*)**	**Description**
Surface Cover	0-1	Grass/ Asphalt
Native Stratum 1	5-10	Clean silty material
Native Stratum 2	10-20	Dense/Med Dense Alluvial Soil
Groundwater	NA	Not Encountered in Borings
Bedrock	20-40+	Soil Borings

bgs – below ground surface

4.2 Groundwater/Soil Moisture:

Groundwater was not encountered in the borings and is not anticipated on the site. Water levels can fluctuate over time.

4.3 Laboratory Evaluation

Soil samples were submitted to a Los Angeles certified testing laboratory, Hamilton and Associates TA10199. A letter from Hamilton and Associates approving the use of their results is attached in Appendix B. We have reviewed and agree with the results. Tests performed included in-place moisture and density, sieve analysis, consolidation, shear strength, R-value and plasticity index. The results of laboratory analyses are presented in the boring logs in Appendix A.

5.0 RECOMMENDATIONS AND PARAMETERS

The following discussion of findings for the site is based on the assumed construction, geologic review, results of the field exploration, and laboratory testing programs. The recommendations of this report are contingent upon adherence to Appendix C of this report, General Geotechnical Design and Construction Considerations.

5.1 Geotechnical Recommendations

The proposed construction is generally feasible from a geotechnical perspective provided the recommendations and assumptions of this report are followed.

GEOLOGIC CONCERNS

- The site is located in a seismically active region of Southern California, and is also near the zone of required seismically induced landslide hazard zone of investigation.

EXCAVATION CONSIDERATIONS

- The site is an existing private school with many classrooms, buildings, athletic courts, fields and landscaping areas. The new construction is planned for both the northwest side of campus and the southeast side of campus. Site soils are a mixture of silty sands and weathered rock and bedrock that ranges from 20 to 40 feet below ground surface. We anticipate that excavation of soil for foundations will be possible with construction equipment in good working order. However, excavations into weathered rock with blow counts of over 75 blows per foot, may be difficult to excavate and require special equipment. Groundwater was not encountered and is not anticipated on the site. Groundwater levels fluctuate over time.
- We anticipate excavations deeper than 4 feet on the site, and recommend native soils to be graded no steeper than 1.5:1 (H: V) for excavations up to 10 feet in depth. It is also recommended that excavated soils be placed a minimum lateral distance from top of slope equal to the height of slope. In some cases shoring/ slot cuts may be needed to establish safe excavations for new utility lines or retaining walls into cut-slopes such as when the excavation is to be within a 2:1 (horizontal to vertical) zone below foundations or property lines. Temporary slopes and shoring should be constructed in accordance with OSHA and City of Los Angeles requirements. The design can use soil data from Section 5.2 of this report. Spacing and depth calculations for temporary soldier pile and lagging retaining walls if needed, should be done by a certified contractor, and should comply with City of Los Angeles requirements. The calculated deflection at the top of the wall should be less than ½ inch. Surcharge loading from nearby buildings should be taken into account, along with seismic accelerations, as described later in the report. Additional details are provided in Appendix C, Excavations and Dewatering. Groundwater is not anticipated to impact this effort.
- For other smaller excavations, slot cutting can be acceptable. Based on shear strength data for weathered bedrock encountered on site, 500 psf is assumed for conservatism. Based on our calculations, a slot width of 8 feet should produce an acceptable factor of safety for excavations up to 10 feet high. The design can use soil data from Section 5.2 of this report. Slot Cut calculations can be found in Appendix D.

  Proposed Athletic Fields (South portion of the campus)

- We understand that significant cuts are planned in the slope where the proposed athletic fields are to be constructed. Borings B-4 and B-6 were located in that area, and encountered weathered rock at depths of 15 and 20 feet. The material over-lying the weathered rock appears to be suitable fill soil. The weathered rock may be difficult to remove, and may require processing to generate usable fill material, as described in the Site Work Considerations below.

- FOUNDATION CONSIDERATIONS

  Spread foundations should be considered for the new building foundations. There are several different bearing conditions on the site; buildings that will be supported on deep fills, buildings supported in native soil and buildings supported on weathered rock. It is preferable that each building have a uniform subgrade material that is either all fill, all native soil or all rock. Following the preparation of the foundation excavations, they should be inspected and approved prior to the installation of reinforcing steel and concrete.

  The Arts Building and Gymnasium

  Based on the grading plan we reviewed, the Arts Building and the Gymnasium may be constructed over a cut/fill transition, which would result in a possible differential foundation bearing condition. As such, for buildings with a differential bearing condition, we recommend that foundation and slab supporting fills deeper than 5 feet be compacted to 98% and fills 5 feet or less may be compacted to 95% of the soil maximum dry density. For the portion of the building that would otherwise bear on hard native soils or weathered rock, we recommend that they be over-excavated by 24 inches and replaced with engineered fill compacted to 95% of the soil maximum dry density. Where engineered fill is used to support new buildings, it should extend laterally 5 feet from the building edges in all directions.

  Buildings or Retaining Walls to be constructed near to or below existing grades

  For new foundations to be constructed at existing grades, we recommend that the foundation excavations be made to the planned bearing grade, and that the bottom of the excavation be moisture conditioned and compacted in-place.

SITE WORK CONSIDERATIONS

- Following removal of the existing remnants of construction, any flatwork and/or driveway areas, as well as any areas to receive new fills, should be dragged clean and proofrolled with a full 4,000 gallon water truck or equivalent equipment under the supervision of an engineering inspector. Soft or unstable areas should be removed or repaired. The remaining areas should be scarified and moisture conditioned to a depth of 12 inches, and should be compacted in-place as structural fill prior to the placement of concrete, asphalt, or fill materials. Slabs should bear on a capillary break layer of open-graded rock and the architect should be consulted regarding the use of a moisture barrier below the slab.

- In general the excavated site soils in the upper 4 or 5 feet should be acceptable for re-use as compacted fill. Debris, organic materials, and clay that are unsuitable may be present on the site. Clay and debris that is not processed, along with organic materials and grasses should be placed in non-structural areas of the site. For the mat foundation option is selected, site soils will need to be exported and replaced with aggregate base structural fill material. Structural fill for this project should include clean, non-expansive material that is moisture conditioned and compacted to 95% or more of the soil's modified Proctor (ASTM 1557) maximum dry density, generally near its optimum moisture content. Aggregate Base mat subgrade should be compacted to 98% or more of the maximum dry density.

- Concrete should be corrosion resistant, using Type II/V Portland Cement, and fly ash mixtures of 25 percent cement replacement. We recommend a water/cement ratio of 0.45 or less. Site soil may be corrosive to un-protected metallic elements such as pipes, poles, etc.

RETAINING WALLS AND SLOPES

- Numerous slopes and retaining walls are planned on the project site. Parameters for their design are provided below. Proper grading and drainage along the slopes and wall, as described in Appendix C are critical to their proper performance. This includes the use of waterproofing, weep holes, and slope protection against erosion. Landscaping maintenance should also be coordinated and planned for the life of the structures.

5.2 Geotechnical Parameters

Based on the findings of our field and laboratory testing, we recommend that design and construction proceed per industry accepted practices and procedures, as described in Appendix C, General Geotechnical Design and Construction Considerations (Considerations).

5.2.1 **Subgrade Preparation** parameters – in accordance with Appendix C:

Subgrade Preparation				
Structure	***Bearing Capacity+***	***Embedment Depth***	***Bearing Surface****	***Total ** Settlement***
Grade Slabs	150 pci	NA	12 in compacted in-place	<1 inch
Spread Foundations	3,000 psf	24 inches	Varies per Section 5.1	<1 inch

+Bearing capacity can be increased by 1/3 for temporary loading conditions, such as seismic and wind loads.

*Repairs in bearing *surface areas should be structural fill per the recommendation of the Earthwork section of Appendix C that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557. Granular soil with more than 35% gravel and less than 12% fines can be used in lieu of Aggregate Base material. Grade slabs should be supported on capillary break material and appropriate moisture barriers*

***For spread foundations differential settlement should be ¾ of total settlement*

5.2.2 **Laterally Loaded Structures** parameters, in accordance with Appendix C.

The design of permanent basement walls, as well as soldier pile walls, and other structures that are loaded laterally should be in accordance with this section of Appendix C, as well as the sections regarding **Excavations and Dewatering**, and **Waterproofing and Drainage**.

Retaining walls that are fixed at top and bottom are handled differently than walls that are flexible at the top. The information is divided into separate sections to cover both cases. Guidance is also provided for handling surcharge and seismic loads.

5.2.2.1 Permanent Basement Walls and Fixed Shoring walls

The parameters in this section pertain to walls that are fixed at the top and bottoms, so that strain is not allowed. This would apply to the underground basements walls and any shoring system that uses boxes, struts, jacks, etc.

Lateral Earth Pressures [b]

Soil Type	Dry Density (pcf)	Static Fluid Pressure (pcf)	Active Fluid Pressure (pcf)	Passive Fluid Pressure (pcf)
In-place Native Soil	110	55	35	350
In-place Weathered Rock	100	35	20	450
Compacted Soil Backfill	110	55	35	350

[b] *These loads should be modified by seismic and surcharge loads as shown in the below equations where k = 0.5. Assumes ML materials with Friction Angle 29 degrees (native); Cohesion 0 psf*

Nearby Foundation Surcharge Loading Equations

Resultant lateral force:

$$R = \frac{0.3Ph^2}{x^2+h^2}$$

Location lateral resultant:

$$d = x\left[\left(\frac{x^2}{h^2}+1\right)\left(\tan^{-1}\frac{h}{x}\right)-\left(\frac{x}{h}\right)\right]$$

WHERE:

R = resultant lateral force measured in pounds per foot (N/m) of wall width.

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P	=	resultant surcharge loads of continuous or isolated footings measured in pounds per foot (N/m) of length parallel to the wall.
X	=	distance of resultant load from back face of wall measured in feet (mm).
h	=	depth below point of application of surcharge loading to top of wall footing measured in feet (mm).
d	=	depth of lateral resultant below point of application of surcharge loading measured in feet (mm).
$\tan^{-1} h/x$	=	The angle in radians whose tangent is equal to *h/x*.

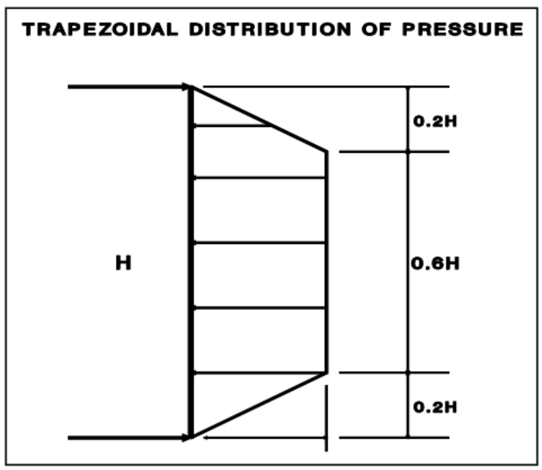
Loads applied within a horizontal distance equal to the wall stem height, measured from the back face of the wall, shall be considered as surcharge.

For isolated footings having a width parallel to the wall less than 3 feet (914 mm), "*R*" may be reduced to one-sixth the calculated value.

The resultant lateral force "*R*" shall be assumed to be uniform for the length of footing parallel to the wall and to diminish uniformly to zero at the distance "*x*" beyond the ends of the footing.

Vertical pressure due to surcharge applied to the top of the wall footing may be considered to spread uniformly within the limits of the stem and planes making an angle of 45 degrees with the vertical.

For fixed shoring the pressure distribution curve should be as below:



5.2.2.2 Non-fixed Retaining Walls

The parameters in this section pertain to walls that are not fixed at the top and allow for some strain. Such walls would likely include the excavation shoring if soldier piles and lagging are used, or other site retaining walls at the project perimeter, if any.

***Lateral Earth Pressures** [b]*				
Soil Type	**Dry Density (pcf)**	**Static Fluid Pressure (pcf)**	**Active Fluid Pressure (pcf)**	**Passive Fluid Pressure (pcf)**
In-place Native Soil	110	55	35	350
In-place Weathered Rock	100	35	20	450

Compacted Soil Backfill	110	55	35	350

These loads should be modified by seismic loads as shown in the below equations where gamma = 120 pcf, and by surcharge loads as shown above:

Seismic Loading Equations (From LABD)

Combined effect of static and seismic lateral force:
$P_{AE} = F_1 + F_2$

$F_1 = 1/2*A*H^2$ Resultant acting at a distance of H/3 from base of wall
$F_2 = 3/8*K_h* \gamma*H^2$ Resultant acting at a distance of (0.6*H) from base of wall

Where:
F_1 = Static Force (plf) based on active pressure
F_2 = Seismic Lateral Force (plf) based on seismic pressure
γ = 120 pcf
$K_h = S_{DS}/2.5$
A = Active Pressure (pcf)
H = Height of retained soil (ft)

5.2.3 **Paving** recommended structural section – in accordance with Appendix C:

Pavement Sections		
Roadway Type	***Subgrade Preparation***	***Pavement Section***
Parking Area Light Duty	Proofrolled Subgrade*	3-in asphalt / 6-in aggregate base
Parking Area Heavy Duty	Proofrolled Subgrade*	3-in asphalt / 9-in aggregate base
Parking Area Heavy Duty	Proofrolled Subgrade*	6-in concrete / 4-in aggregate base

**Repairs in proofrolled areas should be structural fill per the recommendation of the Earthwork section of Appendix C that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557. Expansive material should not be located within the upper 3 feet of the soil subgrade*

FIGURES

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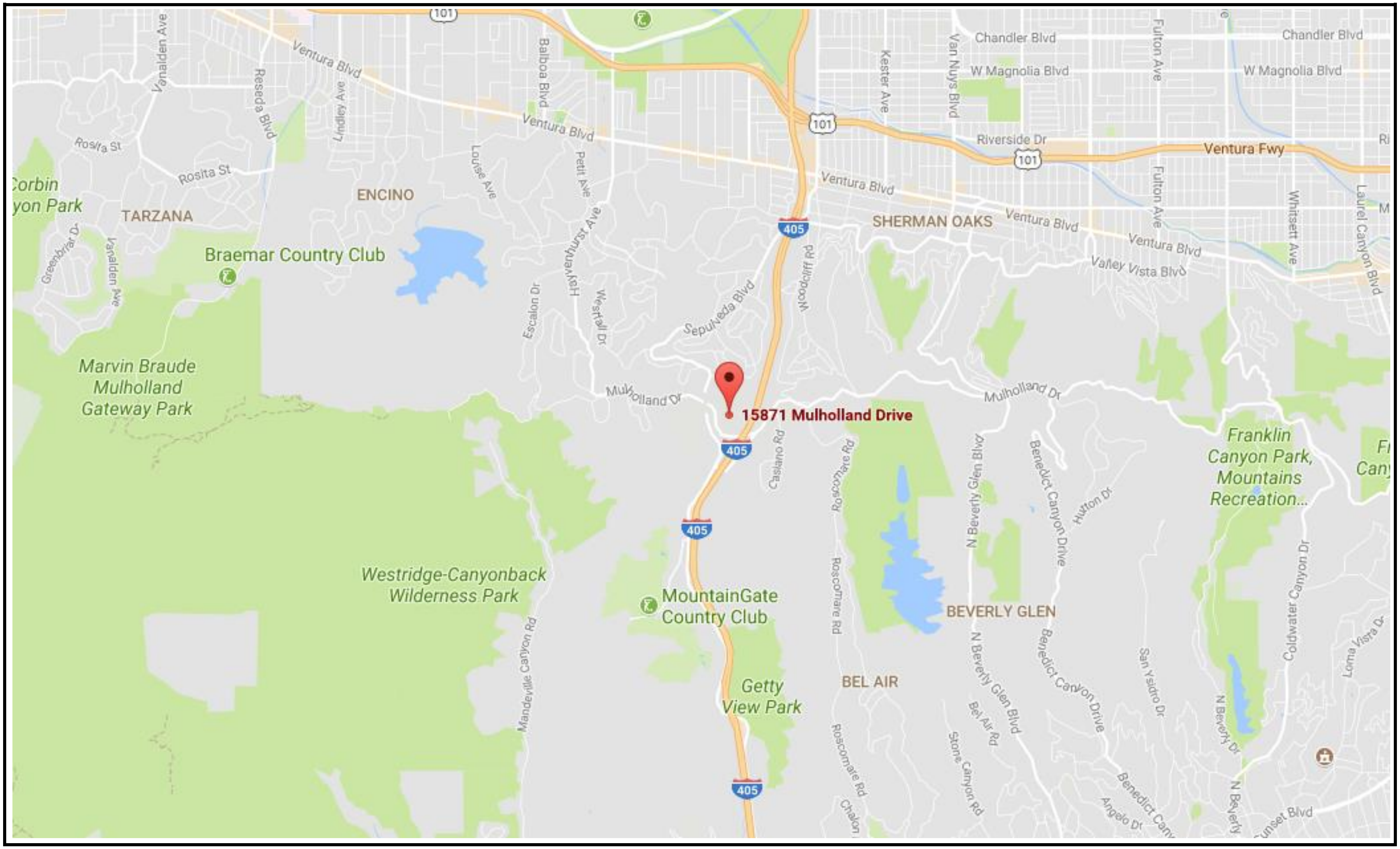

N

Key:

Approximate Site Location

FIGURE 1: SITE LOCATION
Project No. 17-196035.1

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FIGURE 2: 2010 & 2017 BORING PLAN
Project No. 17-196035.1

