

Geotechnical Investigation

South Cove Public Dock and Parking Lot Renovation Project Berkeley Marina, Berkeley, California



SUBMITTED TO:

Jerome de Verrier, P.E.
Senior Civil Engineer
TranSystems Corporation
505 14th Street, Suite 100
Oakland, CA 94612

February 12, 2013

A3GEO

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A3GEO Project #1118-1A

Jerome de Verrier, P.E.
Senior Civil Engineer
TranSystems Corporation
505 14th Street, Suite 100
Oakland, CA 94612
jcdeverrier@transystems.com

RE: Geotechnical Investigation Report
South Cove Public Dock and Parking Lot Renovation Project
Berkeley Marina, Berkeley, California

Dear Mr. de Verrier:

This report presents the results of our geotechnical investigation for the South Cove Public Dock and Parking Lot Renovation project in Berkeley, California. A3GEO is providing services for this project in accordance with our professional services agreement with TranSystems Corporation dated August 10, 2012.

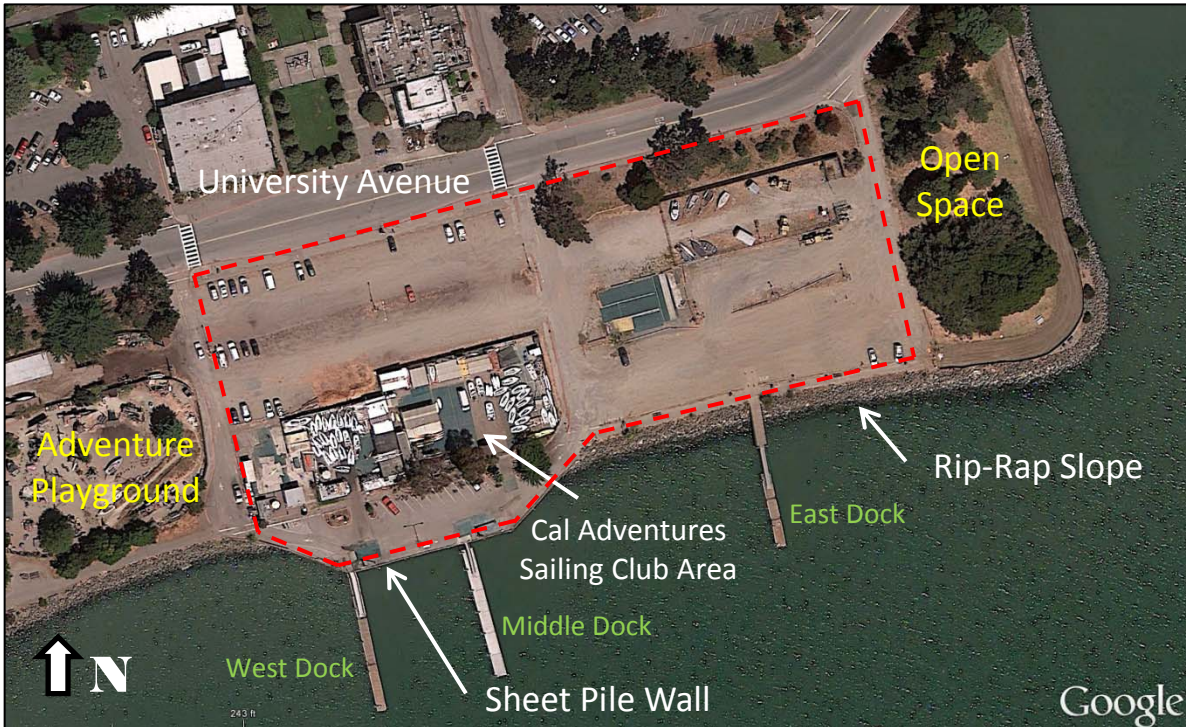
1.00 INTRODUCTION

1.01 Project Setting

As shown below, the project site is located at the Berkeley Marina at the western end of University Avenue. The Berkeley Marina is situated on a narrow piece of man-made land which was created by filling in the bay. The historic shoreline is approximately 3,000 feet east of the site.



A recent aerial photograph of the project site is presented below. As shown on the photograph, the site is bordered by University Avenue to the north, the San Francisco Bay to the south, Adventure Playground to the west and open space to the east. The site is currently occupied by gravel parking lots and the Cal Adventures Sailing Club. The sailing club consists of numerous sheds, boat storage areas and three small floating docks along the southern edge of the site. For the purposes of this report, the docks are identified at the West Dock, Middle Dock and East Dock. The southern edge of the site is supported by a sheet pile wall along the western half and by a rip-rap slope along the eastern half.



1.02 Project Description

As currently planned, the project will include the following elements:

- Replacing the East and West Docks,
- Adding an ADA accessible gangway and supporting dock to the Middle Dock,
- Constructing a new 625 square foot restroom facility with outdoor showers in the center of the site;
- Paving the existing parking lot areas (approximately 75,750 square feet) with asphalt concrete; and
- Constructing a bio-swale for water infiltration.

1.03 Purpose and Scope

The purpose of our investigation was to: 1) evaluate subsurface conditions in the areas of the planned parking lots, restroom facility and ADA accessible gangway; and 2) develop geotechnical recommendations for the new pavements and the new foundations to support the restroom facility and ADA accessible gangway. Our scope of services included drilling four shallow exploratory borings, performing geotechnical laboratory tests, conducting engineering analyses, and preparing this report.

As outlined in our proposal, our scope of services did *not* include investigations, evaluations, conclusions or recommendations pertaining to: 1) earthquake-induced liquefaction or lateral spreading; 2) flooding; 3)

tsunami run-up; 4) long-term consolidation of bay mud; 5) bio-swale design; and/or 6) hazardous, toxic, or corrosive materials on, below, or around the site.

2.00 METHODS OF INVESTIGATION

2.01 Review of Published Information

We reviewed a variety of published materials containing information relevant to the subject site. These sources included reports and maps published by the United States Geological Survey and by the California Geological Survey (formerly the California Division of Mines and Geology). Information obtained from our review of published information is discussed in Section 3.01, Geologic and Seismic Setting.

2.02 Site Reconnaissance Visits

Our site reconnaissance visit was performed on December 4, 2012. During this visit, we observed the surficial conditions present and checked for obvious geotechnical concerns. Observations made during our site reconnaissance visit are discussed in Section 3.03, Surface Conditions.

