
**GEOTECHNICAL INVESTIGATION
BLOCKS 33 AND 34 PUBLIC IMPROVEMENTS
MISSION BAY
San Francisco, California**

**Catellus
San Francisco, California**

**1 May 2008
Project No. 3349.01**

Treadwell&Rollo

1 May 2008
Project 3349.01

Mr. Scott Shepard
Catellus
255 Channel Street
San Francisco, California 94158

Subject: Geotechnical Investigation
Blocks 33 and 34 Public Improvements
Mission Bay
San Francisco, California

Dear Mr. Shepard:

Treadwell & Rollo, Inc. is pleased to present our geotechnical investigation report for the proposed Blocks 33 and 34 Public Improvements in Mission Bay, San Francisco, California. The recommendations presented in this report supplement the recommendations presented in our earlier report titled *Revised Geotechnical Recommendations Infrastructure Improvements Mission Bay*, dated 4 April 2001. Copies of this report have been distributed as indicated at the end of the report.


The site is comprised of the north and south sides of 16th Street between Third Street and the proposed Terry Francois Boulevard and Illinois Street between 16th Street and Mariposa Street. The proposed site development will consist of grading, installation of utilities, and streetscape including trees and light poles, and new sidewalks, streets and pavement.

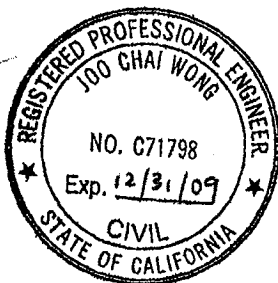
The results of the investigations performed at the site and in the vicinity indicate the site is blanketed by heterogeneous fill, which is approximately 6 to 19 feet thick. Fill in Mission Bay varies in density and typically contains rubble. The fill is underlain by weak, compressible Bay Mud, which is approximately 0 to 16-1/2 feet thick. Medium dense to very dense sand and stiff to very stiff clay is below the Bay Mud. Bedrock is approximately 6 to 45 feet deep.

Our recommendations are based on limited subsurface information from this and previous investigations at the site and in the vicinity. Consequently, variations between the expected and actual soil conditions may be found in localized areas during construction. Additionally, unknown obstructions, such as abandoned pile caps and utilities should also be anticipated. We should be retained to observe grading operations, placement and compaction of utility trench backfill, placement and compaction of structural soil and installation of light pole foundations.

We appreciate the opportunity to assist you with this project. If you have any questions, please call.

Sincerely yours,
TREADWELL & ROLLO, INC.


Joo Chai Wong
Civil Engineer



33490101.LTR


Serena T. Jang
Geotechnical Engineer



ENVIRONMENTAL AND GEOTECHNICAL CONSULTANTS

555 MONTGOMERY STREET, SUITE 1300 SAN FRANCISCO CALIFORNIA 94111 T 415 955 9040 F 415 955 9041 www.treadwellrollo.com

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APPENDIX B – Laboratory Test Results from Previous Investigations

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DISTRIBUTION

**GEOTECHNICAL INVESTIGATION
BLOCKS 33 and 34 PUBLIC IMPROVEMENTS
MISSION BAY
San Francisco, California**

1.0 INTRODUCTION

This report presents the results of our geotechnical investigation of Blocks 33 and 34 Public Improvements project area in Mission Bay. Our services were performed in accordance with our revised proposal dated 2 January 2008. This report supplements the recommendations presented in our report titled *Revised Geotechnical Recommendations Infrastructure Improvements Mission Bay*, dated 4 April 2001, referred to hereafter as the Infrastructure Report.

Our studies are in part based on plan sets, referred to hereafter as the project plans, listed below:

- "16th Street/Illinois Street, Public Improvements, Mission Bay, San Francisco, California, 90% Submittal," by Freyer & Laureta, dated 14 February 2008.

The site location is shown on Figure 1. Based on the project plans, the site is comprised of the north and south sides of 16th Street between Third Street and the proposed Terry Francois Boulevard and Illinois Street between 16th Street and Mariposa Street, as shown on Figure 2. We also understand that temporary pavement with less than a 5-year design life will be constructed at the intersection of 16th Street and Terry Francois Boulevard, as shown on Figure 2. Geotechnical aspects of the project include placement and compaction of fill and structural soil, backfill of utility trenches, installation of light poles, and preparation of new sidewalks and roadway subgrade, with the exception of the sidewalks adjacent to Block X4 on 16th Street and Illinois Street, which are under a separate project (as shown on Sheets C3.1 through C3.4 on the project plans).

2.0 SCOPE OF SERVICES

The purposes of our investigation were to investigate the fill and Bay Mud and to evaluate settlement and seismic hazards at the site as they relate to the infrastructure improvements. To supplement existing subsurface information, we drilled two test borings and performed laboratory tests on selected soil samples recovered from the test borings.

3.0 FIELD EXPLORATION AND LABORATORY TESTING

We began our investigation by reviewing the results of previous studies at and in the vicinity of the site. Treadwell & Rollo (T&R) has performed numerous investigations in the vicinity. In addition, we have developed a database of boring logs from various sources for the Mission Bay area in our files. Locations of test borings and cone penetration tests (CPTs) performed during previous investigations in the site vicinity are shown on Figure 2. The boring logs and laboratory test results for borings that were previously drilled have been included in Appendix A. Laboratory test results from these borings are included in Appendix B. Many of the logs of the boring in our database are generally not of sufficient quality to provide quantitative engineering information, but they provide qualitative data for use in our subsurface evaluation. Logs from previous investigations by others are not presented.

To supplement the subsurface data available to us, we drilled two test borings as part of our current investigation. The approximate locations of the borings are shown on Figure 2. The logs are presented in Appendix C.

Prior to performing the field investigation, we:

- prepared a health and safety plan;
- obtained a soil boring permit from the Monitoring Wells Section of the San Francisco Department of Public Health (SFDPH);
- notified Underground Service Alert; and
- cleared the boring locations of underground utilities using an independent utility locating contractor.

3.1 Test Borings

On 25 January 2008, two test borings, designated as B34-1 and BP24-1, were drilled using a truck-mounted, rotary-wash drill rig provided by Pitcher Drilling Company. The test borings were drilled to total depths of 48.0 and 77.5 feet below the existing ground surface. Our field engineers logged the boring and obtained samples of the material encountered for visual classification and laboratory testing. The borings were backfilled with grout consisting of cement, bentonite and water under the observation of a SFDPH inspector.

The logs of the borings are presented on Figures C-1 and C-2 in Appendix C. The soil is classified in accordance with the chart shown on Figure C-3.

Soil samples were obtained using three different types of samplers: two split-barrel samplers and a thin-walled sampler. The sampler types are as follows:

- Sprague and Henwood (S&H) split-barrel sampler with a 3.0-inch outside diameter and 2.5-inch-inside diameter, lined with brass tubes with an inside diameter of 2.43 inches
- Standard Penetration Test (SPT) split-barrel sampler sampler with a 2.0-inch-outside and 1.5-inch-inside diameter, without liners
- Shelby tubes with a 3.0-inch outside diameter and 2.875-inch inside diameter

The sampler types were chosen on the basis of soil type and desired sample quality for laboratory testing. In general, the S&H sampler was used to obtain samples in medium stiff to very stiff cohesive soil and the SPT sampler was used to evaluate the density of sandy soil. The Shelby tubes were used to obtain relatively undisturbed samples of soft to stiff cohesive soil.

The S&H and SPT samplers were driven with an automatic trip system and a 140-pound safety hammer falling about 30 inches. Where the S&H sampler was used, the blow counts required to drive the sampler the final 12 inches of an 18-inch drive were corrected to approximate SPT blow counts by multiplying by a factor of 0.7, and the unconverted and converted SPT N-values are shown on the boring logs. Where the SPT sampler was used, the blow counts required to drive the sampler the final 12 inches of an 18-inch drive were corrected to approximate SPT blow counts by multiplying by a factor of 1.2, and the unconverted and converted SPT N-values are shown on the boring logs. Hydraulic pressure was used to advance the 36-inch-long Shelby tubes into the soil and the pressure required is shown on the logs, measured in pounds per square inch (psi).

3.2 Laboratory Testing

The samples recovered from the field exploration program were examined for soil classification, and representative samples were selected for laboratory testing. Our laboratory testing program was designed to correlate soil properties and to evaluate engineering properties of the soil at the site. Samples were tested to measure moisture content, percent fines, Atterberg limits, and consolidation parameters. The test results are presented on the boring logs and in Appendix D.

Additional laboratory testing was performed to evaluate the corrosivity of the various soil types, as corrosive soil can adversely affect underground utilities and foundation elements. The results of the corrosivity analyses are presented in Appendix E.

4.0 SITE CONDITIONS

We evaluated site conditions based on our knowledge of the site history and the results of this and previous investigations in the area. Locations of test borings and cone penetration tests performed during this and previous investigations at the site and in the vicinity are shown on Figure 2.

Mission Bay was originally a shallow bay. It was reclaimed during the late 1800s and early 1900s using excavated soil and rock from other parts of San Francisco. Our studies indicate that the project area was reclaimed around 1884.

Between 1913 and 1969, crude oil storage, stables, garage, warehouse, truck, auto parking were present on site and also used for ship-related activities. Between 1975 and 1985, the site was primarily used for shipping and receiving (ESA, 1990).

In 2005, Block X4 was remediated. Site remediation included excavation and off-site disposal of selected soil within the parcel footprint and backfill of the excavation with engineered fill. Borings performed by T&R (designated BX4-1 through BX4-9) were drilled after the remediation work was completed.

4.1 Existing Conditions

Based on existing topographic plans, the site is relatively flat, ranging from approximately Elevations 100 feet to 103 feet¹. Currently, the western portion of 16th Street is a paved roadway and the eastern portion of 16th Street is used for construction staging for the construction of Block X4. Illinois Street is a paved roadway with two rails in the central part of the roadway, with power and light poles, underground utilities, and sidewalks.

¹ Elevations are based on the San Francisco City Datum plus 100 feet.

4.2 Subsurface Conditions

The results of our study of the area indicate the site, where explored, is blanketed by heterogeneous fill which ranges from approximately 6 to 19 feet in thickness. The existing fill in Mission Bay varies in density and typically contains rubble. It consists predominately of very loose to dense sand with varying amounts of clay, silt and gravel and contains organics, bricks, and wood fragments. Large boulders, rubble and old foundations have been encountered within the fill in the site vicinity. Layers of potentially liquefiable soil were encountered in all the borings and CPTs; these layers range from approximately 4-1/2 to 12-1/2 feet thick.

A soft to medium stiff marine clay deposit, known locally as Bay Mud, is present beneath the fill. The Bay Mud thickness ranges approximately between 0 and 16-1/2 feet and generally becomes thicker to the west along 16th Street and to the south along Illinois Street. The Bay Mud was not encountered in borings BX4-1, BX4-2, BX4-4, BX4-9, and BP23-1. Laboratory test results from this and nearby investigations indicate the Bay Mud is overconsolidated² with consolidation ratios ranging from 1.3 to 1.7. The Bay Mud has compression ratio of 0.22 to 0.41 and has a coefficient of consolidation, c_v , of 4 to 81 feet squared per year (ft^2/yr) along the virgin compression curve. The coefficient of consolidation is a measure of the time rate of consolidation settlement; the higher the value, the faster the soil will consolidate.

The Bay Mud is generally underlain by stiff to hard clay and sandy clay, and dense to very dense clayey sand and sand with clay. Bedrock was encountered from a depth of 6 feet in Boring BX4-4 (Elevation 89 feet) to a depth of 45 feet in Boring 127 (Elevation 55 feet).