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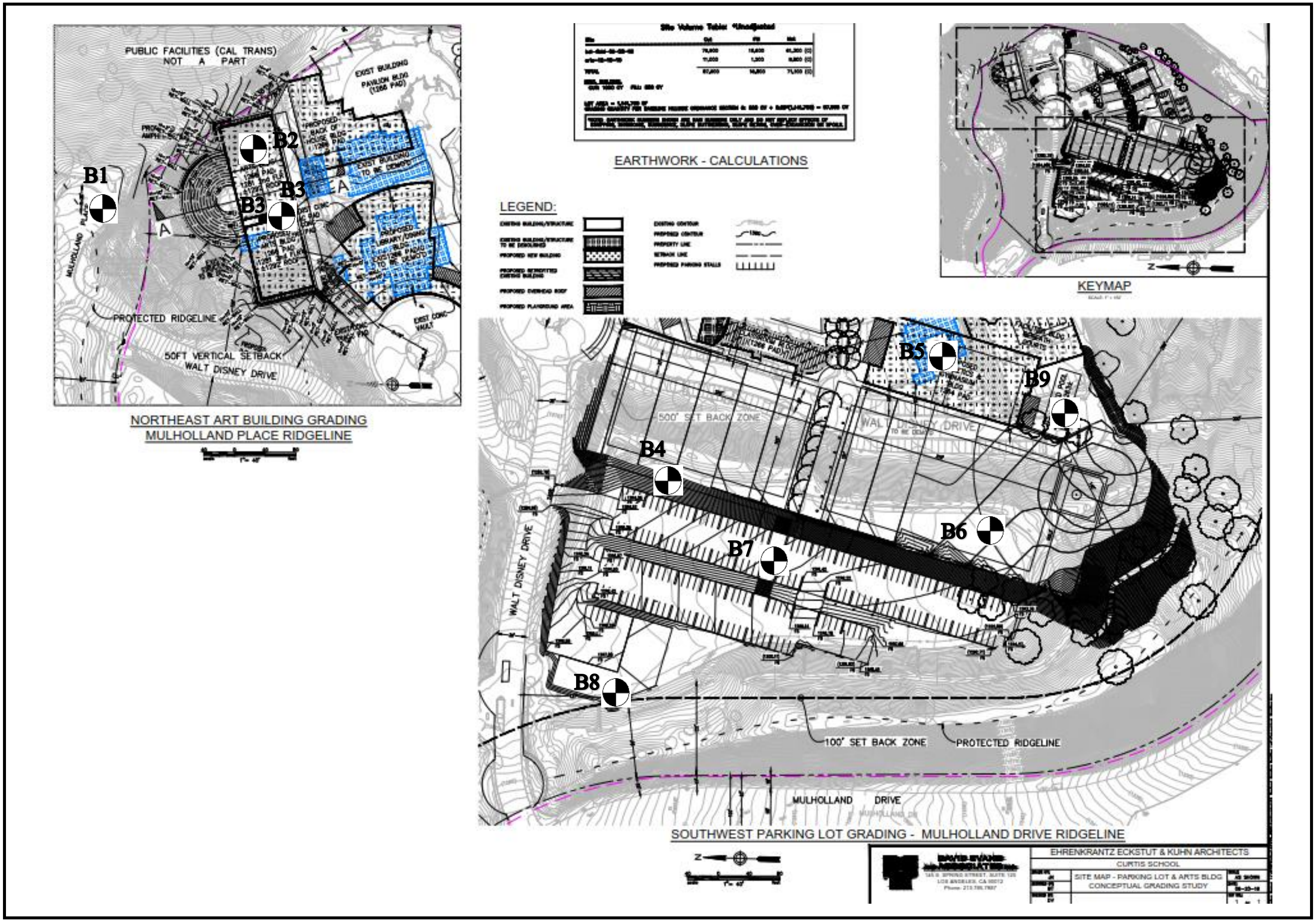
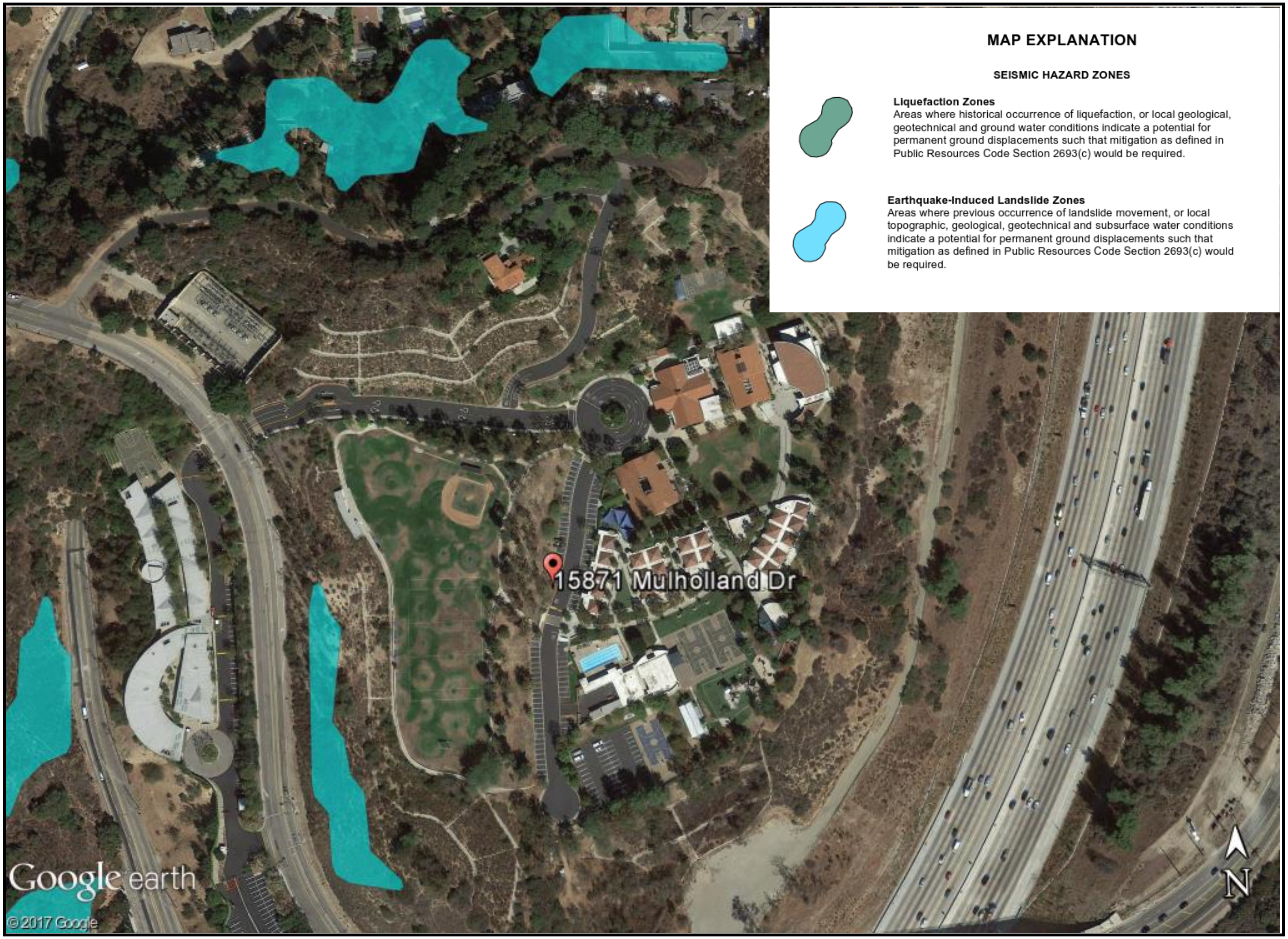


FIGURE 3: 2017 BORING PLAN
Project No. 17-196035.1

PARTNER



Source: California Geological Survey, Earthquake Zones of Required Investigation, Van Nuys Quadrangle, Seismic Hazard Zones, Official Map, 1998.

FIGURE 4: SEISMIC HAZARD MAP
Project No. 17-196035.1

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APPENDIX A

Boring Logs

PARTNER

Boring Number:	B1	Page 1 of 10	
Location:	Northeast corner on hill	Date Started:	9/12/2017
Site Address:	15871 Mulholland Drive	Date Completed:	9/12/2017
	Los Angeles, California	Depth to Groundwater:	--
Project Number:	17-196035	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** Topsoil and rooted vegetation
1				
2				
3				
4				
5	R	50/4"	WR	**WEATHERED ROCK:** Light brown, stiff, dry, SILTSTONE w/ fine sand
6				(Dry Density: 83.9 pcf; Moisture Content: 20.5%)
7				
8				
9				
10	S	50/3"		Brown, stiff, moist, weathered SILTSTONE w/clay
11				
12				
13				
14				
15	R	50/2"		(Dry Density: 92.9 pcf; Moisture Content: 20.5%)
16				
17				
18				
19				
20	S	50/6"		Grey brown w/ oxidation mottled clayey silt
21				
22				
23				
24				
25	R	50/4"		(Dry Density: 92.8 pcf; Moisture Content: 21.5%)
26				
27				
28				
29				...continued on next page

Boring Number:	B1		
Location:	Northeast corner on hill	Date Started:	9/12/2017
Site Address:	15871 Mulholland Drive	Date Completed:	9/12/2017
	Los Angeles, California	Depth to Groundwater:	--
Project Number:	17-196035	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
30	S	50/4"		Grey brown, stiff, moist, weathered SILTSTONE w/clay
31				
32				
33				
34				
35	R	50/6"		Brown, w/oxidation mottling (Dry Density: 92.7 pcf; Moisture Content: 17.2%)
36				
37				
38				
39				
40	S	50/6"	WR	Brownish red, very dense, moist, weathered SANDSTONE w/ silty fines
41				
42				
43				
44				
45	R	50/4"		Grey, hard, moist, weathered SANDSTONE w/mica and oxidation mottling
46				(Dry Density: 92.0 pcf; Moisture Content: 15.3%)
47				
48				
49				
50	S	50/3"	WR	Dark grey brown, hard, moist, weathered SILTSTONE w/clay

Boring Terminated at 50 feet

Backfilled with spoils upon completion

Groundwater was not encountered

Boring Number:	B2		
Location:	Northeast corner behind building	Date Started:	9/11/2017
Site Address:	15871 Mulholland Drive	Date Completed:	9/11/2017
	Los Angeles, California	Depth to Groundwater:	--
Project Number:	17-196035	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** Topsoil and rooted vegetation
1				
2	R	59	WR	**WEATHERED ROCK:** Tan, moist, dense, weathered SANDSTONE w/ shale interbeds
3				(Dry Density: 107.7 pcf; Moisture Content: 12.5%)
4				
5	R	49		(Dry Density: 102.9 pcf; Moisture Content: 21.4%)
6				
7	R	45		Dark olive, w/ fines (Dry Density: 101.3 pcf; Moisture Content: 22.0%)
8				
9				
10	S	50/5"		Light yellow, very dense
11				
12				
13				
14				
15	R	50/6"		(Dry Density: 99.3 pcf; Moisture Content: 9.4%)
16				
17				
18				
19				
20	S	50/5"		
21				Boring Terminated at 21 feet
22				Backfilled with spoils upon completion
23				Groundwater was not encountered
24				
25				
26				
27				
28				
29				
30				
31				
32				

Boring Number:	B3		Page 4 of 10
Location:	Northeast of property behind Tuttle building	Date Started:	9/12/2017
Site Address:	15871 Mulholland Drive	Date Completed:	9/12/2017
	Los Angeles, California	Depth to Groundwater:	--
Project Number:	17-196035	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** Topsoil and rooted vegetation
1				
2	S	28	WR	**WEATHERED ROCK:** Tan, moist, medium dense, SANDSTONE w/ trace organics & shale
3				
4				
5	R	72		dense (Dry Density: 99.8 pcf; Moisture Content: 21.0%)
6				
7	S	50/5"		Light yellow, very dense, w/ silty fines
8				
9				
10	R	50/6"		Light brown w/clay (Dry Density: 102.1 pcf; Moisture Content: 13.0%)
11				
12				
13				
14				
15	S	50/4"		Brown
16				
17				
18				
19				
20	R	50/6"		Brown/grey mottled (Dry Density: 98.8 pcf; Moisture Content: 17.8%)
21				Boring Terminated at 21 feet
22				Backfilled with spoils upon completion
23				Groundwater was not encountered
24				
25				
26				
27				
28				
29				
30				
31				
32				

Boring Number:	B4		Page 5 of 10
Location:	Center of propoerty behind backstep of field	Date Started:	9/11/2017
Site Address:	15871 Mulholland Drive	Date Completed:	9/11/2017
	Los Angeles, California	Depth to Groundwater:	--
Project Number:	17-196035	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** Topsoil and rooted vegetation
1				
2				
3				
4				
5	R	48	SM	**NATIVE:** Brown, moist, dense, silty SAND w/ interbedded sandstone
6				(Dry Density: 109.9 pcf; Moisture Content: 9.5%)
7				
8				
9				
10	S	24		Light brown, medium dense, w/sand and organic mottling
11				
12				
13				
14				
15	R	72	ML	Grey brown, moist, stiff, clayey SILT w/ trace sandstone and organic mottling
16				(Dry Density: 111.2 pcf; Moisture Content: 11.1%)
17				
18				
19				
20	S	49		no sandstone
21				
22				
23				
24				
25	R	50/6"	SM	Light grey, moist, very dense, silty SAND w/ mottling and interbedded sandstone
26				(Dry Density: 107.2 pcf; Moisture Content: 14.8%)
27				
28				
29				
30	S	36		Brown, moist, medium dense, silty SAND
31				Boring terminated at 31 feet - groundwater not encountered
32				Backfilled with spoils upon completion

Boring Number:	B5		
Location:	South center of property in parking lot	Date Started:	9/11/2017
Site Address:	15871 Mulholland Drive Los Angeles, California	Date Completed:	9/11/2017
		Depth to Groundwater:	--
Project Number:	17-196035	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** 2" asphalt over 6" base
1				
2	R	50/6"	ML	**NATIVE:** Dark grey, moist, stiff, SILT w/ trace sand and mica
3				(Dry Density: 114.1 pcf; Moisture Content: 13.3%)
4				
5	R	28	SM	Light grey, moist, dense, silty SAND w/ oxidation mottling
6				
7	R	50/6"		Brown, very dense, w/ increased poorly graded sand
8				(Dry Density: 109.9 pcf; Moisture Content: 15.2%)
9				
10	S	44		dense
11				
12				
13				
14				
15	R	74	ML	Grey brown, moist, stiff, clayey SILT w/ interbedded sandstone
16				(Dry Density: 110.2 pcf; Moisture Content: 17.7%)
17				
18				
19				
20	S	18		Brown, firm, w/ trace sand
21				Boring Terminated at 21 feet
22				Backfilled with spoils upon completion
23				Groundwater was not encountered
24				
25				
26				
27				
28				
29				
30				
31				
32				

Boring Number:	B6		
Location:	Southeast corner of field	Date Started:	9/12/2017
Site Address:	15871 Mulholland Drive	Date Completed:	9/12/2017
	Los Angeles, California	Depth to Groundwater:	--
Project Number:	17-196035	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** Topsoil and rooted vegetation
1				
2				
3				
4				
5	R	54	SM	**NATIVE:** Brown, moist, dense, silty SAND w/ interbedded siltstone
6				(Dry Density: 98.4 pcf; Moisture Content: 22.4%)
7				
8				
9				
10	S	15	CL	Brown, moist, firm, silty CLAY (LL=45, PI=20)
11				
12				
13				
14				
15	R	50/6"	WR	**WEATHERED ROCK:** Brown, moist, very stiff, weathered SILTSTONE w/silty fines
16				(Dry Density: 98.7 pcf; Moisture Content: 18.4%)
17				
18				
19				
20	S	50/6"		
21				
22				
23				
24				
25	R	50/6"		w/ increased clay and silt (Dry Density: 91.5 pcf; Moisture Content: 6.8%)
26				
27				
28				
29				
30	S	50/4"		Grey brown, w/ trace organics and mottling
31				Boring terminated at 31 feet - groundwater not encountered
32				Backfilled with spoils upon completion

Boring Number:	B7		
Location:	Behind 2nd base in field, western side of property	Date Started:	9/12/2017
Site Address:	15871 Mulholland Drive	Date Completed:	9/12/2017
	Los Angeles, California	Depth to Groundwater:	--
Project Number:	17-196035	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** Topsoil and rooted vegetation
1				
2				
3				
4				
5	S	21	CL	**NATIVE:** Brown, moist, stiff, sandy CLAY w/and mottling (PI: 14; LL: 37)
6				Boring Terminated at 6 feet
7				Backfilled with spoils upon completion
8				Groundwater was not encountered
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				

Boring Number:	B8			
Location:	Southwest corner of field by gate	Date Started:	9/11/2017
Site Address:	15871 Mulholland Drive Los Angeles, California	Date Completed:	9/11/2017
		Depth to Groundwater:	--
Project Number:	17-196035.1	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** Topsoil with rooted vegetation
1				
2	R	41	SM	**NATIVE:** Light brown, moist, dense, silty SAND w/ trace clay and mottling
3				(Dry Density: 107.6 pcf; Moisture Content: 12.4%)
4				
5	S	-	-	No recovery, rock encountered
6				
7	S	50/6"	WR	**WEATHERED ROCK**: Brown, moist, very dense, weathered SANDSTONE w/silt
8				
9				
10	R	50/6"		w/ interebbed shale (Dry Density: 87.2 pcf; Moisture Content: 23.5%)
11				
12				
13				
14				
15	S	50/6"		Light grey
16				
17				
18				
19				
20	R	50/4"		Brown (Dry Density: 80.8 pcf; Moisture Content: 15.3%)
21				Boring Terminated at 21 feet
22				Backfilled with spoils upon completion
23				Groundwater was not encountered
24				
25				
26				
27				
28				
29				
30				
31				
32				

Boring Number:	B9		
Location:	Southwest cul-de-sac	Date Started:	9/12/2017
Site Address:	15871 Mulholland Drive	Date Completed:	9/12/2017
	Los Angeles, California	Depth to Groundwater:	--
Project Number:	17-196035	Field Technician:	J.C.
Drill Rig Type:	CMT 75	**Partner**	
Sampling Equipment:	SPT, Rings	2154 Torrance Boulevard, Suite 201	
Borehole Diameter:	10"	Torrance, California 90501	

Depth	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** 4" asphalt over 4" of base
1				
2				
3				
4				
5	S	19	SM	**NATIVE:** Brown, damp, medium dense, silty SAND w/ gravel
6				
7				
8				
9				
10	S	50		Light grey/brown, dense
11				Boring Terminated at 11 feet
12				Backfilled with spoils upon completion
13				Groundwater was not encountered
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
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32				

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BORING LOG

Drill Rig:	CME 75	Date Drilled:	8/18/2010	Logged By:
Boring Dia:	8 Inches	Boring Number:	B-1	T. Smith

Sample	Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
							Grass Top soil to 6"
■	9-14-21	100.8	8.3			Silt stone	Clayey SILT: pale yellow (2.5Y7/3) damp, very stiff, slightly plastic, weak, poorly indurated.
■	13-27-27	97.7	8.7				Clayey SILT: pale yellow (2.5Y7/3) damp, very stiff, slightly plastic, weak, poorly indurated.
■	3-5-11	97.5	23.4	5			Clayey SILT: very dark grey (2.5Y3/2) damp, very stiff, slightly plastic, weak, poorly indurated.
■	5-9-20	97.6	19.3				Clayey SILT:olive brown (2.5Y3/3) moist, very stiff, slightly plastic, weak, poorly indurated.
■	6-9-15	98.0	23.0	10			Clayey SILT: light olive brown (2.5Y5/4) mottled olive brown (2.5Y6/8), moist, very stiff, slightly plastic, weak, poorly indurated.
■	6-14-20	87.3	24.7				Clayey SILT: light olive brown (2.5Y5/4), moist, very stiff, slightly plastic, weak, poorly indurated.
■	6-14-28	101.8	20.5	15			Clayey SILT: light olive brown (2.5Y5/4), moist, hard.
■	7-12-15	96.1	9.9	20		Sand stone	Silty SANDSTONE: dark grey, 2.5Y4/1) moist, dense, very fine grained sand poorly indurated,

Completion Notes:

End boring at 20 feet. No Groundwater. Boring backfilled with drill cuttings.

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BORING LOG

Drill Rig:	CME 75	Date Drilled:	8/18/2010	Logged By:	T. Smith
Boring Dia:	8 Inches	Boring Number:	B-2		

Sample ID Blow Counts	Dry Density	Moist. (%)
8-14-18	98.5	7.6
11-18-36	100.2	3.7
11/28/50	101.9	4.4
55 for 6"	97.3	7.2
60 for 6"	95.9	8.0
50 for 2"	109.2	12.9
65 for 6"	94.3	13.7

Depth Feet	USCS	Description
0 – 4.5	Siltstone	Grass Top soil 6" Clayey SILT: oive yellow (2.5Y6/6), damp, very stiff, slightly plastic, weak, poorly indurated. Sandy Silt: pale yellow (2.5Y7/6), damp, hard, non plastic, poorly indurated. Increasing sand content with depth.
4.5 – 9	Sandstone	Silty SANDSTONE: pale yellow (2.5Y6/6), damp, very dense, fine grained sand, poorly indurated. Silty SANDSTONE: pale yellow (2.5Y6/6), damp, very dense, fine grained sand interbedded with finely laminated siltstone, poorly indurated.
9 – 18	Sandstone	SANDSTONE: pale yellow (2.5Y6/6) damp, very dense, very fine grained sand, SANDSTONE: pale yellow (2.5Y7/6), damp, very dense, very fine grained sand.
18 – 20	Siltstone	SILTSTONE: olive brown (2.5Y4/4) damp, finely laminated, poorly indurated, slightly plastic, weak.

