REVISED GEOTECHNICAL ENGINEERING REPORT
UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
SOUTHWEST OF STORKE ROAD AND WHITTIER DRIVE
GOLETA, CALIFORNIA

August 19, 2016

Prepared for

Environmental Science Associates

Prepared by

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PROJECT: UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
SOUTHWEST OF STORKE ROAD AND WHITTIER DRIVE
GOLETA, CALIFORNIA

SUBJECT: Revised Geotechnical Engineering Report

REF: Second Revised Proposal for the Stage 2 Geotechnical Engineering Services – Geotechnical Engineering Report; and Drilling and Sampling Services for the Other Consultants, UCSB North Campus Open Space Restoration Project, Southwest of Storke Road and Whittier Drive, Goleta, California, by Earth Systems Pacific, dated November 30, 2015, Doc. No. 1510-031.REV2PRP

Dear Mr. Battalio:

This revised geotechnical engineering report has been prepared for Environmental Science Associates (ESA) use in the development of plans and specifications for the University of California Santa Barbara (UCSB) North Campus Open Space Restoration project. The project is located southwest of Storke Road and Whittier Drive in the City of Goleta, California. The original report was revised to include additional information as requested by the engineering design team and the client. Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, abutments and wing walls, pavement sections, flatwork, drainage and maintenance, and construction observation and testing are presented herein. Two bound copies and an electronic copy of this report are being furnished for your use.

We appreciate the opportunity to have provided services for this project and look forward to working with you again in the future. If there are any questions concerning this report, please do not hesitate to contact me.

Sincerely,
Earth Systems Pacific

Doug Dunham

Doug Dunham, GE
Associate Engineer

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1.0 INTRODUCTION

The UCSB North Campus Open Space Restoration project will generally consist of enhancing the ecology and overall natural function of the various habitats within an approximately 140-acre site known as the Devereux Slough Ecosystem (referred to herein as "the site"). The site is located southwest of Storke Road and Whittier Drive in the City of Goleta, California. The site is shown on the Boring Location Map presented in Appendix A.

The project generally includes an expansion of the lower elevation wetland, creek, mudflat, and marsh areas of the site to improve water flow and extend the hydrological connectivity of the existing Devereux Slough Ecosystem. The transition zones to and including the surrounding upland areas will also be modified to restore the original topography and native plant life to the degree practicable. This is intended as a means to enhance habitats for threatened and endangered species, and to improve the resiliency of the entire wetland and upland ecosystems.

As part of the project, access structures and improvements will be constructed to create recreational, research, and educational opportunities for a variety of visitors within and around the restoration area. We understand the structures will generally include a summer crossing, two pedestrian bridges, a boardwalk, and an elevated pier with a viewing platform to provide access over the wetland and creek areas. To the best of our knowledge, no other structures will be constructed as part of the project. For the purposes of this report, maximum line and point loads of 2 kips/foot and 100 kips, respectively, were assumed. A brief description of these structures are provided as follows, and their respective locations are also identified on the Boring Location Map.

- Bridge A is the Sierra Madre Wetlands Crossing. It will be a 12-foot wide by 100-foot long Portland cement concrete (PCC) slab-on grade summer type crossing. This structure will be elevated 2.5 feet above the existing ground elevation, and will have a perimeter PCC cutoff wall that will extend down 4 feet from the structure's surface. Underlying 2-foot by 2-foot drainage culverts or slots with rip-rap erosion controls on both the upstream and downstream sides of the culverts or slots will be installed near the center of the crossing to keep the structure's surface from flooding. This structure will be designed to support pedestrian, bicycle, and light vehicle traffic.

- Bridge B will cross over the Whittier channel. It will be a 12-foot wide by 100-foot long low-rise timber boardwalk with vertical supports spaced on 10-foot centers. This structure will be elevated 4 feet above the existing ground elevation. This structure will be designed to support pedestrian and bicycle traffic, but not any vehicle traffic.

- Bridge C will cross over the eastern arm of Devereux Slough. It will consist of three 12-foot wide by 100-foot long prefabricated steel-frame bridge structures connected end to end to form a total length of 300 feet. Each bridge will be supported at their respective ends. The type of bridge deck is not known at this time. This structure will be elevated 10 feet above the final channel elevation. This structure will be designed to support pedestrian, bicycle, and light vehicle traffic.

- Bridge D will cross over Devereux Slough near its interface with Phelps Creek. It will consist of a 12-foot wide by 100-foot long prefabricated steel-frame bridge structure. The bridge will be supported at both ends. The type of bridge deck is not known at this time. This structure will be elevated 9 feet above the final channel elevation. This structure will be designed to support pedestrian, bicycle, and light vehicle traffic.

- The Pier and Viewing Platform will be constructed off a trail at the confluence of two natural drainage areas near the middle of Devereux Slough. It will consist of a 12-foot wide by 100-foot long bridge or pier providing access to a 25-foot by 25-foot timber viewing platform. As this structure is in the early design stages, the components used to construct the structure, the spacing of the vertical supports, and the loading conditions are not known at this time.

We understand the surface improvements planned for the project will consist of a paved vehicle parking area, flatwork, and improved trails for access across various areas of the site.

We have assumed the vehicle parking area will consist of hot mix asphalt (HMA) pavement placed over aggregate base (AB), and that the flatwork will be constructed of PCC. Some of the trails will be covered with AB, while others will be native soil trails created and/or improved by grading. We have assumed the subsurface improvements will include the underground conduits for the service utilities and drainage controls. All of the aforementioned structures and improvements are planned to provide reasonable site access and viewing areas for the public's use while protecting the environmentally sensitive areas.

As part of the restoration process to re-establish the upper portion of Devereux Slough and the southerly open space areas back to near their original grades, substantial mass grading construction will be needed. The Boring Location Map depicts the general location of the planned excavation and fill placement areas to accomplish this goal. As the mass grading operations near completion, fine grading operations will then be needed to develop the final grades within the building and surface improvement areas; and to improve access and drainage. Cuts and fills on the order of 10 feet or more are anticipated. Graded slopes are planned at 2 to 1 (horizontal to vertical) or flatter inclinations.

2.0 SCOPE OF SERVICES

The scope of work for this geotechnical engineering report included a general site reconnaissance, subsurface investigation, laboratory testing of selected soil samples, geotechnical analysis of data, and preparation of this report. The analysis and subsequent recommendations were based, in part, upon information provided by the client.

This report and preliminary geotechnical recommendations are intended to comply with the considerations of California Building Code (CBC) Sections 1803.1 through 1803.6, J104.3, and

J104.4 (CBSC, 2013) and common geotechnical engineering practice in this area under similar conditions at this time. The test procedures were accomplished in general conformance with the standards noted, as modified by common geotechnical engineering practice in this area under similar conditions at this time.

Preliminary geotechnical recommendations for site preparation, grading, utility trenches, foundations, abutments and wing walls, pavement sections, flatwork, drainage and maintenance, and construction observation and testing are presented to guide the development of project plans and specifications. It is our intent that this report be used exclusively by the client to form the geotechnical basis of the design of the project and in the preparation of plans and specifications. Application beyond this intent is strictly at the user's risk. If future parties wish to use this report, such use will be allowed to the extent the report is applicable, only if the user agrees to be bound by the same contractual conditions as the original client, or contractual conditions that may be applicable at the time of the report use.

This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, dewatering, shoring, temporary slope angles, construction means and methods, etc. Analyses of the areal or site geology, and of the soil for asbestos (either man-made or naturally occurring), radioisotopes, mold or other microbial content, hydrocarbons, lead, or other chemical properties (except for geotechnical corrosivity) are beyond the scope of this report. Ancillary features such as temporary access roads, fences and site walls; flag and light poles; signage; and nonstructural fills are not within our scope and are also not addressed.

As there may be unresolved geotechnical issues with respect to this project, the geotechnical engineer should be retained to provide consultation as the design progresses, and to review project plans as they near completion to assist in verifying that pertinent geotechnical issues have been addressed and to aid in conformance with the intent of this report. In the event that there are any changes in the nature, design, or location of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified by the geotechnical engineer in writing. The criteria presented in this report are considered preliminary until such time as any peer review or review by any jurisdiction has been completed, conditions are observed by the geotechnical engineer in the field during construction, and the recommendations have been verified as appropriate or are modified by the geotechnical engineer in writing.

3.0 SITE SETTING

The site is located southwest of the intersection of Storke Road and Whittier Drive which is in the western sector of the City of Goleta, California. The approximate central site coordinates obtained from the Google Earth website (Europa Technologies, 2015) are latitude 34.4198 degrees north, longitude 119.8783 degrees west.

The general surrounding areas to the north and east are residentially developed, and the areas to the west and south are generally undeveloped open space with the exception of the Veneco property which lies near the southwest corner of the site. The northern portion of the site supports the abandoned Ocean Meadows Golf Course and its associated structures; and surface, subsurface, and landscape improvements. The southern portion of the site is covered with a sparse to moderately dense growth of vegetation. Topographically, the site generally ranges from relatively flat to moderately sloping; however, steeply sloping ground does exist along the perimeter of some of the natural drainage areas. Drainage is by sheet flow.

4.0 FIELD INVESTIGATION AND LABORATORY ANALYSIS

During the week of March 7 through 10, 2016, and on April 20, 2016, seventeen borings were drilled at the site to depths ranging from approximately 2 to 51.5 feet below the existing ground surface. Thirteen of the borings (Borings 1 through 13) were drilled with a Mobile Model B-53 drill rig, equipped with a 6-inch outside diameter hollow stem auger and an automatic trip hammer for sampling. The remaining four borings (Borings HA-A, HA-B, HA-C, and HA-D) were drilled with a 4-inch diameter hand auger. These hand auger borings were drilled for near soil surface sample acquisition and laboratory testing purposes only. The hand auger borings were not logged but the laboratory test data is included within this report. The approximate locations where all the aforementioned borings were drilled are shown on the Boring Location Map presented in Appendix A.

Soils encountered in Borings 1 through 13 were logged and categorized in general accordance with the Unified Soil Classification System and ASTM D2488-09a. Copies of those boring logs can be found in Appendix A along with a boring log legend. In reviewing the boring logs and legend, the reader should recognize that the legend is intended as a guideline only, and there are a number of conditions that may influence the characteristics observed during excavation. These include, but are not limited to, the presence of cobbles or boulders, organics, cementation, variations in soil moisture, presence of groundwater, and other factors. Consequently, the logger must exercise judgment in interpreting soil characteristics, possibly resulting in soil descriptions that vary from the legend.

As the borings were drilled, soil samples were taken using a ring-lined barrel sampler (ASTM D3550-01/07, with shoe similar to D2937-10) and Standard Penetration Tests (SPT) were conducted at selected depths in the borings (ASTM D1586-11). Bulk soil samples were also obtained from the auger cuttings.

Ring samples were tested for unit weight and moisture (ASTM D2937-10, as modified for ring liners). One bulk sample was tested for maximum density and optimum moisture (ASTM D1557-12). The expansion index (ASTM D4829-11) was determined for another of the bulk samples. Four direct shear tests (ASTM D3080/D3080M-11) were conducted on ring samples. Eight ring samples were also tested for unconfined compressive strength (ASTM D 2166-06). Seven particle size tests (ASTM D422-63/07 and D1140-00/06) were performed on both bulk and ring samples. A one-dimensional consolidation test (ASTM D2435/D2435M-11) was conducted on a ring sample. Two bulk samples were sent to Cerco Analytical of Concord, California for use in preparing a corrosion evaluation report. The corrosion evaluation report and associated test results are for use by the architect/engineer in determining appropriate corrosion mitigation measures. The laboratory test results and the corrosion evaluation report prepared by Cerco Analytical are presented in Appendices B and C, respectively.

5.0 GENERAL SUBSURFACE PROFILE

The general subsurface profile observed in Borings 1 through 13 consisted of layered sand and clay soils. All of the soils were in a moist to wet condition. The sands had a loose to very dense consistency, and the clays were very soft to hard. Gravel of various size and amount was also observed within some of the soil layers. Subsurface water was encountered in eight of the thirteen borings. The groundwater appeared to be a perched condition as it was discontinuous in nature, and also occurred in variable thicknesses and depths below the existing ground surface. Please refer to the boring logs for a more complete description of the subsurface conditions.

6.0 CONCLUSIONS

In our opinion, the site is suitable, from a geotechnical engineering standpoint, for the planned structures and improvements as described in the "Introduction" section of this report, provided the recommendations contained herein are implemented in the design and construction. In our opinion, the primary geotechnical concerns at the site will be the type of foundations used to support the structures, the potential for settlement, the expansive soils, the excavation characteristics of the soils, the suitability of the soils for use as fill and backfill, the stability of the soils during grading, the corrosive nature of the soils, the erodible nature of the soils, and the potential for liquefaction and seismically induced settlement of dry sand.

Foundation Type

Based on the general subsurface profile observed in the borings, it is our opinion that deep foundation systems should be used to support all of the structures with the exception of Bridge A, the summer crossing. Bridge A can be supported by either a deep or shallow foundation system; however, if a shallow foundation system is used, special grading in the form of gravel, geogrid, and AB material enhancement placed beneath the foundation will be necessary. Recommendations for the gravel, geogrid, and AB material enhancement are provided in the "Grading" section of this report. Shallow foundations, if used for Bridge A, should consist of either conventional or mat foundations. We understand from the design team that the deep foundation systems will consist of cast-in-drilled-hole (CIDH) piles as the construction of driven piles has been previously deemed unacceptable due to the nearby residential areas.

Settlement Potential

Settlement (total and differential) can occur when shallow foundations and surface improvements span materials having variable consolidation characteristics, such as the soils on this site with variable in-situ moisture and density. Such a situation could stress and possibly damage shallow foundations and surface improvements, often resulting in severe cracks and/or displacement. To reduce this settlement potential, it is necessary for all shallow foundations and surface improvements to bear on material that is as uniform as practicable. A program of overexcavation, scarification, moisture conditioning, and compaction of the upper soils in the foundation and surface improvement areas is recommended within the "Grading" section of this report to provide more uniform soil moisture and density, and to provide appropriate support.

Expansive Soils

The expansion index test performed on a bulk sample of the upper clay soils produced a value of 64. This places the clay soils in the *"medium"* expansion category per ASTM D4829-11. Expansive soils tend to swell with seasonal increases in soil moisture and shrink during the dry season as soil moisture decreases. The volume changes that the soils undergo in this cyclical pattern can stress and damage PCC flatwork and shallow foundations if precautionary measures are not incorporated in design and in the construction procedure. Methods commonly used for flatwork protection include placement of nonexpansive material beneath the flatwork, premoistening of subgrade soils, or a combination of the two. While premoistening alone can be helpful in *reducing* the effects of expansive soil, this method generally does not (and should not be expected to) provide protection from expansive soil damage to the extent that can be achieved by use of nonexpansive material in conjunction with premoistening. Due to the expansive nature of the clay soils at the site and subsequent likelihood that differential expansion and subsequent cracking of flatwork would occur if premoistening were used by itself, it is not recommended as the only means of expansive soil mitigation. Use of nonexpansive soil materials beneath flatwork, in combination with premoistening, will result in more uniform flatwork support conditions with less tendency for heave and random cracking. Thickened edges in the form of perimeter grade beams can provide further expansive soil mitigation. Expansive soil concerns with respect to the foundation systems will be mitigated by increased depth and reinforcement of shallow foundation elements, or by using deep foundation systems.

Excavation Characteristics

The soils are anticipated to be excavatable with conventional earthmoving equipment; however, the stability of excavations and the potential for shallow groundwater near the natural drainages and the slough is a concern. Additionally, various size rocks were noted within some of the soil layers. Based on our preliminary testing, the soils are considered to be "Type C" soils per the Cal/OSHA classification system (Cal/OSHA, 2007), and layers of flowing sands may be encountered near or below any groundwater surface. This classification should be verified by the contractor's "Competent Person" at the time of construction. Excavation sloping or shoring and dewatering will be needed to safely work in, restrict the size of, and reduce the potential for falling rock hazards in the excavations.

Dewatering can cause the settlement of surrounding ground and improvements; therefore, the groundwater should be lowered no more than is necessary and for no longer than is necessary for construction. A program of monitoring the surrounding areas, the structures and improvements, and the discharge should be implemented where dewatering is utilized. *A professional consultant specializing in shoring and groundwater dewatering design and installation techniques, as well as the protection of existing structures and improvements should be retained by the contractor.*

Suitability of the Soils for Use as Fill and Backfill

We anticipate that the majority, if not all, of the soils excavated at the site will be appropriate from a geotechnical viewpoint for reuse as compacted fill and backfill. However, special requirements for select fill soils used to construct the slopes, the trails, and the foundation areas are presented in the "Grading" section of this report. Special requirements for the soils used for utility trench bedding and shading per the specifications of the City of Goleta, the conduit manufacturer, and the utility companies should also be anticipated.

Stability of Soils During Grading

The soils may be susceptible to temporary high soil moisture contents, especially during or soon after the rainy season. The soils that exist within and near the natural drainages and the slough will have high soil moisture contents no matter the season. Attempting to compact the soils in an overly moist condition may create unstable conditions in the form of pumping, yielding, shearing, and/or rutting. These conditions will not allow proper compaction and are inappropriate for continued fill placement. Therefore, the construction schedule should allow adequate time during grading for aerating and drying the soils to near optimum moisture content prior to compaction. If unstable conditions occur, the geotechnical engineer should be consulted to provide recommendations for correction of the conditions.

Corrosive Soils

Based on the testing performed by Cerco Analytical, the upper site soils were classified as "severely corrosive" to certain construction materials that will be in contact with the soils. The architect/engineer should refer to the Cerco Analytical report presented in Appendix C for use in determining appropriate mitigation measures for soil corrosivity.

Soil Erosion

The site soils are considered to be highly erodible. Stabilization of surface soils, particularly those disturbed during construction, by vegetation or other means *during* and *following* construction is essential to reduce the potential of erosion damage. Care should be taken to establish and maintain proper drainage around the structures and improvements.

Liquefaction and Seismically Induced Settlement of Dry Sand

Liquefaction is the loss of soil strength caused by a significant seismic event. It occurs primarily in loose, fine to medium-grained sands, and in very soft to medium stiff silts that are saturated by groundwater. During a major earthquake, the saturated sands and silts tend to compress and the void spaces between the soil particles that are filled with water decrease in volume. This causes the pore water pressure to build up in the soils. Then if the water does drain away rapidly, the soils may lose their strength and transition into a liquefied state.

Seismically induced settlement of dry sand is also caused by a significant seismic event, and may occur in lower density and sand and silt soils that are not saturated by groundwater.

During a major earthquake, the void spaces between the unsaturated soil particles that are filled with air tend to compress which translates to a decrease in volume or settlement.

In order to estimate the potential for liquefaction and seismically induced settlement of dry sand and its effects on the site, we analyzed the boring data and utilized methods suggested by the Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117a (CDMG, 2008). Based on our analysis, we have concluded there is a potential for liquefaction to occur at the site. Liquefaction appears to be isolated to a few sand layers where perched groundwater was observed and where flow sands were recorded in the borings. It is our opinion that the clay soil layers are generally not susceptible or have a very low potential to liquefy due to their cohesive nature and the lack of groundwater saturation within these soils. If liquefaction were to occur at the site, the repercussions would likely be in the form of dynamic settlement; loss of soil bearing strength and lateral spreading are not anticipated to occur. Based on the discontinuous nature of the perched groundwater and the variable density and thickness of the sand soil layers, total and differential dynamic settlement is not anticipated to exceed 1-inch.

The potential for seismically induced settlement of dry sand is considered to be very low. This assessment is based on the relative density and thickness of the soil layers not saturated by groundwater, and the grading recommendations presented later in the "Grading" section of this report. Accordingly, no special measures with respect to liquefaction and seismically induced settlement dry sand are considered necessary for this project.