Groundwater was encountered in several borings. Measured groundwater ranges from Elevation 90-1/2 feet (2-1/2 feet below ground surface in boring B32-5) to Elevation 95-1/2 feet (6-1/2 feet below ground surface in boring B34-1).

5.0 GEOLOGY AND SEISMICITY

Our evaluation of the geology and seismicity of the area is based on our review of published reports and information in our files from other sites in the vicinity.

² An overconsolidated clay has experienced a pressure greater than its current load.

5.1 Regional Geology

The site is in the northeast portion of the San Francisco peninsula, which lies within the Coast Ranges geomorphic province. The northwesterly trend of ridges and valleys characteristic of the Coast Ranges is obscured in San Francisco, except for features such as Russian Hill, Telegraph Hill, Hunters Point, and Potrero Hill. San Francisco Bay and the northern portion of the peninsula lie within a down-dropped crustal block bound by the East Bay Hills and the Santa Cruz Mountains. The San Francisco Bay depression resulted from interaction between the major faults of the San Andreas fault zone, particularly the Hayward and San Andreas faults east and west of the bay, respectively (Atwater, 1979).

San Francisco's topography is characterized by relatively rugged hills formed by Jurassic- to Cretaceous-aged bedrock (Schlocker, 1974). The bedrock consists of highly deformed and fractured sedimentary rocks of the Franciscan complex. The present topography resulted mainly from east-west compression of coastal California during the late Pliocene and Pleistocene epochs (Norris and Webb, 1990).

The low-lying areas of the San Francisco peninsula are underlain by Quaternary sediments deposited on eroded Franciscan bedrock. Oscillating late-Quaternary sea levels that resulted from the advance and retreat of glaciers worldwide influenced sediment deposition within the pre-historic bay margin. The resulting sequence of alternating estuarine and terrestrial sediments corresponds to high and low sea-level stands, respectively. In contrast, Quaternary sediments in the plains landward of the bay are predominantly terrestrial.

By late Pleistocene time, the high sea level associated with the Sangamon interglacial (about 125,000 years ago) resulted in deposition of the Yerba Buena Mud (Sloan, 1992). Also known locally as "Old Bay Clay," the Yerba Buena Mud was deposited in an estuarine environment similar in character and extent to the present bay. Sea level lowering associated with the onset of Wisconsin glaciation exposed the bay floor and resulted in terrestrial sedimentation, such as the Colma formation, on the Yerba Buena Mud. Sea level rose again starting roughly 20,000 years ago, fed by the melting of Wisconsin-age glaciers. The sea re-entered the Golden Gate about 10,000 years ago (Atwater, 1979). Inundation of the present bay resulted in deposition of estuarine sediments, called Bay Mud, which continue to accumulate in the bay.

Historical development of the San Francisco Bay area resulted in placement of artificial fill material over substantial portions of modern estuaries, marshlands, tributaries, and creek beds in an effort to reclaim land (Nichols and Wright, 1971).

5.2 Regional Seismicity

The major active faults in the area are the San Andreas, San Gregorio, Hayward, and Calaveras Faults. These and other faults of the region are shown on Figure 3. For the active faults within approximately 50 kilometers, the distance from the site and estimated maximum Moment magnitude³ [Working Group on California Earthquake Probabilities (WGCEP) (2003) and Cao et al. (2003)] are summarized in Table 1.

TABLE 1
Regional Faults and Seismicity

Fault Segment	Approx. Distance from fault (km)	Direction from Site	Mean Characteristic Moment Magnitude
San Andreas – 1906 Rupture	12.4	West	7.90
San Andreas – Peninsula	12.4	West	7.15
San Andreas – North Coast South	17	West	7.45
North Hayward	17	East	6.49
Total Hayward	17	East	6.91
Total Hayward-Rodgers Creek	17	East	7.26
South Hayward	17	East	6.67
Northern San Gregorio	19	West	7.23
Total San Gregorio	19	West	7.44
Mt. Diablo – MTD	33	East	6.65
Total Calaveras	34	East	6.93
Rodgers Creek	36	North	6.98
Concord/Green Valley	38	East	6.71
Monte Vista-Shannon	39	Southeast	6.80
Point Reyes	44	West	6.80
West Napa	46	Northeast	6.50
Greenville	51	East	6.94

Figure 3 also shows the earthquake epicenters for events with magnitude greater than 5.0 from January 1800 through January 1996. Since 1800, four major earthquakes have been recorded on the

³ Moment magnitude is an energy-based scale and provides a physically meaningful measure of the size of a faulting event. Moment magnitude is directly related to average slip and fault rupture area.

San Andreas Fault. In 1836 an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) scale (Figure 4) occurred east of Monterey Bay on the San Andreas Fault (Toppozada and Borchardt 1998). The estimated Moment magnitude, M_w , for this earthquake is about 6.25. In 1838, an earthquake occurred with an estimated intensity of about VIII-IX (MM), corresponding to a M_w of about 7.5. The San Francisco Earthquake of 1906 caused the most significant damage in the history of the Bay Area in terms of loss of lives and property damage. This earthquake created a surface rupture along the San Andreas Fault from Shelter Cove to San Juan Bautista approximately 470 kilometers in length. It had a maximum intensity of XI (MM), a M_w of about 7.9, and was felt 560 kilometers away in Oregon, Nevada, and Los Angeles. The most recent earthquake to affect the Bay Area was the Loma Prieta Earthquake of 17 October 1989, in the Santa Cruz Mountains with a M_w of 6.9, approximately 93 km from the site.

In 1868 an earthquake with an estimated maximum intensity of X on the MM scale occurred on the southern segment (between San Leandro and Fremont) of the Hayward Fault. The estimated M_w for the earthquake is 7.0. In 1861, an earthquake of unknown magnitude (probably a M_w of about 6.5) was reported on the Calaveras Fault. The most recent significant earthquake on this fault was the 1984 Morgan Hill earthquake ($M_w = 6.2$).

In 2003 the Working Group on California Earthquake Probabilities (WGCEP 2003) at the U.S. Geologic Survey (USGS) predicted a 62 percent probability of a magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area by the year 2031. More specific estimates of the probabilities for different faults in the Bay Area are presented in Table 2.

TABLE 2
WGCEP (2003) Estimates of 30-Year Probability (2002 to 2031)
of a Magnitude 6.7 or Greater Earthquake

Fault	Probability (percent)
Hayward-Rodgers Creek	27
San Andreas	21
Calaveras	11
San Gregorio	10
Concord-Green Valley	4
Greenville	3

6.0 DISCUSSION

On the basis of our investigation and our recent experience during building and infrastructure development elsewhere in Mission Bay, we conclude the project is feasible from a geotechnical standpoint. Geotechnical issues of concern include:

- static and seismically-induced settlement
- potential for liquefaction
- soil corrosivity
- groundwater
- construction considerations.

6.1 Geologic Hazards

During a major earthquake, strong to violent ground shaking is expected to occur at the project site. Strong ground shaking during an earthquake can result in ground failure such as that associated with soil liquefaction⁴, lateral spreading⁵, seismic densification⁶, landsliding, or can cause a tsunami. Each of these conditions has been evaluated based on our literature review, field investigation, and analysis, and is discussed in this section.

6.1.1 Liquefaction and Associated Hazards

When a saturated soil with little to no cohesion liquefies during a major earthquake, it experiences a temporary loss of shear strength as a result of a transient rise in excess pore water pressure generated by strong ground motion. Flow failure, lateral spreading, differential settlement, loss of bearing, ground fissures, and sand boils are evidence of excess pore pressure generation and liquefaction. The site is within a designated liquefaction hazard zone as designated by the California Geological Survey (CGS)

⁴ Liquefaction is a transformation of soil from a solid to a liquefied state during which saturated soil temporarily loses strength resulting from the buildup of excess pore water pressure, especially during earthquake-induced cyclic loading. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits.

⁵ Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces.

⁶ Seismic densification is a phenomenon in which non-saturated, cohesionless soil is densified by earthquake vibrations, causing ground-surface settlement.

seismic hazard zone map for the area titled *State of California Seismic Hazard Zones, City and County of San Francisco, Official Map*, dated 17 November 2001. However, there was no documented observation of liquefaction at this site during the 1906 Earthquake or the 1989 Loma Prieta Earthquake. [Youd and Hoose (1978) and Benuska (1990)].

The CGS has provided recommendations for the content of site investigation reports within seismic hazard zones in Special Publication 117 (SP 117) titled *Guidelines for Evaluating and Mitigating Seismic Hazard Zones in California*, dated 13 March 1997. Our evaluation of site seismic hazards was performed in general accordance with these guidelines.

Borings BP22-5, BP23-1, B32-5, B34-1, BP24-1, and CPT C31-1 encountered a relatively loose to medium dense sand and gravel layer with varying silt and clay content just above or below the water table, with thicknesses ranging from 4-1/2 to 12-1/2 feet. This soil could liquefy in a major earthquake. Borings BX4-1 through BX4-9 were not relied upon in the liquefaction study because they were drilled after the remediation work on Block X4 and do not represent conditions within this project site. Using the Tokimatsu and Seed (1984) method for evaluating earthquake-induced liquefaction settlement, we estimate settlement of approximately 1-1/2 to 4-1/2 inches may occur depending upon the layer thickness. Liquefaction-induced settlement may cause damage to pavements, sidewalks, and utilities.

Considering the shallow groundwater table and the relatively shallow liquefiable deposits, we conclude ground failure, such as lurch cracking and/or the development of sand boils, could occur. The ground-surface settlement will likely be larger than estimated (1-1/2 to 4-1/2 inches) in areas where sand boils and associated ground failure occur; however, the additional settlement is not predictable.

6.1.2 Lateral Spreading

Lateral spreading is a phenomenon in which a surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. The surficial blocks are transported downslope or in the direction a free face, such as a channel, by earthquake and gravitational forces. Lateral spreading is generally the most pervasive and damaging type of liquefaction-induced ground failure generated by earthquakes.

According to Youd, Hansen and Barlett (1999), for significant lateral spreading displacements to occur, the soils should consist of saturated cohesionless sandy sediments with $(N_1)_{60}$ less than 15, where liquefaction of the soils are likely based on standard liquefaction analysis. Some of the potentially

liquefiable soils underlying the project site were evaluated to consist of gravels with varying silt and clay. This material does not fall within the parameters applicable to the Youd, Hansen and Bartlett lateral displacement model. The remaining potentially liquefiable soil consists of sands with varying fines. However, the potentially liquefiable sand layers do not appear to be continuous. Therefore, we conclude large-scale lateral spreading is unlikely. However, localized lateral spreading may occur in some areas with horizontal movements in the order of one to two feet.

The project site should not be subject to landslide or erosion. No springs or seepages were observed on site.

6.1.3 Seismic Densification

During strong ground shaking in loose, clean granular deposits above the water table, seismic densification (also referred to as cyclic densification and differential compaction) can also occur. Their development could result in ground surface settlement. 6-1/2 feet of very loose to medium dense sand was encountered above the groundwater table in boring B34-1. This layer may densify in a major earthquake. Using the Tokimatsu and Seed (1984) method for evaluating seismically induced settlement in dry sand, we estimate settlement should be approximately 3-1/2 inches. Settlement will be abrupt between areas that are susceptible to seismic densification and areas that are not.

6.1.4 Tsunami

According to published data (URS/Blume, 1974) the maximum run up (tsunami wave) at the Presidio occurred after the 1964 Alaskan earthquake. The wave measured 7.5 feet at the Golden Gate; no damage was reported along the San Francisco shoreline. The United States Geologic Survey (USGS) estimates the maximum probable tsunami wave run up at the Golden Gate will be 20 feet (Ritter and Dupre, 1972). If the maximum probable tsunami occurs, the site is within an area of potential tsunami inundation. In the China Basin Channel, the run up would be reduced to less than 10 feet (URS/Blume 1974).