2.03 Subsurface Exploration

On December 4, 2012, we drilled four exploratory borings (B-1 through B-4) at the approximate locations shown on the Site Plan, Figure 1. Boring B-1 was drilled in the northwest corner of the parking lot. Boring B-2 was drilled at the north end of the Middle Dock. Boring B-3 was drilled in the area of the planned restroom facility, and Boring B-4 was drilled in the southeast corner of the parking lot. Borings B-1 and B-4 extended to 5.0 feet. Boring B-2 extended to 16.5 feet, and Boring B-3 extended to 18.0 feet.

Northstar Drilling, Inc. of Escalon, California drilled the borings using a truck mounted, B-24 type drill rig equipped with a 4.5-inch-diameter solid stem flight auger. An A3GEO engineer directed the drilling operations, logged the subsurface conditions encountered and obtained samples at frequent intervals. Soil samples were obtained using a 3-inch O.D. Modified California (MC) sampler with liners and a standard penetration test (SPT) sampler without liners. The samplers were driven with a rope-and-cathead activated, 140-pound hammer falling about 30 inches. The hammer blows required to drive the sampler the final 12 inches of each 18-inch drive are presented on the attached logs. Sampler blow counts presented on the logs are adjusted N-values. Blow counts have been adjusted for sampler type only (i.e., the MC field blow counts were “adjusted” to approximate N-value equivalents by multiplying by a factor of 0.63). At the conclusion of the field investigation, the borings were checked for indications of free groundwater and were then grouted in accordance with City of Berkeley drilling permit requirements.

During drilling, the soils were visually/manually classified in general accordance with ASTM D2488 classifications which are based on the Unified Soil Classification System (USCS). Field classifications were subsequently checked and revised, where appropriate, based on laboratory test data. The logs of the borings are attached at the end of this report and are preceded by a Key to Exploratory Boring Logs that describes the USCS and the symbols used on the logs.

Please note that the attached boring logs and related information depict subsurface conditions only at the boring locations shown on the Site Plan on the particular date designated on the boring logs. The attached boring logs represent our interpretation of the subsurface materials at the boring locations at the time of drilling and the passage of time may result in changes in the subsurface conditions. The boring locations indicated on the attached materials were determined by measuring from existing improvements and should be considered approximate. A summary of our findings from our subsurface exploration can be found in Section 3.04, Subsurface Conditions.

2.04 Laboratory Testing

Our geotechnical laboratory testing program was directed toward a quantitative and qualitative evaluation of the physical properties of the soils that underlie the site. The following geotechnical laboratory tests were performed:

- Water content per ASTM Test Designation D-2216;
- Dry density per ASTM Test Designation D-2937; and
- Atterberg limits per ASTM Test Designation D-4318.

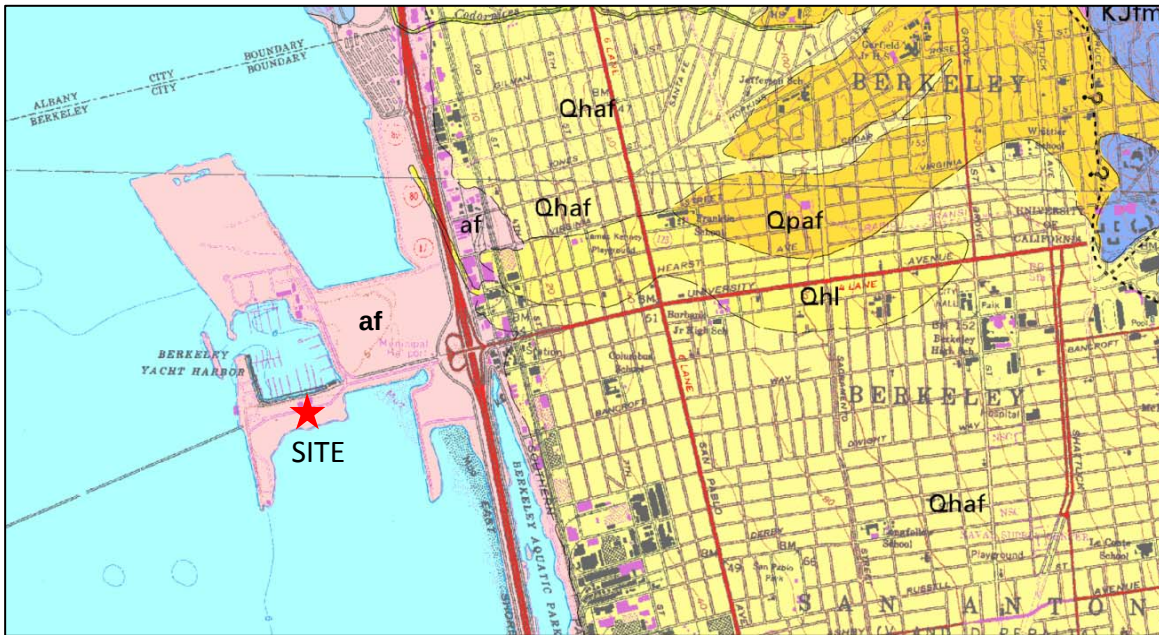
The results of the laboratory tests are presented on the attached boring logs at the corresponding sample depths as well as on the attached laboratory data sheets.

3.00 SITE CONDITIONS

3.01 Geologic and Seismic Setting

A recent USGS geologic map showing the site area (Graymer, 2000) is presented below. On this map, the site is mapped as artificial fill. The unit is described by the USGS (Graymer, 2000) as follows:

Artificial fill (Historic) [map symbol af] – Man-made deposit of various materials and ages. Some are compacted and quite firm, but fills made before 1965 are nearly everywhere not compacted and consist simply of dumped materials.



The site is located within the San Francisco Bay Region, which includes a series of major northwest-trending faults that are seismically active. The nearest active fault is the Hayward fault approximately 3.1 miles to the northeast of the project site (Jennings, 2010). The site is not located within an Alquist-Priolo Earthquake Fault Zone designated by the State of California (CDMG, 1982) and no active faults have been mapped in the direct vicinity of the site.