Completion Notes:

End boring at 20 feet. No Groundwater. Boring backfilled with drill cuttings.

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BORING LOG

Drill Rig:	CME 75	Date Drilled:	8/18/2010	Logged By:
Boring Dia:	8 Inches	Boring Number:	B-3	T. Smith

Sample	Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
							Grass surface Top soil 12"
■	6-9-15	94.6	14.9				Sandy SILT: olive yellow (2.5Y6/6), moist, very stiff, non plastic. Weatheres siltstone rock fragments.
■	10-17-19	91.5	19.3				Sandy SILT: olive yellow (2.5Y6/6), moist, very stiff , non plastic, siltstone rock fragments.
■	5-9-17	92.4	26.4	5			Sandy SILT: olive brown (2.5Y4/4), moist, very stiff, non plastic, siltstone fragments.
■	4-7-22	96.8	24.2				Clayey SILT: olive brown (2.5Y4/4), moist, very stiff, slightly plastic, weak,
■	3-7-14	96.6	24.2	10		ML	Clayey SILT: olive brown (2.5Y4/4), moist, very stiff, slightly plastic, weak.
■	9-15-23	95.6	20.8	15			SILT: olive brown (2.5Y4/4), moist, hard, non plastic
■	12-21-21	94.1	23.8	20			SILT: olive brown (2.5Y4/4), moist, hard, non plastic, Fill to 20'

Completion Notes:

End boring at 20 feet. No Groundwater. Boring backfilled with drill cuttings.

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BORING LOG

Drill Rig: CME 75	Date Drilled: 8/18/2010	Logged By:
Boring Dia: 8 Inches	Boring Number: B-4	T. Smith

Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
			0			Grass surface Top soil 12"
7-15-21	97.2	21.1				Sandy SILT: olive brown (2.5Y4/4), moist, very stiff , non plastic, weak, mineralized replacement of rootlets, siltstone rock fragments.
6-12-16	91.1	23.5	5			SILT: light olive brown (2.5Y5/6), moist, very stiff, non plastic, weak.
21-35-26	104.2	13.3				SILT: light olive brown (2.5Y5/6), moist, very stiff, non plastic, weak,
5-11-20	94.3	24.4	10		ML	Sandy SILT: light olive brown (2.5Y5/6), moist, very stiff, non plastic, weak.
7-12-25	99.0	19.8	15			Sandy SILT: light olive brown (2.5Y5/3), moist, hard, non plastic, weak.
8-14-20	94.2	23.8	20			Sandy SILT: light olive brown (2.5Y5/3), moist, hard,

Completion Notes:

End boring at 20 feet. No Groundwater. Boring backfilled with drill cuttings.

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BORING LOG

Drill Rig:	CME 75	Date Drilled:	8/18/2010	Logged By:	
Boring Dia:	8 Inches	Boring Number:	B-5	T. Smith	

Sample	Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
							concrete 4"
	3-7-6	98.5	12.5			SP	SAND: olive yellow (2.5Y6/8), damp, medium dense, trace silt, very fine grained sand.
	6-14-30	95.3	8.0				SAND: pale yellow (2.5Y6/8), damp, very dense, trace silt, very fine grained sand.
	8-14-30	104.9	15.5	5			SAND: olive yellow (2.5Y6/8), damp, very dense, trace silt, very fine grained sand. Fill to 6.5 feet.
	50 for 5"	95.2	15.7			Sand ston e	SANDSTONE: olive yellow (2.5Y6/8) damp, very dense, very fine grained sand.
	35-50	95.6	28.3	10			SANDSTONE: light yellow brown (2.5Y6/3), damp, very dense, very fine grained sand, with shale interbeds- 10 to 15 mm, olive brown (2.5Y6/6) finely laminated.
	50 for 4"	95.1	11.4	15			SANDSTONE: light yellow brown (2.5Y6/3) damp, very dense, very fine grained sand, traace silt.
	50 for 5"	99.0	16.1	20			SANDSTONE: light olive brown (2.5Y6/3) damp, very

Completion Notes:

End boring at 20 feet. No Groundwater. Boring backfilled with drill cuttings.

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BORING LOG

Drill Rig: CME 75	Date Drilled: 8/19/2010	Logged By: T. Smith
Boring Dia: 8 Inches	Boring Number: B-6	

Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	USCS	Description
					Grass at Surface Top Soil 12"
3-6-9	89.7	9.4		SP	SAND: olive yellow (2.5Y6/6), damp, medium dense, rock fragments, very fine grained sand.
4-9-18	83.4	14.8		Silt ston e	Sandy SILTSTONE: olive yellow (2.5Y6/6) damp, very stiff, finely laminated, poorly indurated.
			5		
13-25-38	100.7	16.7			Sandy SILTSTONE: olive yellow (2.5Y6/6) damp, hard, finely laminated, poorly indurated, gypsiferous.
16-29-45	97.5	22.2			Sandy SILTSONE: olive yellow (2.5Y6/6) damp, hard, finely laminated, poorly indurated, gypsiferous seam 5-10 mm.
			10		
7-9-18	92.5	28.2			Sandy SILTSTONE: olive yellow (2.5Y6/6), damp, hard, finely laminated, poorly indurated, gypsiferous, non plastic, weak.
			15		
30-50	92.1	24.6			SILTSTONE: olive yellow (2.5Y6/6) damp, hard, laminated, poorly indurated, non plastic, weak.
			20		
50 for 4"	89.4	26.5			SILTSTONE: olive yellow (2.5Y6/6) damp, hard, laminate, poorly indurated, non platic, weak.

Completion Notes:

End boring at 20 feet. No Groundwater. Boring backfilled with drill cuttings.

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Drill Rig:	CME 75	Date Drilled:	8/19/2010	Logged By:	T. Smith
Boring Dia:	8 Inches	Boring Number:	B-7		

Sample	Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
							Grass at Surface Top Soil 12"
■	3-6-7	99.3	13.8				Silty SAND: olive yellow (2.5Y6/6), damp, medium dense, rock fragments, very fine grained sand.
						SP	
							Silty SAND: olive yellow (2.5Y6/6) damp, dense, fine grained sand.
■	9-18-27	111.9	15.1	5			
				10			
				15			
				20			

Completion Notes:

End boring at 6 feet due to obstruction. No Groundwater. Boring backfilled with drill cuttings.

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BORING LOG

Drill Rig: Mobil Drill B-61 HDX	Date Drilled: 9/9/2010	Logged By: T. Smith
Boring Dia: 8 Inches	Boring Number: B-7a	

Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	USCS	Description
					Grass
10-12-14			5	SM	Silty SAND: olive yellow (2.5Y6/6) moist, dense, very fine grained sand, silt ~ 15%.
12-14-14					Silty SAND: olive yellow (2.5Y6/6), moist, dense, very fine grained sand, silt~ 15%.
10-11-14			10		Silty SAND: olive brown (2.5Y6/6), moist, dense, very finegrained sand, silt ` 15%.
8-10-10				ML	Sandy SILT: olive brown (2.5Y4/4), moist, very stiff, slightly plastic, weak, very finegrained sand ~ 20%.
8-15-18			15		Silty SAND: light olive brown (2.5Y5/6), moist, dense, fine grained sand, silt ~ 15%
			20	SM	
13-14-20					Silty SAND: light olive brown (2.5Y5/6), moist, dense, fine grained sand, silt ~ 15%.

Completion Notes:

End boring at 35.5 feet. No Groundwater. boring backfilled with drill cuttings.

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Drill Rig: Mobil Drill B-61 HDX	Date Drilled: 9/9/2010	Logged By: T. Smith
Boring Dia: 8 Inches	Boring Number: B-7a	

Sample	Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
X	9-10-13					ML	Sandy SILT: dark yellowish brown 10YR4/4), moist, very stiff, plastic, weak, fine grained sand ~ 30%. Fill to 28'
X	50 for 5"			30		Sandstone	SANSTONE: light yellow brown (2.5Y6/4), moist, very dense, very fine grained sand with siltstone beds ~5 to 10 mm thick, finely laminated.
X	50 for 6"			35			SANSTONE: light yellow brown (2.5Y6/4), moist, very dense, very fine grained sand.
				40			
				45			

Completion Notes:

End boring at 35.5 feet. No Groundwater. boring backfilled with drill cuttings.

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BORING LOG

Drill Rig:	CME 75	Date Drilled:	8/20/2010	Logged By:	T. Smith
Boring Dia:	8 Inches	Boring Number:	B-8		

Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	USCS	Description
					Concrete 4"
3-6-12	92.6	24.0		MH	Sandy SILT: dark greyish brown, moist, medium stiff, non plastic, weak.
5-12-19	105.5	17.4		MH	Sandy SILT: dark greyish brown, moist, hard, non plastic, weak.
12-20-35	115.6	13.8	5	SM	Silty SAND: pale yellow (2.5Y67/3), moist,very dense, fine grained sand, silt ~ 15%.
3-6-12	106.0	16.9		SM	Silty SAND: olive yellow (2.5Y6/6) dense, fine grained sand, silt ~ 15%.
3-7-16	97.9	25.3	10	ML	Clayey SILT: light olive brown (2.5Y5/6), moist, stiff, non plastic, weak,
4-9-23	104.3	14.0	15	SM	Silty SAND: light olive brown (2.5Y5/3) moist, dense, very fine grained sand.
5-10-17	93.8	24.0	20	ML	Sandy SILT: grey (2.5Y4/0) moist, very stiff, decayed organic matter (brush) .

Completion Notes:

End boring at 20 feet. No Groundwater. Boring backfilled with drill cuttings.

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El Segundo, California 90245

BORING LOG

Drill Rig: CME 75	Date Drilled: 8/20/10	Logged By: T. Smith	
Boring Dia: 8 Inches	Boring Number: B-9		

Sample	Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
							Grass Top Soil 18"
				5			
X	SPT 3-5-6	--	26.2				Clayey SILTSTONE: very dark grey (2.5Y3/1), damp, medium stiff, slightly plastic, finely laminated.
				10			
X	SPT 3-7-9	--	25.2			Silt ston e	Clayey SILTSTONE: olive brown (2.5Y4/4) moist, medium stiff, slightly plastic, finely laminated.
				15			
X	SPT 6-10-13	--	20.0				Clayey SILTSTONE: olive brown (2.5Y4/4) moist, stiff, slightly plastic, finely laminated, trace fine grained sand.
							Bulk sample from 15- 20 feet.
				20			
X	SPT 12-24-32	--	21.6				Clayey SILTSTONE: olive brown (2.5Y4/4) moist, very stiff, finely laminated, iron oxide stained, clay ~ 15%..

Completion Notes:

End Boring at 20 feet. No Groundwater. Boring backfilled with cuttings.

Site:

Curtis School Geotechnical Investigation
15871 Mulholland Drive
Los Angeles, California

Project No.: 10-69397

Page 1

BORING LOG

PARTNER Engineering and Science, Inc.
1990 East Grand Avenue, Suite 100
El Segundo, California 90245

Drill Rig:	CME 75	Date Drilled:	8/20/10	Logged By:	T. Smith
Boring Dia:	8 Inches	Boring Number:	B-10		

Sample	Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
				0–5		Siltstone	Grass Top Soil 18" Bulk Sample 0-5 feet. Clayey SILTSTONE: olive brown (2.5Y4/4) damp, slightly plastic, weak, trace fine grained sand.
				5			
				10			
				15			
				20			

Completion Notes:

End boring at 5 feet.

Site:

Curtis School Geotechnical Investigation
15871 Mulholland Drive
Los Angeles, California

Project No.: 10-69397

Page 1

PARTNER
Engineering and Science, Inc.
1990 East Grand Avenue, Suite 100
El Segundo, California 90245

BORING LOG

Drill Rig: Mobil Drill B-61 HDX	Date Drilled: 9/9/2010	Logged By:
Boring Dia: 8 Inches	Boring Number: B-11	T. Smith

Sample	Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
				0			Grass
						SM	
X	10-14-16			5			Silty SAND: light olive brown (2.5Y5/4) moist, dense, very fine grained sand, silt ~ 20%.
X	10-13-15						Silty SAND: light olive brown (2.5Y5/4), moist, dense, very fine grained sand, silt~ 20%.
				10		ML	Sandy SILT: light olive brown (2.5Y5/4), moist, very stiff, non plastic, weak, very fine grained sand ~ 20%.
X	10-8-8					SM	Silty SAND: light olive brown (2.5Y5/4
X	6-7-10					ML	Sandy SILT: light olive brown (2.5Y5/4), very stiff, non plastic, weak, with rock fragments.
				15			
X	10-13-15						Silty SAND: light olive brown (2.5Y5/6), moist, dense, fine to very fine grained sand, silt ~ 20%
				20			
X	16-20-30					SM	Silty SAND: greyish brown (2.5Y5/2) to light olive brown (2.5Y5/6), moist, dense, fine to very fine grained sand, decayed organics at 21 feet.

Completion Notes:

End boring at 41 feet. No Groundwater. boring backfilled with drill cuttings.

Site:

Curtis School Geotechnical Investigation
15871 Mulholland Drive
Los Angeles, California

Project No.: 10-69397 | Page 1

PARTNER
Engineering and Science, Inc.
1990 East Grand Avenue, Suite 100
El Segundo, California 90245

BORING LOG

Drill Rig: Mobil Drill B-61 HDX	Date Drilled: 9/9/2010	Logged By:
Boring Dia: 8 Inches	Boring Number: B-11	T. Smith

Sample	Sample ID Blow Counts	Dry Density	Moist. (%)	Depth Feet	Lithology	USCS	Description
X	6-8-10						Silty SAND: greyish brown (2.5Y5/2) to light olive brown (2.5Y5/6) , moist, medium dense, fine grained sand, decayed organics at 25 feet, rock fragments with gypsum ay 26 feet.
				30			Fill to approximately 30 to 31 feet.
X	5-7-8						SANDSTONE: light yellow brown (2.5Y6/3) moist, weathered bedrock silty sand with silt interbeds, finely laminated, medium dense to stiff, very fine grained sand, non plastic silts, weak.
X	10-13-15			35		Sandstone	
							SANDSTONE: light yellow brown (2.5Y6/3), moist, dense, very fine grained sand iron oxide stains.
X	42-50 for 6"			40			SANDSTONE: light yellow brown (2.5Y6/3), moist, very dense, very fine grained sand with interbedded siltstone.
				45			

Completion Notes:

End boring at 41 feet. No Groundwater. boring backfilled with drill cuttings.

Site:

Curtis School Geotechnical Investigation
15871 Mulholland Drive
Los Angeles, California

Project No.: 10-69397

Appendix B

Geotechnical Laboratory Testing/ Results

HAMILTON
& Associates

1641 Border Avenue • Torrance, CA 90501 T 310.618.2190 888.618.2190 F 310.618.2191 W hamilton-associates.net

September 16, 2010
Project No. 10-10170

Partner Engineering
1990 E. Grand Ave, Suite 100
El Segundo, CA 90245
Email: tsmith@partneresi.com

Attention: Mr. Thomas Smith, Project Geologist

Subject: Laboratory Testing of Soil Samples, Curtis School.

Dear Mr. Smith:

We have completed the laboratory tests on the samples provided for the subject project. Enclosed is a summary of laboratory test results.

We thank you for the opportunity to provide laboratory testing services. If there are any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
HAMILTON & ASSOCIATES, INC.

REGISTERED PROFESSIONAL ENGINEER
DAVID THOMAS HAMILTON
GE 2721
EXP. 6/30/11
GEOTECHNICAL
STATE OF CALIFORNIA

David T. Hamilton, M.S., P.E., G.E.
President

MOISTURE CONTENT AND DENSITY TESTS

The relatively undisturbed soil retained within the rings of the Modified California barrel sampler was tested in the laboratory to determine in-place dry density and moisture content. Soil obtained with an SPT sampler was tested to determine moisture content only. Test results are presented on the following table.

Boring No.	Depth (feet)	Dry Density (pcf)	Field Moisture (%)
B-1	1'	100.8	8.3
B-1	3'	97.7	8.7
B-1	5'	97.5	23.4
B-1	7'	97.6	19.3
B-1	10'	98	23
B-1	12'	87.3	24.7
B-1	15'	101.8	20.5
B-1	20'	96.1	9.9
B-2	1'	98.5	7.6
B-2	3'	100.2	3.7
B-2	5'	101.9	4.4
B-2	7'	97.3	7.2
B-2	10'	95.9	8
B-2	15'	109.2	12.9
B-2	20'	94.3	13.7
B-3	1'	94.6	14.9
B-3	3'	91.5	19.3
B-3	5'	92.4	26.4
B-3	7'	96.8	24.2
B-3	10'	96.6	24.2
B-3	15'	95.6	20.8
B-3	20'	94.1	23.8
B-4	3'	97.2	21.1
B-4	5'	91.1	23.5
B-4	7'	104.2	13.3
B-4	10'	94.3	24.4
B-4	15'	99	19.8

Boring No.	Depth (feet)	Dry Density (pcf)	Field Moisture (%)
B-4	20'	94.2	23.8
B-5	1'	98.5	12.5
B-5	3'	95.3	8.0
B-5	5'	104.9	15.5
B-5	7'	95.2	15.7
B-5	10'	95.6	28.3
B-5	15'	95.1	11.4
B-5	20'	99.0	16.1
B-6	1'	89.7	9.4
B-6	3'	83.4	14.8
B-6	5'	100.7	16.7
B-6	7'	97.5	22.2
B-6	10'	92.5	28.2
B-6	15'	92.1	24.6
B-6	20'	89.4	26.5
B-7	1'	99.3	13.8
B-7	5'	111.9	15.1
B-7a	5’	-	14.8
B-7a	10’	-	16.9
B-7a	15’	-	22.8
B-7a	20’	-	18.7
B-7a	25’	-	24.3
B-7a	30’	-	13.6
B-7a	35’	-	8.6
B-8	1'	92.6	24.0
B-8	3'	105.5	17.4
B-8	5'	115.9	13.8
B-8	7'	106.0	16.9
B-8	10'	97.9	25.3
B-8	15'	104.3	14.0
B-8	20'	93.8	24.0

Boring No.	Depth (feet)	Dry Density (pcf)	Field Moisture (%)
B-9	5'	-	26.2
B-9	10'	-	25.2
B-9	15'	-	20.0
B-9	20'	-	21.6
B-11	5’	-	14.4
B-11	10’	-	24.2
B-11	15’	-	18.8
B-11	20’	-	15.6
B-11	25’	-	25.2
B-11	30’	-	21.7
B-11	35’	-	19.3
B-11	40’	-	16.7

CONSOLIDATION AND DIRECT SHEAR TESTS

Consolidation (ASTM D-2435) and direct shear (ASTM D-3080) tests were performed on selected relatively undisturbed samples to determine the settlement characteristics and shear strength parameters of various soil samples, respectively. The results of these tests are shown graphically on the appended “C” and “D” Plates.