6.2 Consolidation Settlement

The results of consolidation testing indicate most of the Bay Mud is overconsolidated; therefore, primary settlement is complete under the weight of the existing fill and secondary compression is occurring.

Placement of new fill bearing in the fill will cause a new cycle of primary consolidation. Again, the magnitude of settlement will depend on the amount of new fill, the present grades, and the variable existing fill and Bay Mud thickness.

Our settlement analysis was based on the original and proposed grades as shown on the project plans. At each settlement point, the thickness of existing fill and Bay Mud was established based on this and previous investigations. We modeled the fill history, proposed fill thickness, and consolidation properties of the Bay Mud using the TCON⁷ computer program to predict the amount of settlement that should occur in 50 years. The approximate location of our settlement points is shown on Figure 2 and our estimates of consolidation settlement are presented in Table 3, which is attached. The stationing reference presented in the table is in accordance with the project plans. These predicted settlements should be used to evaluate future changes in grade and settlement of utilities. If any changes are made to the grades as shown on the project plans, we will need to re-evaluate our settlement estimates.

As discussed previously, we estimate 1-1/2 to 3-1/2 inches of liquefaction-induced settlement and approximately 3-1/2 inches of seismic densification may occur during a major earthquake. This settlement is in addition to the predicted consolidation settlement. Therefore, static and seismically-induced settlement will affect various aspects of the planned development, including utilities, building entrances, and sidewalks. Where it is desirable and practical to limit damage to utilities resulting from an earthquake, the utilities should also be designed to tolerate the predicted seismic movements.

6.3 Soil Corrosivity

CERCO Analytical performed tests on two soil samples to evaluate corrosion potential to buried metals and concrete. The results of the tests and a brief evaluation are presented in Appendix E.

The soil samples tested classified the fill as corrosive. Therefore, precautions should be taken to mitigate the effects of corrosion for buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron. Furthermore, all buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion. A corrosion consultant should be consulted, as needed, to provide recommendations and details for corrosion protection.

⁷ TCON is a computer program for computing consolidation and time rates of settlements caused by surface loadings.

6.4 Groundwater

Groundwater was encountered in several borings from this and previous investigations. Measured groundwater ranged from Elevation 90-1/2 feet (2-1/2 feet below ground surface in boring B32-5) to Elevation 95-1/2 feet (6-1/2 feet below ground surface in boring B34-1). Considering the drilling method which in most cases involved the addition of fluids, and method and timing of groundwater measurement, we believe some of these reported groundwater elevations do not represent stabilized groundwater levels. However, for engineering analyses, we recommend a design groundwater elevation of 96 feet be used.

6.5 Construction Considerations

The soil at the site consists mainly of sand, gravel and clay that can be excavated with conventional earth-moving equipment such as loaders and backhoes. The fill is easily remolded and loses strength when wet. Therefore, site preparation and grading may be difficult if performed during the rainy season. In addition, heavy vibratory equipment should not be used during site preparation and compaction; vibrators will likely cause a capillary rise, creating a wet subgrade.

Brick, concrete, and other building rubble may be encountered in the fill. Handling and disposal of the fill material should be performed in accordance with a site mitigation plan that includes health and safety criteria.

We anticipate construction dewatering will only be required for excavations extending more than four feet below final site grades, such as excavations for gravity-flow utility lines. From our experience on other projects in Mission Bay, we believe trenches can likely be locally dewatered using sumps. Prior to construction, the groundwater should be tested to determine if it can be discharged directly to the storm drain system or if it must be treated on-site prior to discharge.

7.0 RECOMMENDATIONS

From a geotechnical standpoint, we conclude the site can be developed as planned, provided the improvements can tolerate the predicted settlement and the recommendations presented in this section of the report are incorporated into the design and contract documents. The applicable recommendations presented in our 4 April 2001 report should be incorporated into the project plans and specifications, except as recommended in the following sections.

7.1 New Utilities

Site preparation, fill placement, stabilization of wet and/or soft subgrade and backfilling of utility trenches should be performed in accordance with the recommendations provided in our 4 April 2001 report.

Where encountered, all pile caps and footings should be completely removed beneath new utilities, pavements, sidewalks, and landscaped areas. In general, single piles should be removed to a depth of at least four feet below new improvements and/or utilities and pile groups should be removed at least eight feet below new improvements and/or utilities, or to the Bay Mud, whichever is shallower. The geotechnical engineer may vary the depth of pile removal based upon site specific conditions.

Utilities should be designed to accommodate the predicted settlement throughout the project site, as well as differential settlement where they connect to new and existing structures, where they cross over pile-supported structures, and where they cross over abandoned piles.

7.2 Crushed Rock

Where crushed rock is used as backfill, bedding, cover and/or stabilization material, the material should be placed in eight-inch loose lifts and mechanically densified or tamped into place. All open graded rock should be wrapped with filter fabric.

7.3 Pavements

Currently, the City and County of San Francisco (CCSF) requires city streets to consist of concrete with an asphalt overlay. Concrete pavement is likely to respond to surface settlement in a rigid manner, with displacement strain concentrated at joints or cracks between concrete elements. Asphalt pavement, with a constant more flexible section, can respond to surface settlement with more gradual displacement and less concentrated material strain. The asphalt pavement, better suited to distributing settlement related strain, is less likely to crack in response to long term settlement characteristics of the site. Therefore we recommend all private streets be constructed using a flexible pavement section. In addition, we recommend CCSF considers substituting its standard section with an equivalent street section of aggregate base and asphalt concrete.

Flexible pavements should be designed as recommended in Section 5.8.1 Flexible Pavements of our 4 April 2001 report. Aggregate base should conform to Section 26-1.02A of the current Caltrans Standard Specifications. All aggregate base should be compacted to at least 95 percent relative compaction.

Where rigid pavement is required for loading and service areas, we recommend six inches of concrete for medium traffic and eight inches of concrete for heavy traffic. Loading and service areas should be underlain by six inches of Class 2 aggregate base compacted to 95 percent relative compaction.

7.4 Acceptable Backfill

In accordance with the City and County of San Francisco Standard Specifications, acceptable backfill material can include lumps, ballast, rocks and broken concrete provided they measure three inches or less in greatest dimensions. Pieces that measure six inches or less in greatest dimension may also be incorporated into the fill provided they are satisfactorily distributed in earth or other fine materials, and are not placed within three feet of finished grade or subgrade. However, rocks, broken concrete or other solid materials, larger than four inches in greatest dimension, should not be placed in backfill or embankment areas where piles are to be installed or driven.

8.0 CONSTRUCTION MONITORING

We should be retained to review final grading and improvement plans. During construction, we should observe site preparation, excavation, compaction of fill and backfill and mat subgrade. These observations will allow us to compare actual with anticipated soil conditions and to check that the contractor's work conforms with the geotechnical aspects of the plans and specifications.

9.0 LIMITATIONS

The conclusions and recommendations presented in this report result from limited engineering studies based on our interpretation of the existing geotechnical conditions and available subsurface data. Actual subsurface conditions may vary. If any variations or unforeseen conditions are encountered during construction, or if the proposed construction will differ from that which is described in this report, Treadwell & Rollo, Inc. should be notified so that supplemental recommendations can be made.

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TABLES

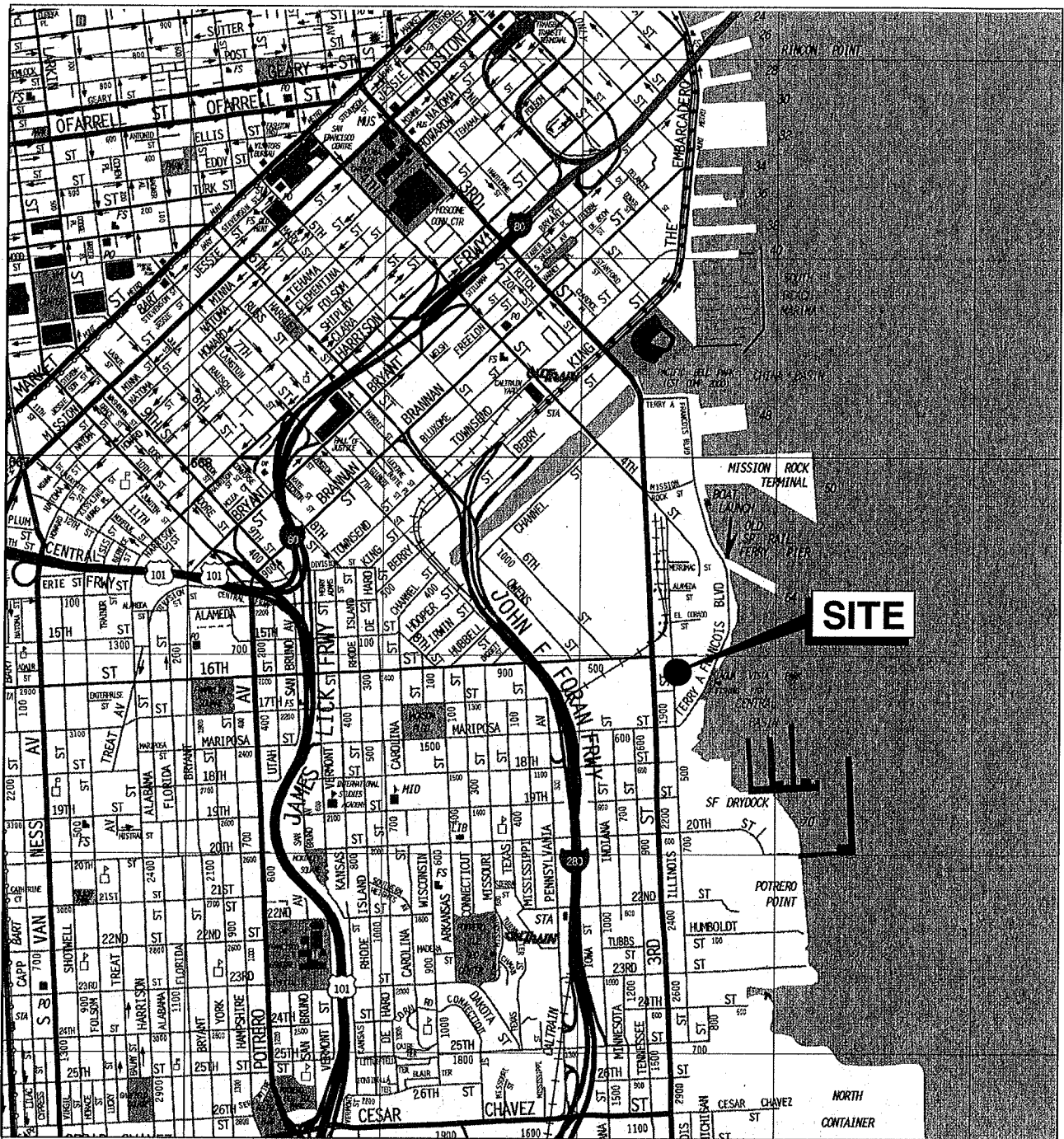
TABLE 3
Estimated 50-Year Elevations
Blocks 33-34 Public Improvements, Mission Bay
San Francisco, California
Project No. 3349.01