Studies by the United States Geological Survey's Working Group on California Earthquake Probabilities (WGCEP, 2008) have estimated:

- A 63 percent probability of at least one magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Region before the year 2037, and
- A 31 percent probability of at least one magnitude 6.7 or greater earthquake occurring on the Hayward/Rogers Creek fault system before the year 2037

The California Geological Survey (CGS) Seismic Hazard Zone map for the Oakland West quadrangle shows the site in an area that may be subject to earthquake-induced liquefaction. A regional USGS map of liquefaction susceptibility (Knudsen et al, 2000) shows the site in an area of "very high" susceptibility.

3.02 Site Development History

Historic USGS topographic maps show that the much of the land within the Berkeley Marina area was constructed by filling in the bay sometime between 1949 and 1959, but that the land supporting the project site was not filled-in until sometime between 1959 and 1968.

An existing, 1965 geotechnical report shows a boring that was drilled on the northern side of University Avenue directly across from what is now the project site. The 1965 investigation was performed prior to the project site being filled. The 1965 boring shows approximately 16 feet of fill overlying bay deposits.

3.03 Surface Conditions

The site is basically level. The Revised Concept Layout by TranSystems dated October 9, 2012, shows that surface grades slope very gently down toward the south-southeast. The high point (Elevation +16 feet) is located at the northwest corner of the site. The low point (Elevation +10 feet) is located along the southern edge of the site near the West and Middle Docks. The elevation at the southeast corner of the site is at +12.0 feet. During our reconnaissance, there were numerous low areas with ponded water within the gravel parking lot areas.

The majority of the site is covered with gravel, with the exception of the small trapezoidal area between the sailing club and the West and Middle Docks. The existing asphalt concrete in this area was observed to be distressed, cracking, and contained low areas with ponding water. There are two small boat hoists near the West and Middle docks adjacent to the sheet-pile wall. At the time of our reconnaissance, the water level in the bay was about 6 feet below the top of the sheet pile wall. A buried electrical vault was observed on the site in the vicinity of the new restroom facility. No significant surface drainage features were observed on site.

3.04 Subsurface Conditions

The borings encountered highly variable fill materials extending to the full depths explored. In general, the fill consisted of very loose to medium dense gravels and soft to stiff, lean to fat clays. The gravels contained varying amounts of clay and sand, and the clays contained varying amounts of sand and gravel. Atterberg Limits tests were performed on clay samples taken at a depth of 2.5 feet in Boring B-3 and at a depth of 2.0 feet in Boring B-4. Both samples produced Plasticity Indexes (PI) of 20 which are indicative of soil with a moderate expansion potential (expansive soils are prone to shrinking/swelling with changes in moisture content).

Groundwater was encountered between 4.5 and 8.0 feet below the ground surface at the time of drilling. These water levels relate specifically to the dates/times shown on the boring logs and are not necessarily indicative of stabilized groundwater levels at the time that the borings were drilled (the borings may not have remained open long enough to establish equilibrium groundwater conditions). In addition, it should be anticipated that groundwater levels at the site may fluctuate significantly due to variations in rainfall and other factors.

4.00 EVALUATIONS AND CONCLUSIONS

4.01 General

We conclude that the proposed project is generally feasible from a geotechnical standpoint. Geotechnical evaluations and conclusions relating to the design and construction of the project follow; geotechnical recommendations are presented in Section 5.00.

As previously noted, the site is mapped in a State of California Seismic Hazard Zone for potential earthquake-induced liquefaction. State regulations and guidelines pertaining to these official Seismic Hazard Zones apply to “projects” that include structures intended for human occupancy (which is defined as occupancy at a rate of at least 2,000 person-hours per year). Therefore, from a regulatory perspective, we understand that the official State guidelines do not apply to the South Cove Public Dock and Parking Lot Renovation project, as it does not include structures intended for human occupancy. Investigations, evaluations, conclusions and/or recommendations pertaining to earthquake-induced liquefaction and/or lateral spreading were *not* included in our scope.

4.02 Seismic Design

The subject site is located in the highly seismic San Francisco Bay Region, and the site is likely to experience one or more episodes of strong ground shaking during the life of the project. The California Building Code (CBC) has adopted provisions for incorporation of strong ground shaking into the design of all structures.

Our recommendations for geotechnical parameters to be used in the seismic design of the restroom facility are presented in Section 5.01, Building Code Seismic Design Parameters.

4.03 Poorly-Compacted Fill, Expansive Near-Surface Soils and Compressible Bay Deposits

The site is underlain by fill which extended to the maximum depths explored (i.e., 18 feet). The fill was found to be highly variable, poorly compacted and moderately to highly expansive. Expansive soils tend to shrink and swell with changes in moisture content and have the potential to damage overlying improvements, unless appropriately mitigated. The damaging effects of expansive soils can be mitigated in a variety of ways, the most common of which include removal and replacement with a layer of non-expansive material and/or extending foundations to depths below the zone of seasonal moisture fluctuations.

Bay mud underlies the fill materials at the site and has the potential to consolidate when additional loads are imposed on the ground surface. Although the consolidation of bay mud occurs very slowly, it can result in settlement at the ground surface. Unfortunately, the evaluation of the potential consolidation of the bay mud underlying the site was beyond the scope of this study, and our borings did not extend into or through the bay mud. Published maps show the thickness of young bay mud to be about 20 feet at the project site. Considering the relatively light loads which will be imposed by the proposed restroom facility (dead plus live loads equal to about 435 pounds per square foot) and the depth of the bay mud, we estimate that the long-term static settlement due to consolidation would be less than about 2 inches.

This report provides the following recommendations to mitigate the existing fill, expansive soils and compressible bay mud:

- Supporting the new restroom facility on a mat foundation underlain by a layer of compacted, non-expansive fill;
- Supporting the new gangway footing on a layer of compacted, non-expansive fill; and
- Using an R-value of 5 for flexible pavement design. An R-value of 5 is representative of the poor subgrade soils.

4.04 Construction Considerations

It is likely that some site excavations will encounter wet (i.e., over optimum) and/or soft subgrade soils that may be difficult to compact. If excessively wet and/or soft subgrade soils are encountered, additional mitigation may be required such as local over-excavation and/or placement of geotextile fabric. Seepage zones or locally perched groundwater conditions could also be encountered, particularly if the work is performed during or shortly after the winter rainy season. The control of groundwater during construction is the responsibility of the contractor. Possible groundwater control methods include pumping from sumps at low points within excavations, horizontal drains and dewatering wells. The design, permitting, installation, monitoring, and abandonment of site dewatering and discharge systems are the contractor's responsibility. These responsibilities also include any special regulatory or health and safety requirements that may be associated with the disposal and/or discharge of construction water.