7.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The following recommendations are applicable to the structures and improvements as described in the "Introduction" section of this report. If other structures, improvements, or features are incorporated into site development, the geotechnical engineer should be contacted for individual assessment.

Dewatering and shoring plans should be prepared and implemented by a professional consultant that specializes in this type of work. The groundwater level should be monitored so that the effectiveness of the dewatering program can be determined. As dewatering can cause settlement of the surrounding ground surface and improvements, the groundwater should be lowered no more than is necessary and for no longer than is necessary for construction. A program of monitoring surrounding areas, structures and improvements, as well as the dewatering discharge should be implemented.

The upper site soils were classified as "severely corrosive." We recommend that the architect/engineer review the Cerco Analytical Corrosivity Analysis report presented in Appendix C for determining the appropriate mitigation measures for certain types of construction materials that will be in contact with the site soils.

Definitions

Unless otherwise noted, the following definitions are used in these recommendations. Where specific terms are not defined, common definitions used in the construction industry are intended.

- **Grading Area:** The area within and extending a minimum of 5 feet beyond the excavation and fill placement areas as denoted on the Boring Location Map.

- **Foundation Area:** The area within and extending a minimum of 5 feet beyond the perimeter of the foundations for a structure.

- **Surface Improvement Area:** The area within and extending a minimum of 2 feet beyond the perimeter of the surface improvement.

- **Scarified**: Ripping the exposed soil surface in two orthogonal directions to a minimum depth of 12 inches.

- **Moisture Conditioning:** Adjusting the soil moisture to optimum moisture content, or slightly, above prior to the application of compaction effort.

- **Compacted or Recompacted:** Soils placed in level lifts not exceeding 8 inches in loose thickness, and compacted to a minimum of 90 percent of maximum dry density. A minimum of 95 percent is recommended in the upper 1-foot of subgrade below vehicle HMA or PCC pavement and in all AB. The standard tests used to define maximum dry density and field density should be ASTM D1557-12 and ASTM D6938-15, respectively, or by other methods acceptable to the geotechnical engineer and the governing jurisdiction.

Site Preparation

1. The existing ground surface in the grading area should generally be prepared for construction by removing existing structures, improvements, vegetation, tree stumps, large roots, debris, and other deleterious material. At the direction of the client, the removal of vegetation, tree stumps, and large roots beyond the foundation and surface improvements areas within the fill placement area depicted on the Boring Location Map is not required. Any existing fill soils within the foundation and surface improvements areas should be completely removed and replaced as compacted fill. Any existing utilities that will not remain in service should be removed or properly abandoned. The appropriate method of utility abandonment will depend upon the type and depth of the utility. Recommendations for abandonment can be made as necessary.

2. Voids created by the removal of materials or utilities, and extending below the recommended overexcavation depth, should be immediately called to the attention of the geotechnical engineer. No fill should be placed unless the geotechnical engineer has observed the underlying soil.

Grading

Bridge A Shallow Foundation

1. Following site preparation, the soil in the foundation area should be removed to a level plane at a minimum depth of 2 feet below the bottom of the cut-off wall or culvert, *whichever is deeper*. During construction, locally deeper removals may be recommended based on field conditions. The exposed soil surface should then be scarified, moisture conditioned, and compacted.

2. If the exposed soil surface is too wet and/or unstable to traverse with heavy earthmoving equipment, the soil surface should be initially treated by placing a layer of 3-inch minus crushed rock within the foundation area where the soils are unstable. The rock should then be pushed or worked into the soil by the earthmoving equipment until the area has stabilized sufficiently.

3. Tensar TX 160 triaxial geogrid or equivalent should then be placed on the surface of the subgrade soils. The geogrid should be anchored and overlapped as recommended by the manufacturer.

4. A minimum of 24 inches of Class 2 AB (Caltrans, 2010) should then be placed and compacted directly on the geogrid per the procedures specified by the geogrid manufacturer.

5. Provided the geogrid and the first 12 inches of Class 2 AB produce non-yielding conditions, the placement of the remaining 12 inches of the AB should then proceed. Otherwise, another layer of geogrid should be placed as previously recommended on top of the first 12 inches of AB material prior to placing the remainder of the AB.

Bridges with Deep Foundations

6. Following site preparation and any excavations to develop final grades, the soil in the foundation area should be scarified, moisture conditioned, and compacted prior to constructing the deep foundations. Where a pile cap or grade beam will be used in conjunction with the deep foundations, the soil in the foundation area should be removed to a level plane to allow for the placement of any select fill soil (see

paragraph 11 below) or AB, and the pile cap or grade beam. The exposed soil surface should be scarified, moisture conditioned, and compacted prior to placement of the select underlayment material and/or construction of the pile cap or grade beam and the deep foundations.

Surface Improvements

7. Following site preparation, the soil in the surface improvement area should be removed to a minimum depth of 1-foot below the proposed subgrade elevation or 1-foot below the existing ground surface, whichever is deeper. During construction, locally deeper removals may be recommended based on field conditions. The resulting soil surface should then be scarified, moisture conditioned, and compacted prior to placing any select fill soil (see paragraph 11 below) or AB material.

Fill Areas Beyond the Foundation and Surface Improvement Areas

8. Following site preparation, the soil in fill areas beyond the foundation and surface improvement areas should be removed to a minimum depth of 1-foot below the existing ground surface. During construction, locally deeper removals may be recommended based on field conditions. The resulting soil surface should then be scarified, moisture conditioned, and compacted prior to placing any fill soil.

Grading, General

9. Voids created by dislodging cobbles and/or debris during scarification should be backfilled and compacted, and the dislodged materials should be removed from the area of work.

10. All materials used as fill should be cleaned of any debris and rocks larger than 6 inches in diameter. No rocks larger than 3 inches in diameter should be used within the upper 3 feet of finish grade. When fill material includes rocks, the rocks should be placed in a sufficient soil matrix to ensure that voids caused by nesting of the rocks will not occur and that the fill can be properly compacted.

11. There is a wide range in the stability and support characteristics the various soil types that exist at the site. Furthermore, these various soil types will be mixed together when graded. The fill slopes, the trails, and foundation areas will require the use of select fill soils in order to provide appropriate stability and support. Minimum requirements for the select fill soils for the various usages are defined in the following Table.

Usage	Minimum phi Angle (Ø) (degrees)	Minimum Cohesion (psf)
Fill Slopes	26	100
Trails	26	100
Foundation Areas	32	50

12. Cut slopes and fill over cut slopes should be overexcavated and constructed as compacted fill slopes. Fill slopes should be constructed with select fill soil (see paragraph 11 above). Fill slopes should be also should be keyed and benched into competent soil as generally shown on the Typical Bench and Keyway Detail presented in Appendix D. The geotechnical engineer should approve all keyways and benches. The keyway should be a minimum of 10 feet wide.

Utility Trenches

1. Unless otherwise recommended, utility trenches adjacent to foundations should not be excavated within the zone of foundation influence as shown on Typical Detail A presented in Appendix E.

2. Utilities that will pass beneath a foundation should be placed with properly compacted utility trench backfill, and the foundation should be designed to span the trench.

3. A select, noncorrosive, granular, easily compacted material should be used as bedding and shading immediately around utilities. Generally, the soil found at the site may be used for trench backfill above the select material, provided the soil is properly moisture conditioned.

4. Generally, utility trench backfill should be moisture conditioned and compacted; however, the Engineering Design Standards (SBC, 2011) require a minimum compaction of 95 percent of maximum dry density in trench backfill in existing or future public roadway areas. A minimum of 95 percent of maximum dry density should also be obtained where trench backfill comprises the upper 1-foot of subgrade beneath PCC pavement, and in all AB. A minimum of 85 percent of maximum dry density will generally be sufficient where trench backfill is located in landscaped or other unimproved areas, where settlement of trench backfill would not be detrimental.

5. Jetting of the trench backfill should generally not be allowed as a means of backfill densification. However, to aid in encasing utility conduits, particularly corrugated conduits and multiple closely spaced conduits in a single trench, jetting or flooding may be useful. Jetting or flooding should only be attempted with extreme caution, and any jetting or flooding operation should be subject to review by the geotechnical engineer.

6. The recommendations of this section are minimums only, and may be superseded by the architect/engineer based upon the soil corrosivity, or the requirements of the pipe manufacturer, the utility companies, or the governing jurisdiction.

Foundations

Bridge A

1. Bridge A can be supported by a shallow foundation system underlain by geogrid and Class 2 AB (Caltrans, 2010) as recommended in the "Grading" section of this report. The shallow foundation system should consist of either conventional footings, or a shear and moment resisting mat foundation.

2. If Bridge A utilizes conventional footings, they should be designed using an allowable bearing capacity of 2,000 psf dead plus live loads. If Bridge A utilizes a mat foundation, it can either be designed using an allowable bearing capacity of 2,000 psf dead plus live loads, or by using a modulus of subgrade reaction (K_{30}) of 100 pci. Using either of these criteria, maximum total and differential settlement is expected to be on the order of 1-inch and 0.5-inch across the foundation footprint, respectively.

3. Due to the specialized design required for Bridge A, reinforcement is left to the discretion of the architect/engineer.

4. Lateral loads may be resisted by soil friction and by passive resistance of the soil acting on foundations. Lateral capacity is based on the assumption that backfill adjacent to foundations is properly compacted. A passive equivalent fluid pressure of 200 pcf and a coefficient of friction of 0.40 may be used in design. These are ultimate values as no factors of safety, load factors, and/or other factors have been applied to either of the values.

Deep Foundations

5. CIDH piles can be used to support the bridges. Due to the various bridge usages and the variable support locations, we understand the CIDH piles could have diameters that range between 8 inches and 36 inches. The piles should not be constructed closer than three diameters (clear span) to each other without approval from the geotechnical engineer.

6. At the discretion of the structural engineer, the CIDH piles may or may not be interconnected by pile caps or grade beams.

7. The piles should be designed using allowable concrete to soil skin friction values of 180 psf in compression and 120 psf in tension; end bearing capacity should be neglected. The upper 5 feet of soil friction, and soil friction where there is less than 10 feet of horizontal distance from the side of the pile to any slope face, should also be neglected.

8. An ultimate passive equivalent fluid pressure of 200 pcf may be used to determine the lateral capacity of the piles. This ultimate value may require application of appropriate factors of safety, load factors, and/or other factors as deemed appropriate by the architect/engineer. Lateral capacity of the upper 5 feet of soil, and where there is less than 10 feet of horizontal distance from the pile to any slope face, should also be neglected.

9. Based upon the recommended friction capacities of the piles, long-term settlement of the bridges (i.e., settlement continuing past the construction period) is not anticipated to exceed about 1-inch.

10. If the structural engineer wants to perform an All Pile computer analysis, the following soil parameters should be used.

Material Property	**Alluvial Soft Lean Clay with Sand or Sandy Lean Clay Soil (Above Groundwater)**	**Alluvial Soft Lean Clay with Sand or Sandy Lean Clay Soil (Below Groundwater)**
G, density	105 pcf	70 pcf
Phi, friction angle	10 degrees	10 degrees
Cohesion	1,240 psf	1,240 psf
k, soil modulus	50 pci	50 pci
E_{50}, soil strain	0.015	0.015
SPT N_{60}	5 blows/foot	5 blows/foot

11. The upper soils may not stand vertically during pile construction, especially in areas where there are sand soils and perched groundwater present. Casing, drill fluid, or other means of keeping the holes open are likely to be necessary.

12. Depending on the location and depth of the piles, and the weather conditions at and preceding the time of construction, subsurface water could be encountered during pile drilling operations. Therefore, pile reinforcing should be designed to accommodate a minimum 5 inch diameter tremie pipe. Any water encountered should be removed from the hole prior to placing PCC, or the PCC should be tremied. The recommended Tremie Procedure is presented in Appendix F.

13. As the piles will utilize skin friction for support, it is not necessary to thoroughly clean the bottoms of the excavations, although excessive loose debris and slough material should be removed by means of a clean out bucket. As stated earlier, use of any end bearing capacity is not recommended.

14. PCC used in the piles should be placed at a slump between 4 and 6 inches in dry excavations and should be flowable with a slump between 7 and 9 inches when placed under water.

15. The piles should not deviate from a plumb line taken from the center of the pile by more than 2 percent of the pile length, from the top to the point of interest. Adequate pile oversize may be assumed to provide required tolerance.

General Recommendations and Comments for Shallow and Deep Foundations

16. The allowable bearing and skin friction capacities may be increased by one-third when transient loads such as wind or seismicity are included. The foundations should be designed using the following seismic parameters. Based on the subsurface conditions encountered in the borings, the Site Class should be "D," a "Stiff Soil Profile." Using

the Earthquake Hazards Program website (USGS, 2014), the ASCE Standard 7-10 setting, Risk Category II per CBC Table 1604.5 (CBSC, 2013), and the site coordinates from the "Site Setting" section of this report, the following seismic parameters were determined.

2013 CBC Mapped Values		**Site Class "D" Adjusted Values**				**Design Values**	
Seismic Parameters	**Values (g)**	**Site Coefficients**	**Values**	**Seismic Parameters**	**Values (g)**	**Seismic Parameters**	**Values (g)**
S_S	2.947	F_a	1.00	S_{MS}	2.947	S_{DS}	1.965
S_1	1.058	F_v	1.50	S_{M1}	1.587	S_{D1}	1.058
Peak Mean Ground Acceleration (PGA_M) = 1.21g							

17. Foundation excavations should be observed by the geotechnical engineer prior to placement of reinforcing steel or any formwork. Shallow foundation excavations should be thoroughly moistened prior to PCC placement and no desiccation cracks should be present. The geotechnical engineer should observe the pile excavations during drilling and prior to PCC placement. Special inspection of reinforcing steel and PCC placement should be provided for the piles.

Abutments and Wing Walls

1. All abutments and wing walls should be supported by CIDH piles interconnected by pile caps or grade beams. We have assumed that abutment and wing wall heights will not exceed 6 feet.

2. Provided that abutment and wing wall heights do not exceed a height of 6 feet, seismic design per CBC Section 1803.5.12.1 (CBSC, 2013) is not required. If any

abutments or wing walls will retain more than 6 feet of soil, seismic design will be necessary. Please contact the geotechnical engineer if seismic design values are needed.

3. Design of the abutments and wing walls should be based on the following parameters:

Active equivalent fluid pressure (imported sand or gravel backfill)	35 pcf
Active equivalent fluid pressure (native soil)	70 pcf
At-rest equivalent fluid pressure (imported sand or gravel backfill)	50 pcf
At-rest equivalent fluid pressure (native soil)	85 pcf
Passive equivalent fluid pressure (compacted fill)	200 pcf

4. No surcharges are taken into consideration in the above values. These are ultimate values that may require application of appropriate factors of safety, load factors, depth factors, and/or other factors as deemed appropriate by the architect/engineer. If the values for imported sand or gravel are used in the design, the sand or gravel should be utilized exclusively as backfill above a 1 to 1 plane extended from the base of the abutment or wing wall to daylight.

5. The above pressures are applicable to a horizontal retained surface behind the walls. Walls having a retained surface that slopes upward from the wall should be designed for an additional equivalent fluid pressure of 1 pcf for the active case and 1.5 pcf for the at-rest case, for every two degrees of slope inclination.

6. The active and at-rest values presented above are for drained conditions. Consequently, abutments and wing walls should all be drained with a rigid perforated pipe encased in a free draining gravel blanket. The pipe should be placed perforations downward and should discharge in a nonerosive manner away from foundations and other improvements. The gravel blanket should have a width of approximately 1-foot and should extend upward to approximately 1-foot from the top of the wall. The upper foot should be backfilled with on-site soil, except in areas where PCC flatwork or AB will abut the top of the wall. In such cases, the gravel should extend to the material that supports the PCC or the AB. To reduce infiltration of the soil into the gravel, a permeable synthetic fabric conforming to Section 88-1.02B – Class C of the Standard Specifications (Caltrans, 2010) should be placed between the two. Where drainage can be properly controlled, weep holes on maximum 4-foot centers may be used in lieu of perforated pipe. A filter fabric as described above should be placed between the weep holes and the drain gravel. Manufactured geocomposite wall drains conforming to the Standard Specifications (Caltrans, 2010) Section 88-1.02C are acceptable alternatives to the use of gravel, provided that they are installed in accordance with the recommendations of the manufacturer.

7. Where moisture transmission through the abutments or wing walls would be undesirable, these items should be *thoroughly* waterproofed in accordance with the specifications of the architect/engineer.

Pavement Sections

The following HMA pavement sections are based on an assumed R-value of 5. The R-value of the soil exposed at the parking lot subgrade should be determined during construction to verify that the assumed pavement sections are appropriate, otherwise revised pavement sections should be prepared. Pavement design sections are provided for assumed Traffic Indices (TI) of 4.5, 5.0, 5.5, 6.0, 6.5, and 7.0. Determination of the appropriate TI for specific areas is left to others. The HMA sections were calculated in accordance with the Highway Design Manual (Caltrans, 2012). The calculated Class 2 AB (Caltrans, 2010) and the HMA thickness are for compacted material. Normal Caltrans construction tolerances should apply.

R-value	TI	HMA (inches)	Class 2 AB (inches)
5	4.5	2.50	9.5
5	5.0	2.75	10.5
5	5.5	3.00	12.0
5	6.0	3.25	13.0
5	6.5	3.75	14.5
5	7.0	4.00	15.5

1. The upper 12 inches of subgrade and all AB should be compacted to a minimum of 95 percent of maximum dry density.

2. Subgrade and AB should be firm and unyielding when proof-rolled by heavy rubber-tired equipment prior to paving.

3. To provide stability for curbs, they should be set back a minimum of 5 feet from the tops of slopes, or the curbs should be deepened to provide stability. The geotechnical engineer should review all conditions where curbs are deepened to provide stability.

4. Where HMA will lie within 5 feet of landscape or drainage infiltration improvements, the HMA should be separated from these improvements by deepened curbs or other

means that will reduce the potential for moisture fluctuations in the soils beneath the HMA and improve the stability of the pavement.

5. Finished HMA surfaces should slope toward drainage facilities such that rapid runoff will occur and no ponding is allowed on or adjacent to the HMA.

Flatwork

1. PCC flatwork should have a minimum thickness of 4 full inches. Reinforcement size and placement should be as directed by the architect/engineer. Light duty pedestrian flatwork should be reinforced, at a minimum, with No. 3 rebar at 24 inches on-center each way. Heavy duty flatwork should have minimum rebar sizing and spacing that meets the criteria of American Concrete Institute (ACI) 318, Section 7.12.2 (ACI, 2011). A modulus of subgrade reaction (K_{30}) of 25 psi/inch may be used in the design of heavy duty flatwork founded on compacted native soil. The modulus of subgrade reaction (K_{30}) may be increased to 100 psi/inch if the flatwork is underlain with a minimum of 12 inches of compacted Class 2 AB (Caltrans, 2010).

2. In conventional construction, it is common to use 4 to 6 inches of sand beneath the flatwork. Due to the soil's expansion potential, there will be a risk of movement and damage to such flatwork if conventional measures are used. Heaving and cracking are likely to occur. This movement could be reduced by the placement of a 12 to 18-inch thick layer of compacted, nonexpansive soil beneath the flatwork; however, the thicker the nonexpansive soil layer, the better the expansive soil protection. Nonexpansive material is defined as being a coarse grained soil (ASTM D2487-11) and having an expansion index of 10 or less (ASTM D4829-11).

3. Another measure that can be taken to reduce the risk of movement of flatwork is to provide thickened edges or grade beams around the perimeter of the flatwork. The thickened edges or grade beams could be up to 18 inches deep, with the deeper edges or grade beams providing better protection. At a minimum, the thickened edges or grade beams should be reinforced by two No. 4 rebar, one near the top and one near the bottom.