T&R Point ¹	Street Name	Station	Approximate Year Fill Placed ²	Thickness ³		Elevation ⁴							
				Existing Fill (feet)	Existing Bay Mud (feet)	1997 Grade ⁵ (feet)	2006 Existing Grade ⁶ (feet)	Proposed Grade ⁷ (feet)	Final Grade in (feet) ⁸				
									1 year	3 years	5 years	10 years	50 years
SX-1	16th Street	0+69	1884	18	12	102.8	102.1	102.3	102.3	102.3	102.3	102.3	102.3
SX-2	16th Street	1+18	1884	16	9	101.8	101.8	103.8	103.7	103.7	103.7	103.7	103.7
SX-3	16th Street	2+38	1884	15	3	101.3	101.3	101.0	101.0	101.0	101.0	101.0	101.0
SX-4	16th Street	2+80	1884	15	3	101.3	101.1	101.3	101.3	101.3	101.3	101.3	101.3
SX-5	16th Street	3+99	1884	11	3	100.1	100.4	101.1	101.1	101.1	101.1	101.1	101.1
SX-6	16th Street	4+99	1884	11	3	100.2	101.1	101.1	101.1	101.1	101.1	101.1	101.1
SX-7	16th Street	5+66	1884	11	3	100.2	101.7	101.1	101.1	101.1	101.1	101.1	101.1
SX-8	16th Street	6+74	1884	11	1	101.1	101.5	100.7	100.7	100.7	100.7	100.7	100.7
SX-9	16th Street	8+00	1884	20	1	100.6	101.0	100.7	100.7	100.7	100.7	100.7	100.7
ILL-1	Illinois Street	0+93	1884	17	4	101.1	101.3	101.1	101.1	101.1	101.1	101.1	101.1
ILL-2	Illinois Street	1+96	1884	15	3	100.7	101.2	100.9	100.9	100.9	100.9	100.9	100.9
ILL-3	Illinois Street	3+10	1884	9	1	100.4	100.6	100.9	100.9	100.9	100.9	100.9	100.9
ILL-4	Illinois Street	4+10	1884	12	0	100.4	100.5	100.9	100.9	100.9	100.9	100.9	100.9
ILL-5	Illinois Street	5+30	1884	17	0	100.4	100.2	100.5	100.5	100.5	100.5	100.5	100.5
ILL-6	Illinois Street	6+19	1884	19	8	100.3	100.2	100.8	100.8	100.8	100.8	100.8	100.8
ILL-7	Illinois Street	7+11	1884	17	12	100.4	100.3	100.8	100.8	100.8	100.8	100.8	100.8
ILL-8	Illinois Street	8+08	1884	16	17	100.6	100.5	100.7	100.7	100.7	100.7	100.7	100.7
ILL-9	Illinois Street	8+88	1884	16	17	100.6	100.7	100.7	100.7	100.7	100.7	100.7	100.7

Notes:

1. Refer to Figure 2 - Site Plan, prepared by Treadwell & Rollo, Inc. for settlement point locations.
2. Mission Bay Infrastructure, Boring Location Plan with Fill Placement History, Project No. 1273-004, Figure 3, Trans Pacific Geotechnical Consultants, Inc., dated 7 July 1993.
3. Based on investigations by Treadwell & Rollo and others within site and site vicinity. Thickness estimated to nearest one foot.
4. All elevations reference San Francisco City Datum plus 100 feet.
5. "1997 Grade" obtained from 1997 Mission Bay Topographic Map by Towill, Inc.
6. The "2006 Existing Grade" are obtained from the existing grades shown on Sheets C3.1 through C3.4 of the project drawings dated 14 February 2008.
7. The proposed grade is estimated from the elevations of top of curb, as shown on Sheets C3.1 through C3.4 of the project drawings.
8. Does not include seismically-induced settlement or secondary compression.

FIGURES



Base map: Google Map, 2008



0 1/4 1/2 Mile
Approximate scale

BLOCKS 33-34 PUBLIC IMPROVEMENTS
MISSION BAY
San Francisco, California

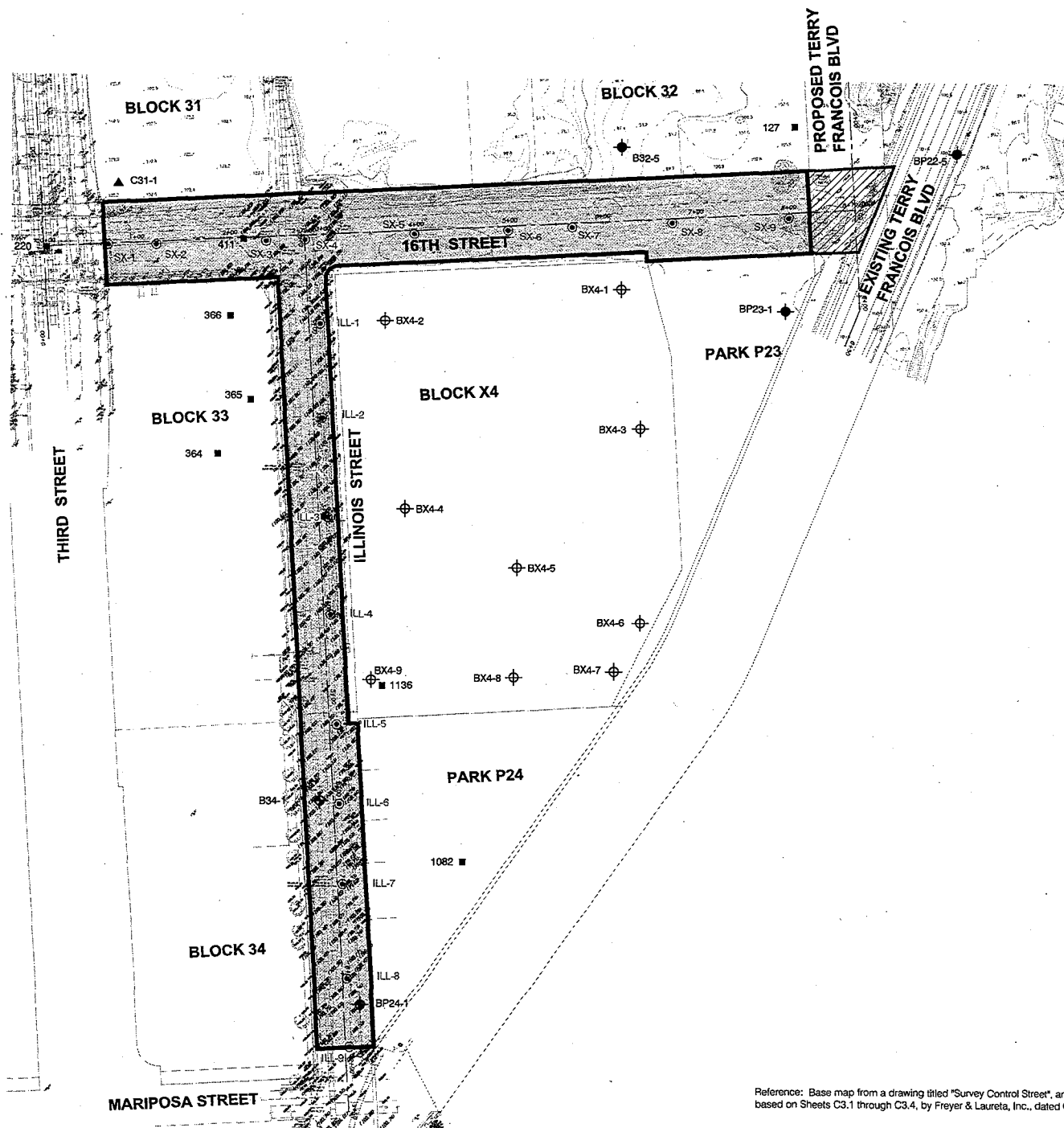
Treadwell & Rollo

SITE LOCATION MAP

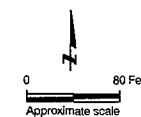
Date 04/14/08

Project No. 3349.01

Figure 1



- EXPLANATION**
- BP22-5 ◆ Approximate location of boring by Treadwell & Rollo, Inc., for previous investigation
 - BX4-1 ◆ Approximate location of previous boring by Treadwell & Rollo, Inc., for others (boring logs not included)
 - B34-1 ◆ Approximate location of boring by Treadwell & Rollo, Inc., January 2008
 - C31-1 ▲ Approximate location of cone penetration test by Treadwell & Rollo, Inc., January 2008
 - 366 ■ Borings by others (database designation, boring logs not included)
 - ILL-1 ⊕ Settlement Point
 - Approximate project limits
 - Approximate area of temporary pavement



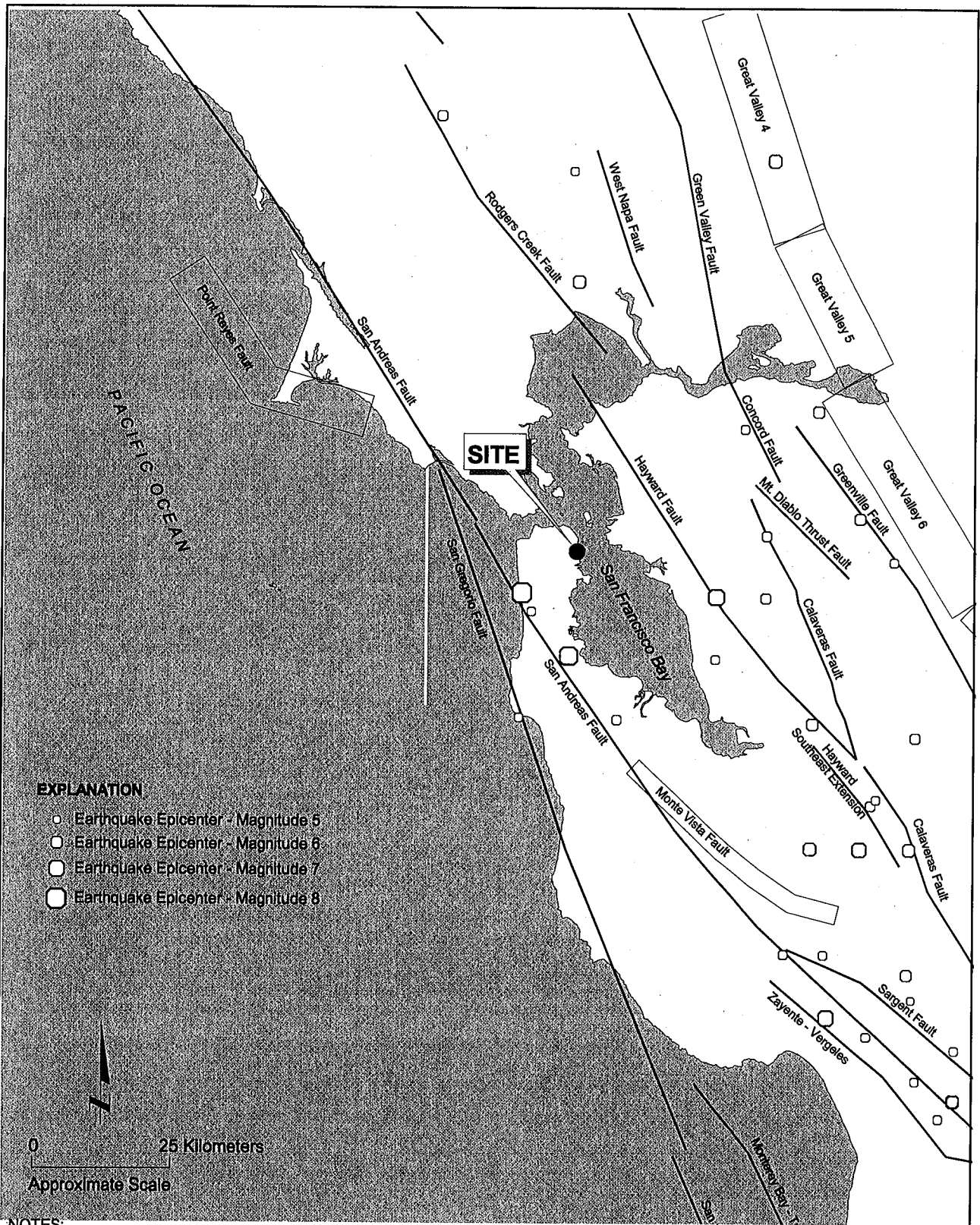
Reference: Base map from a drawing titled "Survey Control Street", and project limits based on Sheets C3.1 through C3.4, by Freyer & Laureta, Inc., dated 02/14/08.