Although it is possible for construction to proceed during or immediately following the wet winter months, a number of geotechnical problems may occur which may increase costs and cause project delays. The water content of onsite soils may increase during the winter and rise significantly above optimum moisture content for compaction of subgrade or backfill materials. If this occurs, the contractor may be unable to achieve the specified levels of compaction. Dewatering requirements will potentially increase due to rainfall, surface runoff, seepage and rises in groundwater level. The stability of temporary slopes will decrease, potentially increasing the lateral extent of excavation required. If excavation trenches are open during winter rains, caving of the trench walls may occur. In general, we note that it has also been our experience that increased clean-up costs may be incurred, and greater safety hazards may exist, if the work proceeds during the wet winter months.

5.00 RECOMMENDATIONS

5.01 California Building Code Seismic Design Parameters

Structures at the site should be designed to resist strong ground shaking in accordance with the applicable building codes and local design practice. This section provides seismic design parameters for use with the 2010 California Building Code.

Site Class E = Soft Soil Profile

Site Location

Latitude = 37.8633 degrees

Longitude = -122.3128 degrees

Mapped Spectral Accelerations

Short Period (S_s , Site Class B) = 1.532g

1-Second Period (S_1 , Site Class B) = 0.600g

Maximum Considered Earthquake Spectral Response Accelerations

Short Period (SM_s , Site Class E) = 1.379g

1-Second Period (SM_1 , Site Class E) = 1.440g

Design Spectral Response Accelerations

Short Period (SD_s , Site Class E) = 0.919g

1-Second Period (SD_1 , Site Class E) = 0.960g

The acceleration parameters presented above were obtained using the United States Geological Survey's Java-based website application (<http://earthquake.usgs.gov/research/hazmaps/design/>), which we accessed on December 13, 2012. The Maximum Considered Earthquake Spectral Response Accelerations are associated with 2 percent probability of exceedence in 50 years level-of-hazard. The Design Spectral Response Accelerations are two-thirds of the Maximum Considered Earthquake values.

5.02 Foundations

5.02.1 Restroom Foundations

The proposed bathroom facility can be supported on a mat foundation underlain by an 18-inch thick layer of compacted, non-expansive fill placed in accordance with Section 5.03, Earthwork. The mat foundation should be at least 12 inches thick and the bottom of the mat should extend at least 12 inches below the lowest adjacent ground surface. The mat can be designed using the following allowable bearing pressures:

Allowable Bearing Pressures

Load Case	Allowable Bearing Pressure in pounds per square foot (psf)	Factor of Safety
Dead Loads	500 psf	3.0
Dead plus Live Loads	750 psf	2.0
Total Loads (including wind or seismic)	1,000 psf	1.5

These allowable bearing pressures are net values; therefore, the weight of the mat can be neglected for design purposes. The mat should be integrally connected to all portions of the structure so that the entire foundation system acts as a unit. The mat should be reinforced with sufficient top and bottom steel (in both directions). For structural mat design purposes, a modulus of subgrade reaction of 50 kips per cubic foot can be used for the existing ground.

In areas where floor wetness would be undesirable, a vapor barrier (Stego 15 mil Class A, or equivalent) should be placed under the mat. Any tears in the retarder and all plumbing penetrations should be sealed with an approved mastic material. We also recommend that the specifications for the mat require moisture emission tests to be performed on the mat prior to the installation of any flooring.

Resistance to lateral loads can be provided by friction along the base of the mat foundation. If the mat is underlain by an impermeable membrane, a friction coefficient of 0.25 can be used to evaluate frictional resistance along the bottom of the mat. If the mat is directly supported on non-expansive fill, a friction coefficient of 0.35 can be used to evaluate frictional resistance along the bottom of the mat. The above frictional resistance values includes a factor of safety of at least 1.5.

5.02.2 Gangway Foundations

The proposed gangway can be supported on a single square spread footing foundation. The footing should be at least 30 inches square and should bear at least 12 inches below the top of the sheet-pile wall. The footing can be designed using the allowable bearing capacities presented above. The gangway should be pinned to the footing and free to rotate. The gangway should be able to slide freely along the dock. We have assumed no significant lateral loads will be applied to the footing. The gangway footing should be underlain by 18 inches of compacted non-expansive fill placed in accordance with Section 5.03, Earthwork.

5.02.3 Light Pole Foundations

The light poles can be supported on drilled, cast-in-place, straight-shaft piers at least 24 inches in diameter. Piers should be located at least 5 feet horizontally from the top of any adjacent slope. All piers should be designed to gain support through skin friction; any contribution from end bearing should be ignored. The axial capacity of drilled piers can be evaluated starting at a depth of 3 feet using the following skin friction values:

Drilled Pier Skin Friction

Load Case	Skin Friction (starting at a depth of 3 feet) (psf)	Factor of Safety
DL+LL Allowable	300	2.0
Total Allowable	400	1.5
Ultimate	600	1.0

Lateral load resistance can be provided by passive pressures acting on the sides of the piers. An allowable passive pressure equal to an equivalent fluid weighing 100 pounds per square foot (psf) per foot of depth, up to a maximum value of 1,000 psf may be used to evaluate passive resistance. Passive resistance may be assumed to start at a depth of one foot below the ground surface for level ground conditions. This passive pressure can be assumed to act over two pier diameters. The preceding passive resistance values have a factor of safety of at least 2.0.

It is the drilled pier contractor's responsibility to verify that no utilities or other subsurface elements to be protected are present at planned foundation pier locations prior to the start of pier drilling. Holes for drilled piers should be drilled straight and plumb (within 1 percent of vertical) and should be cleaned of loose soil. The contractor should be prepared to case pier holes or drill using slurry, as appropriate. The contractor should also be prepared to break up and remove subsurface obstructions from the hole, if encountered. Groundwater will likely be encountered in the drilled piers. If water accumulates in the holes, it should be removed by pumping or bailing prior to concrete placement or the concrete should be placed utilizing the tremie method. Concrete placement should start as soon as possible after the drilling and cleanout is complete. In all cases, holes for drilled piers should be concreted on the day they are drilled. Following placement of the reinforcing steel, holes should be concreted from the bottom up in a single operation. If water is present in the hole, the tremie pipe should be constantly maintained several feet below the surface of the concrete during casting of the pier. As the concrete is placed, any casing used to stabilize the hole should be withdrawn with the bottom of the casing embedded at least one foot but no more than 5 feet below the surface of the concrete as it is withdrawn.