MAXIMUM DENSITY TEST

The following maximum density test was conducted in accordance with the latest edition of ASTM D1557, Method A, using 5 equal layers, 25 blows each layer, 10-pound hammer, 18 inch drop in a 1/30 cubic foot mold. The results are as follows:

Boring No.	Depth, Ft	Maximum Dry Density, pcf	Optimum Moisture Content, %	Material Classification
B-3	0.0-5.0	110.0	17.0	Silty Sand

EXPANSION TEST

Expansion tests were performed on soil samples to determine the swell characteristics. The expansion test was conducted in accordance with ASTM D4829, Expansion Index Test. The expansion samples were remolded to approximately 90 percent relative compaction at near optimum moisture content, subjected to 144 pounds per square foot surcharge load and saturated.

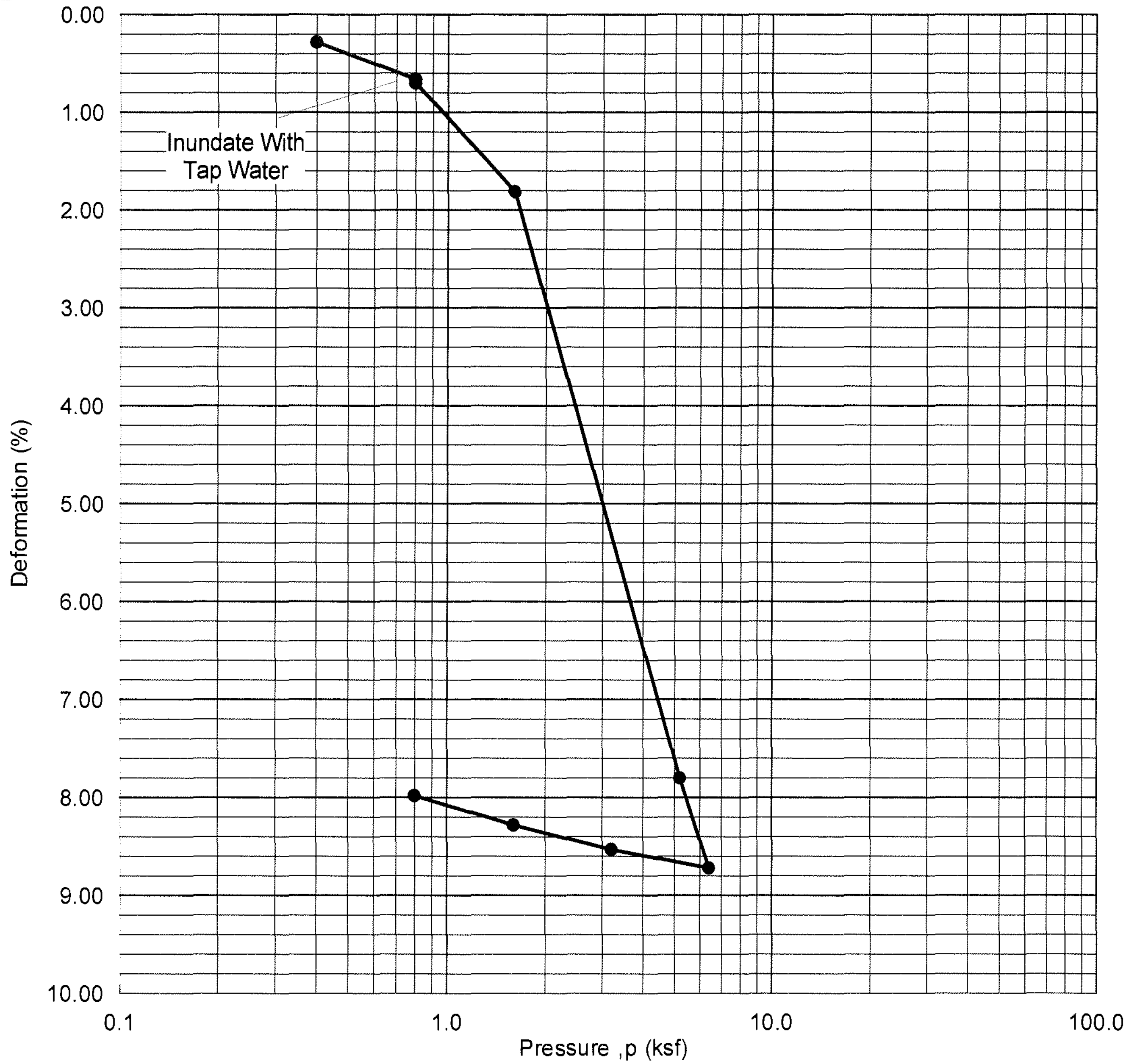
Location	Molded Dry Density, pcf	Molded Moist. Content, %	% Saturation	Expansion Index	Expansion Classification
Boring 1 @ 0.0 -5.0'	97.7	12.8	47.7	38	Low
Boring 3 @ 0.0 -5.0'	94.7	15.5	53.6	55	Medium
Boring 10 @ 0.0 -5.0'	101.1	12.7	51.7	38	Low

CORROSIVITY TEST

Corrosivity tests were performed on samples in accordance with Methods CT-417, CT-422, and CT-532 (643). These tests were performed by Cal Land Engineering, Inc. The results are provided in Appendix A.

R-VALUE TEST

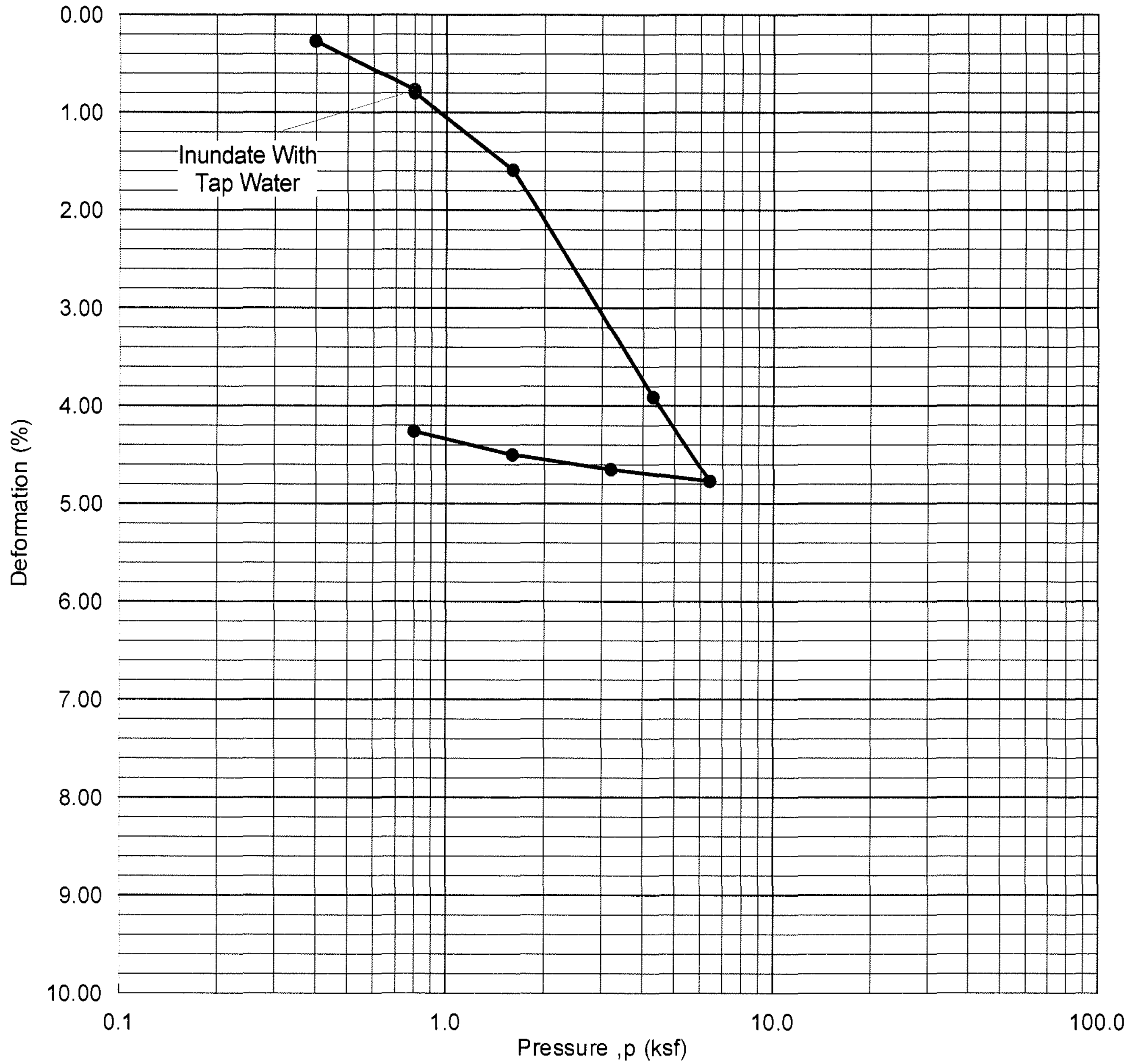
An R-Value test was performed on one sample by Associated Soils Engineering, Inc. in accordance with method CT-301. The results are provided in Appendix A.



Boring No. : B-3
Depth (ft.) : 7.0
Sample : Relatively Undisturbed
Sample Type : Silty Sand with Clay

Dry Density (pcf) = 96.8
Moisture (%) = 24.2

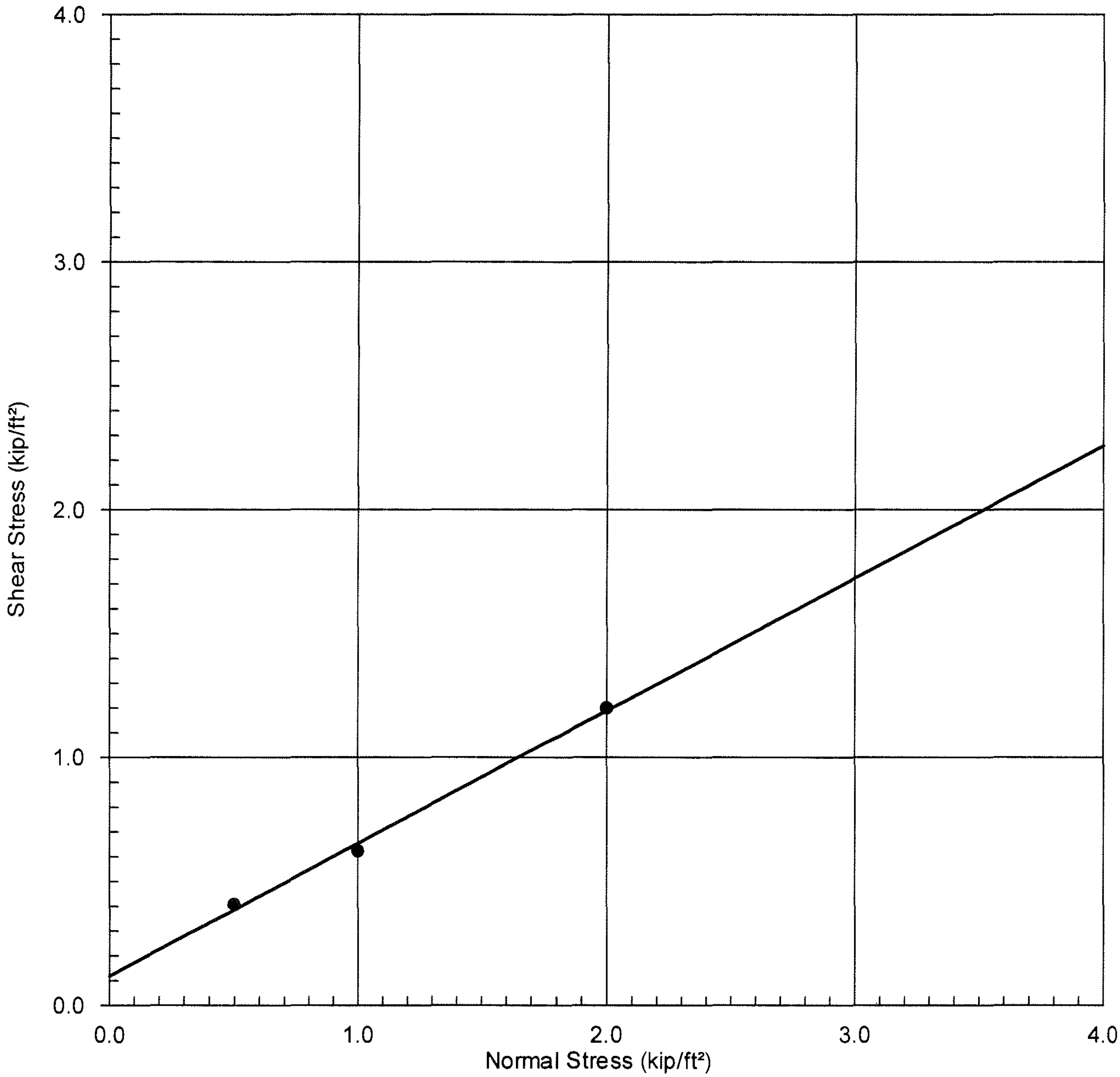
HAMILTON & Associates	Project No: 10-10170	ONE-DIMENSIONAL CONSOLIDATION TEST (ASTM D 2435)
	Project Name: Partner Engineering (Curtis School)	**PLATE C-1**



Boring No. : B-4
Depth (ft.) : 10.0
Sample : Relatively Undisturbed
Sample Type : Sandy Silt with Clay

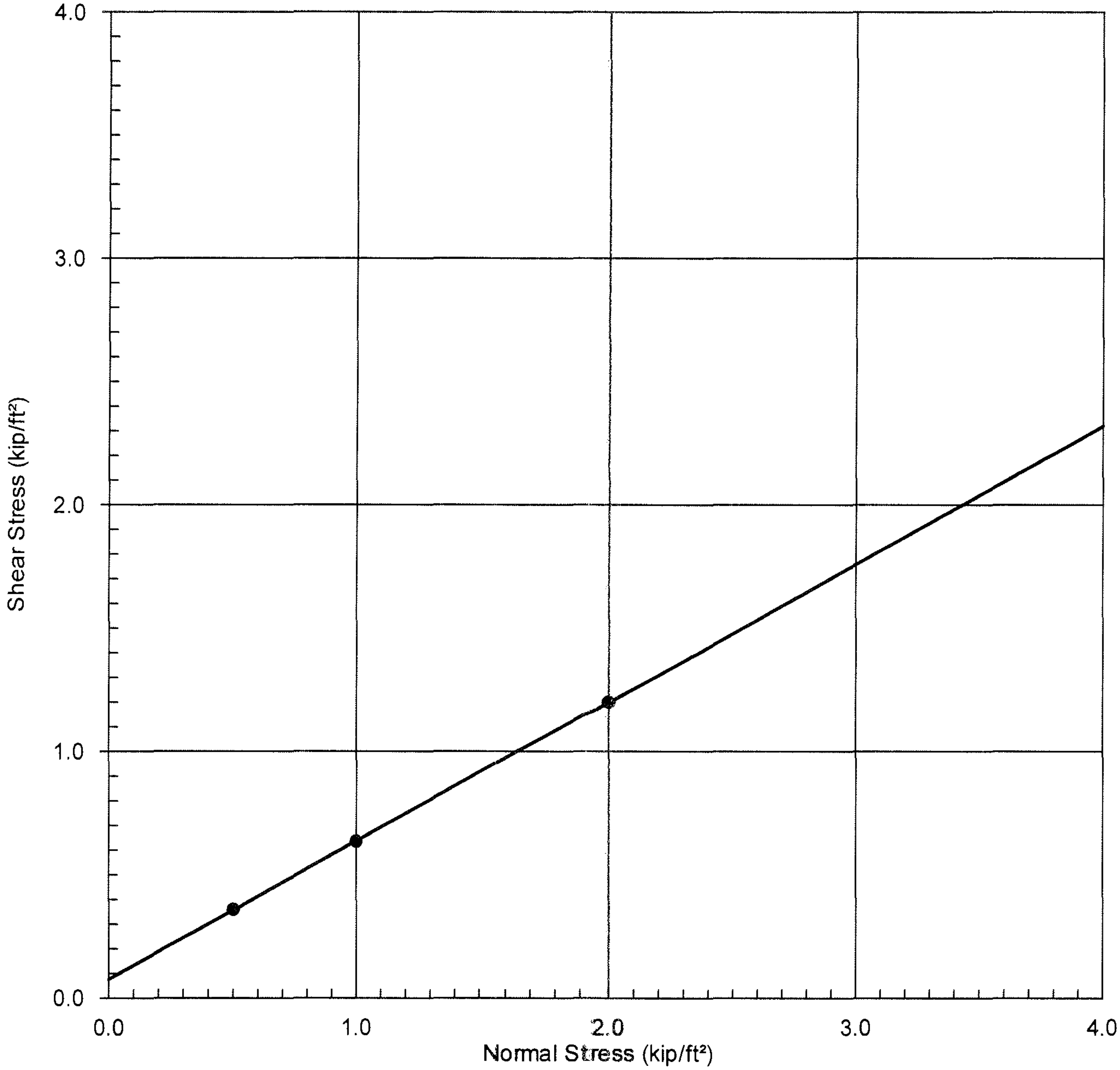
Dry Density (pcf) = 94.3
Moisture (%) = 24.4

HAMILTON & Associates	Project No: 10-10170	ONE-DIMENSIONAL CONSOLIDATION TEST (ASTM D 2435)
	Project Name: Partner Engineering (Curtis School)	**PLATE C-2**



Boring No.	: B-3		Cohesion (C)	= 120 psf
Depth (ft.)	: 10'		Friction (ϕ)	= 28°
Sample	: Relatively Undisturbed		Dry Density (pcf)	= 96.6
Moisture	: Saturated		Moisture (%)	= 24.2
Sample Type	: Sandy Silt with Clay			