4. It is recognized that the measures discussed above for protecting exterior flatwork from expansive soils are expensive; possibly more expensive than simply replacing the flatwork that has heaved and/or cracked. Therefore, the degree to which the flatwork is protected from expansive soil damage is left to the discretion of the architect/engineer or the owner.

5. Flatwork should be constructed with frequent joints to allow articulation as flatwork moves in response to seasonal moisture fluctuations, temperature variations, and variable soil support. The soil in the subgrade should be moisture conditioned and no desiccation cracks should be present prior to casting the flatwork.

Drainage and Maintenance

1. Unpaved ground surfaces should be *finish graded* to direct surface runoff away from slopes, foundations, and other improvements. Where this is not practicable due to structures or other improvements, etc., swales with improved surfaces, area drains, or other drainage facilities, should be used to collect and discharge runoff.

2. Runoff from pavement, flatwork, gutters, area drains, etc. should discharge in a nonerosive manner away from slopes, foundations, and other improvements in accordance with the requirements of the governing agencies.

3. The on-site soils are highly erodible; stabilization of soils disturbed during construction by vegetation or other means *during* and *following* construction, is essential to reduce erosion damage. Care should be taken to establish and maintain vegetation. The landscaping should be planned and installed to maintain the surface drainage recommended above. Surface drainage should also be maintained during construction.

4. To reduce migration of surface drainage into the subgrade soils, maintenance of PCC flatwork and HMA pavement areas is critical. Any cracks that develop in the flatwork and pavement should be promptly sealed.

5. Maintenance personnel should periodically observe the areas within and around the foundation and surface improvement areas for indications of rodent activity, soil instability, and soil erosion. An aggressive program for controlling the rodent activity in those general areas should be implemented.

6. All slopes, including those in the slough and along the creek banks, should be observed on a periodic basis and following major storms. Any sloughing or erosion of the slopes should be evaluated and repaired as practicable as weather conditions permit.

7. Bridge approach fills may settle slightly after the approaches are constructed. This may necessitate some maintenance of the associated surface improvements in the form of patching of cracks, filling of depressions, etc.

Construction Observation and Testing

1. It must be recognized that the recommendations contained in this report are based on a limited number of borings and rely on continuity of the subsurface conditions encountered. It is assumed that the geotechnical engineer will be retained to provide consultation during the design phase, to review final plans once they are available, to interpret this report during construction, and to provide construction monitoring in the form of testing and observation.

2. At a minimum, the geotechnical engineer should be retained to provide:
    - Review of final grading, utility, and foundation plans
    - Professional observation during grading, foundation excavations, and trench backfill
    - Oversight of compaction testing during grading
    - Oversight of special inspection during grading

3. Special inspection of grading should be provided as per CBC Section 1705.6 and CBC Table 1705.6 (CBSC, 2013). Deep foundation construction should be considered to fall under CBC Section 1705.8 "Cast-in-Place Deep Foundations." Special inspection of the installation of CIDH piles should be provided as per CBC Table 1705.8. The special inspector should be under the direction of the geotechnical engineer. All construction associated with the deep foundations should be subject to continuous

special inspection. It is our opinion that none of the grading construction is of a nature that should warrant continuous special inspection; periodic special inspection should suffice. Subject to approval by the Building Official, the exception to continuous special inspection is described in CBC Section 1704.2 and should be specified by the architect/engineer and periodic special inspection of the following items should be provided by the special inspector.

- Stripping and clearing of vegetation
- Overexcavation to the recommended depths
- Scarification, moisture conditioning, and compaction of the soil
- Fill quality, placement, and compaction
- Utility trench backfill
- Abutment and wing wall drains and backfill
- Subgrade and AB compaction and proofrolling

4. A program of quality control should be developed prior to beginning grading. The contractor or project manager should determine any additional inspection items required by the architect/engineer or the governing jurisdiction.

5. Locations and frequency of compaction tests should be as per the recommendation of the geotechnical engineer at the time of construction. The recommended test location and frequency may be subject to modification by the geotechnical engineer, based upon soil and moisture conditions encountered, size and type of equipment used by the contractor, the general trend of the results of compaction tests, or other factors.

6. A preconstruction conference among the owner, the geotechnical engineer, UCSB, City of Goleta, the special inspector, the project inspector, the architect/engineer, and contractors is recommended to discuss planned construction procedures and quality control requirements.

7. The geotechnical engineer should be notified at least 48 hours prior to beginning construction operations. If Earth Systems Pacific is not retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising therefrom.

8.0 CLOSURE

Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client as discussed in the "Scope of Services" section of this report. Application beyond this intent is strictly at the user's risk.

This report is valid for conditions as they exist at this time for the type of project described herein. The conclusions and recommendations contained in this report could be rendered invalid, either in whole or in part, due to changes in building codes, regulations, standards of geotechnical or construction practice, changes in physical conditions, or the broadening of knowledge.

If changes with respect to development type or location become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions used in the preparation of this report are not correct, this firm shall be notified for modifications to this report. Any items not specifically addressed in this report should comply with the CBC (CBSC, 2013) and the requirements of the governing jurisdiction.

The preliminary recommendations of this report are based upon the geotechnical conditions encountered at the site, and may be augmented by additional requirements of the architect/engineer, or by additional recommendations provided by the geotechnical engineer based on conditions exposed at the time of construction.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and the client's authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. If you have any questions, please feel free to contact this office at your convenience.

End of Text

TECHNICAL REFERENCES

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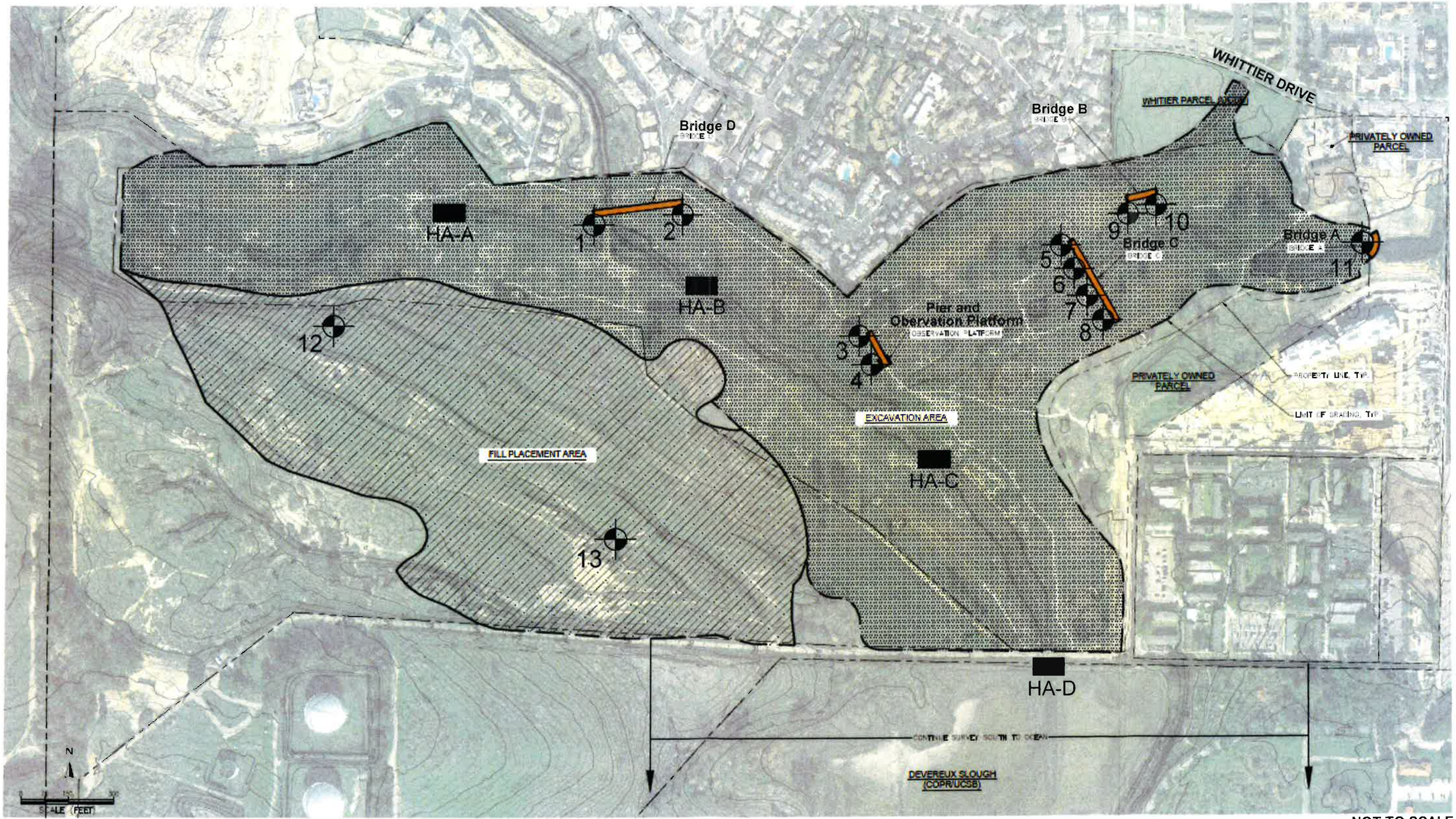
APPENDIX A

Boring Location Map

Boring Log Legend

Boring Logs



Base Map Provided By: Client

NOT TO SCALE

LEGEND

13 ⌖ **Boring Location (Approx.)**

HA ■ **Hand Auger Sample Location (Approx.)**

Earth Systems Pacific

2049 Preisker Lane, Suite E
Santa Maria, California 93454
(805) 928-2991 • FAX (805) 928-9253
E-mail: esc@earthsystems.com

BORING LOCATION MAP

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION

Southwest of Storke Road and Whittier Drive, Goleta, California

May 4, 2016

SMK

SL-17588-SB

JCSB N. Campus Open Space Restoration BLM 05-04-16.dwg

Earth Systems Pacific

BORING LOG LEGEND

SAMPLE / SUBSURFACE WATER SYMBOLS	GRAPH. SYMBOL
CALIFORNIA MODIFIED	■
STANDARD PENETRATION TEST (SPT)	●
SHELBY TUBE	▭
BULK	○
SUBSURFACE WATER DURING DRILLING	▼
SUBSURFACE WATER AFTER DRILLING	▽

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

MAJOR DIVISIONS	GROUP SYMBOL	TYPICAL DESCRIPTIONS	GRAPH. SYMBOL
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN #200 SIEVE SIZE	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	▨
	GP	POORLY GRADED GRAVELS, OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	▨
	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, NON-PLASTIC FINES	▨
	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, PLASTIC FINES	▨
	SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	▨
	SP	POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES	▨
	SM	SILTY SANDS, SAND-SILT MIXTURES, NON-PLASTIC FINES	▨
	SC	CLAYEY SANDS, SAND-CLAY MIXTURES, PLASTIC FINES	▨
FINE GRAINED SOILS HALF OR MORE OF MATERIAL IS SMALLER THAN #200 SIEVE SIZE	ML	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	▥
	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	▧
	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	▨
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	▥
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	▧
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	▨
	PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	▽ ▽ ▽

OBSERVED MOISTURE CONDITION

DRY	SLIGHTLY MOIST	MOIST	VERY MOIST	WET (SATURATED)

CONSISTENCY

COARSE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-10	0-16	LOOSE
11-30	17-50	MEDIUM DENSE
31-50	51-83	DENSE
OVER 50	OVER 83	VERY DENSE

FINE GRAINED SOILS

BLOWS/FOOT		DESCRIPTIVE TERM
SPT	CA SAMPLER	
0-2	0-3	VERY SOFT
3-4	4-7	SOFT
5-8	8-13	MEDIUM STIFF
9-15	14-25	STIFF
16-30	26-50	VERY STIFF
OVER 30	OVER 50	HARD

GRAIN SIZES

U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENING		
# 200	# 40	# 10	# 4	3/4"	3"	12"

SILT & CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

TYPICAL BEDROCK HARDNESS

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
EXTREMELY HARD	CORE, FRAGMENT, OR EXPOSURE CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CAN ONLY BE CHIPPED WITH REPEATED HEAVY HAMMER BLOWS
VERY HARD	CANNOT BE SCRATCHED WITH KNIFE OR SHARP PICK; CORE OR FRAGMENT BREAKS WITH REPEATED HEAVY HAMMER BLOWS
HARD	CAN BE SCRATCHED WITH KNIFE OR SHARP PICK WITH DIFFICULTY (HEAVY PRESSURE); HEAVY HAMMER BLOW REQUIRED TO BREAK SPECIMEN
MODERATELY HARD	CAN BE GROOVED 1/16 INCH DEEP BY KNIFE OR SHARP PICK WITH MODERATE OR HEAVY PRESSURE; CORE OR FRAGMENT BREAKS WITH LIGHT HAMMER BLOW OR HEAVY MANUAL PRESSURE
SOFT	CAN BE GROOVED OR GOUGED EASILY BY KNIFE OR SHARP PICK WITH LIGHT PRESSURE, CAN BE SCRATCHED WITH FINGERNAIL; BREAKS WITH LIGHT TO MODERATE MANUAL PRESSURE
VERY SOFT	CAN BE READILY INDENTED, GROOVED OR GOUGED WITH FINGERNAIL, OR CARVED WITH KNIFE; BREAKS WITH LIGHT MANUAL PRESSURE

TYPICAL BEDROCK WEATHERING

MAJOR DIVISIONS	TYPICAL DESCRIPTIONS
FRESH	NO DISCOLORATION, NOT OXIDIZED
SLIGHTLY WEATHERED	DISCOLORATION OR OXIDATION IS LIMITED TO SURFACE OF, OR SHORT DISTANCE FROM, FRACTURES: SOME FELDSPAR CRYSTALS ARE DULL
MODERATELY WEATHERED	DISCOLORATION OR OXIDATION EXTENDS FROM FRACTURES, USUALLY THROUGHOUT; Fe-Mg MINERALS ARE "RUSTY", FELDSPAR CRYSTALS ARE "CLOUDY"
INTENSELY WEATHERED	DISCOLORATION OR OXIDATION THROUGHOUT; FELDSPAR AND Fe-Mg MINERALS ARE ALTERED TO CLAY TO SOME EXTENT, OR CHEMICAL ALTERATION PRODUCES IN SITU DISAGGREGATION
DECOMPOSED	DISCOLORATION OR OXIDATION THROUGHOUT, BUT RESISTANT MINERALS SUCH AS QUARTZ MAY BE UNALTERED; FELDSPAR AND Fe-Mg MINERALS ARE COMPLETELY ALTERED TO CLAY

drafting/masters/Boring Log Legend121714.dwg

Boring No. 1

PAGE 1 OF 2
JOB NO.: SL-17588-SB
DATE: 4/20/2016

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 13 Feet

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SM		SILTY SAND: brown, loose, moist					
2	CL		SANDY LEAN CLAY: dark brown, stiff, moist					
3			light brown					
4	SP		POORLY GRADED SAND: light brown, loose, very moist					
8			wet, flow sands ▽					
14	SC		CLAYEY SAND: light gray/light orange brown mottled, loose, very moist, thin cemented lenses, fine grained	15.0-16.5	▬	96.3	27.0	3 6 8
19	CL		SANDY LEAN CLAY: gray brown, hard, very moist, trace silt, fine sand	20.0-21.5	▬	106.6	19.3	6 20 31
25				25.0-26.5	●			6 16 22

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Boring No. 1

PAGE 2 OF 2

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 13 Feet

JOB NO.: SL-17588-SB
DATE: 4/20/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
27	CL	▨	SANDY LEAN CLAY: as above					
28		▨						
29		▨						
30		▨		30.0-31.5	▬	107.8	19.7	16 50/6.0"
31		▨						
32		▨						
33		▨						
34		▨						
35		▨	increasing silt content	35.0-36.5	●			12 23 28
36		▨						
37		▨						
38		▨						
39		▨						
40		▨	trace fine shells	40.0-41.5	●			9 18 28
41		▨						
42		▨						
43		▨						
44		▨						
45		▨						
46		▨						
47		▨						
48		▨						
49		▨						
50		▨		50.0-51.5	●			13 25 31
51		▨						
52			End of Boring @ 51.5' Subsurface Water Encountered Between 8.0' and 14.0'					
53								

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 2

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 3/10/2016

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem
SURFACE ELEVATION: ~ 13 Feet

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: brown, medium stiff, moist					
3	CL	▨	LEAN CLAY WITH SAND: gray to dark gray, soft, very moist, thin lenses of sand, trace organics					
5		▨		5.0-6.5	▬	87.2	32.3	1 3 3
		▨		5-10	○			
8		▨	water rose to 8' upon removal of auger					
10		▨		10.0-11.5	●			0 0 2
		▨	wet, very soft					
15		▨	olive/gray mottled, soft	15.0-16.5	▬	77.9	40.1	1 3 4
20	SP	░	POORLY GRADED SAND: gray, loose, wet	20.0-21.5	●	Poor Recovery		3 3 4
23	CL	▨	SANDY LEAN CLAY: olive/gray mottled, medium stiff, very moist					
25		▨		25.0-26.5	▬	96.5	26.9	2 6 7
26.5			End of Boring @ 26.5' Subsurface Water Encountered Between 10.5' and 23.0' and Rose to 8' After Auger Removal					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 3

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 12 Feet

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 3/10/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: brown, medium stiff, moist					
				0-3	○			
2			thin layers of light brown clay and clayey sand					
5			dark gray brown, very moist	5.0-6.5	▬	103.8	20.2	2 3 6
			dark gray, very soft, trace organics					
10				10.0-11.5	▬	71.5	45.3	1 1 1
15				15.0-16.5	●			0 0 0
17			End of Boring @ 16.5' No Subsurface Water Encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 4

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 3/10/2016

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 12 Feet

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: brown, soft, moist					
4	CL	▨	SANDY LEAN CLAY: dark gray, very soft, very moist, trace organics					
10		▨		10.0-11.5	▬	65.9	56.6	0 1 2
15		▨		15.0-16.5	●			0 0 0
20		▨	▼ wet	20.0-21.5	▬	No Return		0 0 2
25		▨		25.0-26.5	●			0 0 0
26			End of Boring @ 26.5' Seepage Encountered @ 20.0'					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 5

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 13 Feet

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 3/08/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: dark brown, medium stiff, moist					
4		▨	orange brown, very stiff, moist, thin lenses of clayey sand					
5		▨		5.0-6.5	▬	112.9	16.8	6 10 16
		▨		5-8	○			
10		▨		10.0-11.5	●			2 2 6
		▨	wet, medium stiff ▽					
11		▨	very moist					
15		▨	stiff	15.0-16.5	▬	113.1	19.0	4 9 13
20		▨	very stiff	20.0-21.5	●			3 9 10
25	SP	⁙	POORLY GRADED SAND: light brown, very dense, moist	25.0-26.5	●			11 25 38
26			End of Boring @ 26.5' Subsurface Water Encountered Between 10.5' and 11.0'					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Boring No. 6

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 10 Feet

PAGE 1 OF 2
JOB NO.: SL-17588-SB
DATE: 4/20/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SM		SILTY SAND: dark brown, loose, slightly moist, trace fine gravel					
3	CL		SANDY LEAN CLAY: dark brown, stiff, slightly moist					
6			light brown, medium stiff, moist					
9			light brown/light gray mottled, stiff, increasing sand content					
10				10.0-11.5	●			3 6 8
15				15.0-16.5	▬	115.3	16.5	4 10 12
17			▽ trace fine to coarse gravel, trace caliche deposits, wet					
19	SP		POORLY GRADED SAND: light brown/light orange brown mottled, medium dense, wet, fine grained, flow sands					
20				20.0-21.5	●			1 7 9
25				25.0-26.5	●			3 12 18