5.03 Earthwork**5.03.1 Fill Materials**

General fill can be used as engineered fill, except where non-expansive fill is specifically required. An 18-inch thick layer of non-expansive fill is required beneath the mat foundation. The non-expansive layer should extend at least three feet beyond the perimeter of the mat. Fill material should conform to the requirements presented below:

General Fill - General fill material should have an organic content of less than 3 percent by volume and should not contain environmental contaminants or rocks or lumps larger than 6 inches in greatest dimension. From a geotechnical standpoint, onsite materials can be reused as General Fill if they meet or can be processed (e.g. by sorting and/or crushing) to meet the above requirements. General fill can be used anywhere except where non-expansive fill is required.

Non-Expansive Fill - Non-expansive fill should conform to the requirements for General Fill, have a Plasticity Index no greater than 15 and a Liquid Limit no greater than 40.

Imported Fill – Imported fill should conform to the requirements for Non-Expansive Fill and should be evaluated by our firm and the project environmental consultant prior to its importation to the site.

All proposed fill materials should be approved by A3GEO prior to their use. The materials cleared or excavated from the site may be suitable for re-use as fill, from a geotechnical standpoint, if they meet or can be processed (i.e., by crushing and/or blending) to meet the above requirements. Material that cannot be mixed or processed to meet specification requirements should be disposed of offsite or stockpiled for other uses at the discretion of the owner. If the re-use of aggregate base, gravel, or crushed asphalt is to be considered, it must first be approved by the owner in consultation with our firm.

5.03.2 Subgrade Preparation and Fill Placement

The subgrade surface in those areas to receive engineered fill should be firm, unyielding, and compacted to the requirements provided below. Soft or yielding subgrade soils should be excavated to a depth adequate to expose firm, non-yielding materials. The exposed soils in those areas receiving fill should be scarified to a depth of 6 inches or the full depth of any existing shrinkage cracks (whichever is deeper). The scarified soils should then be moisture conditioned to slightly above optimum water content and compacted to at least 90 percent relative compaction based on the ASTM D-1557 test method (latest version).

All fill should be placed on surfaces that are firm, non-yielding and approximately horizontal. Preliminary geotechnical requirements for fill compaction are presented below (per ASTM D-1557 Test Methods):

- Fill that is predominantly cohesive (>20 percent passing #200 sieve) should be moisture conditioned, as necessary, to between 3 and 5 percent over optimum moisture content and compacted to at least 90 percent relative compaction.
- Fill that is predominantly granular (<20 percent passing #200 sieve) should be moisture conditioned, as necessary, to slightly over optimum moisture content and compacted to at least 95 percent relative compaction. This includes AB.

All fill should be spread in lifts not exceeding 8 inches in un-compacted thickness. It is possible that fill and/or subgrade soils may be excessively wet or dry depending on the moisture content at the time of construction. If the fill soils are too wet, they may be dried by aeration or by mixing with drier materials.

5.04 Asphalt Concrete (AC) Pavements

We developed the following recommended pavement sections for various traffic indices using the Caltrans R-value design method for flexible pavements. In general, a minimum recommended traffic index of 4 is generally considered appropriate for pedestrian pathways that may be accessed by light vehicles (traffic indices of 4.0 and 5.0 are considered to be reasonable values for automobile and light truck parking areas and access driveways, respectively). A traffic index of 6.0 is applicable for moderate truck access and parking areas. The suggested traffic indices below are not based on a traffic study; the project civil engineer should review the traffic indices to confirm that they are appropriate and select the areas where the sections will be used.

The design pavement sections that follow are based on an estimated subgrade R-value of 5 which is considered appropriate for the site based on visual classification of the near surface fill soils.

Flexible Pavement Thickness Design for Subgrade R-Value = 5

Traffic Index	Asphalt Concrete (inches)	Caltrans Class 2 Aggregate Base (inches)	Total Thickness (inches)
4	2.5	8.5	11
5	3	11	14
6	3	13.5	16.5

The subgrade beneath planned pavements should be compacted to at least 95 percent relative compaction per ASTM D-1557. Pavement subgrades should be proofrolled and confirmed to be uniformly firm and non-yielding prior to the placement of aggregate base. Aggregate base for use in pavements should conform to Caltrans Standard Specifications for Class 2 Aggregate Base. The aggregate base used in pavement sections should be compacted to at least 95 percent relative compaction as determined by ASTM D-1557.

5.05 Trench Backfill

Utility trenches should be backfilled with fill placed in lifts not exceeding 8 inches in uncompacted thickness. Trenches should be filled by placing a granular shading layer beneath and around the pipe, and then 6 to 12 inches of shading should be carefully placed and tamped above the pipe. The remaining portion of the trench should be backfilled with onsite or import soil. The backfill (above shading layers) should be placed and compacted to a minimum relative degree of compaction of 90 percent based on ASTM D1557. For trenches beneath AC pavement, backfill material should consist of AB compacted to 95 percent relative compaction. The compaction requirements given above should be considered minimum recommended requirements. If City and/or utility company specifications require more stringent backfill requirements, those specifications should be followed.

If imported granular soil is used, sufficient water should be added during the trench backfilling operations to prevent the soil from “bulking” during compaction. All compaction operations should be performed by mechanical means only. We recommend against jetting.

5.06 Surface and Subsurface Drainage

Positive surface drainage should be provided to direct surface water away from foundations. Finished grades should be sloped to drain to appropriate discharge facilities. Ponding of surface water should not be allowed.

6.00 FUTURE GEOTECHNICAL SERVICES

A3GEO should review the geotechnical aspects of the project plans and specifications as they are being developed to check conformance with the intent of our recommendations and provide geotechnical services during construction to check whether geotechnical conditions are as anticipated, provide supplemental recommendations where necessary, and document that the geotechnical aspects of the work substantially conform to the approved Contract Documents and the intent of our geotechnical recommendations. If our firm is not accorded the privilege of providing these services, we can assume no responsibility for misinterpretation of our recommendations or whether the geotechnical conditions were as anticipated.