BLOCKS 33-34 PUBLIC IMPROVEMENTS
MISSION BAY
San Francisco, California

SITE PLAN

Date 04/30/08 | Project No. 3349.01 | Figure 2

Treadwell & Rollo



BLOCKS 33-34 PUBLIC IMPROVEMENTS
MISSION BAY
 San Francisco, California

Treadwell & Rolb

**MAP OF MAJOR FAULTS AND
 EARTHQUAKE EPICENTERS IN
 THE SAN FRANCISCO BAY AREA**

Date: 03/18/08 Project No. 3349.01 Figure 3

- I Not felt by people, except under especially favorable circumstances. However, dizziness or nausea may be experienced.**
Sometimes birds and animals are uneasy or disturbed. Trees, structures, liquids, bodies of water may sway gently, and doors may swing very slowly.
- II Felt indoors by a few people, especially on upper floors of multi-story buildings, and by sensitive or nervous persons.**
As in Grade I, birds and animals are disturbed, and trees, structures, liquids and bodies of water may sway. Hanging objects swing, especially if they are delicately suspended.
- III Felt indoors by several people, usually as a rapid vibration that may not be recognized as an earthquake at first. Vibration is similar to that of a light, or lightly loaded trucks, or heavy trucks some distance away. Duration may be estimated in some cases.**
Movements may be appreciable on upper levels of tall structures. Standing motor cars may rock slightly.
- IV Felt indoors by many, outdoors by a few. Awakens a few individuals, particularly light sleepers, but frightens no one except those apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like a heavy body striking building, or the falling of heavy objects inside.**
Dishes, windows and doors rattle; glassware and crockery clink and clash. Walls and house frames creak, especially if intensity is in the upper range of this grade. Hanging objects often swing. Liquids in open vessels are disturbed slightly. Stationary automobiles rock noticeably.
- V Felt indoors by practically everyone, outdoors by most people. Direction can often be estimated by those outdoors. Awakens many, or most sleepers. Frightens a few people, with slight excitement; some persons run outdoors.**
Buildings tremble throughout. Dishes and glassware break to some extent. Windows crack in some cases, but not generally. Vases and small or unstable objects overturn in many instances, and a few fall. Hanging objects and doors swing generally or considerably. Pictures knock against walls, or swing out of place. Doors and shutters open or close abruptly. Pendulum clocks stop, or run fast or slow. Small objects move, and furnishings may shift to a slight extent. Small amounts of liquids spill from well-filled open containers. Trees and bushes shake slightly.
- VI Felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; general excitement, and some persons run outdoors.**
Persons move unsteadily. Trees and bushes shake slightly to moderately. Liquids are set in strong motion. Small bells in churches and schools ring. Poorly built buildings may be damaged. Plaster falls in small amounts. Other plaster cracks somewhat. Many dishes and glasses, and a few windows break. Knickknacks, books and pictures fall. Furniture overturns in many instances. Heavy furnishings move.
- VII Frightens everyone. General alarm, and everyone runs outdoors.**
People find it difficult to stand. Persons driving cars notice shaking. Trees and bushes shake moderately to strongly. Waves form on ponds, lakes and streams. Water is muddied. Gravel or sand stream banks cave in. Large church bells ring. Suspended objects quiver. Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary buildings; considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. Plaster and some stucco fall. Many windows and some furniture break. Loosened brickwork and tiles shake down. Weak chimneys break at the roofline. Cornices fall from towers and high buildings. Bricks and stones are dislodged. Heavy furniture overturns. Concrete irrigation ditches are considerably damaged.
- VIII General fright, and alarm approaches panic.**
Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperatures of spring and well waters varies. Damage slight in brick structures built especially to withstand earthquakes; considerable in ordinary substantial buildings, with some partial collapse; heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed pilings break off. Walls fall. Solid stone walls crack and break seriously. Wet grounds and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns.
- IX Panic is general.**
Ground cracks conspicuously. Damage is considerable in masonry structures built especially to withstand earthquakes; great in other masonry buildings - some collapse in large part. Some wood frame houses built especially to withstand earthquakes are thrown out of plumb, others are shifted wholly off foundations. Reservoirs are seriously damaged and underground pipes sometimes break.
- X Panic is general.**
Ground, especially when loose and wet, cracks up to widths of several inches; fissures up to a yard in width run parallel to canal and stream banks. Landsliding is considerable from river banks and steep coasts. Sand and mud shifts horizontally on beaches and flat land. Water level changes in wells. Water is thrown on banks of canals, lakes, rivers, etc. Dams, dikes, embankments are seriously damaged. Well-built wooden structures and bridges are severely damaged, and some collapse. Dangerous cracks develop in excellent brick walls. Most masonry and frame structures, and their foundations are destroyed. Railroad rails bend slightly. Pipe lines buried in earth tear apart or are crushed endwise. Open cracks and broad wavy folds open in cement pavements and asphalt road surfaces.
- XI Panic is general.**
Disturbances in ground are many and widespread, varying with the ground material. Broad fissures, earth slumps, and land slips develop in soft, wet ground. Water charged with sand and mud is ejected in large amounts. Sea waves of significant magnitude may develop. Damage is severe to wood frame structures, especially near shock centers, great to dams, dikes and embankments, even at long distances. Few if any masonry structures remain standing. Supporting piers or pillars of large, well-built bridges are wrecked. Wooden bridges that "give" are less affected. Railroad rails bend greatly and some thrust endwise. Pipe lines buried in earth are put completely out of service.
- XII Panic is general.**
Damage is total, and practically all works of construction are damaged greatly or destroyed. Disturbances in the ground are great and varied, and numerous shearing cracks develop. Landslides, rock falls, and slumps in river banks are numerous and extensive. Large rock masses are wrenched loose and torn off. Fault slips develop in firm rock, and horizontal and vertical offset displacements are notable. Water channels, both surface and underground, are disturbed and modified greatly. Lakes are dammed, new waterfalls are produced, rivers are deflected, etc. Surface waves are seen on ground surfaces. Lines of sight and level are distorted. Objects are thrown upward into the air.

BLOCKS 33-34 PUBLIC IMPROVEMENTS
MISSION BAY
San Francisco, California

Treadwell & Rollo

MODIFIED MERCALLI INTENSITY SCALE

Date 03/10/08

Project No. 3349.01

Figure 4

APPENDIX A
Logs of Borings and CPT from Previous Investigations

PROJECT: STORMWATER PUMP STATION #5
MISSION BAY
San Francisco, California

Log of Boring BP23-1

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2

Logged by: C. Mai

Date started: 2/27/01

Date finished: 3/12/01

Drilling method: Rotary Wash

Hammer weight/drop: 140 lbs./30-inches

Hammer type: Rope & Pulley, Safety

Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES			LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
	Sampler Type	Sample	SPT N-Value ¹								
					Ground Surface Elevation: 100.5 feet ²						
1					CLAYEY SAND (SC) gray-brown and yellow brown, medium dense, moist, with gravel and brick fragments to 2 inches						
2	SPT		19	SC							
3	S&H		26								
4											
5					GRAVEL WITH CLAY (GP-GC) olive-gray and blue-green, loose to dense, wet, varying clay content, gravel to 3 inches, strong odor, some black substance, shale, serpentinite and sandstone gravel (3/12/01) Groundwater encountered at 6 feet						
6	S&H		9	GP-GC							
7											
8											
9											
10											
11	SPT		48								
12											
13											
14					GRAVEL WITH CLAY (GP-GC) yellow-brown and gray, very dense, wet, angular and coarse gravel, cobble to boulder sized						
15	SPT		100/ 4"								
16											
17											
18											
19											
20	SPT		100/ 5"	GP-GC							
21											
22											
23											
24											
25											
26											
27											
28											
29					SERPENTINITE						
30					BEDROCK						

Treadwell&Rollo

Project No.: 1319.31

Figure:

A-1a

TEST GEOTECH LOG 131931-BP23-1.GPJ TR.GDT 4/30/08

PROJECT: STORMWATER PUMP STATION #5
MISSION BAY
San Francisco, California

Log of Boring BP23-1

PAGE 2 OF 2

DEPTH (feet)	SAMPLES			LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	SPT N-Value ¹			Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31	S&H		30/4"		SERPENTINITE (continued) blue-gray and white, soft, weak, completely weathered, very intensely laminated						
32											
33											
34											
35	SPT		75/6"		some shale intrusions, moderately weak, highly weathered						
36											
37											
38											
39											
40											
41											
42											
43											
44											
45											
46											
47											
48											
49					SHALE blue-gray, soft, weak, completely weathered, very intensely laminated						
50											
51	SPT		83								
52											
53											
54											
55											
56											
57											
58											
59											
60											

Boring terminated at 51.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 6.0 feet below ground surface during drilling.

¹ S&H blow counts converted to SPT N-Values using a factor of 0.6.

² Elevations are referenced to San Francisco City Datum plus 100 feet and estimated from 1997 Topographic Survey by Towill.

Treadwell&Rollo

Project No.:

1319.31

Figure:

A-1b

TEST GEOTECH LOG 131931-BP23-1.GPJ TR.GDT 4/30/08

PROJECT: BLOCK 32 MISSION BAY San Francisco, California		Log of Boring B32-5 PAGE 1 OF 2	
Boring location: See Site Plan, Figure 2		Logged by: J. Wong	
Date started: 4/26/07		Date finished: 4/27/07	
Drilling method: Rotary Wash			
Hammer weight/drop: 140 lbs./30 inches		Hammer type: Rope and Cathead	
Sampler: Sprague & Hanwood (S&H), Standard Penetration Test (SPT), Shelby Tube (ST)			

DEPTH (feet)	SAMPLES			LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sample Type	Sample	SPT N-Value			Type of Strength Test	Combing Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content %	Dry Density Lbs/Cu Ft
Ground Surface Elevation: +93 feet ²											
1					SANDY CLAY with GRAVEL (CL) olive-brown, stiff, wet, with fragments of concrete and brick, traces angular to subangular gravels (4/27/07 at 7:00 am)						
2				CL							
3	S&H		16								
4					CLAYEY SAND with GRAVEL (SC) olive-brown, loose, wet, with brick medium dense						
5											
6	SPT		7								
7					CLAY (CH) gray, soft to medium stiff, wet, with shell fragments						
8				SC							
9	SPT		18						18.7	12.1	
10					concrete obstruction at 10.5 feet						
11	S&H		50/3"		CLAY (CH) gray, soft to medium stiff, wet, with shell fragments						
12											
13	SPT		4								
14				CH							
15	ST		75 to 100 psi		SAND (SP) gray, wet						
16				SP							
17					CLAYEY SAND (SC) olive, medium dense, wet						
18	SPT		21	SC							
19					CLAY with SAND (CL) olive with red-brown mottling, stiff, wet						
20	SPT		9								
21					CLAY (CL) yellow-brown with orange-brown mottling, hard, wet, with bedrock fragments						
22				CL							
23											
24					orange-brown, very stiff	TxUU	850	4,450	15.7	118	
25	S&H		26								
26					CLAY (CL) yellow-brown with orange-brown mottling, hard, wet, with bedrock fragments						
27				CL							
28											
29											
30	SPT		35								

TEST GEOTECH LOG 408617.GPJ, TR GDT 7/17/07

Treadwell & Rollo

Project No.: 4086.17 Figure: A-5a

PROJECT: BLOCK 32 MISSION BAY San Francisco, California				Log of Boring B32-5 PAGE 2 OF 2												
DEPTH (feet)	SAMPLES			LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA										
	Sampler Type	Sample	SPT N-Value ¹			Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft					
31	SPT	35		CL	CLAY (CL) (continued)											
32					SERPENTINITE Intensely fractured, friable, deeply weathered, low hardness <div style="position: relative; height: 100px;"> BEDROCK </div>											
33																
34	SPT	60/ 5.5"														
35																
36																
37																
38																
39	SPT	60/ 5"														
40																
41																
42																
43																
44	SPT	60/ 5"														
45																
46																
47																
48																
49																
50																
51																
52																
53																
54																
55																
56																
57																
58																
59																
60																

Boring terminated at a depth of 44.4 feet.
Boring backfilled with cement grout.
Groundwater encountered at 2.5 feet at 7:00 am on
4/27/07.