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Boring No. 6

PAGE 2 OF 2
JOB NO.: SL-17588-SB
DATE: 4/20/2016

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 10 Feet

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
27	SP	⁙	POORLY GRADED SAND: as above					
30		⁙		30.0-31.5	●			10 11 12
31	SM	▥	SILTY SAND: gray, medium dense, moist, trace fine shells and shell fragments, trace clay					
33		▥	trace coarse gravel					
35		▥	dark gray	35.0-36.5	●			4 11 14
40	CL	▨	SANDY LEAN CLAY: dark gray, hard, moist, trace fine shells and shell fragments	40.0-41.5	●			7 13 20
50		▨		50.0-51.5	●			10 17 23
52			End of Boring @ 51.5' Subsurface Water Encountered Between 15.5' and 30.5'					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 7

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 10 Feet

PAGE 1 OF 2
JOB NO.: SL-17588-SB
DATE: 3/10/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: brown, medium stiff, moist, thin layers of clayey sand					
5		▨	decreasing clay content					
6		▨		5-9	○			
9		▨	dark gray, very soft, very moist, trace organics					0
10		▨		10.0-11.5	■	61.7	61.5	0 1
15		▨		15.0-16.5	●			0 0 0
20		▨		20.0-21.5	■	69.7	46.9	0 1 1
25		▨	trace small shells	25.0-26.5	●			0 0 0
26		▨						

LEGEND: ■ Ring Sample ○ Grab Sample ☐ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 7

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 10 Feet

PAGE 2 OF 2
JOB NO.: SL-17588-SB
DATE: 3/10/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
27	CL	▨	SANDY LEAN CLAY: as above					
30		▨	medium stiff, sand lense ~6" thick	30.0-31.5	▬	92.8	28.4	0 3 5
35		▨	soft	35.0-36.5	●			0 1 2
39	SC	▩	CLAYEY SAND: olive/gray mottled, medium dense, moist	40.0-41.5	▬	117.6	16.6	6 9 9
43	CL	▨	LEAN CLAY WITH SAND: olive/gray mottled, stiff, moist, trace fine sandstone gravels	45.0-46.5	●			3 6 9
50		▨	very stiff, trace fine shells	50.0-51.5	●			8 11 19
51.5			End of Boring @ 51.5' No Subsurface Water Encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ☐ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Boring No. 8

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 12 Feet

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 3/10/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: brown, stiff, moist, some silt					
5		▨		5.0-6.5	●			2 3 4
6		▨	brown/gray mottled, very soft, very moist, trace organics					
10		▨		10.0-11.5	▬	57.2	70.2	0 1 1
13		▨	gray to dark gray					
15		▨	olive/gray mottled	15.0-16.5	●			0 0 0
19	SC	▨	CLAYEY SAND: dark gray to gray, loose, very moist, fine to medium grained					
20		▨		20.0-21.5	▬	99.9	21.4	3 6 6
25		▨	medium dense	25.0-26.5	●			4 5 6
26			End of Boring @ 26.5' No Subsurface Water Encountered					

LEGEND: ▬ Ring Sample ○ Grab Sample ☐ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 9

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 11 Feet

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 3/07/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL	▨	SANDY LEAN CLAY: brown, medium stiff, moist					
4	SP	░	POORLY GRADED SAND: light brown, loose, moist					
5		░	wet ▽	5.0-6.5	●			0 1 1
6	CL	▨	LEAN CLAY WITH SAND: gray to dark gray, very soft, very moist					
10		▨		10.0-11.5	▬	68.5	53.2	0 1 1
15		▨	medium stiff	15.0-16.5	●			0 2 3
17			End of Boring @ 16.5' Subsurface Water Encountered Between 5.0' and 5.5'					

LEGEND: ▬ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 10

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 11 Feet

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 3/07/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	CL		SANDY LEAN CLAY: brown, medium stiff, moist					
1–2				0.5-4	○			
5				5.0-6.5	■	82.9	33.0	2 3 3
5.5			gray, soft, very moist, trace organics					
8			▽ water rose to 8' upon removal of auger					
10			very soft	10.0-11.5	●			0 0 1
15			medium stiff	15.0-16.5	■	95.7	27.6	2 3 5
20			stiff, trace caliche deposits	20.0-21.5	■	68.8	48.5	2 6 9
25	SP		▽ POORLY GRADED SAND: light brown, loose, wet	25.0-26.5	■	88.5	23.8	0 0 2
26.5			End of Boring @ 26.5' Subsurface Water Encountered @ 25.0' and Rose to 8' After Auger Removal					

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 11

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 3/09/2016

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 10 Feet

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA: INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SM	░	SILTY SAND: dark brown, loose, moist					
1	CL	▨	SANDY LEAN CLAY: orange brown/gray mottled, medium stiff, moist	1-5	○			
2		▨		2.0-3.5	■	109.6	18.0	2 4 6
3		▨						
4		▨	stiff, increasing sand content					
5		▨		5.0-6.5	■	99.4	21.5	3 5 10
6		▨	▼					
7	SP	░	POORLY GRADED SAND: light brown, loose, wet					
8	CL	▨	SANDY LEAN CLAY: gray, very soft, very moist					
9		▨						
10		▨		10.0-11.5	■	45.2	94.2	0 1 1
11		▨						
12			End of Boring @ 11.5' Subsurface Water Encountered Between 6.5' and 8.0'					
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 12

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 25 Feet

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 4/20/2016

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC	▨	CLAYEY SAND: brown, loose, moist, trace silt					
1								
2								
3								
4								
5			End of Boring @ 5.0' No Subsurface Water Encountered					
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

Earth Systems Pacific

Boring No. 13

PAGE 1 OF 1
JOB NO.: SL-17588-SB
DATE: 4/20/2016

LOGGED BY: R. Wagner
DRILL RIG: Mobile B-53
AUGER TYPE: 6" Hollow Stem

SURFACE ELEVATION: ~ 30 Feet

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION
Southwest of Storke Road & Whittier Drive
Goleta, California

DEPTH (feet)	USCS CLASS	SYMBOL	SOIL DESCRIPTION	SAMPLE DATA				
				INTERVAL (feet)	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.
0	SC	▨	CLAYEY SAND: yellow brown, loose, moist, trace silt					
1		▨						
2		▨						
3		▨						
4		▨						
5			End of Boring @ 5.0' No Subsurface Water Encountered					
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								

LEGEND: ■ Ring Sample ○ Grab Sample ▭ Shelby Tube Sample ● SPT

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.

APPENDIX B

Laboratory Test Results

BULK DENSITY TEST RESULTS

ASTM D 2937-10 (modified for ring liners)

March 31, 2016

BORING NO.	DEPTH feet	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf
1	16.0 - 16.5	27.0	122.3	96.3
1	21.0 - 21.5	19.3	127.2	106.6
1	30.5 - 31.0	19.7	129.0	107.8
2	5.5 - 6.0	32.3	115.4	87.2
2	15.5 - 16.0	40.1	109.2	77.9
2	26.0 - 26.5	26.9	122.5	96.5
3	6.0 - 6.5	20.2	124.8	103.8
3	11.0 - 11.5	45.3	104.0	71.5
4	11.0 - 11.5	56.6	103.2	65.9
5	6.0 - 6.5	16.8	131.9	112.9
5	16.0 - 16.5	19.0	134.5	113.1
6	16.0 - 16.5	16.5	134.3	115.3
7	11.0 - 11.5	61.5	99.7	61.7
7	21.0 - 21.5	46.9	102.5	69.7
7	31.0 - 31.5	28.4	119.2	92.8
7	41.0 - 41.5	16.6	137.2	117.6
8	11.0 - 11.5	70.2	97.4	57.2
8	21.0 - 21.5	21.4	121.3	99.9
9	11.0 - 11.5	53.2	105.0	68.5
10	6.0 - 6.5	33.0	110.2	82.9
10	16.0 - 16.5	27.6	122.2	95.7
10	21.0 - 21.5	48.5	102.1	68.8
10	26.0 - 26.5	23.8	109.6	88.5
11	3.0 - 3.5	18.0	129.3	109.6
11	6.0 - 6.5	21.5	120.8	99.4
11	11.0 - 11.5	94.2	87.9	45.2

University of California Santa Barbara
North Campus Open Space Restoration

SL-17588-SB

EXPANSION INDEX TEST RESULTS

ASTM D 4829-11

BORING NO.	DEPTH feet	EXPANSION INDEX
2	5.0 - 10.0	64

University of California Santa Barbara
North Campus Open Space Restoration

SL-17588-SB

MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

PROCEDURE USED: A

PREPARATION METHOD: Moist

RAMMER TYPE: Mechanical

SPECIFIC GRAVITY: 2.70 (assumed)

March 31, 2016

Boring #11 @ 1.0 - 5.0'

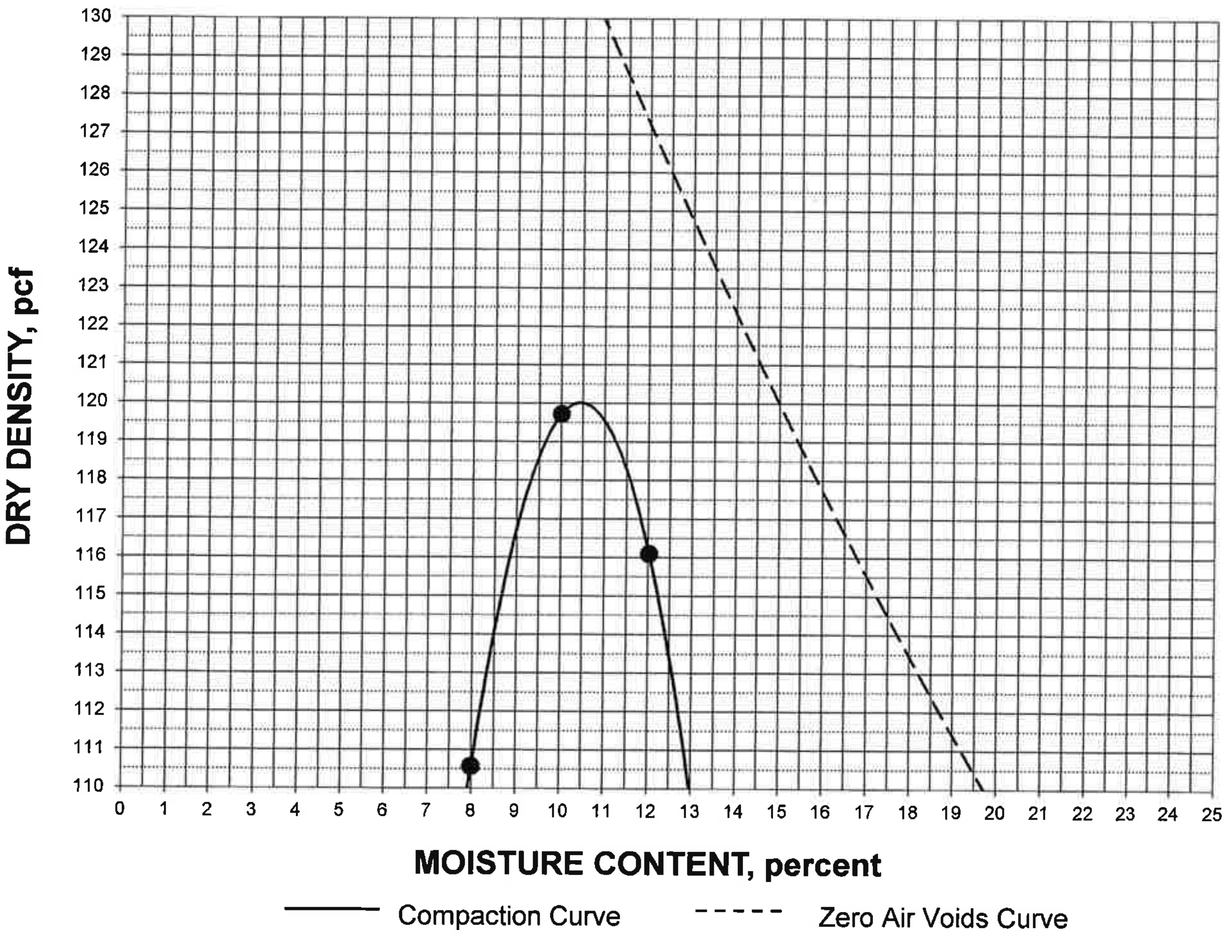
Sandy Lean Clay (CL)

SIEVE DATA:

Sieve Size	% Retained (Cumulative)
3/4"	0
3/8"	1
#4	1

MAXIMUM DRY DENSITY: 120.0 pcf

OPTIMUM MOISTURE: 10.4%



University of California Santa Barbara
Nort Campus Open Space Restoration

SL-17588-SB

UNCONFINED COMPRESSION ON COHESIVE SOIL

ASTM D 2166/D2166M-13

May 2, 2016

Boring #1 @ 16.0 - 16.5'
Clayey Sand (SC)
Ring Sample
COMPRESSIVE STRENGTH: 26 psi (3,677 psf)

Dry Density: 96.3 pcf
Moisture Content: 27.0%
Degree Saturation: 99.8%
Specific Gravity: 2.65 (assumed)
H/D Ratio: 2.07

TIME (MINUTES)	DEFORM, in (X 1000)	AXIAL STRAIN	AREA (SQ. IN.)	APPLIED LOAD (LBS)	STRENGTH (PSI)	STRENGTH (PSF)
0.5	29	0.0058	4.59	13	3	408
1.0	54	0.0108	4.61	20	4	625
1.5	81	0.0162	4.64	26	6	807
2.0	108	0.0216	4.66	31	7	957
2.5	135	0.0270	4.69	41	9	1,259
3.0	163	0.0326	4.72	48	10	1,466
3.5	190	0.0380	4.74	56	12	1,701
4.0	195	0.0390	4.75	64	13	1,942
4.5	198	0.0396	4.75	70	15	2,122
5.0	200	0.0400	4.75	81	17	2,455
5.5	205	0.0410	4.76	90	19	2,725
6.0	229	0.0458	4.78	96	20	2,892
6.5	258	0.0516	4.81	105	22	3,144
7.0	286	0.0572	4.84	113	23	3,363
7.5	315	0.0630	4.87	121	25	3,579
8.0	341	0.0682	4.90	125	26	3,677
8.5	371	0.0742	4.93	125	25	3,653
9.0	403	0.0806	4.96	116	23	3,367
9.5	427	0.0854	4.99	110	22	3,176
10.0	454	0.0908	5.02	91	18	2,612

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UNCONFINED COMPRESSION ON COHESIVE SOIL

ASTM D 2166/D2166M-13

March 31, 2016

Boring #2 @ 26.0 - 26.5'
Sandy Lean Clay (CL)
Ring Sample
COMPRESSIVE STRENGTH: 27 psi (3,907 psf)

Dry Density: 96.5 pcf
Moisture Content: 26.9%
Degree Saturation: 97.4%
Specific Gravity: 2.70 (assumed)
H/D Ratio: 2.07

TIME (MINUTES)	DEFORM, in (X 1000)	AXIAL STRAIN	AREA (SQ. IN.)	APPLIED LOAD (LBS)	STRENGTH (PSI)	STRENGTH (PSF)
0.5	26	0.0052	4.59	30	7	942
1.0	52	0.0104	4.61	56	12	1,749
1.5	88	0.0176	4.64	76	16	2,357
2.0	108	0.0216	4.66	85	18	2,625
2.5	135	0.0270	4.69	95	20	2,918
3.0	155	0.0310	4.71	99	21	3,028
3.5	189	0.0378	4.74	110	23	3,341
4.0	220	0.0440	4.77	111	23	3,350
4.5	235	0.0470	4.79	113	24	3,399
5.0	295	0.0590	4.85	116	24	3,446
5.5	309	0.0618	4.86	120	25	3,554
6.0	320	0.0640	4.87	123	25	3,634
6.5	369	0.0738	4.93	126	26	3,684
7.0	391	0.0782	4.95	127	26	3,696
7.5	405	0.0810	4.96	129	26	3,742
8.0	439	0.0878	5.00	131	26	3,772
8.5	444	0.0888	5.01	131	26	3,768
9.0	474	0.0948	5.04	131	26	3,743
9.5	497	0.0994	5.07	136	27	3,866
10.0	516	0.1032	5.09	138	27	3,907

UNCONFINED COMPRESSION ON COHESIVE SOIL

ASTM D 2166/D2166M-13

March 31, 2016

Boring #3 @ 11.0 - 11.5'
Sandy Lean Clay (CL)
Ring Sample
COMPRESSIVE STRENGTH: 6 psi (919 psf)

Dry Density: 71.5 pcf
Moisture Content: 45.3%
Degree Saturation: 90.3%
Specific Gravity: 2.70 (assumed)
H/D Ratio: 1.68

TIME (MINUTES)	DEFORM, in (X 1000)	AXIAL STRAIN	AREA (SQ. IN.)	APPLIED LOAD (LBS)	STRENGTH (PSI)	STRENGTH (PSF)
0.5	38	0.0095	4.47	10	2	322
1.0	55	0.0138	4.49	13	3	417
1.5	88	0.0220	4.53	16	4	509
2.0	118	0.0295	4.56	20	4	631
2.5	140	0.0350	4.59	21	5	659
3.0	170	0.0425	4.63	23	5	716
3.5	217	0.0543	4.68	25	5	769
4.0	242	0.0605	4.72	26	6	794
4.5	271	0.0678	4.75	28	6	848
5.0	291	0.0728	4.78	28	6	844
5.5	325	0.0813	4.82	30	6	896
6.0	352	0.0880	4.86	31	6	919
6.5	385	0.0963	4.90	31	6	911
7.0	409	0.1023	4.93	31	6	905
7.5	441	0.1103	4.98	31	6	897
8.0	472	0.1180	5.02	31	6	889
8.5	501	0.1253	5.06	31	6	881
9.0	531	0.1328	5.11	31	6	874
9.5	563	0.1408	5.16	31	6	866
10.0	589	0.1473	5.20	31	6	859

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UNCONFINED COMPRESSION ON COHESIVE SOIL

ASTM D 2166/D2166M-13

March 31, 2016

Boring #4 @ 11.0 - 11.5'
Sandy Lean Clay (CL)
Ring Sample
COMPRESSIVE STRENGTH: 5 psi (760 psf)

Dry Density: 65.9 pcf
Moisture Content: 56.6%
Degree Saturation: 98.2%
Specific Gravity: 2.70 (assumed)
H/D Ratio: 2.07

TIME (MINUTES)	DEFORM, in (X 1000)	AXIAL STRAIN	AREA (SQ. IN.)	APPLIED LOAD (LBS)	STRENGTH (PSI)	STRENGTH (PSF)
0.5	41	0.0082	4.60	6	1	188
1.0	90	0.0180	4.65	13	3	403
1.5	109	0.0218	4.66	15	3	463
2.0	144	0.0288	4.70	16	3	491
2.5	173	0.0346	4.73	18	4	549
3.0	204	0.0408	4.76	18	4	545
3.5	233	0.0466	4.78	20	4	602
4.0	367	0.0734	4.92	21	4	614
4.5	398	0.0796	4.96	21	4	610
5.0	431	0.0862	4.99	23	5	663
5.5	460	0.0920	5.02	23	5	659
6.0	479	0.0958	5.04	23	5	656
6.5	524	0.1048	5.10	25	5	706
7.0	544	0.1088	5.12	25	5	703
7.5	574	0.1148	5.15	25	5	699
8.0	609	0.1218	5.19	26	5	721
8.5	641	0.1282	5.23	26	5	716
9.0	673	0.1346	5.27	26	5	710
9.5	700	0.1400	5.30	28	5	760
10.0	731	0.1462	5.34	28	5	755

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UNCONFINED COMPRESSION ON COHESIVE SOIL

ASTM D 2166/D2166M-13

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Boring #5 @ 16.0 - 16.5'
Sandy Lean Clay (CL)
Ring Sample
COMPRESSIVE STRENGTH: 22 psi (3,128 psf)