Critical aspects of construction that we should observe and/or test include: over-excavation and removal of existing fill, preparation of subgrades to receive new fill, fill placement, restroom foundation excavations, and drilled pier installations for the light poles.

7.00 LIMITATIONS

This report has been prepared for the exclusive use of you and your consultants in accordance with generally accepted geotechnical engineering practices for specific application to the construction of the proposed South Cove Public Dock and Parking Lot Renovation Project. No other warranty, either expressed or implied, is made. In the event the nature, design, or location of the proposed improvements differs significantly from what has been noted above, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing. Our scope did not include an assessment of chemical constituents in the soil or groundwater or an assessment of geologic stability.

The findings of this report are valid as of the present date. However, the passing of time will likely change the conditions of the existing property due to natural processes or the works of man. In addition, due to legislation or the broadening of knowledge, changes in applicable or appropriate standards may occur. Accordingly, the findings of this report may be invalidated, wholly or partly, by changes beyond our control. Therefore, this report should not be relied upon after three years without being reviewed by this office.

If you have any questions concerning this report, please do not hesitate to call us.

Sincerely,



Dona K. Mann, P.E., G.E.
Principal Engineer
Cell: (415) 425-0247



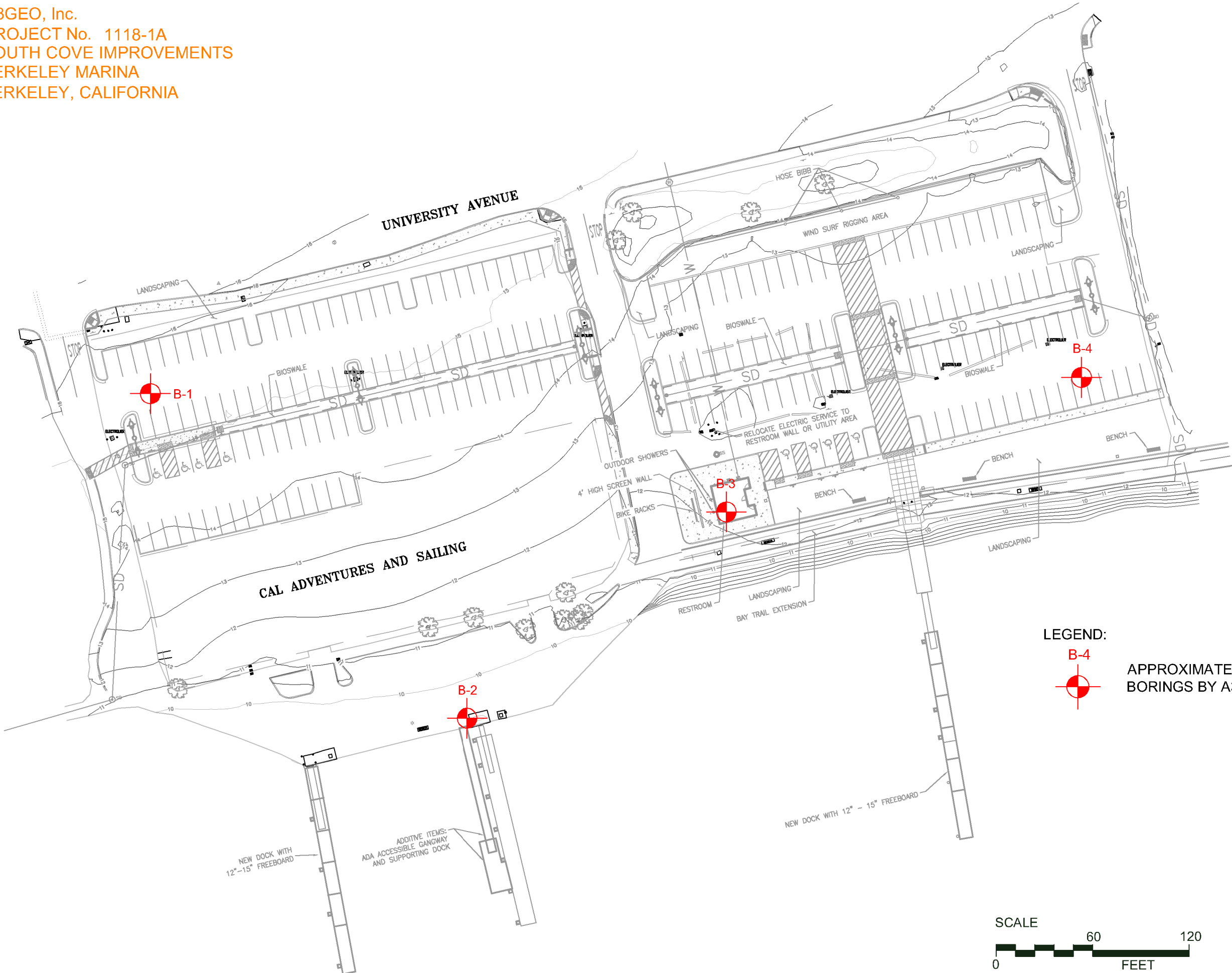
Copies: Addressee (1 via email)

Attachments: Figure 1, Site Plan
Boring Logs
Laboratory Tests

REFERENCES

- California Building Standards Commission, 2010, "California Building Code," Sacramento, California.
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LEGEND:
B-4
APPROXIMATE LOCATION OF EXPLORATORY BORINGS BY A3GEO, Inc. (Dec. 2012)

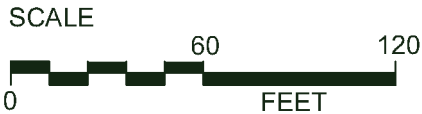


FIGURE 1
SITE PLAN

UNIFIED SOIL CLASSIFICATION CHART				
MAJOR DIVISIONS			SYM	TYPICAL NAMES
COARSE GRAINED SOILS: more than 50% retained on No. 200 sieve	GRAVELS: 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES	GM	Silty gravels and gravel-sand-silt mixtures
			GC	Clayey gravels and gravel-sand-clay mixtures
	SANDS: more than 50% of coarse fraction passes through No. 4 sieve	CLEAN SANDS	SW	Well graded sands and gravelly sand, little or no fines
			SP	Poorly graded sands and gravelly sand, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-silt mixtures
FINE-GRAINED SOILS: 50% or more passes No. 200 sieve	SILTS AND CLAYS: Liquid Limit 50% or less	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	
		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	
	SILTS AND CLAYS: Liquid Limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic clays	
		CH	Inorganic clays of high plasticity, fat clays	
		OH	Organic clays of medium to high plasticity	
HIGHLY ORGANIC SOILS			PT	Peat, muck and other highly organic soils