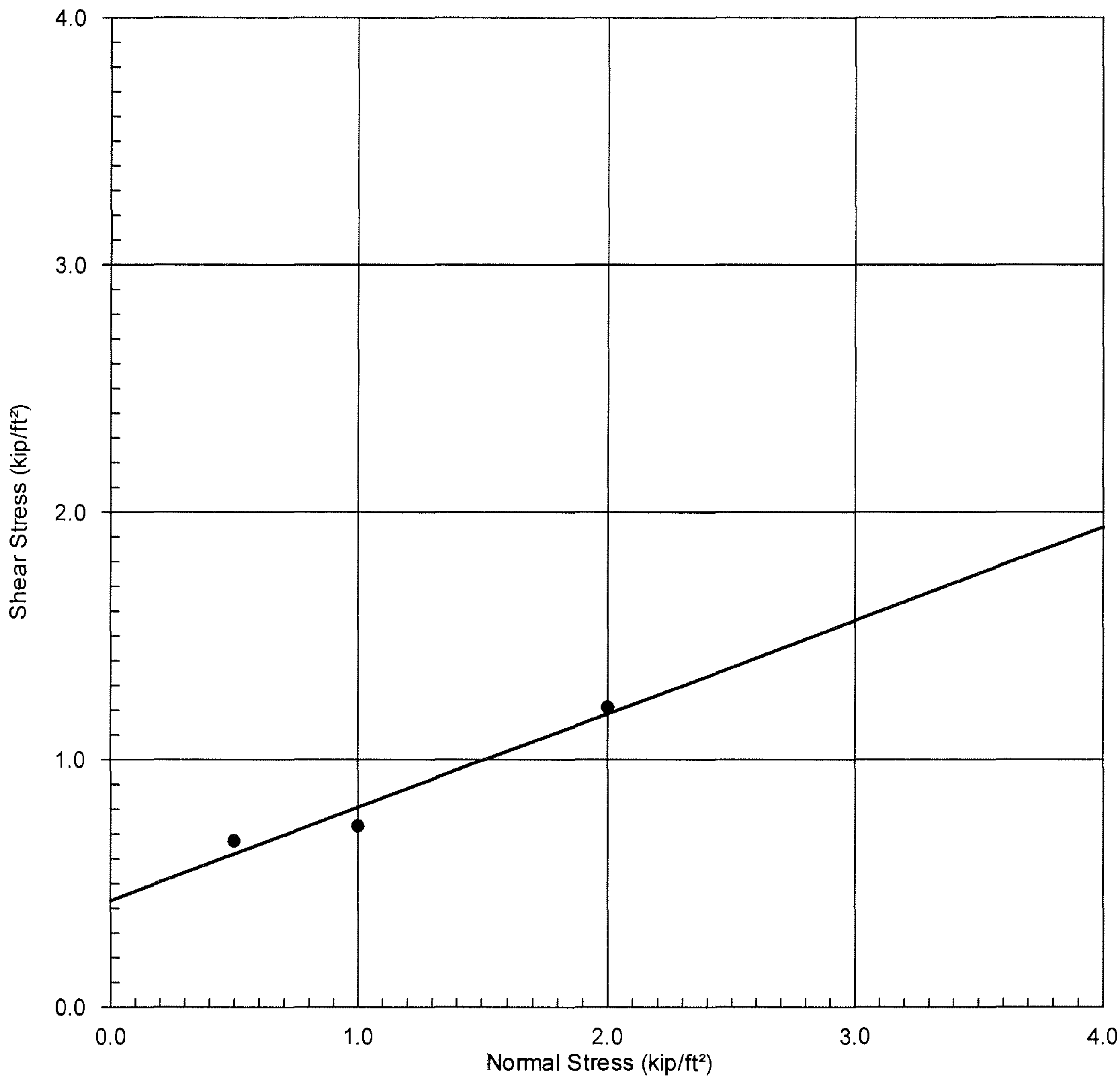
HAMILTON & Associates	Project No: 10-10170	DIRECT SHEAR TEST RESULTS (ASTM D 3080)
	Project Name: Partner Engineering - Curtis School	**PLATE D-1**



Boring No. : B-3
Depth (ft.) : 0-5'
Sample : 90% Remold
Moisture : Saturated
Sample Type : Silty Sand

Cohesion (C) = 78 psf
Friction (ϕ) = 29°
Max Dry Density (pcf) = 110.0
Optimum Moisture (%) = 17.0

HAMILTON & Associates	Project No: 10-10170	DIRECT SHEAR TEST RESULTS (ASTM D 3080)
	Project Name: Partner Engineering - Curtis School	**PLATE D-2**



Boring No.	: B-4		Cohesion (C)	= 432 psf
Depth (ft.)	: 7'		Friction (ϕ)	= 20°
Sample	: Relatively Undisturbed		Dry Density (pcf)	= 104.2
Moisture	: Saturated		Moisture (%)	= 13.3
Sample Type	: Clayey Silt with Sand			

HAMILTON & Associates	Project No: 10-10170	DIRECT SHEAR TEST RESULTS (ASTM D 3080)
	Project Name: Partner Engineering - Curtis School	**PLATE D-3**

HAMILTON & Associates

EXPANSION INDEX OF SOILS
ASTM D 4829

Project Name:	**Partner Engr - Curtis School**	**Tested By:**	**JM**
Project No.:	**10-10170**	**Checked By:**	**D.H.**
Boring No.:	**B-1**	**Depth (ft.):**	**0-5'**
Sample No.:	**Bulk**	**Date:**	**9/9/2010**

Soil Identification: Silty Sand

Dry Wt. of Soil + Cont. (g)	1000
Wt. of Container No. (g)	0
Dry Wt. of Soil (g)	1000
Weight Soil Retained on #4 Sieve	Refer to Proctor
Percent Passing #4	

Molded Specimen	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0420
Wt. Comp. Soil + Mold (g)	553.9	598.0
Wt. of Mold (g)	187.9	187.9
Specific Gravity (Assumed)	2.7	2.7
Container No.	M132	M132
Wet Wt. of Soil + Cont. (g)	388.9	402.8
Dry Wt. of Soil + Cont. (g)	344.7	318.5
Wt. of Container (g)	0.0	0.0
Moisture Content (%)	12.8%	26.5%
Wet Density (pcf)	110.2	118.5
Dry Density (pcf)	97.7	93.7
Void Ratio	0.725	0.799
Total Porosity	0.420	0.444
Pore Volume (cc)	87.0	95.7
Degree of Saturation (%) [S meas]	47.7	89.5

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
9/9/10	1115	1	0	0.1146
9/9/10	1120	1	5	0.1177
ADD DISTILLED WATER				
9/9/10	1125	1	10	0.1449
9/10/10	905	1	1310	0.1566
9/10/10	1005	1	1370	0.1566

Expansion Index (EI meas) = ((Final Rdg – Initial Rdg) / Initial Thick.) x 1000	38.9
Expansion Index $(EI)_{50}$ = EI meas - (50 – S meas) x ((65+EI meas)/ (220-S meas))	38

HAMILTON & Associates

EXPANSION INDEX OF SOILS
ASTM D 4829

Project Name:	Partner Engr - Curtis School	**Tested By:**	JM
Project No.:	10-10170	**Checked By:**	D.H.
Boring No.:	B-3	**Depth (ft.):**	0-5'
Sample No.:	Bulk	**Date:**	9/10/2010

Soil Identification: Silty Sand

Dry Wt. of Soil + Cont. (g)	1000
Wt. of Container No. (g)	0
Dry Wt. of Soil (g)	1000
Weight Soil Retained on #4 Sieve	Refer to Proctor
Percent Passing #4	

Molded Specimen	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0602
Wt. Comp. Soil + Mold (g)	551.3	599.8
Wt. of Mold (g)	187.9	187.9
Specific Gravity (Assumed)	2.7	2.7
Container No.	M132	M132
Wet Wt. of Soil + Cont. (g)	313.8	409.7
Dry Wt. of Soil + Cont. (g)	271.8	312.6
Wt. of Container (g)	0.0	0.0
Moisture Content (%)	15.5%	31.1%
Wet Density (pcf)	109.4	116.9
Dry Density (pcf)	94.7	89.2
Void Ratio	0.778	0.888
Total Porosity	0.438	0.470
Pore Volume (cc)	90.6	103.2
Degree of Saturation (%) [S meas]	53.6	94.4

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
9/8/10	1130	1	0	0.1208
9/8/10	1135	1	5	0.129
ADD DISTILLED WATER				
9/8/10	1140	1	10	0.1455
9/9/10	900	1	1290	0.1810
9/9/10	1000	1	1350	0.1810

Expansion Index (EI_{meas}) = ((Final Rdg – Initial Rdg) / Initial Thick.) x 1000	52.0
Expansion Index $(EI)_{50}$ = EI_{meas} - ($50 - S_{meas}$) x (($65+EI_{meas}$)/ ($220-S_{meas}$))	55

EXPANSION INDEX OF SOILS
ASTM D 4829

HAMILTON & Associates

Project Name:	Partner Engr - Curtis School	Tested By:	JM
Project No.:	10-10170	Checked By:	D.H.
Boring No.:	B-10	Depth (ft.):	0-5'
Sample No.:	Bulk	Date:	9/9/2010

Soil Identification: Silty Sand

Dry Wt. of Soil + Cont. (g)	1000
Wt. of Container No. (g)	0
Dry Wt. of Soil (g)	1000
Weight Soil Retained on #4 Sieve	Refer to Proctor
Percent Passing #4	

Molded Specimen	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0407
Wt. Comp. Soil + Mold (g)	566.7	607.3
Wt. of Mold (g)	187.9	187.9
Specific Gravity (Assumed)	2.7	2.7
Container No.	M132	M132
Wet Wt. of Soil + Cont. (g)	328.4	409.3
Dry Wt. of Soil + Cont. (g)	291.3	327.4
Wt. of Container (g)	0.0	0.0
Moisture Content (%)	12.7%	25.0%
Wet Density (pcf)	114.0	121.3
Dry Density (pcf)	101.1	97.0
Void Ratio	0.666	0.736
Total Porosity	0.400	0.424
Pore Volume (cc)	82.7	91.3
Degree of Saturation (%) [S meas]	51.7	91.7

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
9/7/10	1425	1	0	0.1193
9/7/10	1430	1	5	0.123
ADD DISTILLED WATER				
9/7/10	1435	1	10	0.1381
9/8/10	915	1	1130	0.1600
9/8/10	1015	1	1190	0.1600
Expansion Index (EI meas) = ((Final Rdg – Initial Rdg) / Initial Thick.) x 1000				37.0
Expansion Index (EI) 50 = EI meas - (50 – S meas) x ((65+EI meas)/ (220-S meas))				38

APPENDIX A

Cal Land Engineering, Inc.
Dba Quartech Consultants
Geotechnical, Environmental & Civil Engineering

September 10, 2010

Hamilton & Associates, Inc.
390 Amapola Avenue, Suite 9
Torrance, California 90501

Attn: Mr. Dave Hamilton

RE: LABORATORY TEST RESULTS/REPORT
Project Name: Curtis School
Project No.: 10-10170
QCI Job No.: 10-154-09a

Gentlemen:

We have completed the testing program conducted on samples from the above project. The tests were performed in accordance with testing procedures as follows:

TEST	METHOD
Corrosion Potential	CT- 417, CT- 422, CT-532 (643)

Enclosed is Summary of Laboratory Test Results.

We appreciate the opportunity to provide testing services to Hamilton & Associates, Inc., should you have any questions, please call the undersigned.

Respectfully submitted,
Cal Land Engineering, Inc. (CLE)
dba Quartech Consultants (QCI)

Jack C. Lee, PE, GE
President

Enclosure

576 E. Lambert Road, Brea, CA 92821; Tel: 714-671-1050, Fax: 714-671-1090

Client Name: Hamilton & Associates, Inc.
Project: Name: Curtis School
Project No.: 10-10170

QCI Project No.:10-154-09a
Date: September 10, 2010
Summarized by: ABK

Corrosivity Test Results

Sample ID	Sample Depth	pH CT-532 (643)	Chloride CT-422 (ppm)	Sulfate CT-417 (% By Weight)	Resistivity CT-532 (643) (ohm-cm)
B-1	0-5'	7.87	106	0.0710	765
B-3	0-5'	7.25	142	0.250	410
B-10	0-5'	7.35	125	0.190	540

(2)

DISTRICT SOIL & AGGREGATE TESTS 14993

MA		STAB		PI		OM		Sp.Gr.	
GBW				RC		SG		Color	
Grd.				ω %				LART	

INSTRUCTIONS

DIST. VII CO.	RTE.	SEC.	CONT. NO. 6-10170	TEST NO.	
LIMITS			FAP NO.	SAMPLE NO.	
RES. ENGR.		CONTRACTOR		S.I.C. NO.	
TEST OF		SAMPLED	FROM B10Q		
SAMPLE DESCR. Yel Bm-~~[illegible]~~ Siycl			DEPTH 0-5'		
SOURCE		TT/Sat grul.	QUANT. REP. Partner - Curtis School		
OWNER/MFR.			SAMPLED BY	TITLE	
			DATE 9-13-10	RECD. 9-9-10	
			FOR USE AS	REPORT	

GRADING ANALYSIS

TOT. WT.	SIZE	WT. RET.	% RET.	% PASS	COMB. % PASS	AS RUN	SPEC.
By	3½						
	3						
	2½						
Date	2						
	1½						
	1						
WT	¾						
	½						
	⅜						
	4						
	4						
WT. OF	8						
HYDRO;	16						
WASH	30						
	50						
By	100						
	200						
	270						
Date	5M						
	1M						

L.A.R.T.	REV.	% GR.	WT. RET.	% RET.	% LOSS	AVG.	SPEC.
……GRDG.	100						NM
By / Date	500						NM

TEST REMARKS:

REPORT REMARKS:

MOISTURE CONTENT

	A	B	C	D
GR. WET	200	200	200	
GR. DRY				
H_2O				
TARE	5	327	108	
NET DRY				
% H_2O	16.3	17.0	17.7	

SPECIMEN WT. — % / GRAMS

SP. GR. COARSE

- ⓑ S.S. DRY
- ⓐ OV. DRY
- ABS. %
- Wt. S.+C. in H_2O
- Wt. C. in H_2O
- ⓒ Wt. S. in H_2O

SP. GR. BULK $\frac{a}{b-c}$ ____ APP. $\frac{a}{a-c}$

By ____ Date ____

SP. GR. FINES

WT. SPEC.	S.S.D.	DRY	FLASK NO.	
ⓑ S.S. DRY			DUMMY	2
ⓐ OV. DRY			2	1
ABS.		%	1	A
			CORRN.	
By	Date		ⓥ VOL.	

SP. GR. BULK $\frac{a}{v}$ ____ APP. ____

COLORIMETRIC

1 2 3 4 5 By ____ Date ____

LIQUID LIMIT	PLASTICITY INDEX		NM
SAND EQUIV.	% PASS 200 X P.I.		NM

SPECIMEN IDENTIFICATION		A	B	C	D
1. GRAMS ADDED H_2O		20	26	34	
2. GROSS WT. PAN & WET SPEC.					
3. WEIGHT PAN	LITES	6350	4900	3300	
4. NET WET WT. SPEC.	#2-3				
5. OVEN DRIED SPEC.					
6. GRAMS MOIST. IN SPEC.	#4-5				
7. % MOIST. IN SPEC. BEF. FABRIC.	#6/5				
8. GROSS WT. SPEC. + MOLD		3156	3183	3199	
9. TARE WT. MOLD		2100	2091	2091	
10. NET WT. SPEC.	#8-9	1056	1092	1108	
11. GRAMS ORIG. SPEC. WASTED	#4-10				
12. GROSS WT. SPEC. AFTER SOAK			R=21		
13. TARE WT. MOLD					
14. NET WT. SOAKED SPEC.	#12-13				
15. DRY WT. SPEC.	(1-#11/10)×5				
16. GRAMS H_2O	#14-15	2.43	2.53	2.59	
17. % MOIST. AFTER SOAK	#16/15	113.2	111.8	110.1	
18. HT. OF SPEC.					
19. DRY WT. PER CU. FT.					
20. COMPACTION BLOWS					
21. COMPACT. PRES. P.S.I. COMPACTOR		350	330	300	
22. EXTRUSION PRESSURE P.S.I.		505	390	265	
23. EXPANSION PRESSURE DIAL × 10,000		27	20	0	
24. EXP. PRESSURE DVLPD. P.S.I.					
25. STABILOMETER TOTAL LOAD	500	13	15	17	
26.	1000	31	37	41	
27.	2000	85	101	120	
28.	3000				
29. TURNS DISPLACEMENT		3.75	3.70	3.60	
30. STAB. "R" VALUE		36/35	28	18	
31. THICK. INDIC. BY STAB. — INCHES					
32. THICK. INDIC. BY EXP. PRES. — INCHES					

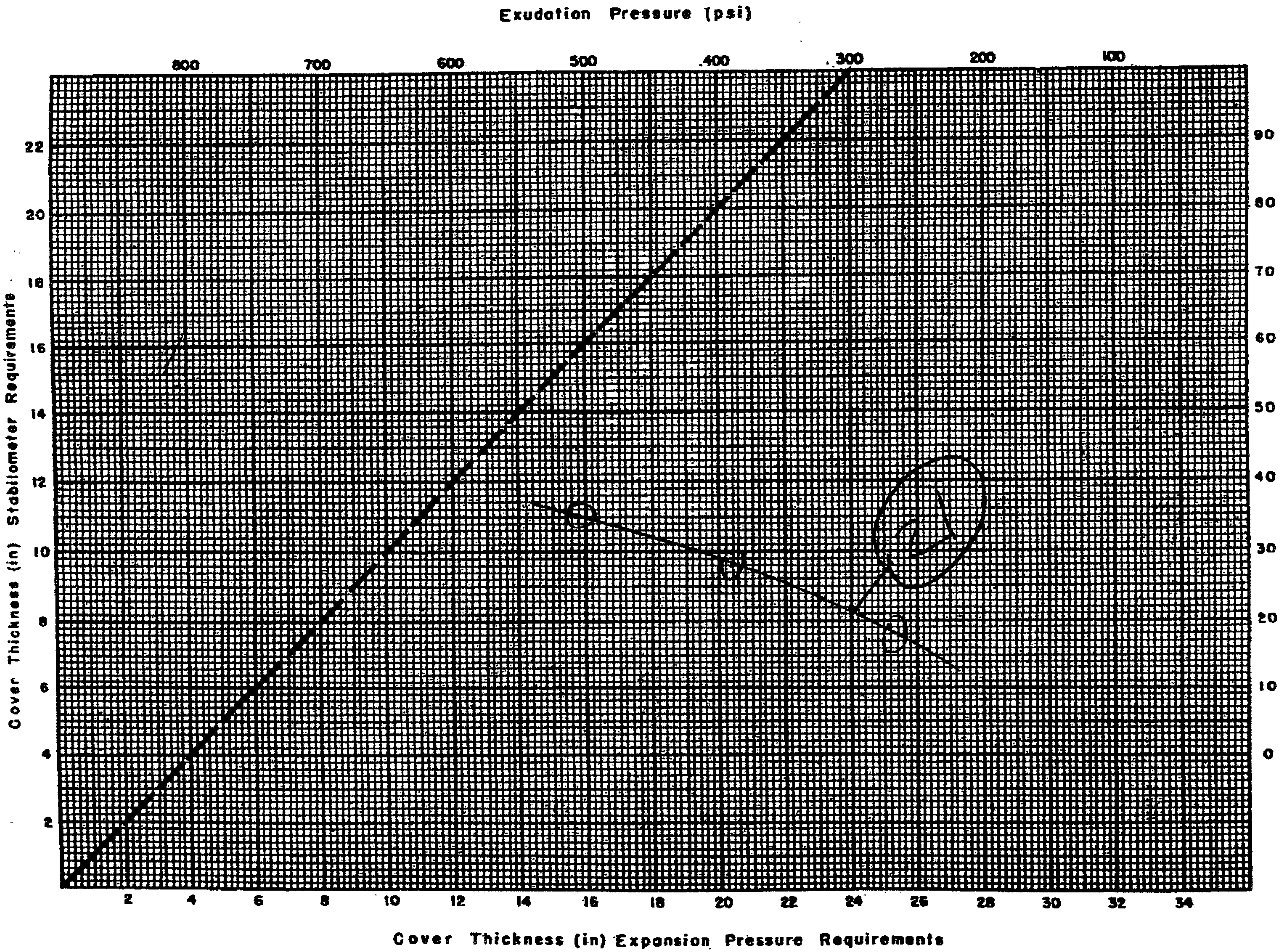
33. TYPE SURF. BASE SUBBASE B.S.