¹ S&H blow counts converted to SPT N-values using a
factor of 0.6.
² Elevation based on San Francisco City Datum plus 100
feet.

Treadwell & Rollo

Project No. **4086.17** Figure: **A-5b**

TEST GEOTECH-LOG-408617.GPJ TR.GDT 7/17/07

PROJECT:

**PARK P22
MISSION BAY**
San Francisco, California

Log of Boring BP22-5

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2

Logged by: A. Heckscher

Date started: 1/2/08

Date finished: 1/2/08

Drilling method: Rotary Wash

Hammer weight/drop: 140 lbs./30-inches

Hammer type: Automatic Safety

Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT), Shelby Tube (ST)

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft	
	Sampler Type	Sample	Blows/ 6"	SPT N-Value ¹									
						Ground Surface Elevation: 100 feet ²							
1						SILTY SAND (SP-SM) olive-gray, loose, moist, coarse sand, with fine gravel	FILL						
2													
3	S&H		7	8	SP-SM								
4			7										
5			5										
6													
7													
8	S&H		4	4		CLAY (CL) gray, soft to medium stiff, wet, with coarse shale fragments, strong hydrocarbon odor							
9			2		CL								
10			3										
11						GRAVEL with SAND and CLAY (GP-GC) olive-gray, loose, wet, fine to coarse gravel - angular to subangular, with fine sand, hydrocarbon odor							
12													
13	S&H		3	5	GP-GC								
14			4										
15			3										
16						SANDY CLAY (CL) yellow-brown, medium stiff, wet							
17					CL								
18	SPT		3	5									
19			2			GRAVEL with SAND and CLAY (GP-GC) brown, loose, wet							
20	S&H		4	7	GP-GC								
21			4										
22			6										
23						GREENSTONE dark gray to olive gray, low hardness, homogeneous, highly to intensely weathered, scattered 1/8" to greater 1" clay seams in fractures, heavily oxidized, subangular fracture, friable, moist to wet	FRANCISCAN FORMATION						
24	SPT		12	76									
25			21										
26			42										
27													
28													
29	SPT		17	61									
30			15										
			36										

FILL
FRANCISCAN FORMATION

TEST GEOTECH LOG 131957-BP22-5.GPJ TR.GDT 4/14/08

Treadwell&Rollo

Project No.:

1319.57

Figure:


B-4a

PROJECT:

**PARK P22
MISSION BAY**
San Francisco, California

Log of Boring BP22-5

PAGE 2 OF 2

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/6"	SPT N-Value ¹			Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31						GREENSTONE (continued)						
32												
33												
34												
35												
36						SERPENTINITE greenish gray to grayish green, low hardness, homogeneous, pervasively fractured, angular to subangular fractures, moist to wet						
37												
38	SPT			50/ 5"								
39												
40												
41												
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at 38.5 feet below ground surface.
Boring backfilled with bentonite grout.
Groundwater obscured by drilling method.

¹ S&H and SPT blow counts converted to SPT N-Values
using a factor of 0.7 and 1.2, respectively for automatic
safety hammer.

² Elevations based on San Francisco City datum plus
100 feet.

Treadwell & Rollo

Project No.:

1319.57

Figure:



B-4b









TEST GEOTECH LOG 131957-BP22-5.GPJ TR.GDT 4/14/08

UNIFIED SOIL CLASSIFICATION SYSTEM			
Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size)	Gravels (More than half of coarse fraction > no. 4 sieve size)	GW	Well-graded gravels or 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
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	SW	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils (more than half of soil < no. 200 sieve size)	Silts and Clays LL = < 50	ML	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	MH	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		PT	Peat and other highly organic soils

SAMPLE DESIGNATIONS/SYMBOLS

GRAIN SIZE CHART		
Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size In Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel coarse fine	3" to No. 4	76.2 to 4.76
	3" to 3/4" 3/4" to No. 4	76.2 to 19.1 19.1 to 4.76
Sand coarse medium fine	No. 4 to No. 200	4.76 to 0.075
	No. 4 to No. 10	4.76 to 2.00
	No. 10 to No. 40	2.00 to 0.420
	No. 40 to No. 200	0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

-  Unstabilized groundwater level
 Stabilized groundwater level

-  Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered
 Classification sample taken with Standard Penetration Test sampler
 Undisturbed sample taken with thin-walled tube
 Disturbed sample
 Sampling attempted with no recovery
 Core sample
 Analytical laboratory sample
 Sample taken with Direct Push sampler

SAMPLER TYPE

- | | | | |
|-----|--|-----|--|
| C | Core barrel | PT | Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube |
| CA | California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter | S&H | Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter |
| D&M | Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube | SPT | Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter |
| O | Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube | ST | Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure |

PARK P22
MISSION BAY
 San Francisco, California

CLASSIFICATION CHART

Treadwell & Rollo

Date 03/20/08 Project No. 1319.57 Figure B-5

I FRACTURING

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

II HARDNESS

1. **Soft** - reserved for plastic material alone.
2. **Low hardness** - can be gouged deeply or carved easily with a knife blade.
3. **Moderately hard** - can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** - can be scratched with difficulty; scratch produced a little powder and is often faintly visible.
5. **Very hard** - cannot be scratched with knife blade; leaves a metallic streak.

III STRENGTH

1. **Plastic** or very low strength.
2. **Frable** - crumbles easily by rubbing with fingers.
3. **Weak** - an unfractured specimen of such material will crumble under light hammer blows.
4. **Moderately strong** - specimen will withstand a few heavy hammer blows before breaking.
5. **Strong** - specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. **Very strong** - specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

IV WEATHERING - The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing.

- D. Deep** - moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.
- M. Moderate** - slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.
- L. Little** - no megascopic decomposition of minerals; little of no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.
- F. Fresh** - unaffected by weathering agents. No disintegration or discoloration. Fractures usually less numerous than joints.

ADDITIONAL COMMENTS:

V CONSOLIDATION OF SEDIMENTARY ROCKS: usually determined from unweathered samples. Largely dependent on cementation.

U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

VI BEDDING OF SEDIMENTARY ROCKS

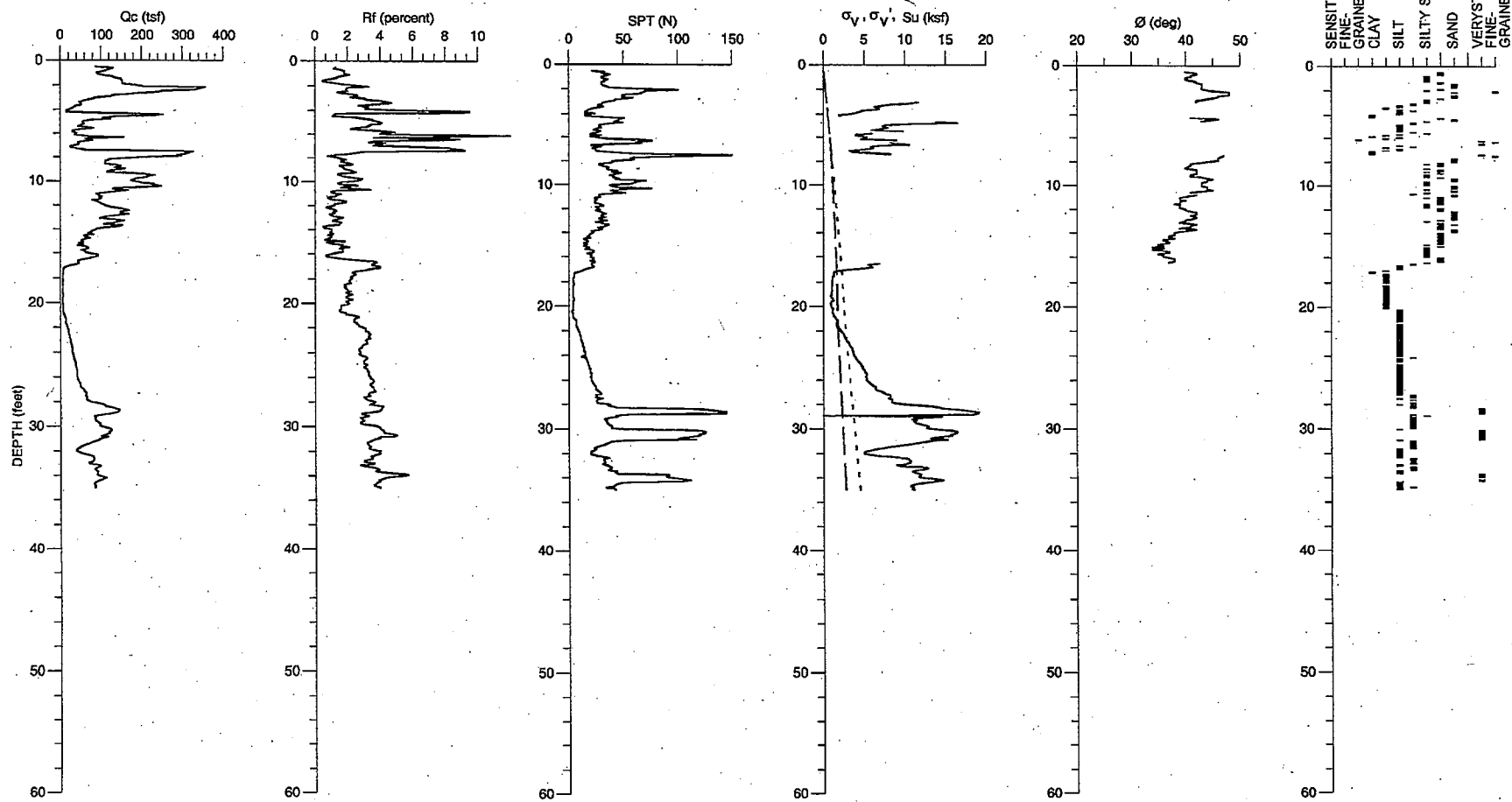
Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	very thick-bedded
Blocky	2.0 to 4.0 ft.	thick bedded
Slabby	0.2 to 2.0 ft.	thin bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01	thinly laminated