BOUNDARY CLASSIFICATION AND GRAIN SIZES								
SILT OR CLAY	SAND			GRAVEL		COBBLES	BOULDERS	
	FINE	MEDIUM	COARSE	FINE	COARSE			
U.S. STANDARD SIEVE SIZES	No. 200	No. 40	No. 10	No. 4	3/4"	3"	12"	

KEY TO LOGS	
SAMPLE TYPE	DESCRIPTION
	Modified California Sampler (3" O.D.): blowcount is equivalent SPT N value (converted by multiplying field blowcounts by 0.63)
	Standard Penetration Test (2" O.D.)
	Thin-walled tube using Pitcher Barrel
	Shelby Tube , pushed or used Osterberg Sampler
	Disturbed Sample
*NOTE: RECORDED BLOW COUNTS HAVE NOT BEEN ADJUSTED FOR HAMMER ENERGY	



A3GEO, Inc
1331 Seventh Street, Unit E
Berkeley, CA 94710

BORING NUMBER B1

PAGE 1 OF 1

CLIENT TranSystems Corporation

PROJECT NUMBER 1118-1A

DATE STARTED 12/4/12 COMPLETED 12/4/12

DRILLING CONTRACTOR Northstar Drilling, Inc.

DRILLING METHOD Solid Stem Auger

LOGGED BY DKM CHECKED BY DI

NOTES No ground water encountered

PROJECT NAME South Cove Public Dock and Parking Lot Renovation Project

PROJECT LOCATION Berkeley Marina, Berkeley, CA

GROUND ELEVATION 15.5 ft HOLE SIZE 4.5"

GROUND WATER LEVELS:
AT TIME OF DRILLING ---
AT END OF DRILLING ---
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0									
		CLAYEY GRAVEL (GC) - Gray, medium dense, angular gravel up to 1" in size, with sand and clay, moist - (FILL)							
		SANDY/GRAVELLY LEAN CLAY (CL) - Reddish brown and gray, very stiff, angular gravel, medium to course grained sand, moist - (FILL)	MC	22					
		POORLY GRADED GRAVEL (GP) - Gray, loose to medium dense, concrete debris, some sand, trace clay, moist. (FILL)	SPT	11					
5									

Bottom of borehole at 5.0 feet.

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1331 Seventh Street, Unit E
Berkeley, CA 94710

BORING NUMBER B2

PAGE 1 OF 1

CLIENT TranSystems Corporation

PROJECT NAME South Cove Public Dock and Parking Lot Renovation Project

PROJECT NUMBER 1118-1A

PROJECT LOCATION Berkeley Marina, Berkeley, CA

DATE STARTED 12/4/12 COMPLETED 12/4/12

GROUND ELEVATION 10 ft HOLE SIZE 4.5"

DRILLING CONTRACTOR Northstar Drilling, Inc.

GROUND WATER LEVELS:

DRILLING METHOD Solid Stem Auger

☒ AT TIME OF DRILLING 5.50 ft / Elev 4.50 ft

LOGGED BY DKM CHECKED BY DI

AT END OF DRILLING ---

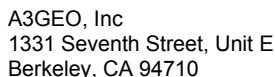
NOTES

AFTER DRILLING ---

GEOTECH BH COLUMN TERM NOTE LEFT ALIGNED - A3GEO DATA TEMPLATE.GDT - 1/7/13 22:27 - A:\A3GEO PROJECTS\1118-1A SOUTH COVE\BORING LOGS_SOUTH_COVE.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0		3.5" Asphalt Concrete Pavement							
		CLAYEY GRAVEL (GC) - Brown and gray, loose to medium dense, angular to sub-rounded well-graded gravel, some fines, with medium to coarse-grained sand, moist - (FILL)	SPT	10					
		- at 3.5': loose, well-graded, clean, angular gravel, trace fines, with coarse-grained sand	SPT	5					
5		☒ - at 6': very loose, wet	SPT	3					- at 5' : Hole caving in, adding bentonite to progress drilling
10		SANDY FAT CLAY (CH) - Reddish brown and dark gray, soft, trace angular gravel, fine to coarse grained sand, wet - (FILL)	MC	3					
		- at 12.5': reddish brown and green, 2" angular sandstone fragment							
15		- at 15': dark gray, with organics, trace tiny white shells, 2" long twig, angular sandstone fragments	SPT	3					

Bottom of borehole at 16.5 feet.



PAGE 1 OF 1

PROJECT NAME South Cove Public Dock and Parking Lot Renovation Project

PROJECT LOCATION Berkeley Marina, Berkeley, CA

GROUND ELEVATION 12 ft **HOLE SIZE** 4.5"

GROUND WATER LEVELS:

 AT TIME OF DRILLING 8.00 ft / Elev 4.00 ft

AT END OF DRILLING ---

AFTER DRILLING ---

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A3GEO, Inc
1331 Seventh Street, Unit E
Berkeley, CA 94710

BORING NUMBER B4

PAGE 1 OF 1

CLIENT TranSystems Corporation
PROJECT NUMBER 1118-1A
DATE STARTED 12/4/12 COMPLETED 12/4/12
DRILLING CONTRACTOR Northstar Drilling, Inc.
DRILLING METHOD Solid Stem Auger
LOGGED BY DKM CHECKED BY DI
NOTES _____

PROJECT NAME South Cove Public Dock and Parking Lot Renovation Project
PROJECT LOCATION Berkeley Marina, Berkeley, CA
GROUND ELEVATION 12.5 ft HOLE SIZE 4.5"
GROUND WATER LEVELS:
▽ AT TIME OF DRILLING 4.50 ft / Elev 8.00 ft
AT END OF DRILLING ---
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	ADJUSTED BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ROCK RECOVERY % (RQD)	OTHER LAB TESTS / NOTES
0									
		CLAYEY GRAVEL (GC) - Brown and gray, medium dense, angular, moist - (FILL)							
		SANDY/GRAVELLY LEAN CLAY (CL) - Reddish brown and gray, stiff, pockets of fat clay, rock fragment 2.5" in size, with foreign debris, moist - (FILL)	MC	11		111	17		LL: 37 PI: 20
		- at 3.5': soft	MC	3					
5		FAT CLAY (CH) - Dark gray, soft, wet							

Bottom of borehole at 5.0 feet.