34. COHESIOMETER VALUE | TRAFFIC INDEX

35. "R" VALUE AT EQUILIBRIUM CONDITION

36. INDICATED MIN. THICK. FOR ABOVE CONDITION

Revised 3-17-51 M.X.L.


Exudation Pressure (psi)
800
700
600
500
400
300
200
100
Cover Thickness (in) Stabilometer Requirements
22
20
18
16
14
12
10
8
6
4
2
90
80
70
60
50
40
30
20
10
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
Cover Thickness (in) Expansion Pressure Requirements

Form T-378-m

APPENDIX B

Laboratory Letter

October 20, 2017
H&A Project No. 17-2357
Partner Project No. 17-196035.9

Partner Engineering and Science, Inc.
4518 N.12 Street Suite 201
Phoenix AZ, 85016

Attention: Mr. Matthew Marcus, Technical Director- Geotechnical Engineering

Subject: Laboratory Testing of Soil Samples, 15871 Mulholland Dr., Los Angeles, CA

Dear Mr. Marcus:

We have completed the laboratory tests on the samples provided for the subject project. Enclosed is a summary of laboratory test results.

We thank you for the opportunity to provide laboratory testing services. If there are any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
HAMILTON & ASSOCIATES, INC.

Rosa E. Murrieta
Laboratory Supervisor | Staff Geologist

David T. Hamilton, PE, GE
President

Distribution: (1) Matthew Marcus
mmarcus@partneresi.com
(2) Brett Bova
bbova@partneresi.com

MOISTURE CONTENT AND DENSITY TESTS
Relatively undisturbed soil retained within the rings of the Modified California barrel sampler was tested in the laboratory to determine in-place dry density and moisture content. Test results are presented in Table 1.

RESISTANCE *R*-VALUE TESTS
"R" Value Stabilometer results were obtained in accordance with California 301-G test to measure potential strength of subgrade, subbase, and base course materials for road and airfield pavements. Results were performed on a select sample of site soils by Associated Soils Engineering, Inc., and are presented in Table 2.

CONSOLIDATION TESTS
Consolidation (ASTM D-2435) tests were performed on selected relatively undisturbed samples or remolded samples to determine the settlement characteristics of various soil samples, respectively. The results of this test are shown graphically on the appended 'C' Plates.

DIRECT SHEAR TESTS
Direct shear (ASTM D3080) tests were performed on selected relatively undisturbed samples to determine the shear strength parameters of various soil samples, respectively. The results of these tests are shown graphically on the appended "D" Plates.

ATTERBERG LIMITS
Atterberg Limits (ASTM D-4318) tests were performed on selected samples to determine the liquid limit, plastic limit, and the plasticity index of soils. The results of these tests are shown on the appended "E" Plates.

HAMILTON & Associates

TABLE 1: LABORATORY RESULTS

JOB TITLE: Partner Lab (15871 Mulholland-196035.9)
H&A PROJECT NO. 17-2357
SCHEDULED BY: Fran Lopez
DATE: 9/19/2017
SHEET: 1 **of** 3

Boring No.	Depth (ft)	Sampler / No. Rings	Field Blowcount (ft)	Field Dry Density (pcf)	Field Moisture (%)	Visual Soil Classification	Atterberg Limits	Particle Size	Particle Size w/ Hydrometer	Fines Fraction (Minus No. 200)	Specific Gravity	Maximum Density / Optimum Moisture	Expansion Index	Consolidation	Direct Shear	Unconfined Compression	Triaxial (UU)	Triaxial (CU)	Hydraulic Conductivity	Corrosivity Suite	Sulfate	R-Value	Other	Other	Remarks
1	5	R		83.9	20.5																				
	10	SPT																							
	15	R		92.9	20.5																				
	20	SPT																							
	25	R		92.8	21.5										x										1.5ksf, 3ksf, 9ksf
	30	SPT																							
	35	R		92.7	17.2																				
	40	SPT																							
	45	R		92	15.3																				
	50	SPT																							
2	2	R		107.7	12.5																				
	5	R		102.9	21.4																				
	7	R		101.3	22.0																				
	10	SPT																							
	15	R		99.3	9.4																				
	20	SPT																							
3	2	SPT																							
	5	R		99.8	21.0																				
	7	SPT																							
	10	R		102.1	13.0																				

SPECIAL INSTRUCTIONS

see next page

TABLE 1: LABORATORY RESULTS

JOB TITLE: Partner Lab (15871 Mulholland-196035.9)
H&A PROJECT NO. 17-2357
SCHEDULED BY: Fran Lopez
DATE: 9/19/2017
SHEET: 2 of 3

Boring No.	Depth (ft)	Sampler / No. Rings	Field Blowcount (ft)	Field Dry Density (pcf)	Field Moisture (%)	Visual Soil Classification	Atterberg Limits	Particle Size	Particle Size w/ Hydrometer	Fines Fraction (Minus No. 200)	Specific Gravity	Maximum Density / Optimum Moisture	Expansion Index	Consolidation	Direct Shear	Unconfined Compression	Triaxial (UU)	Triaxial (CU)	Hydraulic Conductivity	Corrosivity Suite	Sulfate	R-Value	Other	Other	Remarks
3	15	SPT																							
	20	R		98.8	17.8																				
4	5	R		109.9	9.5																				
	10	SPT																							
	15	R		111.2	11.1		x																		
	20	SPT																							
	25	R		107.2	14.8																				
	30	SPT																							
5	2	R		114.1	13.3																				
	5	SPT																							
	7	R		109.9	15.2																				
	10	SPT																							
	15	R		110.2	17.7									x											innundate at 1.6ksf
	20	SPT																							
6	5	R		98.4	22.4																				
	10	SPT					x																		
	15	R		98.7	18.4																				
	20	SPT																							
	25	R		91.5	6.8																				

SPECIAL INSTRUCTIONS

HAMILTON & Associates

TABLE 1: LABORATORY RESULTS

JOB TITLE: Partner Lab (15871 Mulholland-196035.9)
H&A PROJECT NO. 17-2357
SCHEDULED BY: Fran Lopez
DATE: 9/19/2017
SHEET: 3 **of** 3

Boring No.	Depth (ft)	Sampler / No. Rings	Field Blowcount (ft)	Field Dry Density (pcf)	Field Moisture (%)	Visual Soil Classification	Atterberg Limits	Particle Size	Particle Size w/ Hydrometer	Fines Fraction (Minus No. 200)	Specific Gravity	Maximum Density / Optimum Moisture	Expansion Index	Consolidation	Direct Shear	Unconfined Compression	Triaxial (UU)	Triaxial (CU)	Hydraulic Conductivity	Corrosivity Suite	Sulfate	R-Value	Other	Other	Remarks
6	30	SPT																							
7	1-5'	B					x															x			
	5	SPT																							
8	2	R		107.6	12.4									x											innundate at 1.6ksf
	5	SPT																							
	7	SPT																							
	10	R		87.2	23.5																				
	15	SPT																							
	20	R		80.8	15.3																				
9	5	SPT																							
	10	SPT																							

SPECIAL INSTRUCTIONS

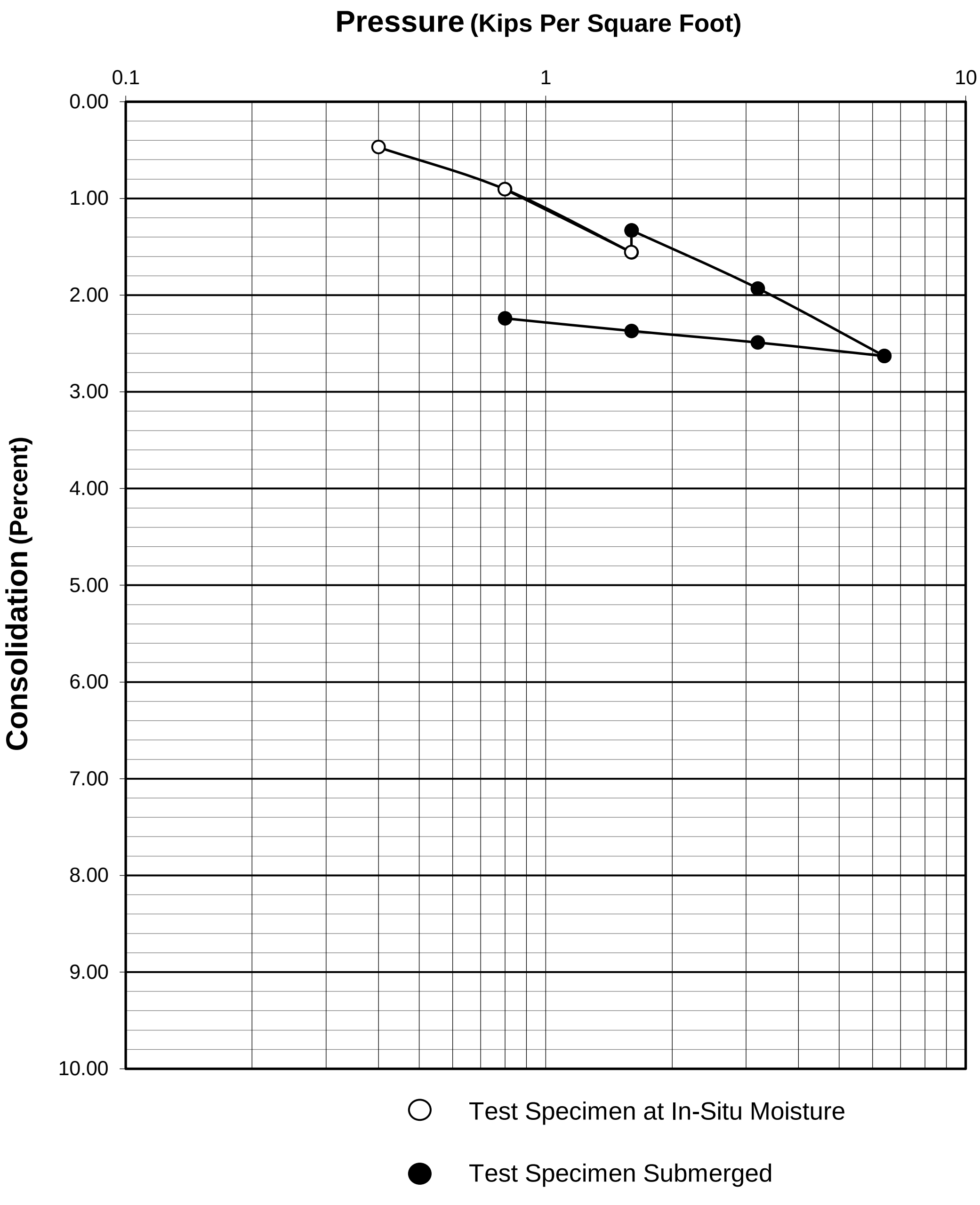
HAMILTON
& Associates

TABLE 2: R - Value Analysis

Stabilometer Results	Trial #1	Trial #2	Trial #3
Dry Density as molded, pcf	118.7	117.8	115.4
Moisture content as molded, %	13	16.3	14.6
Expansion Pressure, dial reading 10^4	53	26	7
Exudation Pressure, psi	690	460	240
Stabilometer "R" Value	62	52	21
"R" Value equilibrium (300 psi Exudation Pressure) = 30			
Classification: Light Yellow Brown Silty Fine Sand with Clay			
Source: B7-192212			

CONSOLIDATION TEST RESULTS

Boring 5 at 15 feet

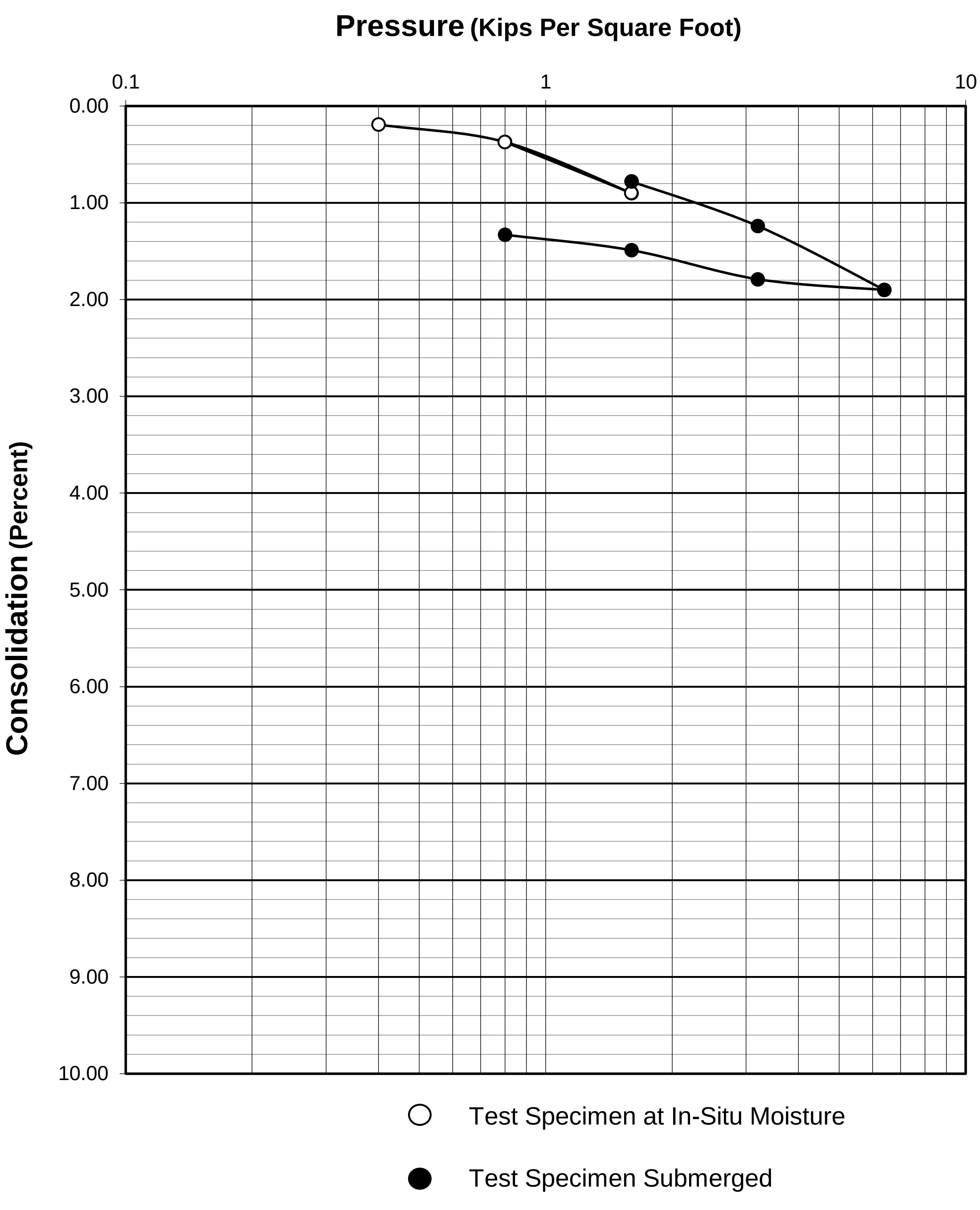


Laboratory Testing 15871 Mulholland Los Angeles, CA	Project No.	17-2357
	Plate	C-1

HAMILTON & ASSOCIATES, INC.

CONSOLIDATION TEST RESULTS

Boring 8 at 2 feet

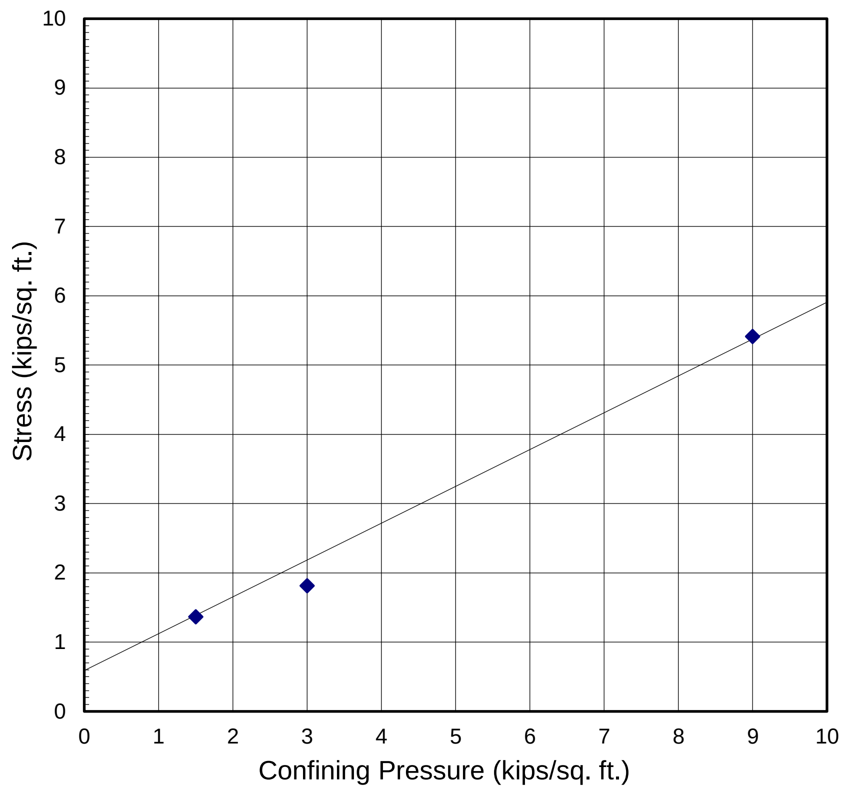


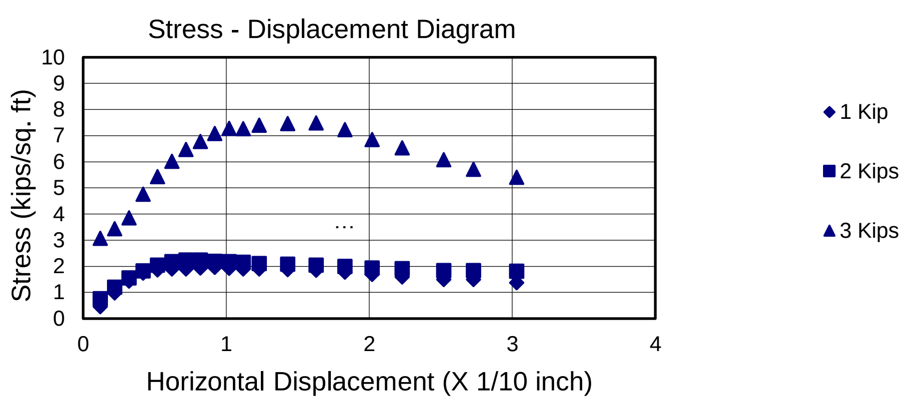
Laboratory Testing 15871 Mulholland Los Angeles, CA	Project No.	17-2357
	Plate	C-2

HAMILTON & ASSOCIATES, INC.