PARK P22
MISSION BAY
San Francisco, California

PHYSICAL PROPERTIES CRITERIA FOR ROCK DESCRIPTIONS

Treadwell & Rollo

Date 03/20/08 Project No. 1319.57 Figure B-6



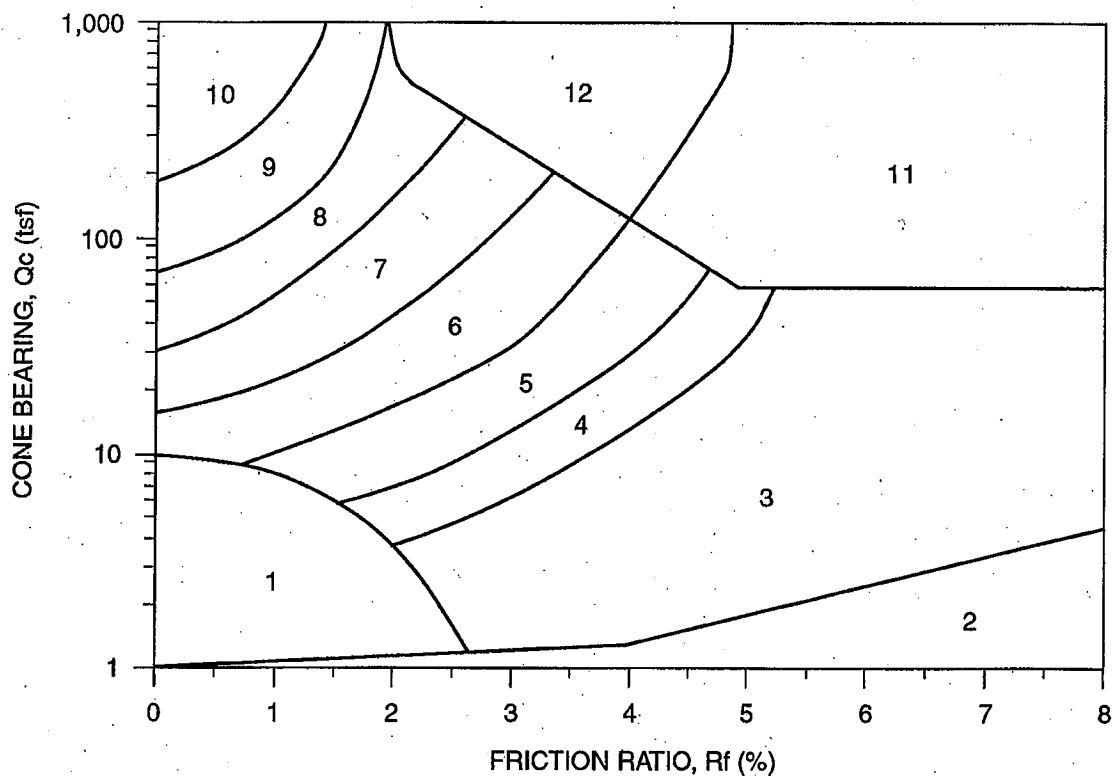
Terminated at 35.0 feet.
 Date performed: 1/24/08.
 Ground surface elevation: 102.2 feet, San Francisco City Datum plus 100 feet.

BLOCKS 29-32 PUBLIC IMPROVEMENTS
MISSION BAY
 San Francisco, California

CONE PENETRATION TEST RESULTS
C31-1

Date 03/20/08 Project No. 3347.01 Figure F-3

Treadwell&Roll



ZONE	Q_c/N^1	S_u Factor (Nk) ²	SOIL BEHAVIOR TYPE ¹
1	2	15 (10 for $Q_c \leq 9$ tsf)	Sensitive Fine-Grained
2	1	15 (10 for $Q_c \leq 9$ tsf)	Organic Material
3	1	15 (10 for $Q_c \leq 9$ tsf)	CLAY
4	1.5	15	SILTY CLAY to CLAY
5	2	15	CLAYEY SILT to SILTY CLAY
6	2.5	15	SANDY SILT to CLAYEY SILT
7	3	---	SILTY SAND to SANDY SILT
8	4	---	SAND to SILTY SAND
9	5	---	SAND
10	6	---	GRAVELLY SAND to SAND
11	1	15	Very Stiff Fine-Grained (*)
12	2	---	SAND to CLAYEY SAND (*)

(*) Overconsolidated or Cemented

Q_c = Tip Bearing

F_s = Sleeve Friction

$R_f = F_s/Q_c \times 100$ = Friction Ratio

Note: Testing performed in accordance with ASTM D3441.

References: 1. Robertson, 1986, Olsen, 1988.

2. Bonaparte & Mitchell, 1979 (young Bay Mud $Q_c \leq 9$).

Estimated from local experience (fine-grained soils $Q_c > 9$).

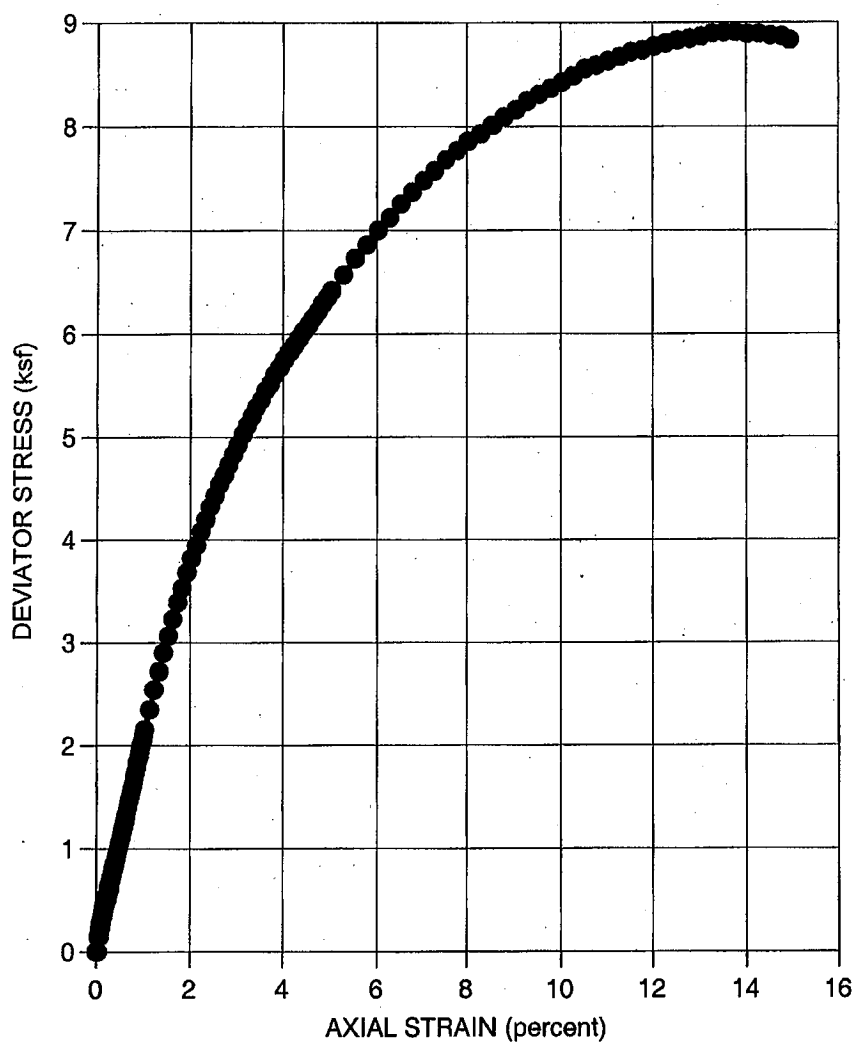
BLOCKS 29-32 PUBLIC IMPROVEMENTS
MISSION BAY
 San Francisco, California

CLASSIFICATION CHART FOR
CONE PENETRATION TESTS

Treadwell & Rollo

Date 03/20/08 Project No. 3347.01 Figure F-4

APPENDIX B
Laboratory Data from Previous Investigations



SAMPLER TYPE Sprague & Henwood (S&H)		SHEAR STRENGTH 4,455 psf	
DIAMETER (in) 2.4	HEIGHT (in) 5.1	STRAIN AT FAILURE 13.5 %	
MOISTURE CONTENT 15.7 %		CONFINING PRESSURE 850 psf	
DRY DENSITY 118 pcf		STRAIN RATE 0.99 % /min	
DESCRIPTION CLAYEY SAND with GRAVEL (SC), reddish brown			SOURCE B32-5 at 24.5 feet
BLOCK 32 MISSION BAY San Francisco, California		UNCONSOLIDATED-UNDRAINED TRIAxIAL COMPRESSION TEST	
Treadwell&Rollo		Date 04/14/08	Project No. 3349.01 Figure B-5

I FRACTURING

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

II HARDNESS

1. **Soft** - reserved for plastic material alone.
2. **Low hardness** - can be gouged deeply or carved easily with a knife blade.
3. **Moderately hard** - can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** - can be scratched with difficulty; scratch produced a little powder and is often faintly visible.
5. **Very hard** - cannot be scratched with knife blade; leaves a metallic streak.

III STRENGTH

1. **Plastic** or very low strength.
2. **Friable** - crumbles easily by rubbing with fingers.
3. **Weak** - an unfractured specimen of such material will crumble under light hammer blows.
4. **Moderately strong** - specimen will withstand a few heavy hammer blows before breaking.
5. **Strong** - specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. **Very strong** - specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

IV WEATHERING - The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing.

- D. Deep** - moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.
- M. Moderate** - slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.
- L. Little** - no megascopic decomposition of minerals; little or no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.
- F. Fresh** - unaffected by weathering agents. No disintegration or discoloration. Fractures usually less numerous than joints.

ADDITIONAL COMMENTS:

V CONSOLIDATION OF SEDIMENTARY ROCKS: usually determined from unweathered samples. Largely dependent on cementation.

U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

VI BEDDING OF SEDIMENTARY ROCKS

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	very thick-bedded
Blocky	2.0 to 4.0 ft.	thick bedded
Slabby	0.2 to 2.0 ft.	thin bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01	thinly laminated

PARK P22
MISSION BAY
San Francisco, California

PHYSICAL PROPERTIES CRITERIA FOR ROCK DESCRIPTIONS

Treadwell & Rollo

Date 03/20/08 Project No. 1319.57 Figure B-6

APPENDIX C
Logs of Borings from Current Investigation

PROJECT: **BLOCKS 33-34 PUBLIC IMPROVEMENTS**
MISSION BAY
 San Francisco, California

Log of Boring B34-1

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2

Logged by: S. Maghsoudi

Date started: 1/25/08

Date finished: 1/25/08

Drilling method: Rotary Wash

Hammer weight/drop: 140 lbs./30-inches

Hammer type: Automatic Safety

Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT), Shelby Tube (ST)

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
	Sampler Type	Sample	Blows/ 6"	SPT N-Value ¹								
						Ground Surface Elevation: 102 feet ²						
1						9-inches Asphalt Concrete (AC)						
2						CLAYEY SAND with GRAVEL (SC) olive gray, very loose, moist						
3												
4					SC							
5												
6						1/25/08 at 9:10 am						
7	S&H		1	1								
8			8	3								
9	SPT		1	5	GP	GRAVEL with SAND (GP) olive gray, loose, moist						
10												
11												
12						CLAY (CH) olive gray, soft, wet						
13	ST			50 psi		Consolidation Test, see Figure D-1					47.3	73
14					CH							
15												
16												
17												
18												
19												
20						CLAY (CL) brown, very stiff, wet						
21												
22			4	7	CL						18.5	
23	SPT		8	18								
24												
25												
26						SANDY CLAY (CL) yellow-brown, hard, wet						
27			7	11	CL							
28	SPT		22	40								
29												
30												

Treadwell&Rollo

Project No.: 3349.01

Figure:

C-1a

TEST GEOTECH LOG 334901.GPJ TR.GDT 4/30/08

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/6"	SPT N-Value ¹			Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31						SANDY CLAY (CL) (continued)						
32												
33	SPT		5 6 8	17		very stiff				52.9	21.2	
34												
35					CL							
36												
37						grades little to no sand						
38	SPT		5 7 9	19								
39												
40												
41						SANDY CLAY with GRAVEL (CL) yellow brown, hard, wet						
42					CL							
43	SPT		7 8 33	49								
44						CLAYEY SAND with GRAVEL (SC) olive-gray, dense, wet						
45					SC							
46												
47	SPT		17 18 20	46								
48												
49												
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 48 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 6.4 feet during drilling.