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B. HILLEBRANDT SOILS TESTING, INC.

29 Sugarloaf Terrace, Alamo, CA 94507 - Tel: (510) 409-2916 - Fax: (925) 891-9267 - Email: soiltesting@aol.com

LAB RESULTS SUMMARY FORM

Project Number: 1118-1A
Requested By: DM

Project Name: South Cove
Request Date: 12/8/12

Results Due By:
Throw Samples Out On:

[illegible]

B. HILLEBRANDT SOILS TESTING, INC.

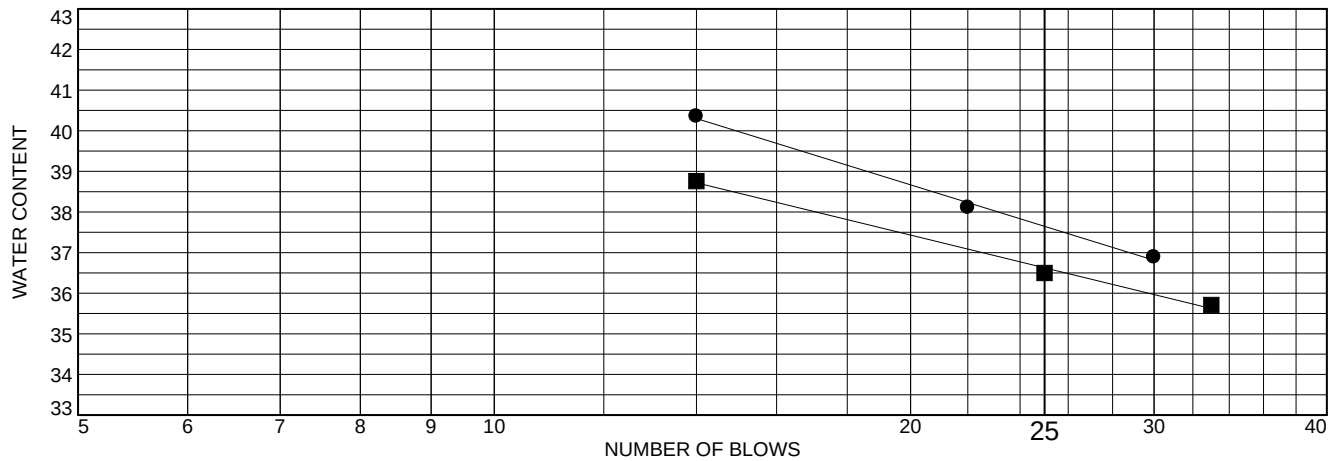
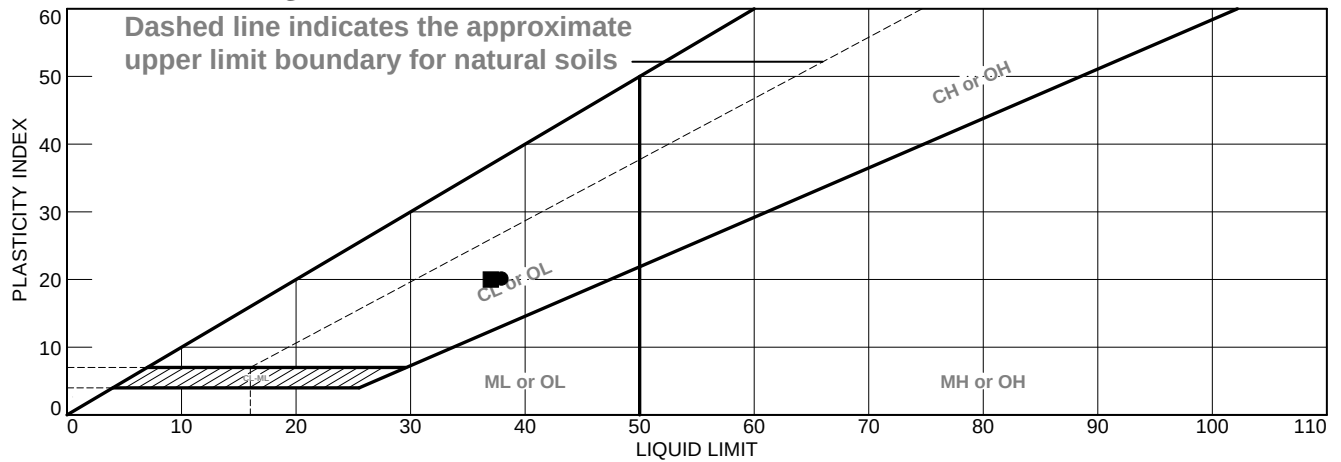
29 Sugarloaf Terrace, Alamo, CA 94507 - Tel: (510) 409-2916 - Fax: (925) 891-9267 - Email: soiltesting@aol.com

MOISTURE CONTENT/DRY DENSITY

Job #: 1118-1A
Job Name: South Cove
Date: 12/8/12
Tested by: Brad Hillebrandt

Additional Tests:	PI	PI				
Boring #:	3	4				
Depth (feet):	2.5	2.0				
Sample Description:	Dark brown gravelly CLAY with sand	Dark yellowish brown gravelly CLAY with sand				
Can #:	335	336				
Wet Sample + can	385.5	388.0				
Dry Sample + can	348.1	337.6				
Weight can	38.4	38.6				
Weight water	37.4	50.4				
Weight Dry Sample	309.7	299				
<u>WATER CONTENT (%)</u>	12.1%	16.9%				
Weight Sample + Liner	938	1193				
Weight Liner	263	258				
Sample Length (Lo)	4.4	6.0				
Multiplication Factor	1.21	1.21				
<u>DRY DENSITY (pcf)</u>	113.4	110.5				

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark brown gravelly CLAY with sand	38	18	20			
■	Dark yellowish brown gravelly CLAY with sand	37	17	20			

Project No. 1118-1A Client: A3Geo

Project: South Cove

● Source of Sample: B3 Depth: 2.5'

■ Source of Sample: B4 Depth: 2.0'

Remarks:

B. HILLEBRANDT SOILS TESTING, INC.
+1 510-409-2816
SoilTesting@aol.com

Figure

Tested By: BH