SHEAR TEST RESULTS

Boring 1 at 25 feet





brown, silty sand, moist, firm samples were submerged for at least 24 hours.
The samples had a density of lbs./cu.ft. and a moisture content of 0 %
Cohesion = 590 psf
Friction Angle = 28 degrees
Based on Ultimate Strength

Partner Lab 15871 Mulholland Los Angeles, CA	Project No.	17-2357
	Plate	D-1

HAMILTON & ASSOCIATES

HAMILTON & Associates

ATTERBERG LIMITS
ASTM D4318

Project Name:	Partner Lab (15871 Mulholland)	**Tested By:**	RM
Project No. :	17-2357 (196035.9)	**Checked By:**	
Boring No. :	B6	**Depth (ft.):**	
Depth (ft):	10	**Date:**	9/28/2017

Visual Sample Description: silty clay

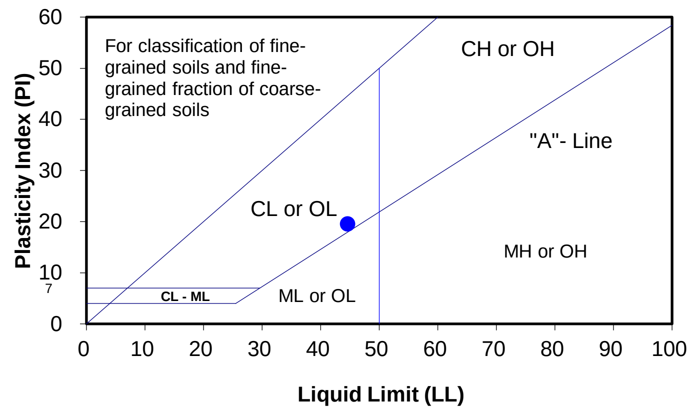
	PLASTIC LIMIT		LIQUID LIMIT			
	1	2	1	2	3	4
Number of Blows [N]:			33	23	18	
Tare No.:	P6	P1	P9/J2	J1	P2/9	
Wt. of Tare (gm):	15.10	14.90	15.58	15.53	15.60	
Wet Wt. of Soil + Tare (gm):	20.30	20.20	46.11	45.63	45.60	
Dry Wt. of Soil + Tare (gm):	19.30	19.10	36.90	36.40	36.00	
Moisture Content (%) [Wn]:	23.81	26.19	43.20	44.23	47.06	

Liquid Limit	**45**
Plastic Limit	**25**
Plasticity Index	**20**
USCS Classification	**CL**

PI at "A" - Line = 0.73(LL-20) = 17.92926

One - Point Liquid Limit Calculation

LL =Wn(N/25)$^{0.121}$



PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test

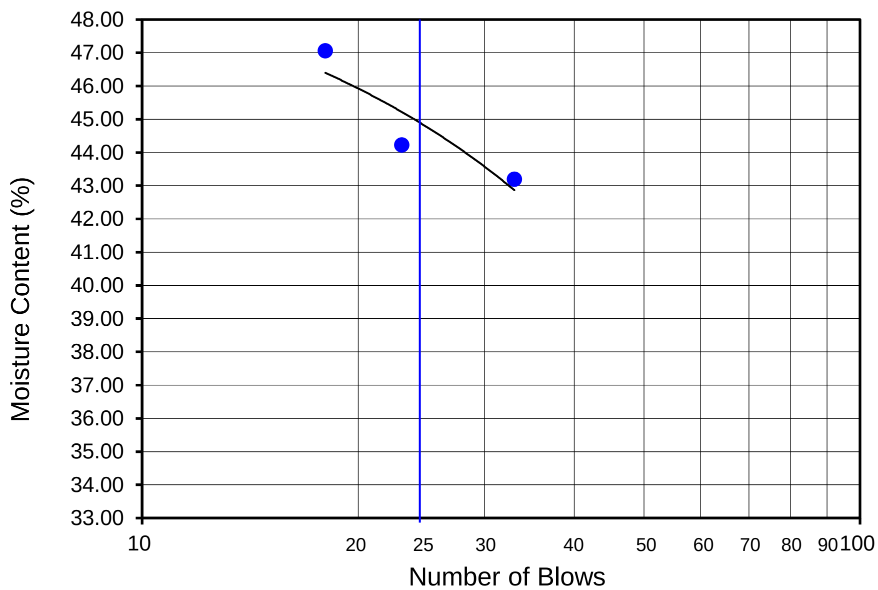


Plate E-1

ATTERBERG LIMITS
ASTM D4318

Project Name: Partner Lab (15871 Mulholland)
Project No. : 17-2357 (196035.9)
Boring No. : B7
Depth (ft): 1-5'

Tested By: RM
Checked By:
Depth (ft.):
Date: 9/26/2017

Visual Sample Description: sandy clay

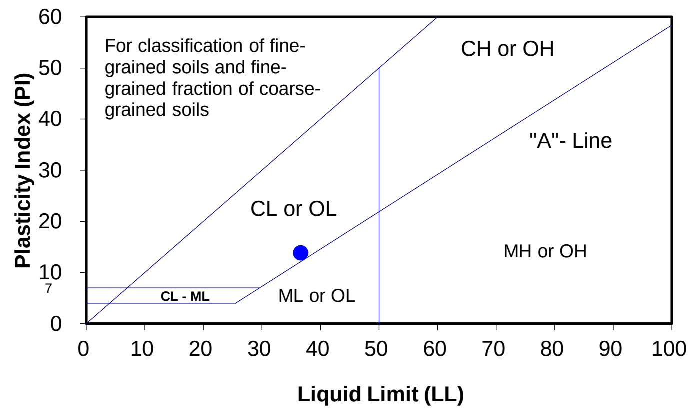
	PLASTIC LIMIT		LIQUID LIMIT			
	1	2	1	2	3	4
Number of Blows [N]:			25	23	17	
Tare No.:	J2/P9	J3	J1	P9/2	P8/6	
Wt. of Tare (gm):	15.70	15.80	15.54	15.64	15.56	
Wet Wt. of Soil + Tare (gm):	21.10	21.20	45.96	45.80	45.68	
Dry Wt. of Soil + Tare (gm):	20.10	20.20	37.90	37.50	37.40	
Moisture Content (%) [Wn]:	22.73	22.73	36.05	37.97	37.91	

Liquid Limit	37
Plastic Limit	23
Plasticity Index	14
USCS Classification	CL

PI at "A" - Line = 0.73(LL-20) = 12.12233

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation Multipoint - Wet
- [X] Dry Preparation Multipoint - Dry
- [X] Procedure A Multipoint Test
- [ ] Procedure B One-point Test

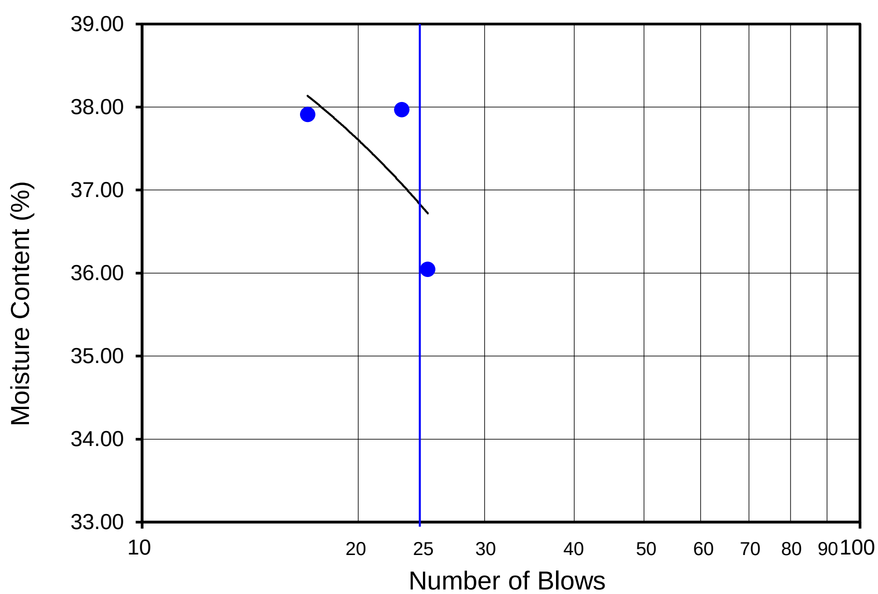


Plate E-2

APPENDIX C

General Geotechnical Design and Construction Considerations

PARTNER

General Geotechnical Design and Construction Considerations

SUBGRADE PREPARATION

1. In general, construction should proceed per the project specifications and contract documents, as well as governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Subgrade preparation in this section is considered to apply to the initial modifications to existing site conditions to prepare for new planned construction.
3. Prior to the start of subgrade preparation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. Existing features that are to be demolished should also be identified and the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned new structural fills, slabs on grade, pavements, foundations, and other structures.
4. The site conflicts, planned demolitions, and subgrade preparation requirements should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others.
5. In the event of preparations that will require work near to existing structures to remain in-place, protection of the existing structures should be considered. This also includes a geotechnical review of excavations near to existing structures and utilities and other concerns discussed in General Geotechnical Design and Construction Considerations, EARTHWORK and UNDERGROUND PIPELINE INSTALLATION.
6. Features to be demolished should be completely removed and disposed of per jurisdictional requirements and/or other conditions set forth as a part of the project. Resulting excavations or voids should be backfilled per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.
7. Vegetation, roots, soils containing organic materials, debris and/or other deleterious materials on the site should be removed from structural areas and should be disposed of as above. Replacement of such materials should be in accordance with the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section
8. Subgrade preparation required by the geotechnical report may also call for as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned structural fills, slabs on grade, pavements, foundations, and other structures. These requirements should be provided within the geotechnical report. The execution of this work should be observed by the geotechnical engineering representative or inspector for the site. Testing of the subgrade preparation should be performed per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.
9. Subgrade Preparation cannot be completed on frozen ground or on ground that is not at a proper moisture condition. Wet subgrades may be dried under favorable weather if they are disked and/or actively worked during hot, dry, weather, when exposed to wind and sunlight.

Frozen ground or wet material can be removed and replaced with suitable material. Dry material can be pre-soaked, or can have water added and worked in with appropriate equipment. The soil conditions should be monitored by the geotechnical engineer prior to compaction. Following this type of work, approved subgrades should be protected by direction of surface water, covering, or other methods, otherwise, re-work may be needed.

General Geotechnical Design and Construction Considerations

EARTHWORK – STRUCTURAL FILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Earthwork in this section is considered to apply to the re-shaping and grading of soil, rock, and aggregate materials for the purpose of supporting man-made structures. Where earthwork is needed to raise the elevation of the site for the purpose of supporting structures or forming slopes, this is referred to as the placement of structural fill. Where lowering of site elevations is needed prior to the installation of new structures, this is referred to as earthwork excavations.
3. Prior to the start of earthwork operations, the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation or scarification and compaction of unsuitable soils below planned structural fills, slabs on grade, pavements, foundations, and other structures. These required preparations should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others. The preparations should be observed by the inspector or geotechnical engineer representative, and following such subgrade preparation, the geotechnical engineer should observe the prepared subgrade to approve it for the placement of earthwork fills or new structures.
4. Structural fill materials should be relatively free of organic materials, man-made debris, environmentally hazardous materials, and brittle, non-durable aggregate, frozen soil, soil clods or rocks and/or any other materials that can break down and degrade over time.
5. In deeper structural fill zones, expansive soils (greater than 1.5 percent swell at 100 pounds per square foot surcharge) and rock fills (fills containing particles larger than 4 inches and/or containing more than 35 percent gravel larger than ¾-inch diameter or more than 50 percent gravel) may be used with the approval and guidance of the geotechnical evaluation or geotechnical engineer. This may require the placement of geotextiles or other added costs and/or conditions. These conditions may also apply to corrosive soils (less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content, more than 0.1 percent sulfates)
6. For structural fill zones that are closer in depth below planed structures, low expansive materials, and materials with smaller particle size are generally recommended, as directed by the geotechnical evaluation (see criteria above in 5). This may also apply to corrosive soils.
7. For structural fill materials, in general the compaction equipment should be appropriate for the thickness of the loose lift being placed, and the thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill.

8. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a modified proctor (ASTM D1557) MDD, depending on the state practices. For subgrades below roadways, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.
9. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.
10. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a "1-sack" slurry. It should be noted that these materials are wet during placement, and require a period of 2 days (24 hours) to cure before additional fill can be placed above them. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.
11. For fills to be placed on slopes, benching of fill lifts is recommended, which may require cutting into existing slopes to create a bench perpendicular to the slope where soil can be placed in a relatively horizontal orientation. For the construction of slopes, the slopes should be over-built and cut back to grade, as the material in the outer portion of the slope may not be well compacted.
12. For subgrade below roadways, runways, railways or other areas to receive dynamic loading, a proofroll of the finished, compacted subgrade should be performed by the geotechnical engineer or inspector prior to the placement of structural aggregate, asphalt or concrete. Proofrolling consists of observing the performance of the subgrade under heavy-loaded equipment, such as full, 4,000 Gallon water truck, loaded tandem-axel dump truck or similar. Areas that exhibit instability during proofroll should be marked for additional work prior to approval of the subgrade for the next stage of construction.
13. Quality control testing should be provided on earthwork. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type. Density testing should be performed per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation of any fill area, with additional tests per 12-inch fill area for each additional 7,500 square-foot section or portion thereof.
14. For earthwork excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or underpinning the adjacent structure. Pre-construction and post-construction condition surveys and vibration

monitoring might also be helpful to evaluate any potential damage to surrounding structures.

15. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or “hard-pan” materials, may result in slower excavation rates, larger equipment with specialized digging tools, and even blasting. It is also not unusual in these situations for screening and or crushing of rock to be called for. Blasting, hard excavating, and material processing equipment have special safety concerns and are more costly than the use of soil excavation equipment. Additionally, this type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.

General Geotechnical Design and Construction Considerations

UNDERGROUND PIPELINE – STRUCTURAL BACKFILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, the State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County Public Works, Occupational Safety and Health Administration (OSHA), Private Utility Companies, and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered, and in some cases work may take place to multiple different standards. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Underground pipeline in this section is considered to apply to the installation of underground conduits for water, storm water, irrigation water, sewage, electricity, telecommunications, gas, etc. Structural backfill refers to the activity of restoring the grade or establishing a new grade in the area where excavations were needed for the underground pipeline installation.
3. Prior to the start of underground pipeline installation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. The geotechnical study should be referenced to determine subsurface conditions such as caving soils, unsuitable soils, shallow groundwater, shallow rock and others. In addition, the utility company responsible for the line also will have requirements for pipe bedding and support as well as other special requirements. Also, if the underground pipeline traverses other properties, rights-of-way, and/or easements etc. (for roads, waterways, dams, railways, other utility corridors, etc.) those owners may have additional requirements for construction.
4. The required preparations above should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and other stake holders.
5. For pipeline excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures or pipelines, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or supporting the adjacent structure or pipeline. A pre-construction and post-construction condition survey and vibration monitoring might also be helpful to evaluate any potential damage to surrounding structures.
6. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or "hard-pan" materials, may result in slower excavation rates, larger equipment with specialized digging tools, and even blasting. It is also not unusual in these situations for screening and or crushing of rock to be called for. Blasting, hard excavating, and material processing equipment have special safety concerns and are more costly than the use soil excavation equipment. Additionally, this

type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.

7. Bedding material requirements vary between utility companies and might depend of the type of pipe material and availability of different types of aggregates in different locations. In general, bedding refers to the material that supports the bottom of the pipe, and extends to 1 foot above the top of the pipe. In general the use of aggregate base for larger diameter pipes (6-inch diameter or more) is recommended lacking a jurisdictionally specified bedding material. Gas lines and smaller diameter lines are often backfilled with fine aggregate meeting the ASTM requirements for concrete sand. In all cases bedding with less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content or more than 0.1 percent sulfates should not be used.
8. Structural backfill materials above the bedding should be relatively free of organic materials, man-made debris, environmentally hazardous materials, frozen material, and brittle, non-durable aggregate, soil clods or rocks and/or any other materials that can break down and degrade over time.
9. In general the backfill soil requirements will depend on the future use of the land above the buried line, but in most cases, excessive settlement of the pipe trench is not considered advisable or acceptable. As such, the structural backfill compaction equipment should be appropriate for the thickness of the loose lift being placed. The thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill. Care should be taken not to damage the pipe during compaction or compaction testing.
10. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a modified proctor (ASTM D1557) MDD, depending on the state practices (in general the modified proctor is required in California and for projects in the jurisdiction of the Army Corps of Engineers). For backfills within the upper portions of roadway subgrades, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.
11. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.
12. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a "1-sack" slurry. It should be noted that these materials are wet, and require a period of 2 days (24 hours) to cure before additional fill can be placed above it. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.

13. Quality control testing should be provided on structural backfill to assist the contractor in meeting project specifications. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type.
14. Density testing should be performed on structural backfill per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation in each area, and additional tests for each additional 500 linear-foot section or portion thereof.

General Geotechnical Design and Construction Considerations

CAST-IN-PLACE CONCRETE

SLABS-ON-GRADE/STRUCTURES/PAVEMENTS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Cast-in-place concrete (concrete) in this section is considered to apply to the installation of cast-in-place concrete slabs on grade, including reinforced and non-reinforced slabs, structures, and pavements.
3. In areas where concrete is bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of concrete construction.
4. In locations where a concrete is approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a concrete subgrade evaluation should be performed prior to the placement of reinforcing steel and or concrete. This can consist of probing with a "t"-handled rod, borings, penetrometer testing, dynamic cone penetration testing, and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable, wet, or frozen bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.
5. Slabs on grade should be placed on a 4-inch thick or more capillary barrier consisting of non- corrosive (more than 2,000 ohm-cm resistivity, less than 50 ppm chloride content and less than 0.1 percent sulfates) aggregate base or open-graded aggregate material. This material should be compacted or consolidated per the recommendations of the structural engineer or otherwise would be covered by the General Considerations for EARTHWORK.
6. Depending on the site conditions and climate, vapor barriers may be required below in-door grade-slabs to receive flooring. This reduces the opportunity for moisture vapor to accumulate in the slab, which could degrade flooring adhesive and result in mold or other problems. Vapor barriers should be specified by the structural engineer and/or architect. The installation of the barrier should be inspected to evaluate the correct product and thickness is used, and that it has not been damaged or degraded.
7. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel or tendons. This serves the purpose of protecting the subgrades from damage once the reinforcement placement has begun.