Dry Density: 113.1 pcf
Moisture Content: 19.0%
Degree Saturation: 100%
Specific Gravity: 2.70 (assumed)
H/D Ratio: 2.07

TIME (MINUTES)	DEFORM, in (X 1000)	AXIAL STRAIN	AREA (SQ. IN.)	APPLIED LOAD (LBS)	STRENGTH (PSI)	STRENGTH (PSF)
0.5	26	0.0052	4.59	18	4	565
1.0	55	0.0110	4.61	26	6	812
1.5	83	0.0166	4.64	36	8	1,118
2.0	108	0.0216	4.66	41	9	1,266
2.5	128	0.0256	4.68	48	10	1,476
3.0	163	0.0326	4.72	56	12	1,710
3.5	188	0.0376	4.74	58	12	1,762
4.0	209	0.0418	4.76	61	13	1,845
4.5	241	0.0482	4.79	66	14	1,983
5.0	267	0.0534	4.82	73	15	2,181
5.5	293	0.0586	4.85	76	16	2,259
6.0	318	0.0636	4.87	80	16	2,365
6.5	338	0.0676	4.89	83	17	2,443
7.0	368	0.0736	4.92	88	18	2,573
7.5	369	0.0738	4.93	91	18	2,661
8.0	411	0.0822	4.97	96	19	2,781
8.5	442	0.0884	5.00	98	20	2,820
9.0	468	0.0936	5.03	103	20	2,947
9.5	491	0.0982	5.06	106	21	3,018
10.0	537	0.1074	5.11	111	22	3,128

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UNCONFINED COMPRESSION ON COHESIVE SOIL

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March 31, 2016

Boring #7 @ 11.0 - 11.5'
Sandy Lean Clay (CL)
Ring Sample
COMPRESSIVE STRENGTH: 5 psi (669 psf)

Dry Density: 61.7 pcf
Moisture Content: 61.5%
Degree Saturation: 96.0%
Specific Gravity: 2.70 (assumed)
H/D Ratio: 2.07

TIME (MINUTES)	DEFORM, in (X 1000)	AXIAL STRAIN	AREA (SQ. IN.)	APPLIED LOAD (LBS)	STRENGTH (PSI)	STRENGTH (PSF)
0.5	26	0.0052	4.59	10	2	314
1.0	49	0.0098	4.61	11	2	344
1.5	73	0.0146	4.63	13	3	404
2.0	96	0.0192	4.65	15	3	464
2.5	115	0.0230	4.67	16	3	493
3.0	141	0.0282	4.69	18	4	552
3.5	163	0.0326	4.72	18	4	550
4.0	183	0.0366	4.73	18	4	547
4.5	203	0.0406	4.75	18	4	545
5.0	225	0.0450	4.78	20	4	603
5.5	251	0.0502	4.80	20	4	600
6.0	272	0.0544	4.82	20	4	597
6.5	296	0.0592	4.85	21	4	624
7.0	316	0.0632	4.87	21	4	621
7.5	342	0.0684	4.90	21	4	618
8.0	370	0.0740	4.93	21	4	614
8.5	396	0.0792	4.95	23	5	669
9.0	427	0.0854	4.99	23	5	664
9.5	452	0.0904	5.02	23	5	660
10.0	480	0.0960	5.05	23	5	656

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UNCONFINED COMPRESSION ON COHESIVE SOIL

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Boring #8 @ 11.0 - 11.5'
Sandy Lean Clay (CL)
Ring Sample
COMPRESSIVE STRENGTH: 6 psi (890 psf)

Dry Density: 57.2 pcf
Moisture Content: 70.2%
Degree Saturation: 97.5%
Specific Gravity: 2.70 (assumed)
H/D Ratio: 2.07

TIME (MINUTES)	DEFORM, in (X 1000)	AXIAL STRAIN	AREA (SQ. IN.)	APPLIED LOAD (LBS)	STRENGTH (PSI)	STRENGTH (PSF)
0.5	21	0.0042	4.58	8	2	251
1.0	43	0.0086	4.60	13	3	407
1.5	66	0.0132	4.62	15	3	467
2.0	87	0.0174	4.64	16	3	496
2.5	111	0.0222	4.67	20	4	617
3.0	133	0.0266	4.69	21	4	645
3.5	154	0.0308	4.71	23	5	704
4.0	175	0.0350	4.73	23	5	701
4.5	200	0.0400	4.75	26	5	788
5.0	225	0.0450	4.78	26	5	784
5.5	249	0.0498	4.80	26	5	780
6.0	281	0.0562	4.83	28	6	834
6.5	306	0.0612	4.86	29	6	859
7.0	327	0.0654	4.88	29	6	856
7.5	341	0.0682	4.90	30	6	882
8.0	361	0.0722	4.92	30	6	879
8.5	388	0.0776	4.95	30	6	874
9.0	411	0.0822	4.97	30	6	869
9.5	432	0.0864	4.99	30	6	865
10.0	451	0.0902	5.01	31	6	890

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UNCONFINED COMPRESSION ON COHESIVE SOIL

ASTM D 2166/D2166M-13

March 31, 2016

Boring #10 @ 16.0 - 16.5'
Sandy Lean Clay (CL)
Ring Sample
COMPRESSIVE STRENGTH: 18 psi (2,529 psf)

Dry Density: 95.7 pcf
Moisture Content: 27.6%
Degree Saturation: 98.1%
Specific Gravity: 2.70 (assumed)
H/D Ratio: 2.07

TIME (MINUTES)	DEFORM, in (X 1000)	AXIAL STRAIN	AREA (SQ. IN.)	APPLIED LOAD (LBS)	STRENGTH (PSI)	STRENGTH (PSF)
0.5	26	0.0052	4.59	30	7	942
1.0	56	0.0112	4.61	51	11	1,592
1.5	86	0.0172	4.64	58	12	1,799
2.0	109	0.0218	4.66	65	14	2,007
2.5	137	0.0274	4.69	68	14	2,088
3.0	163	0.0326	4.72	71	15	2,168
3.5	196	0.0392	4.75	75	16	2,275
4.0	224	0.0448	4.78	78	16	2,352
4.5	249	0.0498	4.80	80	17	2,400
5.0	275	0.0550	4.83	80	17	2,386
5.5	305	0.0610	4.86	81	17	2,401
6.0	333	0.0666	4.89	83	17	2,446
6.5	360	0.0720	4.92	83	17	2,431
7.0	387	0.0774	4.94	86	17	2,505
7.5	413	0.0826	4.97	86	17	2,491
8.0	441	0.0882	5.00	86	17	2,475
8.5	471	0.0942	5.04	88	17	2,516
9.0	500	0.1000	5.07	88	17	2,500
9.5	528	0.1056	5.10	88	17	2,485
10.0	550	0.1100	5.13	90	18	2,529

DIRECT SHEAR

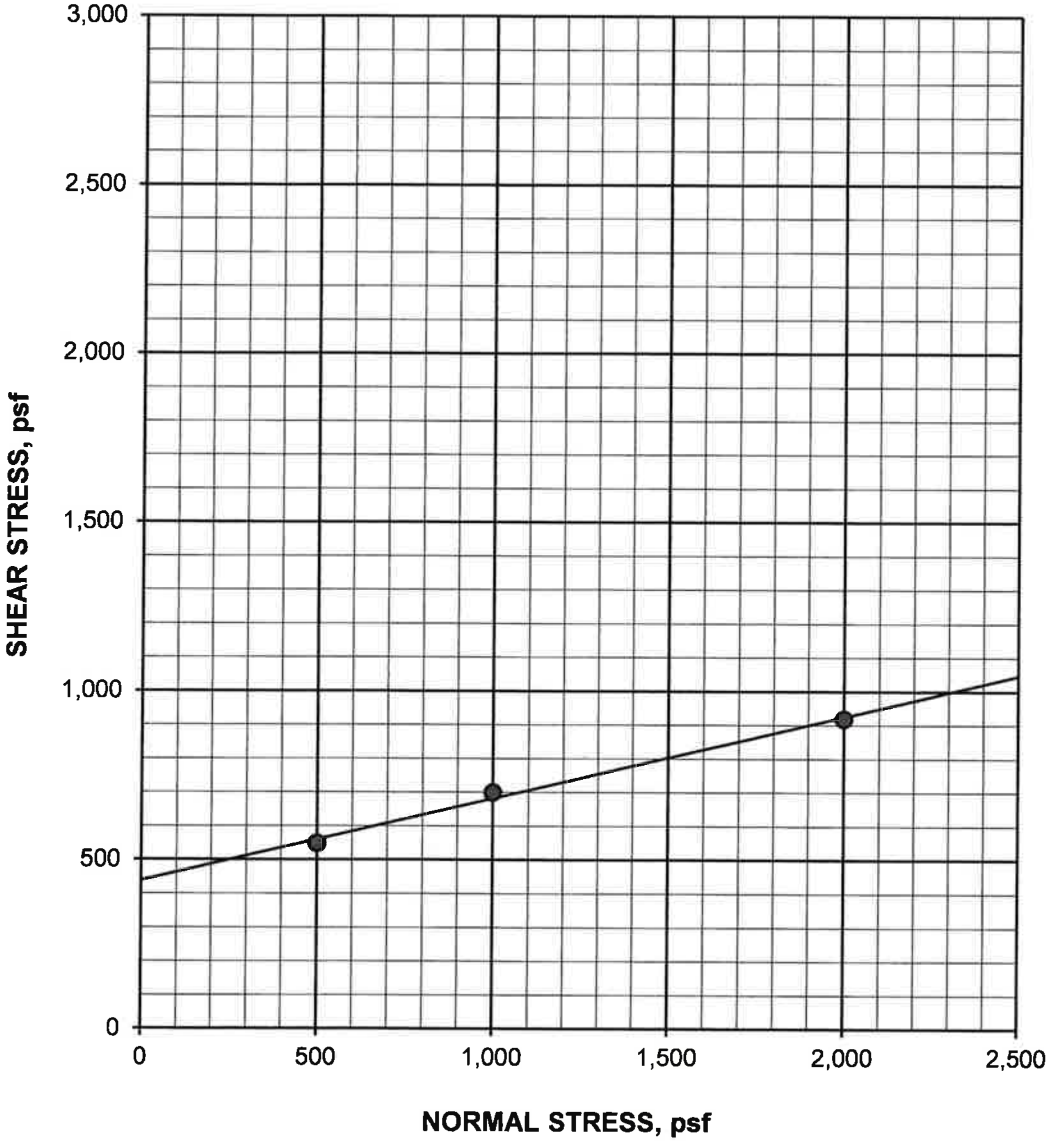
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

March 31, 2016

Boring #2 @ 15.5 - 16.0'
Lean Clay with Sand (CL)
Ring sample, saturated

INITIAL DRY DENSITY: 77.7 pcf
INITIAL MOISTURE CONTENT: 40.1 %
PEAK SHEAR ANGLE (Ø): 14°
COHESION (C): 439 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

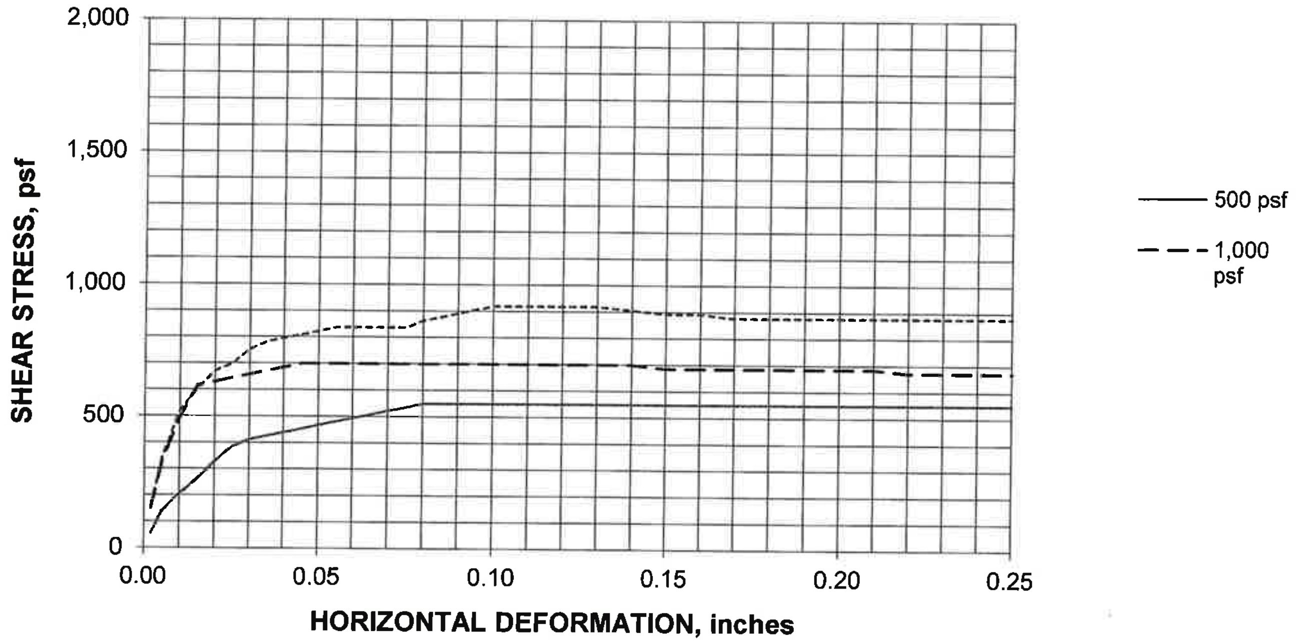
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #2 @ 15.5 - 16.0'
Lean Clay with Sand (CL)
Ring sample, saturated

March 31, 2016

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	40.1	40.1	40.1	40.1
DRY DENSITY, pcf	78.1	77.4	77.5	77.7
SATURATION, %	93.6	92.0	92.3	92.6
VOID RATIO	1.156	1.177	1.173	1.169
DIAMETER, inches	2.375	2.375	2.375	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	51.7	52.2	50.2	
DRY DENSITY, pcf	78.7	78.9	81.3	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	1.141	1.135	1.073	
HEIGHT, inches	0.99	0.98	0.95	



DIRECT SHEAR

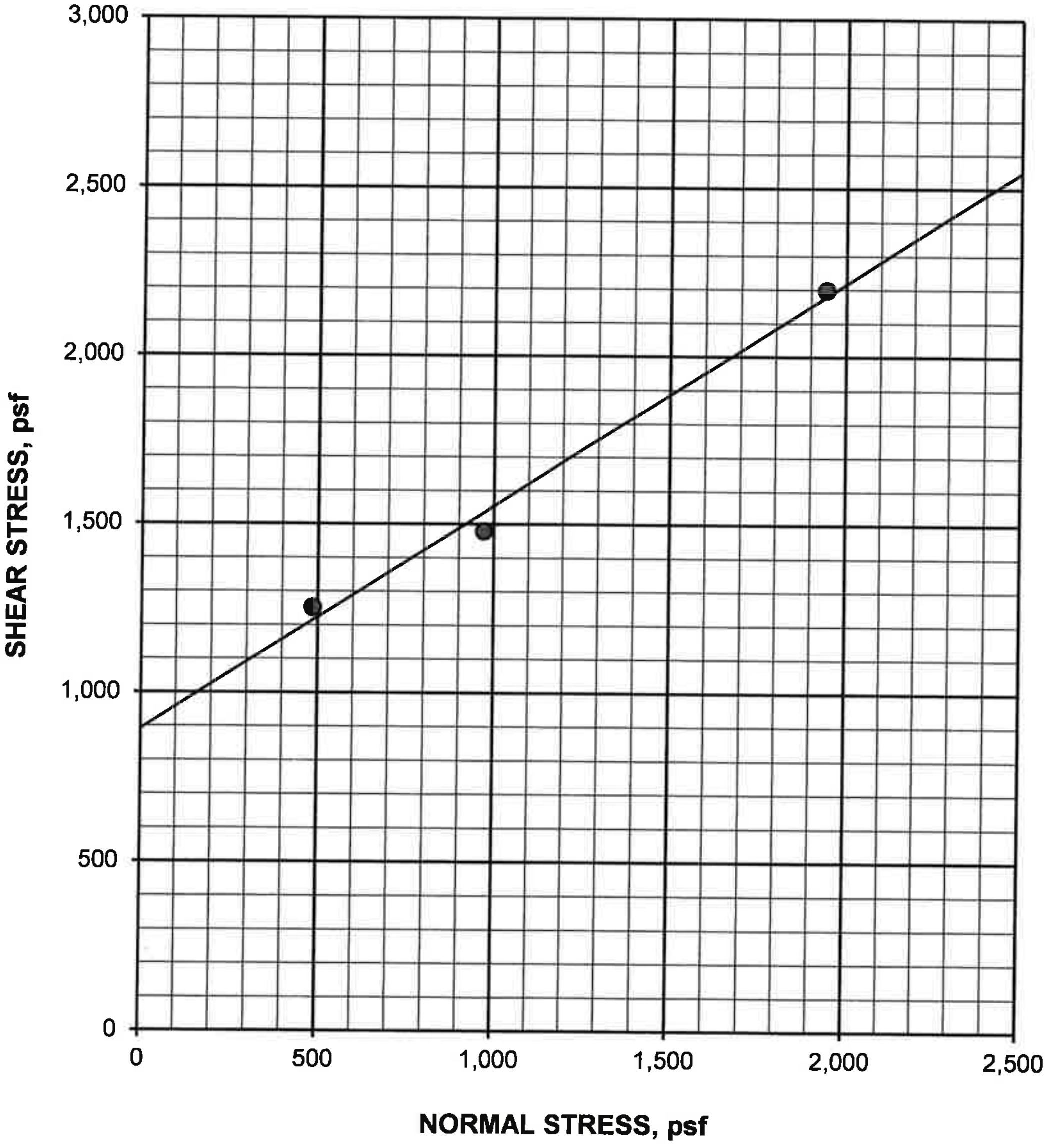
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

May 2, 2016

Boring #6 @ 16.0 - 16.5'
Sandy Lean Clay (CL)
Ring sample, saturated

INITIAL DRY DENSITY: 112.1 pcf
INITIAL MOISTURE CONTENT: 16.5 %
PEAK SHEAR ANGLE (Ø): 34°
COHESION (C): 892 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

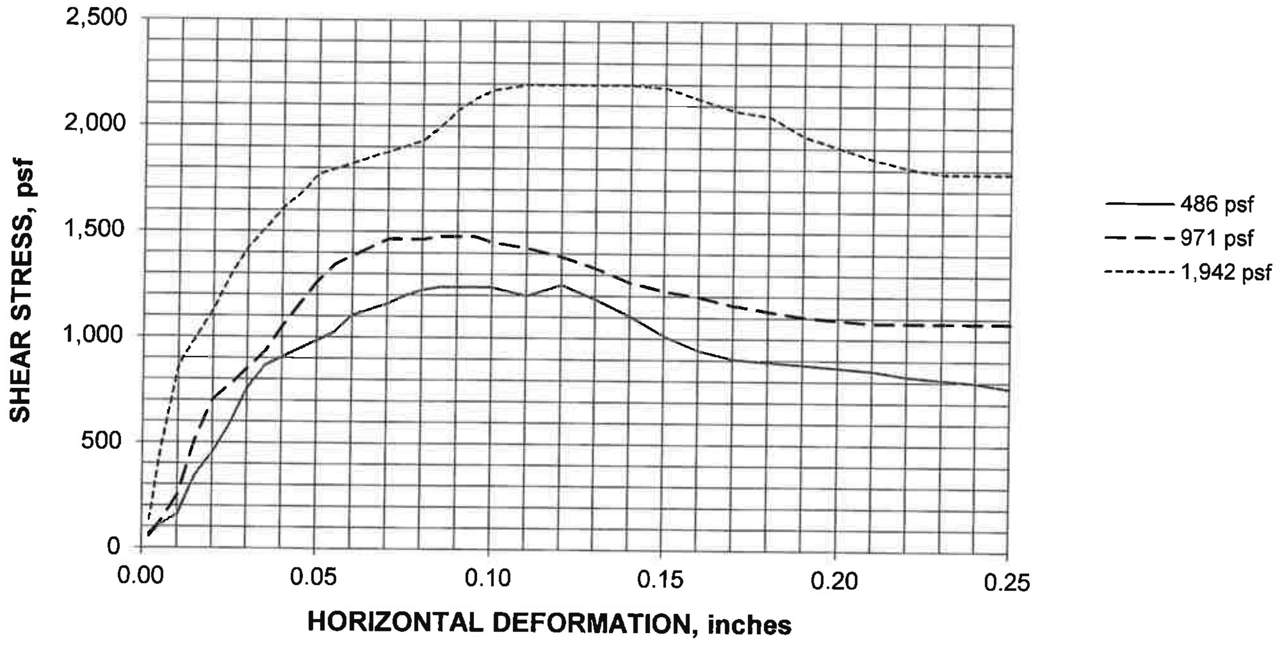
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #6 @ 16.0 - 16.5'
Sandy Lean Clay (CL)
Ring sample, saturated

May 2, 2016

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	16.5	16.5	16.5	16.5
DRY DENSITY, pcf	110.3	111.7	114.3	112.1
SATURATION, %	84.5	87.6	93.9	88.7
VOID RATIO	0.527	0.509	0.474	0.503
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	23.1	22.7	21.3	
DRY DENSITY, pcf	111.3	113.3	117.8	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	0.513	0.487	0.430	
HEIGHT, inches	0.99	0.99	0.97	



DIRECT SHEAR

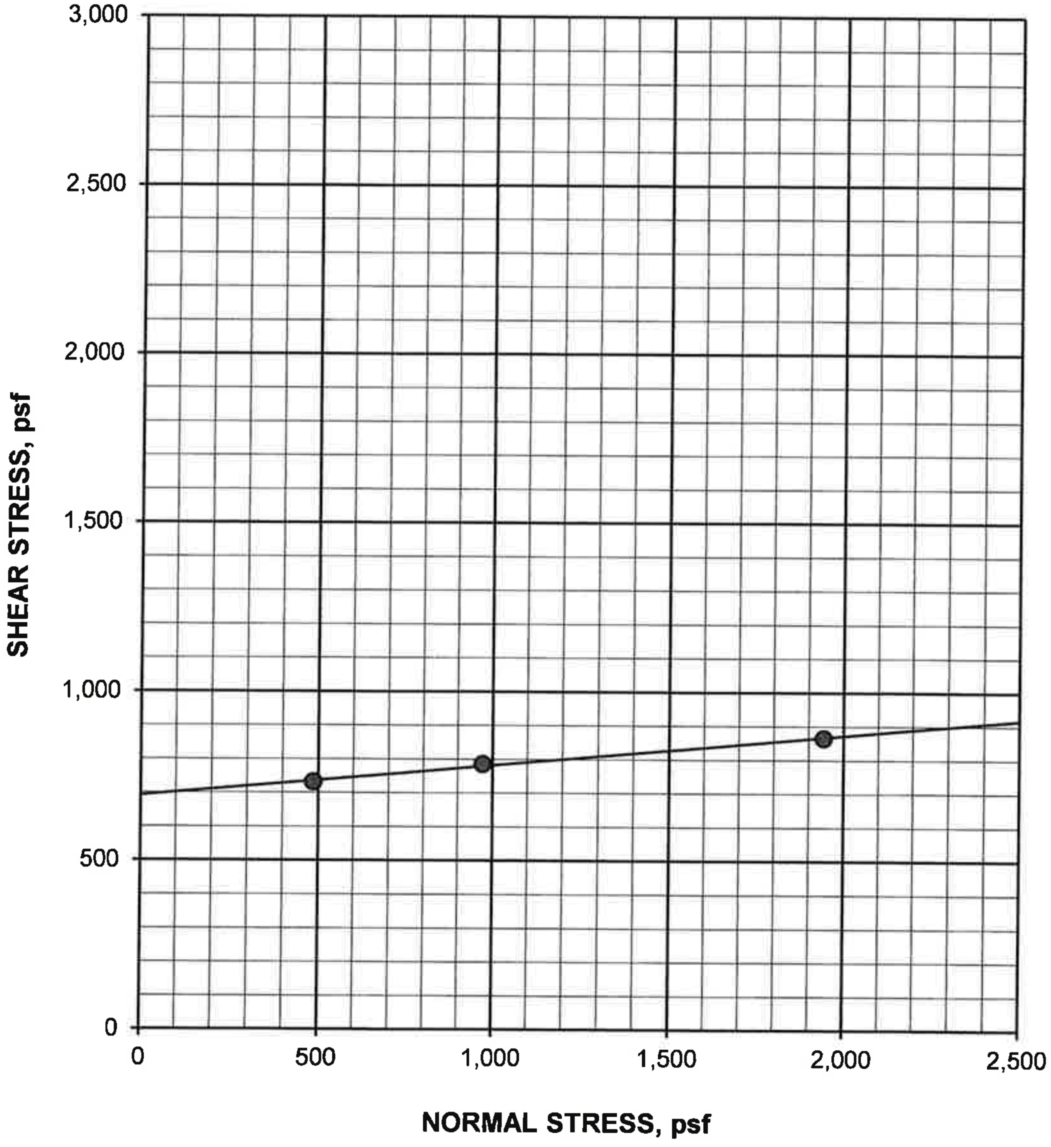
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

March 31, 2016

Boring #7 @ 21.0 - 21.5'
Lean Clay with Sand (CL)
Ring sample, saturated

INITIAL DRY DENSITY: 69.8 pcf
INITIAL MOISTURE CONTENT: 46.9 %
PEAK SHEAR ANGLE (Ø): 5°
COHESION (C): 693 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

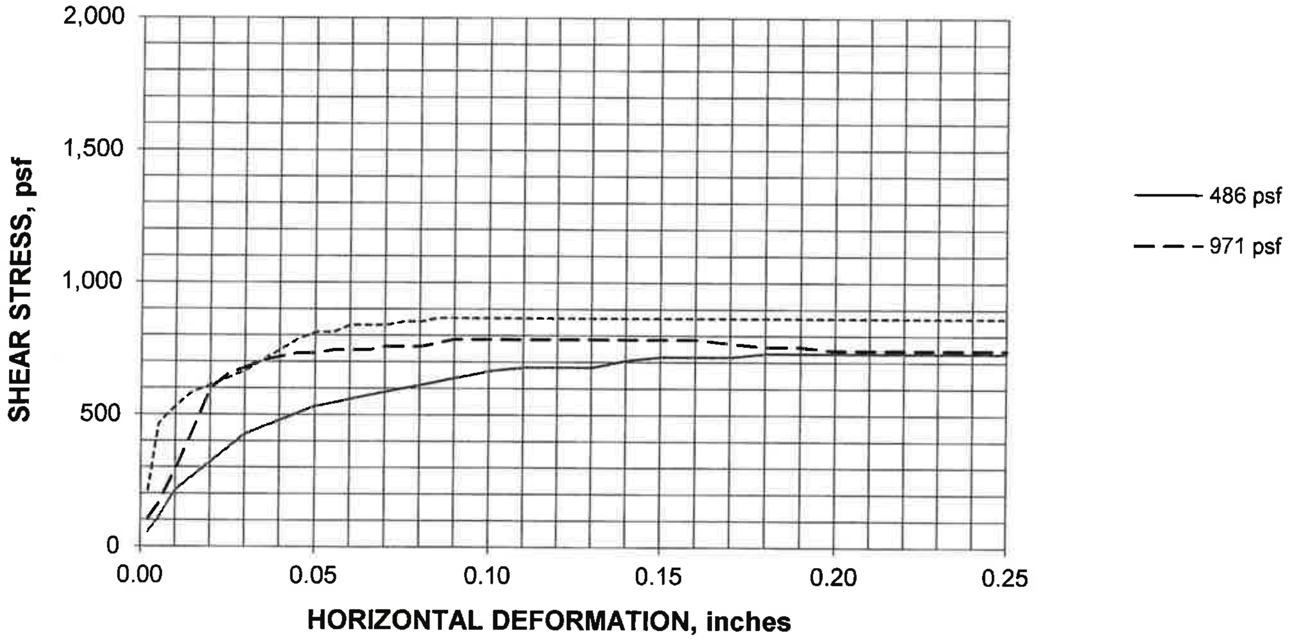
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #7 @ 21.0 - 21.5'
Lean Clay with Sand (CL)
Ring sample, saturated

March 31, 2016

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	**1**	**2**	**3**	**AVERAGE**
INITIAL				
WATER CONTENT, %	46.9	46.9	46.9	46.9
DRY DENSITY, pcf	68.6	71.6	69.3	69.8
SATURATION, %	87.0	93.5	88.5	89.7
VOID RATIO	1.455	1.354	1.431	1.414
DIAMETER, inches	2.410	2.410	2.410	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	55.5	52.6	61.4	
DRY DENSITY, pcf	69.1	72.7	72.1	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	1.438	1.316	1.336	
HEIGHT, inches	0.99	0.98	0.96	



DIRECT SHEAR

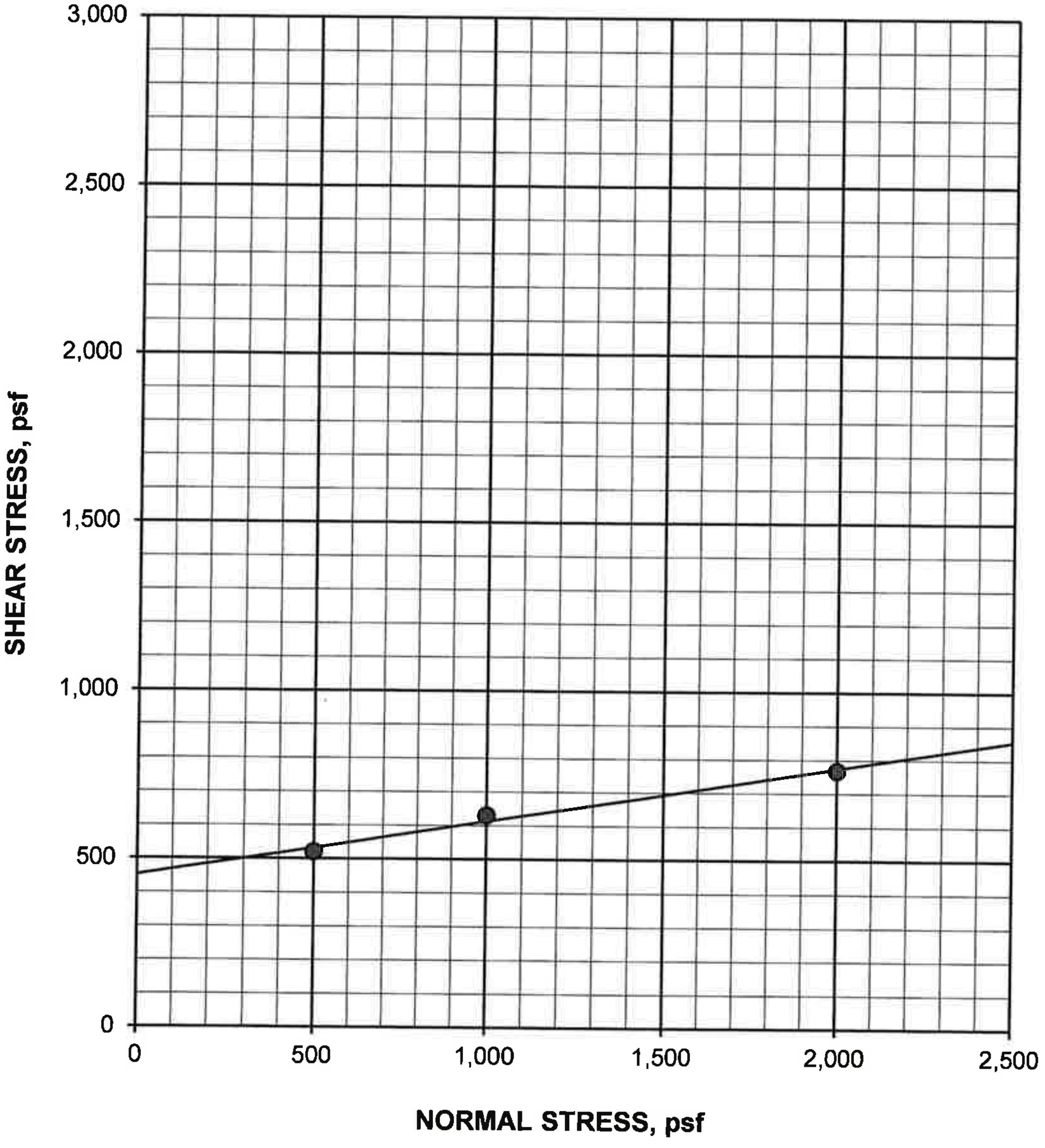
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

March 31, 2016

Boring #9 @ 11.0 - 11.5'
Lean Clay with Sand (CL)
Ring sample, saturated

INITIAL DRY DENSITY: 67.4 pcf
INITIAL MOISTURE CONTENT: 53.2 %
PEAK SHEAR ANGLE (Ø): 9°
COHESION (C): 453 psf

SHEAR vs. NORMAL STRESS



DIRECT SHEAR continued

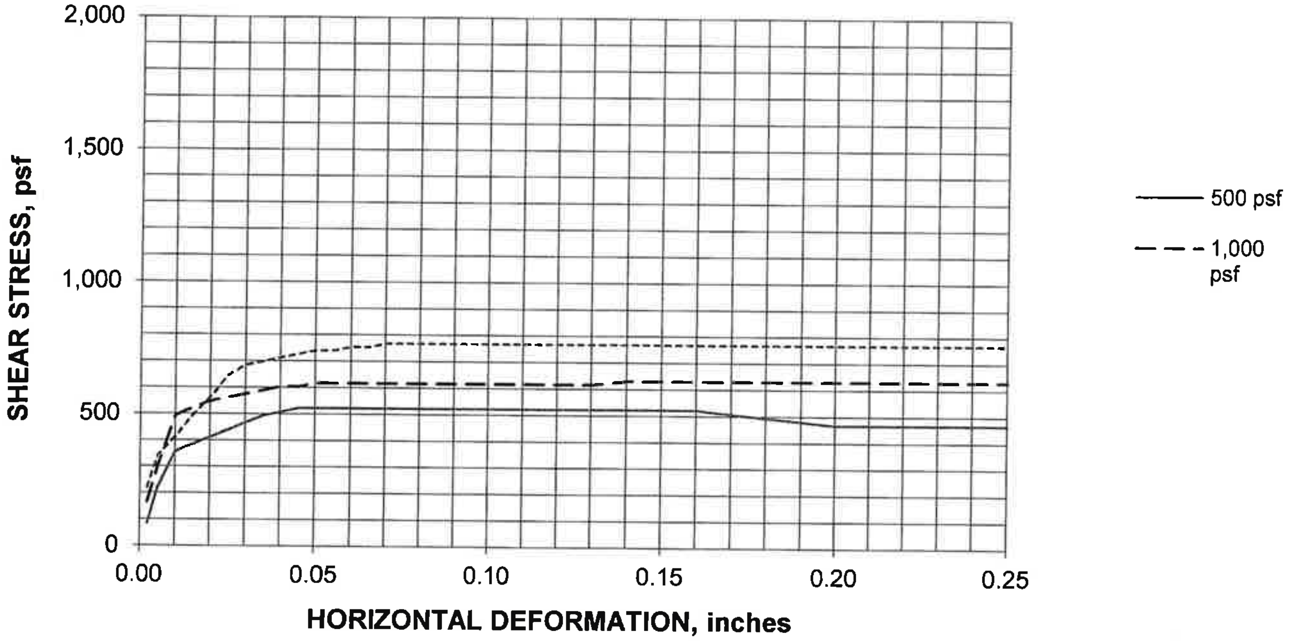
ASTM D 3080/D3080M-11 (modified for consolidated, undrained conditions)

Boring #9 @ 11.0 - 11.5'
Lean Clay with Sand (CL)
Ring sample, saturated

March 31, 2016

SPECIFIC GRAVITY: 2.70 (assumed)

SAMPLE NO.:	1	2	3	AVERAGE
INITIAL				
WATER CONTENT, %	53.2	53.2	53.2	53.2
DRY DENSITY, pcf	66.3	67.6	68.3	67.4
SATURATION, %	93.3	96.3	97.8	95.8
VOID RATIO	1.539	1.491	1.468	1.500
DIAMETER, inches	2.375	2.375	2.375	
HEIGHT, inches	1.00	1.00	1.00	
AT TEST				
WATER CONTENT, %	66.9	61.8	61.1	
DRY DENSITY, pcf	66.6	69.3	74.6	
SATURATION, %	100.0	100.0	100.0	
VOID RATIO	1.529	1.431	1.259	
HEIGHT, inches	1.00	0.98	0.92	



University of California Santa Barbara
North Campus Open Space Restoration

SL-17588-SB

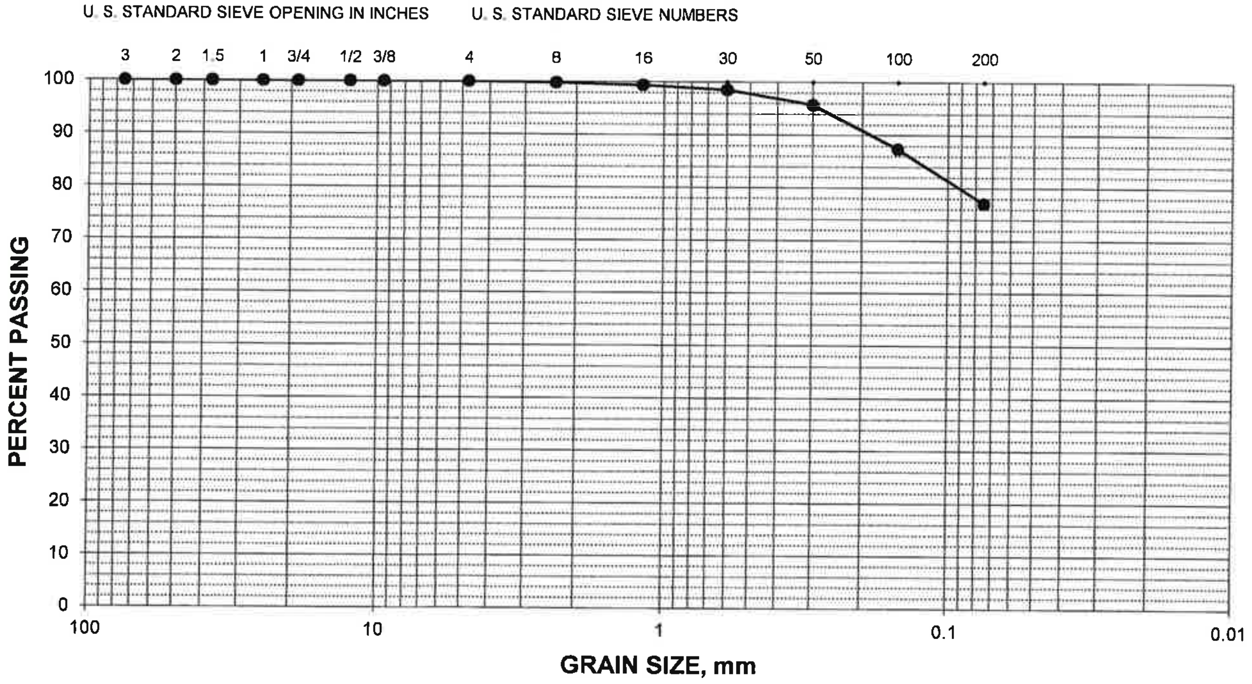
PARTICLE SIZE ANALYSIS

ASTM D 422-63/07; D 1140-06

Boring #2 @ 5.0 - 10.0'
Lean Clay with Sand (CL)