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8. Prior to the placement of concrete, exposed subgrade or base material and forms should be wetted, and form release compounds should be applied. Reinforcement support stands or ties should be checked. Concrete bases or subgrades should not be so wet that they are softened or have standing water.
9. For a cast-in-place concrete, the form dimensions, reinforcement placement and cover, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement. The reinforcement should be specified by the structural engineering drawings and calculations.
10. For post-tension concrete, an additional check of the tendons is needed, and a tensioning inspection form should be prepared prior to placement of concrete.
11. For Portland cement pavements, forms an additional check of reinforcing dowels should performed per the design drawings.
12. During placement, concrete should be tested, and should meet the ACI and jurisdictional requirements and mix design targets for slump, air entrainment, unit weight, compressive strength, flexural strength (pavements), and any other specified properties. In general concrete should be placed within 90 minutes of batching at a temperature of less than 90 degrees Fahrenheit. Adding of water to the truck on the jobsite is generally not encouraged.
13. Concrete mix designs should be created by the accredited and jurisdictionally approved supplier to meet the requirements of the structural engineer. In general a water/cement ratio of 0.45 or less is advisable, and aggregates, cement, flyash, and other constituents should be tested to meet ASTM C-33 standards, including Alkali Silica Reaction (ASR). To further mitigate the possibility of concrete degradation from corrosion and ASR, Type II or V Portland Cement should be used, and fly ash replacement of 25 percent is also recommended. Air entrained concrete should be used in areas where concrete will be exposed to frozen ground or ambient temperatures below freezing.
14. Control joints are recommended to improve the aesthetics of the finished concrete by allowing for cracking within partially cut or grooved joints. The control joints are generally made to depths of about 1/4 of the slab thickness and are generally completed within the first day of construction. The spacing should be laid out by the structural engineer, and is often in a square pattern. Joint spacing is generally 5 to 15 feet on-center but this can vary and should be decided by the structural engineer. For pavements, construction joints are generally considered to function as control joints. Post-tensioned slabs generally do not have control joints.
15. Some slabs are expected to meet flatness and levelness requirements. In those cases, testing for flatness and levelness should be completed as soon as possible, usually the same day as concrete placement, and before cutting of control joints if possible. Roadway smoothness can also be measured, and is usually specified by the jurisdictional owner if is required.
16. Prior to tensioning of post-tension structures, placement of soil backfills or continuation of building on newly-placed concrete, a strength requirement is generally required, which should be specified by the structural engineer. The strength progress can be evaluated by the use of concrete compressive strength cylinders or maturity monitoring in some

jurisdictions. Advancing with backfill, additional concrete work or post-tensioning without reaching strength benchmarks could result in damage and failure of the concrete, which could result in danger and harm to nearby people and property.

17. In general, concrete should not be exposed to freezing temperatures in the first 7 days after placement, which may require insulation or heating. Additionally, in hot or dry, windy weather, misting, covering with wet burlap or the use of curing compounds may be called for to reduce shrinkage cracking and curling during the first 7 days.

General Geotechnical Design and Construction Considerations

FOUNDATIONS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Foundations in this section are considered to apply to the construction of structural supports which directly transfer loads from man-made structures into the earth. In general, these include shallow foundations and deep foundations. Shallow foundations are generally constructed for the purpose of distributing the structural loads horizontally over a larger area of earth. Some types of shallow foundations (or footings) are spread footings, continuous footings, mat foundations, and reinforced slabs-on-grade. Deep foundations are generally designed for the purpose of distributing the structural loads vertically deeper into the soil by the use of end bearing and side friction. Some types of deep foundations are driven piles, auger-cast piles, drilled shafts, caissons, helical piers, and micro-piles.
3. For shallow foundations, the minimum bearing depth considered should be greater than the maximum design frost depth for the location of construction. This can be found on frost depth maps (ICC), but the standard of practice in the city and/or county should also be consulted. In general the bearing depth should never be less than 18 inches below planned finished grades.
4. Shallow continuous foundations should be sized with a minimum width of 18 inches and isolated spread footings should be a minimum of 24 inches in each direction. Foundation sizing, spacing, and reinforcing steel design should be performed by a qualified structural engineer.
5. The geotechnical engineer will provide an estimated bearing capacity and settlement values for the project based on soil conditions and estimated loads provided by the structural engineer. It is assumed that appropriate safety factors will be applied by the structural engineer.
6. In areas where shallow foundations are bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of foundation construction.
7. In locations where the shallow foundations are approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a foundation subgrade evaluation should be performed prior to the placement of reinforcing steel. This can consist of probing with a “t”-handled rod, borings, penetrometer testing, dynamic cone penetration testing, and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable foundation bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.

8. For shallow foundations to bear on rock, partially weathered rock, hard cemented soils, and/or boulders, the entire foundation system should bear directly on such material. In this case, the rock surface should be prepared so that it is clean, competent, and formed into a roughly horizontal, stepped base. If that is not possible, then the entire structure should be underlain by a zone of structural fill. This may require the over-excavation in areas of rock removal and/or hard dig. In general this zone can vary in thickness but it should be a minimum of 1 foot thick. The geotechnical engineer should be consulted in this instance.
9. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel. This serves the purpose of protecting the subgrades from damage once the reinforcing steel placement has begun.
10. For cast-in-place concrete foundations, the excavations dimensions, reinforcing steel placement and cover, structural fill compaction, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement.

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11. For deep foundations, the geotechnical engineer will generally provide design charts that provide foundations axial capacity and uplift resistance at various depths given certain-sized foundations. These charts may be based on blow count data from drilling and or laboratory testing. In general safety factors are included in these design charts by the geotechnical engineer.
12. In addition, the geotechnical engineer may provide other soil parameters for use in the lateral resistance analysis. These parameters are usually raw data, and safety factors should be provided by the shaft designer. Sometimes, direct shear and/or tri-axial testing are performed for this analysis.
13. In general the spacing of deep foundations is expected to be 6 shaft diameters or more. If that spacing is reduced, a group reduction factor should be applied by the structural engineer to the foundation capacities per FHWA guidelines. The spacing should not be less than 2.5 shaft diameters.
14. For deep foundations, a representative of the geotechnical engineer should be on-site to observe the excavations (if any) to evaluate that the soil conditions are consistent with the findings of the geotechnical report. Soil/rock stratigraphy will vary at times, and this may result in a change in the planned construction. This may require the use of fall protection equipment to perform observations close to an open excavation.
15. For driven foundations, a representative of the geotechnical engineer should be on-site to observe the driving process and to evaluate that the resistance of driving is consistent with the design assumptions. Soil/rock stratigraphy will vary at times and may this may result in a change in the planned construction.
16. For deep foundations, the size, depth, and ground conditions should be verified during construction by the geotechnical engineer and/or inspector responsible. Open excavations should be clean, with any areas of caving and groundwater seepage noted. In areas below the groundwater table, or areas where slurry is used to keep the trench open, non-destructive testing techniques should be used as outlined below.

17. Steel members including structural steel piles, reinforcing steel, bolts, threaded steel rods, etc. should be evaluated for design and code compliance prior to pick-up and placement in the foundation. This includes verification of size, weight, layout, cleanliness, lap-splices, etc. In addition, if non-destructive testing such as crosshole sonic logging or gamma-gamma logging is required, access tubes should be attached to the steel reinforcement prior to placement, and should be relatively straight, capped at the bottom, and generally kept in-round. These tubes must be filled with water prior to the placement of concrete.
18. In cases where steel welding is required, this should be observed by a certified welding inspector.
19. In many cases, a crane will be used to lower steel members into the deep foundations. Crane picks should be carefully planned, including the ground conditions at placement of outriggers, wind conditions, and other factors. These are not generally provided in the geotechnical evaluation, but can usually be provided upon request.
20. Cast-in-place concrete, grout or other cementations materials should be pumped or distributed to the bottom of the excavation using a tremmie pipe or hollow stem auger pipe. Depending on the construction type, different mix slumps will be used. This should be carefully checked in the field during placement, and consolidation of the material should be considered. Use of a vibrator may be called for.
21. For work in a wet excavation (slurry), the concrete placed at the bottom of the excavation will displace the slurry as it comes up. The upper layer of concrete that has interacted with the slurry should be removed and not be a part of the final product.
22. Bolts or other connections to be set in the top after the placement is complete should be done immediately after final concrete placement, and prior to the on-set of curing.
23. For shafts requiring crosshole sonic logging or gamma-gamma testing, this should be performed within the first week after placement, but not before a 2 day curing period. The testing company and equipment manufacturer should provide more details on the requirements of the testing.
24. Load testing of deep foundations is recommended, and it is often a project requirement. In some cases, if test piles are constructed and tested, it can result in a significant reduction of the amount of needed foundations. The load testing frame and equipment should be sized appropriately for the test to be performed, and should be observed by the geotechnical engineer or inspector as it is performed. The results are provided to the structural engineer for approval.

General Geotechnical Design and Construction Considerations

LATERALLY LOADED STRUCTURES - RETAINING WALLS/SLOPES/DEEP FOUNDATIONS/MISCELLANEOUS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Laterally loaded structures for this section are generally meant to describe structures that are subjected to loading roughly horizontal to the ground surface. Such structures include retaining walls, slopes, deep foundations, tall buildings, box culverts, and other buried or partially buried structures.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. Laterally loaded structures are generally affected by overburden pressure, water pressure, surcharges, and other static loads, as well as traffic, seismic, wind, and other dynamic loads. The structural engineer must account for these loads. In addition, eccentric loading of the foundation should be evaluated and accounted for by the structural engineer. The structural engineer is also responsible for applying the appropriate factors of safety to the raw data provided by the geotechnical engineer.
5. The geotechnical report should provide data regarding soil lateral earth pressures, seismic design parameters, and groundwater levels. In the report the pressures are usually reported as raw data in the form of equivalent fluid pressures for three cases. 1. Static is for soil pressure against a structure that is fixed at top and bottom, like a basement wall or box culvert. 2. Active is for soil pressure against a wall that is free to move at the top, like a retaining wall. 3. Passive is for soil that is resisting the movement of the structure, usually at the toe of the wall where the foundation and embedded section are located. The structural engineer is responsible for deciding on safety factors for design parameters and groundwater elevations based on the raw data in the geotechnical report.
6. Generally speaking, direct shear or tri-axial shear testing should be performed for this evaluation in cases of soil slopes or unrestrained soil retaining walls over 6 feet in height or in lower walls in some cases based on the engineer's judgment. For deep foundations and completely buried structures, this testing will be required per the discretion of the structural engineer.
7. For non-confined retaining walls (walls that are not attached at the top) and slopes, a geotechnical engineer should perform overall stability analysis for sliding, overturning, and global stability. For walls that are structurally restrained at the top, the geotechnical engineer does not generally perform this analysis. Internal wall stability should be designed by the structural engineer.

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8. Cut slopes into rock should be evaluated by an engineering geologist, and rock coring to identify the orientation of fracture plans, faults, bedding planes, and other features should be performed. An analysis of this data will be provided by the engineering geologist to identify modes of failure including sliding, wedge, and overturning, and to provide design and construction recommendations.
9. For laterally loaded deep foundations that support towers, bridges or other structures with high lateral loads, geotechnical reports generally provide parameters for design analysis which is performed by the structural engineer. The structural engineer is responsible for applying appropriate safety factors to the raw data from the geotechnical engineer.
10. Construction recommendations for deep foundations can be found in the General Geotechnical Design and Construction Considerations-FOUNDATIONS section.
11. Construction of retaining walls often requires temporary slope excavations and shoring, including soil nails, soldier piles and lagging or laid-back slopes. This should be done per OSHA requirements and may require specialty design and contracting.
12. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.
13. Waterproofing for retaining walls is generally required on the backfilled side, and they should be backfilled with an 18-inch zone of open graded aggregate wrapped in filter fabric or a synthetic draining product, which outlets to weep holes or a drain at the base of the wall. The purpose of this zone, which is immediately behind the wall is to relieve water pressures from building behind the wall.
14. Backfill compaction around retaining walls and slopes requires special care. Lighter equipment should be considered, and consideration to curing of cementitious materials used during construction will be called for. Additionally, if mechanically stabilized earth walls are being constructed, or if tie-backs are being utilized, additional care will be necessary to avoid damaging or displacing the materials. Use of heavy or large equipment, and/or beginning of backfill prior to concrete strength verification can create dangers to construction and human safety. Please refer to the General Geotechnical Design and Construction Considerations-CAST-IN-PLACE CONCRETE section. These concerns will also apply to the curing of cell grouting within reinforced masonry walls.
15. Usually safety features such as handrails are designed to be installed at the top of retaining walls and slopes. Prior to their installation, workers in those areas will need to be equipped with appropriate fall protection equipment.

General Geotechnical Design and Construction Considerations

CHEMICAL TREATMENT OF SOIL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Chemical treatment of soil for this section is generally meant to describe the process of improving soil properties for a specific purpose, using cement or chemical lime.
3. A mix design should be performed by the geotechnical engineer to help it meet the specific strength, plasticity index, durability, and/or other desired properties. The mix design should be performed using the proposed chemical lime or cement proposed for use by the contractor, along with samples of the site soil that are taken from the material to be used in the process.
4. For the mix design the geotechnical engineer should perform proctor testing to determine optimum moisture content of the soil, and then mix samples of the soil at 3 percent above optimum moisture content with varying concentrations of lime or cement. The samples will be prepared and cured per ASTM standards, and then after 7-days for curing, they will be tested for compression strength. Durability testing goes on for 28 days.
5. Following this testing, the geotechnical engineer will provide a recommended mix ratio of cement or chemical lime in the geotechnical evaluation for use by the contractor. The geotechnical engineer will generally specify a design ratio of 2 percent more than the minimum to account for some error during construction.
6. Prior to treatment, the in-place soil moisture should be measured so that the correct amount of water can be used during construction. Work should not be performed on frozen ground.
7. During construction, special considerations for construction of treated soils should be followed. The application process should be conducted to prevent the loss of the treatment material to wind which might transport the materials off site, and workers should be provided with personal protective equipment for dust generated in the process.
8. The treatment should be applied evenly over the surface, and this can be monitored by use of a pan placed on the subgrade. This can also be tested by preparing test specimens from the in-place mixture for laboratory testing.
9. Often, after or during the chemical application, additional water may be needed to activate the chemical reaction. In general, it should be maintained at about 3 percent or more above optimum moisture. Following this, mixing of the applied material is generally performed using specialized equipment.
10. The total amount of chemical provided can be verified by collecting batch tickets from the delivery trucks, and the depth of the treatment can be verified by digging of test pits, and the use of reagents that react with lime and or cement.

11. For the use of lime treatment, compaction should be performed after a specified amount of time has passed following mixing and re-grading. For concrete, compaction should be performed immediately after mixing and re-grading. In both cases, some swelling of the surface should be expected. Final grading should be performed the following day of the initial work for lime treatment, and within 2 to 4 hours for soil cement.
12. Quality control testing of compacted treated subgrades should be performed per the recommendations of the geotechnical report, and generally in accordance with General Geotechnical Design and Construction Considerations - EARTHWORK

General Geotechnical Design and Construction Considerations

PAVING

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Paving for this section is generally meant to describe the placement of surface treatments on travel-ways to be used by rubber-tired vehicles, such as roadways, runways, parking lots, etc.
3. The geotechnical engineer is generally responsible for providing structural analysis to recommend the thickness of pavement sections, which can include asphalt, concrete pavements, aggregate base, cement or lime treated aggregate base, and cement or lime treated subgrades.
4. The civil engineer is generally responsible for determining which surface finishes and mixes are appropriate, and often the owner, general contractor and/or other party will decide on lift thickness, the use of tack coats and surface treatments, etc.
5. The geotechnical engineer will generally be provided with the planned traffic loading, as well as reliability, design life, and serviceability factors by the jurisdiction, traffic engineer, designer, and/or owner. The geotechnical study will provide data regarding soil resiliency and strength. A pavement modeling software is generally used to perform the analysis for design, however, jurisdictional minimum sections also must be considered, as well as construction considerations and other factors.
6. The geotechnical evaluation report will generally provide pavement section thicknesses if requested.
7. For construction of overlays, where new pavement is being placed on old pavement, an evaluation of the existing pavement is needed, which should include coring the pavement, evaluation of the overall condition and thickness of the pavement, and evaluation of the pavement base and subgrade materials.
8. In general, the existing pavement is milled and treated with a tack coat prior to the placement of new pavement for the purpose of creating a stronger bond between the old and new material. This is also a way of removing aged asphalt and helping to maintain finished grades closer to existing conditions grading and drainage considerations.
9. If milling is performed, a minimum of 2 inches of existing asphalt should be left in-place to reduce the likelihood of equipment breaking through the asphalt layer and destroying its integrity. After milling and before the placement of tack coat, the surface should be evaluated for cracking or degradation. Cracked or degraded asphalt should be removed, spanned with geosynthetic reinforcement, or be otherwise repaired per the direction of the civil and or geotechnical engineer prior to continuing construction. Proofrolling may be requested.

10. For pavements to be placed on subgrade or base materials, the subgrade and base materials should be prepared per the General Geotechnical Design and Construction Considerations – EARTHWORK section.
11. Following the proofrolling as described in the General Geotechnical Design and Construction Considerations – EARTHWORK section, the application of subgrade treatment, base material, and paving materials can proceed per the recommendations in the geotechnical evaluation and/or project plans. The placement of pavement materials or structural fills cannot take place on frozen ground.
12. The placement of aggregate base material should conform to the jurisdictional guidelines. In general the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. Material that has been stockpiled and exposed to weather including wind and rain should be retested for compliance since fines could be lost. Frozen material cannot be used.
13. The placement of asphalt material should conform to the jurisdictional guidelines. In general the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. The material can be placed in a screed by end-dumping, or it can be placed directly on the paving surface. The temperature of the mix at placement should generally be on the order of 300 degrees Fahrenheit at time of placement and screeding.
14. Compaction of the screeded asphalt should begin as soon as practical after placement, and initial rolling should be performed before the asphalt has cooled significantly. Compaction equipment should have vibratory capabilities, and should be of appropriate size and weight given the thickness of the lift being placed and the sloping of the ground surface.
15. In cold and/or windy weather, the cooling of the screeded asphalt is a quality issue, so preparations should be made to perform screeding immediately after placement, and compaction immediately after screeding.
16. Quality control testing of the asphalt should be performed during placement to verify compaction and mix design properties are being met and that delivery temperatures are correct. Results of testing data from asphalt laboratory testing should be provided within 24 hours of the paving.

General Geotechnical Design Considerations

SITE GRADING AND DRAINAGE

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Site grading and drainage for this section is generally meant to describe the effect of new construction on surface hydrology, which impacts the flow of rainfall or other water running across, onto or off-of, a newly constructed or modified development.
3. This section does not apply to the construction of site grading and drainage features. Recommendations for the construction of such features are covered in General Geotechnical Design and Construction Considerations for Earthwork – Structural Fills section and Underground Pipeline Installation – Backfill section.
4. In general, surface water flows should be directed towards storm drains, natural channels, retention or detention basins, swales, and/or other features specifically designed to capture, store, and or transmit them to specific off-site outfalls.
5. The surface water flow design is generally performed by a site civil engineer, and it can be impacted by hydrology, roof lines, and other site structures that do not allow for water to infiltrate into the soil, and that modify the topography of the site.
6. Soil permeability, density, and strength properties are relevant to the design of storm drain systems, including dry wells, retention basins, swales, and others. These properties are usually only provided in a geotechnical evaluation if specifically requested, and recommendations will be provided in the geotechnical report in those cases.
7. Structures or site features that are not a part of the surface water drainage system should not be exposed to surface water flows, standing water or water infiltration. In general, roof drains and scuppers, exterior slabs, pavements, landscaping, etc. should be constructed to drain water away from structures and foundations. The purpose of this is to reduce the opportunity for water damage, erosion, and/or altering of structural soil properties by wetting. In general, a 5 percent or more slope away from foundations, structural fills, slopes, structures, etc. should be maintained.
8. Special considerations should be used for slopes and retaining walls, as described in the General Geotechnical Design and Construction Considerations - LATERALLY LOADED STRUCTURES section.
9. Additionally, landscaping features including irrigation emitters and plants that require large amounts of water should not be placed near to new structures, as they have the potential to alter soil moisture states. Changing of the moisture state of soil that provides structural support can lead to damage to the supported structures.