March 31, 2016

Sieve size	% Retained	% Passing
3" (75-mm)	0	100
2" (50-mm)	0	100
1.5" (37.5-mm)	0	100
1" (25-mm)	0	100
3/4" (19-mm)	0	100
1/2" (12.5-mm)	0	100
3/8" (9.5-mm)	0	100
#4 (4.75-mm)	0	100
#8 (2.36-mm)	0	100
#16 (1.18-mm)	1	99
#30 (600-µm)	1	99
#50 (300-µm)	4	96
#100 (150-µm)	13	87
#200 (75-µm)	23	77



University of California Santa Barbara
North Campus Open Space Restoration

SL-17588-SB

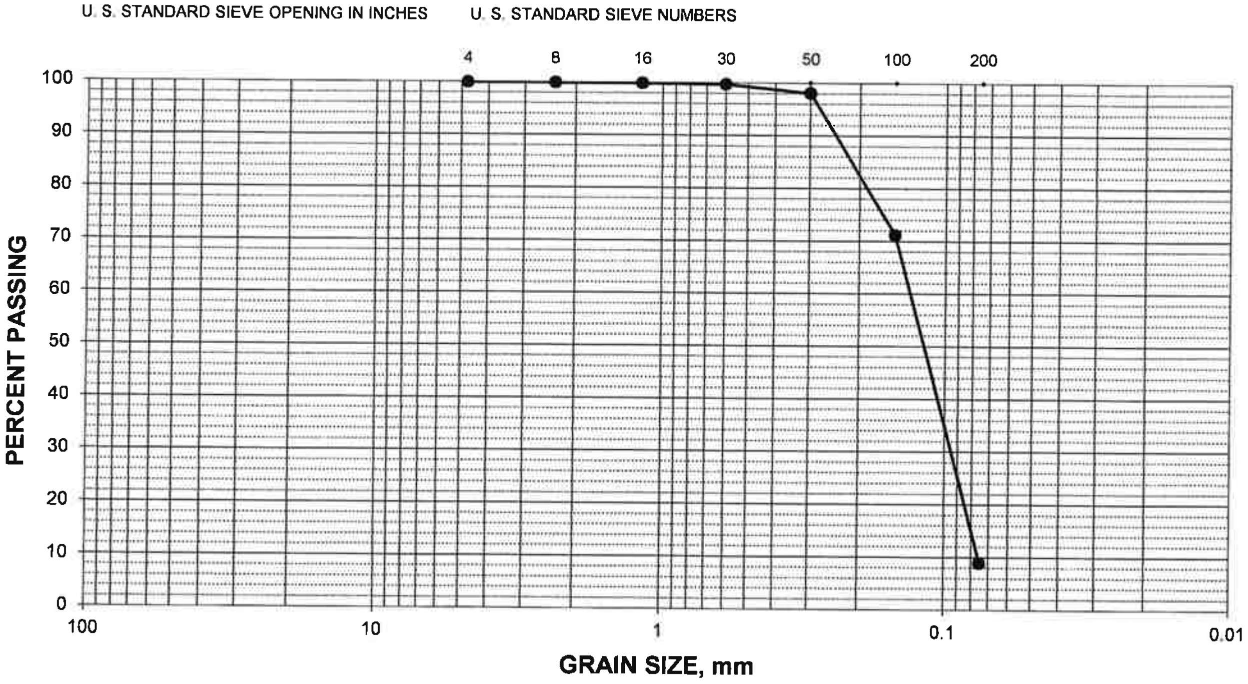
PARTICLE SIZE ANALYSIS

ASTM D 422-63/07; D 1140-06

Boring #6 @ 25.0 - 26.5'
Poorly Graded Sand with Clay (SP-SC)
Cu = 1.7; Cc = 0.9

May 2, 2016

Sieve size	% Retained	% Passing
#4 (4.75-mm)	0	100
#8 (2.36-mm)	0	100
#16 (1.18-mm)	0	100
#30 (600-µm)	0	100
#50 (300-µm)	2	98
#100 (150-µm)	29	71
#200 (75-µm)	91.1	8.9



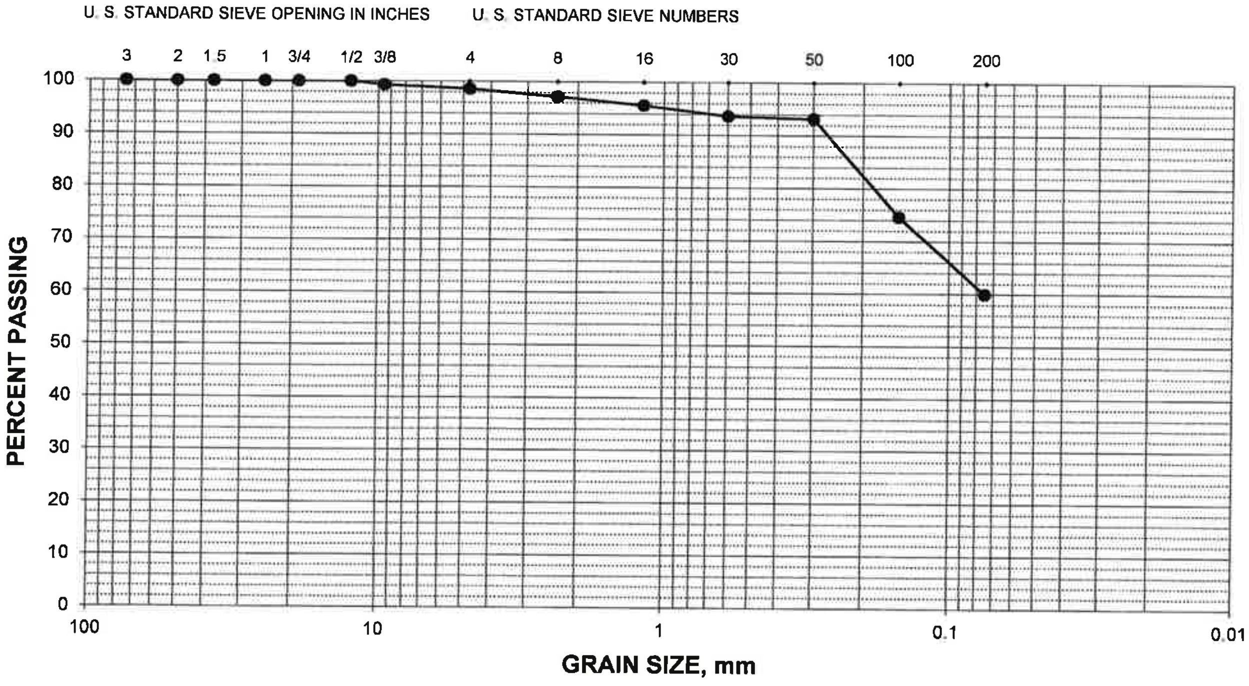
PARTICLE SIZE ANALYSIS

ASTM D 422-63/07; D 1140-06

Boring #11 @ 1.0 - 5.0'
Sandy Lean Clay (CL)

March 31, 2016

Sieve size	% Retained	% Passing
3" (75-mm)	0	100
2" (50-mm)	0	100
1.5" (37.5-mm)	0	100
1" (25-mm)	0	100
3/4" (19-mm)	0	100
1/2" (12.5-mm)	0	100
3/8" (9.5-mm)	1	99
#4 (4.75-mm)	1	99
#8 (2.36-mm)	3	97
#16 (1.18-mm)	4	96
#30 (600-µm)	6	94
#50 (300-µm)	7	93
#100 (150-µm)	25	75
#200 (75-µm)	40	60



University of California Santa Barbara
North Campus Open Space Restoration

SL-17588-SB

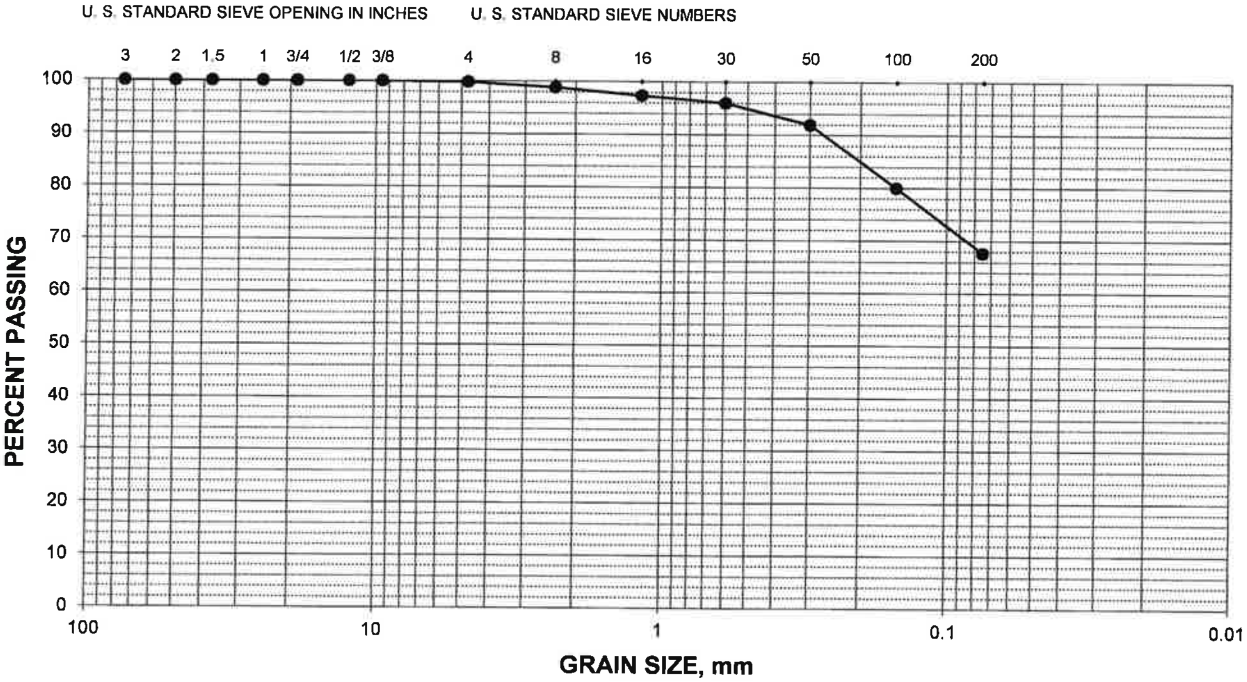
PARTICLE SIZE ANALYSIS

ASTM D 422-63/07; D 1140-06

HA-A
Sandy Lean Clay (CL)

March 31, 2016

Sieve size	% Retained	% Passing
3" (75-mm)	0	100
2" (50-mm)	0	100
1.5" (37.5-mm)	0	100
1" (25-mm)	0	100
3/4" (19-mm)	0	100
1/2" (12.5-mm)	0	100
3/8" (9.5-mm)	0	100
#4 (4.75-mm)	0	100
#8 (2.36-mm)	1	99
#16 (1.18-mm)	3	97
#30 (600-µm)	4	96
#50 (300-µm)	8	92
#100 (150-µm)	20	80
#200 (75-µm)	32	68



University of California Santa Barbara
North Campus Open Space Restoration

SL-17588-SB

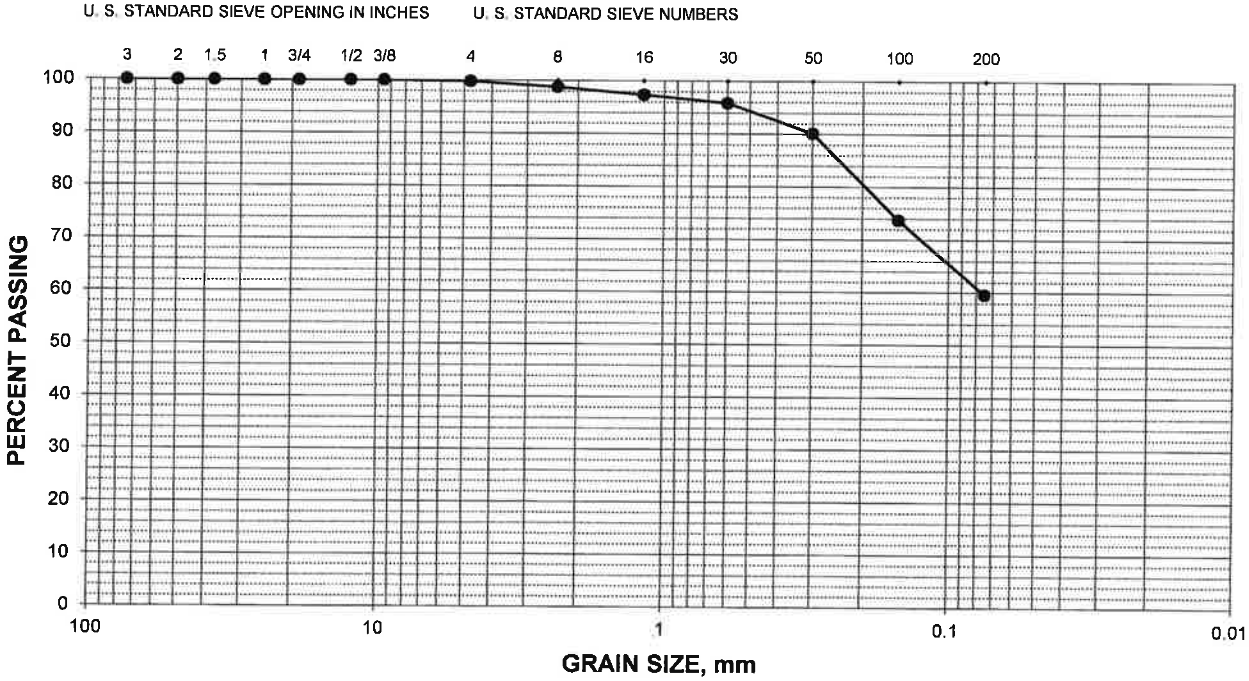
PARTICLE SIZE ANALYSIS

ASTM D 422-63/07; D 1140-06

HA-B
Sandy Lean Clay (CL)

March 31, 2016

Sieve size	% Retained	% Passing
3" (75-mm)	0	100
2" (50-mm)	0	100
1.5" (37.5-mm)	0	100
1" (25-mm)	0	100
3/4" (19-mm)	0	100
1/2" (12.5-mm)	0	100
3/8" (9.5-mm)	0	100
#4 (4.75-mm)	0	100
#8 (2.36-mm)	1	99
#16 (1.18-mm)	3	97
#30 (600-µm)	4	96
#50 (300-µm)	10	90
#100 (150-µm)	26	74
#200 (75-µm)	40	60



University of California Santa Barbara
North Campus Open Space Restoration

SL-17588-SB

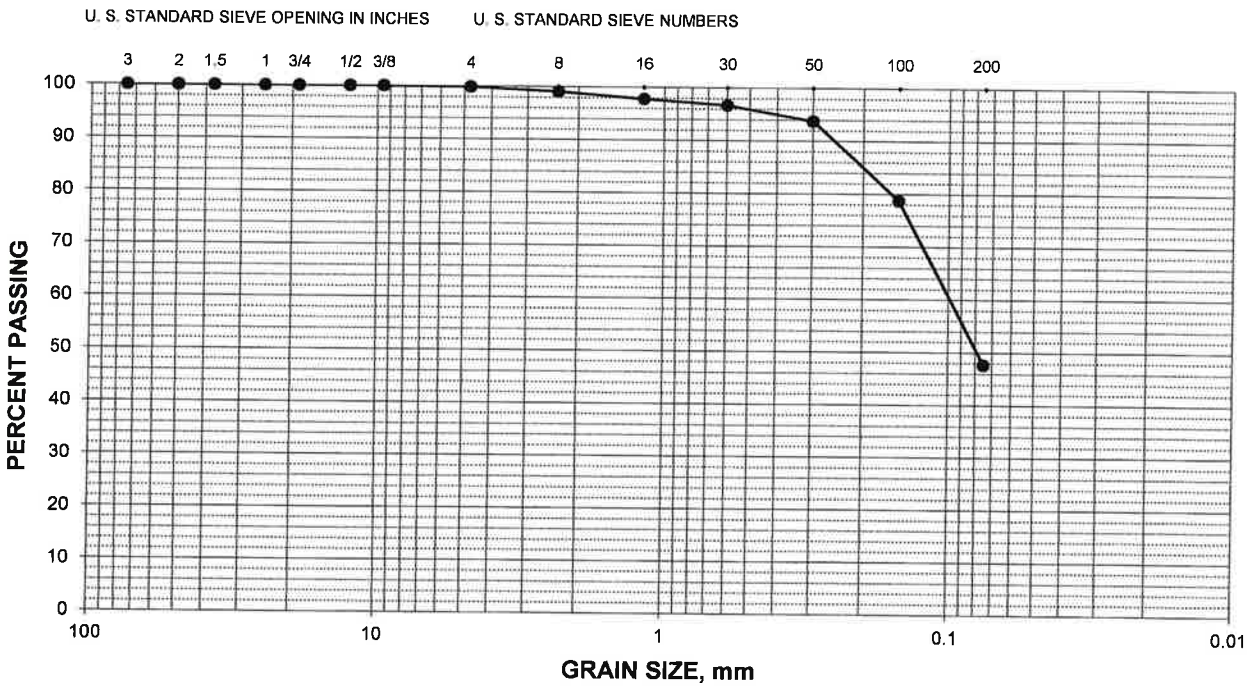
PARTICLE SIZE ANALYSIS

ASTM D 422-63/07; D 1140-06

HA-C
Clayey Sand (SC)

March 31, 2016

Sieve size	% Retained	% Passing
3" (75-mm)	0	100
2" (50-mm)	0	100
1.5" (37.5-mm)	0	100
1" (25-mm)	0	100
3/4" (19-mm)	0	100
1/2" (12.5-mm)	0	100
3/8" (9.5-mm)	0	100
#4 (4.75-mm)	0	100
#8 (2.36-mm)	1	99
#16 (1.18-mm)	2	98
#30 (600-µm)	3	97
#50 (300-µm)	6	94
#100 (150-µm)	21	79
#200 (75-µm)	52	48



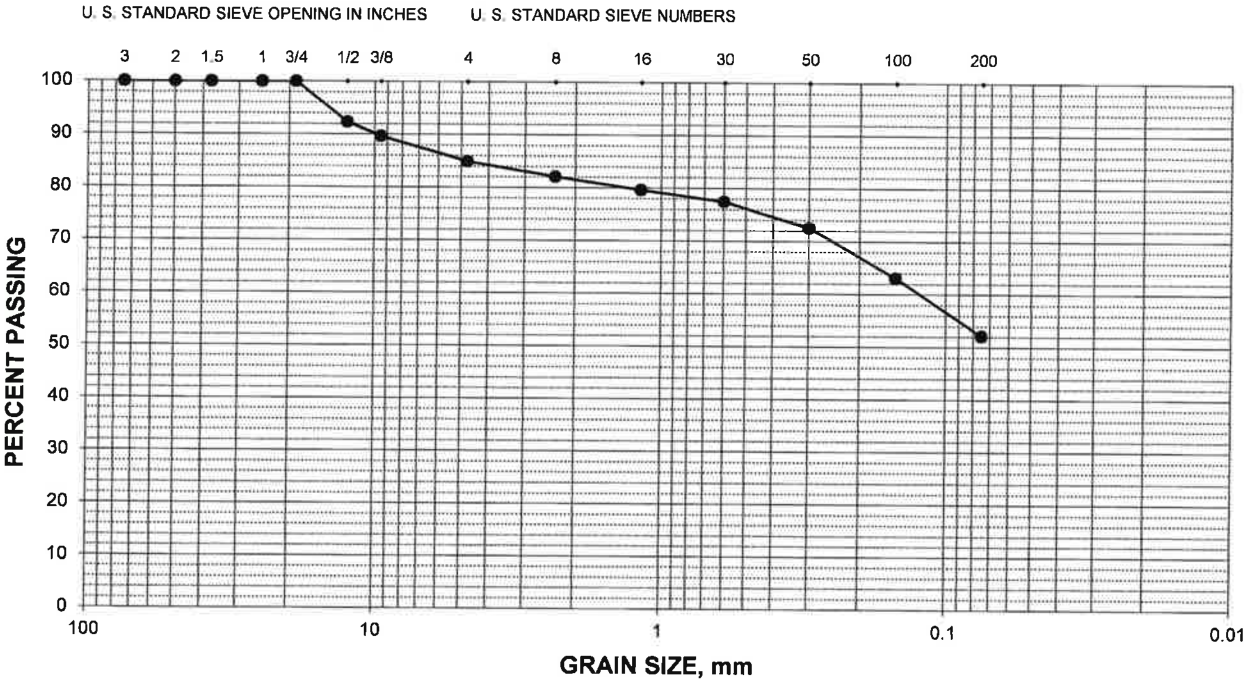
PARTICLE SIZE ANALYSIS

ASTM D 422-63/07; D 1140-06

HA-D
Sandy Lean Clay with Gravel (CL)

March 31, 2016

Sieve size	% Retained	% Passing
3" (75-mm)	0	100
2" (50-mm)	0	100
1.5" (37.5-mm)	0	100
1" (25-mm)	0	100
3/4" (19-mm)	0	100
1/2" (12.5-mm)	8	92
3/8" (9.5-mm)	10	90
#4 (4.75-mm)	15	85
#8 (2.36-mm)	18	82
#16 (1.18-mm)	20	80
#30 (600-µm)	23	77
#50 (300-µm)	27	73
#100 (150-µm)	37	63
#200 (75-µm)	48	52



University of California Santa Barbara
North Campus Open Space Restoration

SL-17588-SB

CONSOLIDATION TEST

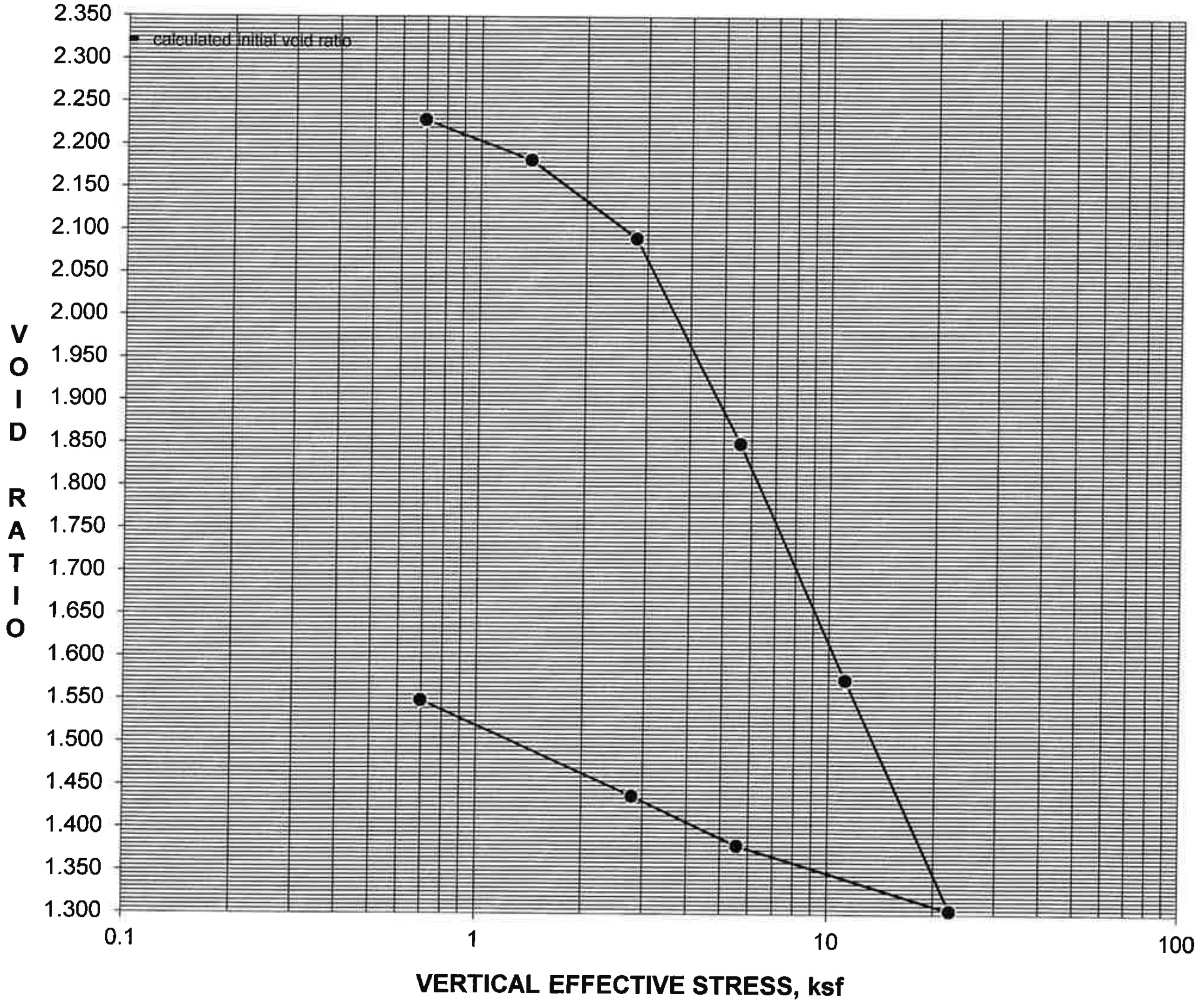
ASTM D 2435/D2435M-11

March 31, 2016

Boring #11 @ 11.0 - 11.5'
Sandy Lean Clay (CL)
Ring Sample

DRY DENSITY: 50.8 pcf
MOISTURE CONTENT: 87.9%
SPECIFIC GRAVITY: 2.70 (assumed)
INITIAL VOID RATIO: 2.321

VOID RATIO vs. NORMAL PRESSURE DIAGRAM



APPENDIX C

Corrosion Evaluation Report
Prepared by Cerco Analytical

California State Certified Laboratory No. 2153

CERCO
analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

30 March, 2016

Job No. 1603221
Cust. No.12651

Mr. Doug Dunham
Earth Systems Pacific
2049 Preisker Lane, Suite E
Santa Maria, CA 93454

Subject: Project No.: SL-17558-SB
Project Name: UCSB North Campus Open Space Restoration
Corrosivity Analysis – CalTrans Test Methods

Dear Mr. Dunham:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on March 23, 2016. Based on the analytical results, a brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurements, both samples are classified as “severely corrosive”. All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentrations were 760 & 4,100 mg/kg. Chloride ion concentrations greater than 300 mg/kg are considered corrosive to embedded reinforcing steel; and, as such, the concrete mix design shall be adjusted accordingly by a qualified corrosion engineer.

The sulfate ion concentrations were 880 & 920 mg/kg and are determined to be sufficient to potentially be detrimental to reinforced concrete structures and cement mortar-coated steel at these locations. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

The pH of the soils were 7.83 & 7.95, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: Earth Systems Pacific
Client's Project No.: SL-17558-SB
Client's Project Name: UCSB North Campus Open Space Restoration, Goleta, CA
Date Sampled: 03/09 & 10/16
Date Received: 23-Mar-16
Matrix: Soil
Authorization: Letter dated March 16, 2016

Date of Report: 30-Mar-2016

Job/Sample No.	Sample I.D.	Moisture (%)	pH	Min.Resistivity (ohms-cm)**	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1603221-001	Boring No.2 @ 5-10'	-	7.83	100	-	4,100 (1)	920 (1)
1603221-002	Boring No.11 @ 1-5'	-	7.95	310	-	760	880

Method:	CT 226 (a)	CT 643 (b)	CT 643 (b)	-	CT 422 (c)	CT 417 (c)
Reporting Limit:	-	-	-	50	15	15
Date Analyzed:	-	28-Mar-2016	28-Mar-2016	-	28-Mar-2016	28-Mar-2016

Cheryl McMiller

Cheryl McMiller
Laboratory Director

* Results Reported on an "As Received" Basis

(a) Rev. July 2010 (b) Rev. June 2007 (c) Rev. November 2006

N.D. - None Detected

(1) Reporting limit elevated to 75 mg/kg due to matrix

Quality Control Summary - **All laboratory quality control parameters were found to be within established limits**

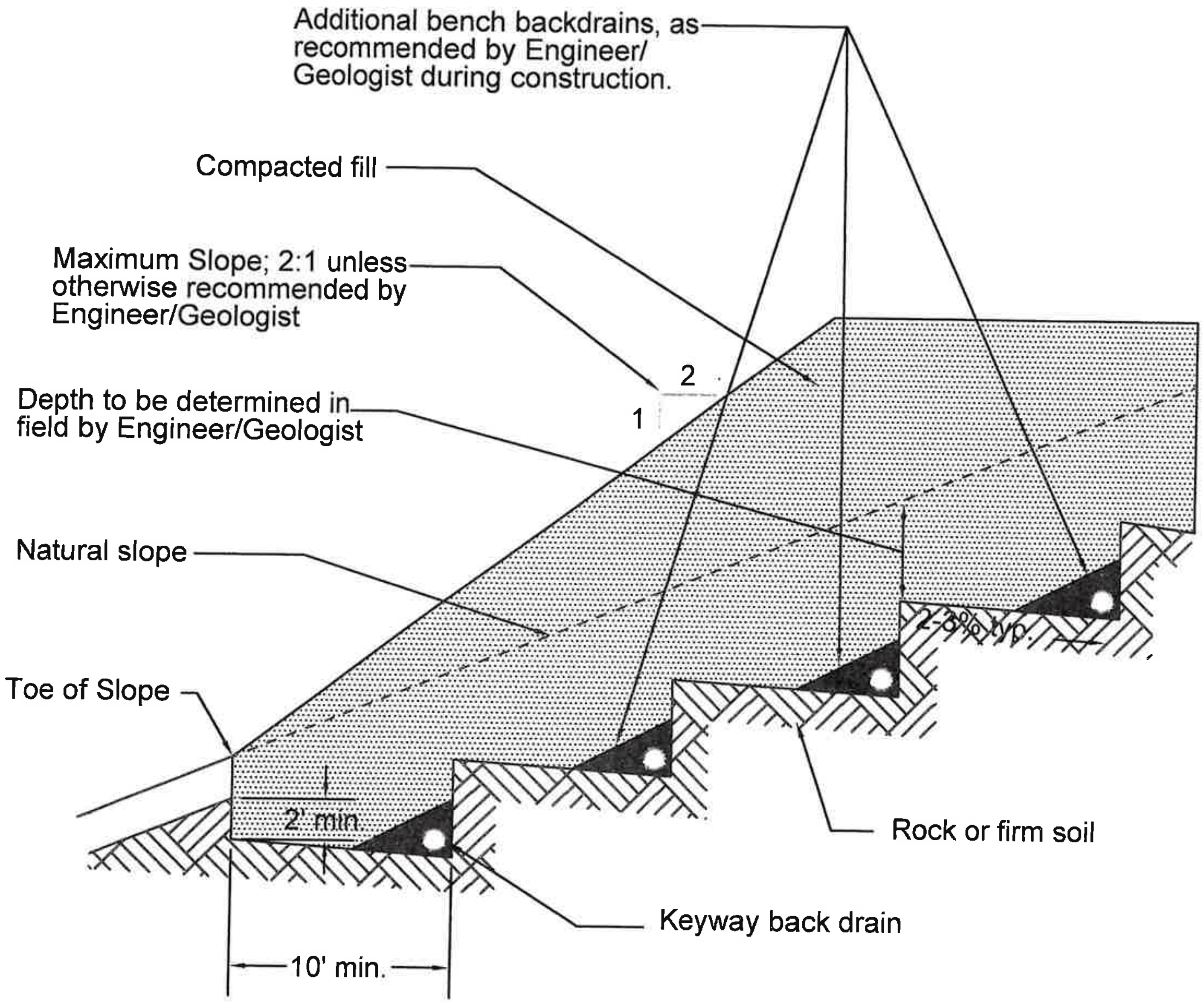
APPENDIX D

Typical Bench and Keyway Detail

BENCH and KEYWAY DETAIL (Typical)

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION

Southwest of Storke Road and Whittier Drive, Goleta, California



SCHEMATIC ONLY
NOT TO SCALE

Earth Systems Pacific

2049 North Preisker Lane, Suite E
Santa Maria, California, 93454
(805) 928-2991 • FAX (805) 928-9253
E-mail: esc@earthsystems.com

May 12, 2016

SMK

SL-17588-SB
BENCH-D01-V03.dwg

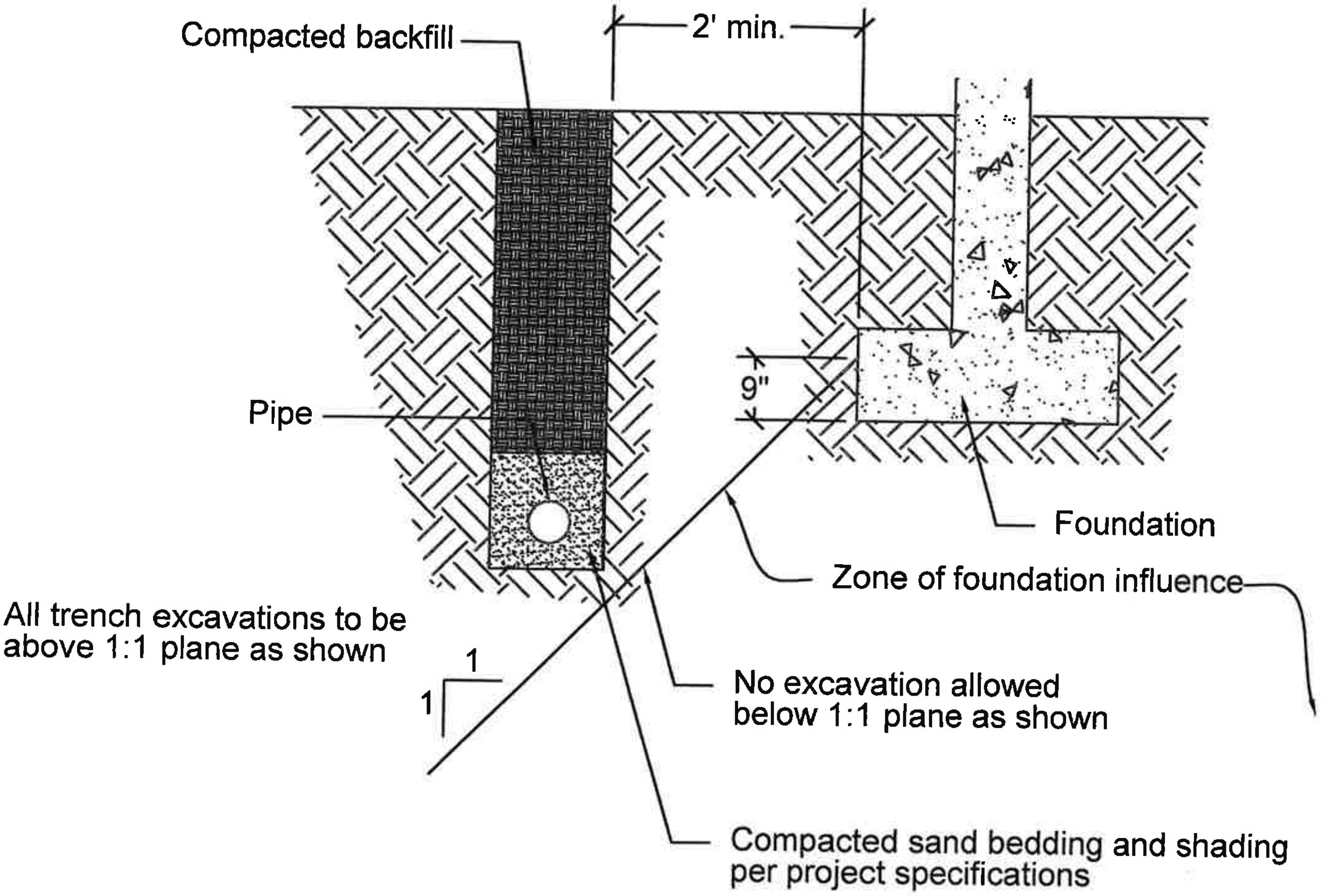
APPENDIX E

Typical Detail A: Pipe Placed Parallel to Foundations

TYPICAL DETAIL A:
PIPE PLACED PARALLEL TO FOUNDATIONS

UNIVERSITY OF CALIFORNIA SANTA BARBARA
NORTH CAMPUS OPEN SPACE RESTORATION

Southwest of Storke Road and Whittier Drive, Goleta, California



SCHEMATIC ONLY

NOT TO SCALE

APPENDIX F

Tremie Method

RECOMMENDED PROCEDURE FOR TREMIE-PLACED CONCRETE IN CAISSON (DRILLED SHAFT) FOUNDATION CONSTRUCTION

The following are general guidelines only, and may be subject to modification by the architect/engineer and/or geotechnical engineer.

1. Concrete should be placed in caisson excavations by means of a tremie when the depth of water in the excavation cannot be limited to a maximum of 2 inches, or when the freefall of the concrete would result in the concrete striking the rebar or excavation walls as it falls.

2. The concrete should be pumped to the tremie pipe or, a hopper with a tremie pipe attached should be used. An "elephant's trunk" should not be used to place concrete under water; however, an elephant's trunk may be used to direct the fall of the concrete in dry excavations. The elephant's trunk should be of sufficient length to prevent the concrete from striking the rebar or excavation walls as it falls.

3. Concrete for dry excavations should be designed for, and placed at, a slump of 4 to 6 inches. Concrete to be placed below water should be designed for, and placed at, a slump of 7 to 9 inches.

4. The tremie pipe should consist of rigid steel pipe with tight couplings. The tremie pipe should be 4 to 6 inches in diameter and should be longer than the deepest caisson excavation.

5. The tremie pipe should be lowered with caution through the center of the reinforcing to within 1 foot of the bottom of the excavation; the tremie should not be allowed to penetrate into the muck on the bottom of the hole

6. The pump hose and tremie pipe should be "slicked" with Portland cement slurry. No clay, bentonite, or other material should be used unless approved by the architect/engineer and geotechnical engineer.

7. Pumping of the concrete should begin immediately after the reinforcing and the tremie pipe have been placed in the excavation and the excavation has been inspected. The tremie pipe should not be raised until the concrete surface in the caisson excavation is at least 5 feet above the bottom of the tremie pipe. The bottom of the tremie pipe should then be kept at least 5 feet below the top of the concrete until the pour is completed.

8. The concrete should be pumped until all muck, laitance, and unsuitable concrete has been lifted above the top-of-caisson elevation. All muck, laitance, and unsuitable concrete should be immediately removed from the excavation.

9. Concrete poured at a 6-inch or greater slump should *not* be vibrated during the pour, unless directed by the architect/engineer. When vibration is required, it should *not* be started until the concrete pour is completed and the muck, laitance and unsuitable concrete have been removed. At a minimum, the upper 10 feet of the concrete should then be vibrated. Additional concrete may be added as necessary during vibration. The vibrator should not be allowed to contact the reinforcing.

10. During the pour, if the tremie pipe has to be removed from the concrete, (e.g., to allow removal of casing), it should be reset at the top of the concrete. The tremie should then be purged, as directed by the inspector, and then immediately lowered to at least 5 feet below the top of the concrete as the concrete is being pumped. All degraded concrete should be lifted with the continuing pour and removed from the top of the caisson.