¹ S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7 and 1.2, respectively to account for sampler type and hammer energy.
² Elevations based on San Francisco City datum plus 100 feet.

Treadwell & Rollo

Project No.: 3349.01

Figure:

C-1b

TEST GEOTECH LOG 334901.GPJ TR.GDT 4/30/08

PROJECT: **BLOCKS 33-34 PUBLIC IMPROVEMENTS**
MISSION BAY
 San Francisco, California

Log of Boring BP24-1

PAGE 1 OF 3

Boring location: See Site Plan, Figure 2

Logged by: S. Maghsoudi

Date started: 1/25/08

Date finished: 1/25/08

Drilling method: Rotary Wash

Hammer weight/drop: 140 lbs./30-inches

Hammer type: Automatic Safety

Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT), Shelby Tube (ST)

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
	Sampler Type	Sample	Blows/6'	SPT N-Value ¹								
						Ground Surface Elevation: 102 feet ²						
1						9-inch Asphalt Concrete (AC)						
2						Hand Auger 0 to 6 feet because of existing nearby utilities on Illinois Street						
3												
4					CL							
5												
6			3			CLAY with GRAVEL (CL) olive brown and olive gray, soft to medium stiff, moist						
7	S&H		3	4								
8			3			01/25/08 at 1:20 pm						
9			3			CLAYEY SAND with GRAVEL (SC) olive gray, loose, wet						
10	SPT		3	6						17.2	22.0	
11			3									
12			2		SC							
13												
14			3									
15	SPT		2	5								
16			2			CLAY (CH) gray, soft, wet						
17												
18												
19												
20						Consolidation Test, see Figure D-2						
21	ST			50 psi							84.9	49
22												
23					CH							
24												
25												
26												
27												
28						Consolidation Test, see Figure D-3						
29	ST			75 psi							88.3	49
30												

BAY MUD

FILL

TEST GEOTECH LOG 334901.GPJ TR.GDT 4/30/08

Treadwell&Rollo

Project No.: 3349.01

Figure: C-2a

PROJECT:

BLOCKS 33-34 PUBLIC IMPROVEMENTS
MISSION BAY
San Francisco, California

Log of Boring BP24-1

PAGE 2 OF 3

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/6"	SPT N-Value ¹			Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31					CH	CLAY (CH) (continued)						
32												
33												
34	SPT		5	38	CL	SANDY CLAY (CL) olive, hard, moist						
35			15									
36			17									
37												
38												
39	SPT		13	49	SP- SC	SAND with CLAY (SP-SC) yellow brown, dense, moist						
40			17									
41			24									
42												
43												
44												
45						SANDY CLAY (CL) yellow brown, very stiff, wet						
46												
47												
48												
49	SPT		5	22								
50			8									
51			10									
52					CL							
53												
54												
55												
56												
57												
58						hard						
59	SPT		7	31								
60			12									
			14									

Treadwell&Rollo

Project No.:

3349.01

Figure:

C-2b

TEST GEOTECH LOG 334901.GPJ TR.GDT 4/30/08

PROJECT: BLOCKS 33-34 PUBLIC IMPROVEMENTS
MISSION BAY
San Francisco, California

Log of Boring BP24-1

PAGE 3 OF 3

DEPTH (feet)	SAMPLES				LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA					
	Sampler Type	Sample	Blows/ 6"	SPT N-Value ¹			Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
61						SANDY CLAY (CL) (continued)						
62												
63												
64					CL							
65												
66												
67												
68						CLAYEY SAND (SC) yellow brown, very dense, moist						
69					SC							
70												
71	SPT		17	24	77							
72			40									
73												
74												
75												
76												
77												
78												
79												
80												
81												
82												
83												
84												
85												
86												
87												
88												
89												
90												

RESIDUAL SOIL

Boring terminated at a depth of 71.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 7.4 feet during drilling.

¹ S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7 and 1.2, respectively to account for sampler type and hammer energy.
² Elevations based on San Francisco City datum plus 100 feet.

Treadwell&Rollo

Project No.:

3349.01

Figure:


C-2c


TEST GEOTECH LOG 334901.GPJ TR.GDT 4/30/08










UNIFIED SOIL CLASSIFICATION SYSTEM			
Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size)	Gravels (More than half of coarse fraction > no. 4 sieve size)	GW	Well-graded gravels or 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
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	SW	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils (more than half of soil < no. 200 sieve size)	Silts and Clays LL = < 50	ML	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	MH	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		PT	Peat and other highly organic soils

SAMPLE DESIGNATIONS/SYMBOLS

GRAIN SIZE CHART		
Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size in Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel coarse fine	3" to No. 4	76.2 to 4.76
	3" to 3/4"	76.2 to 19.1
	3/4" to No. 4	19.1 to 4.76
Sand coarse medium fine	No. 4 to No. 200	4.76 to 0.075
	No. 4 to No. 10	4.76 to 2.00
	No. 10 to No. 40	2.00 to 0.420
	No. 40 to No. 200	0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

 Unstabilized groundwater level

 Stabilized groundwater level

	Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered
	Classification sample taken with Standard Penetration Test sampler
	Undisturbed sample taken with thin-walled tube
	Disturbed sample
	Sampling attempted with no recovery
	Core sample
	Analytical laboratory sample
	Sample taken with Direct Push sampler
	Sonic

SAMPLER TYPE

C	Core barrel	PT	Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube
CA	California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter	S&H	Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter
D&M	Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube	SPT	Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter
O	Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube	ST	Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

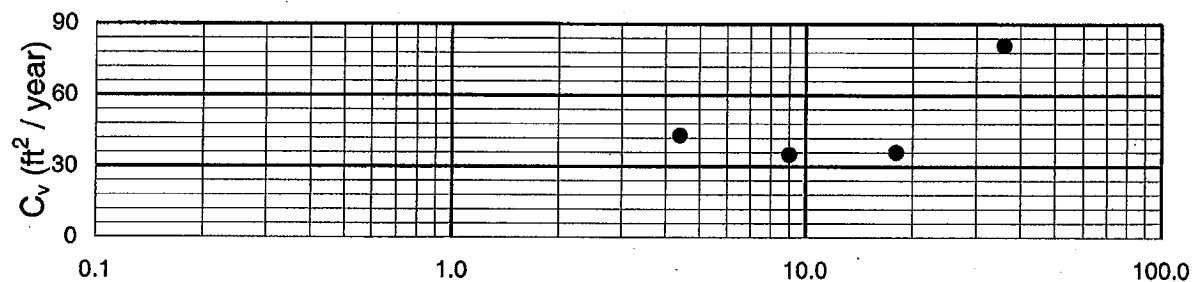
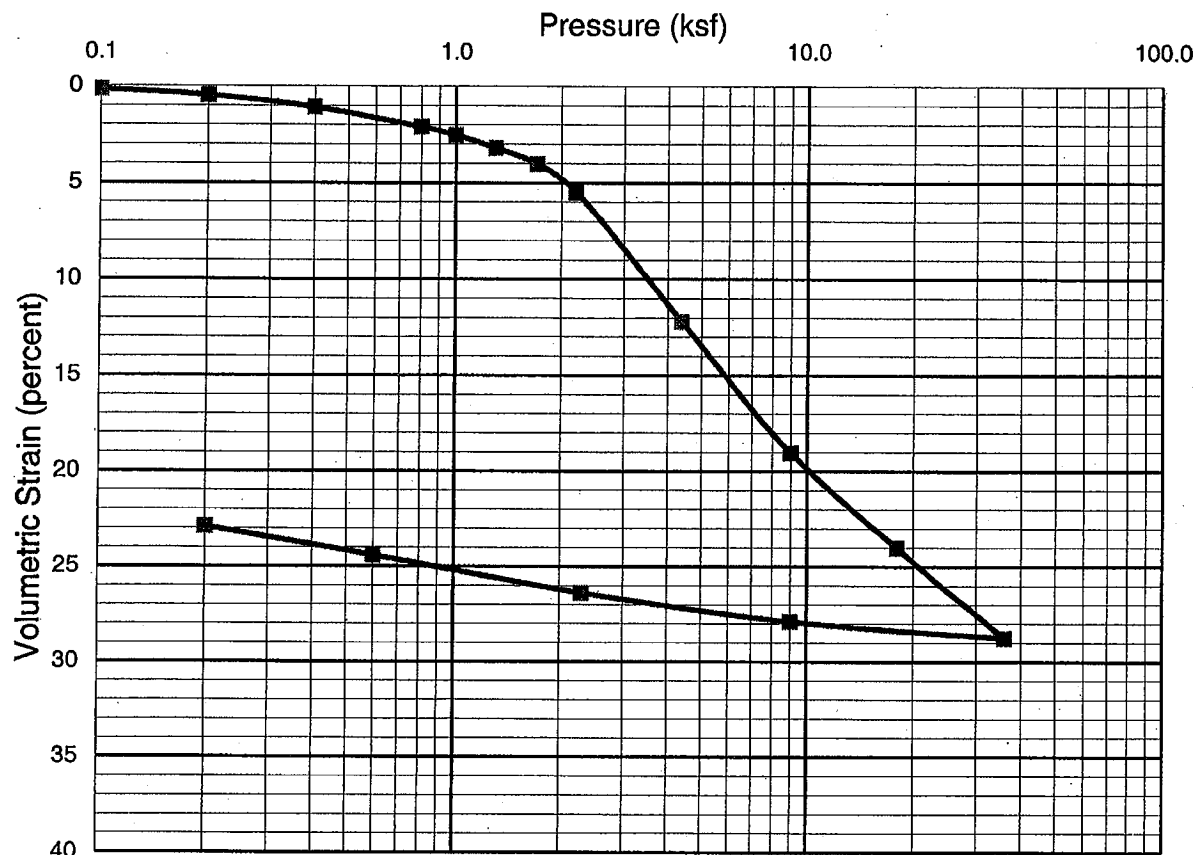
BLOCKS 33-34 PUBLIC IMPROVEMENTS
MISSION BAY
San Francisco, California

Treadwell & Rollo

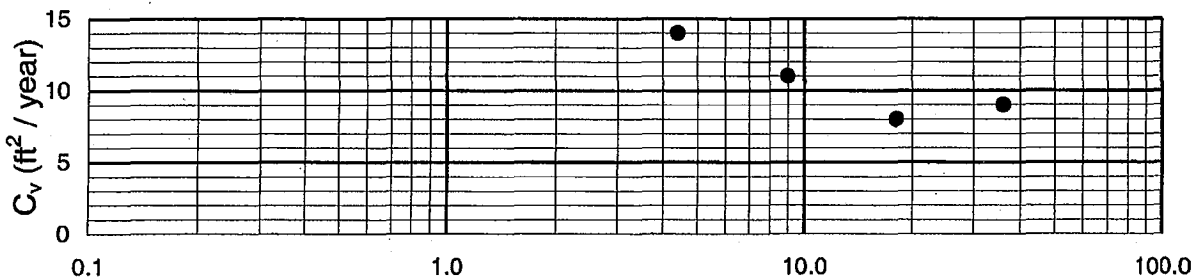
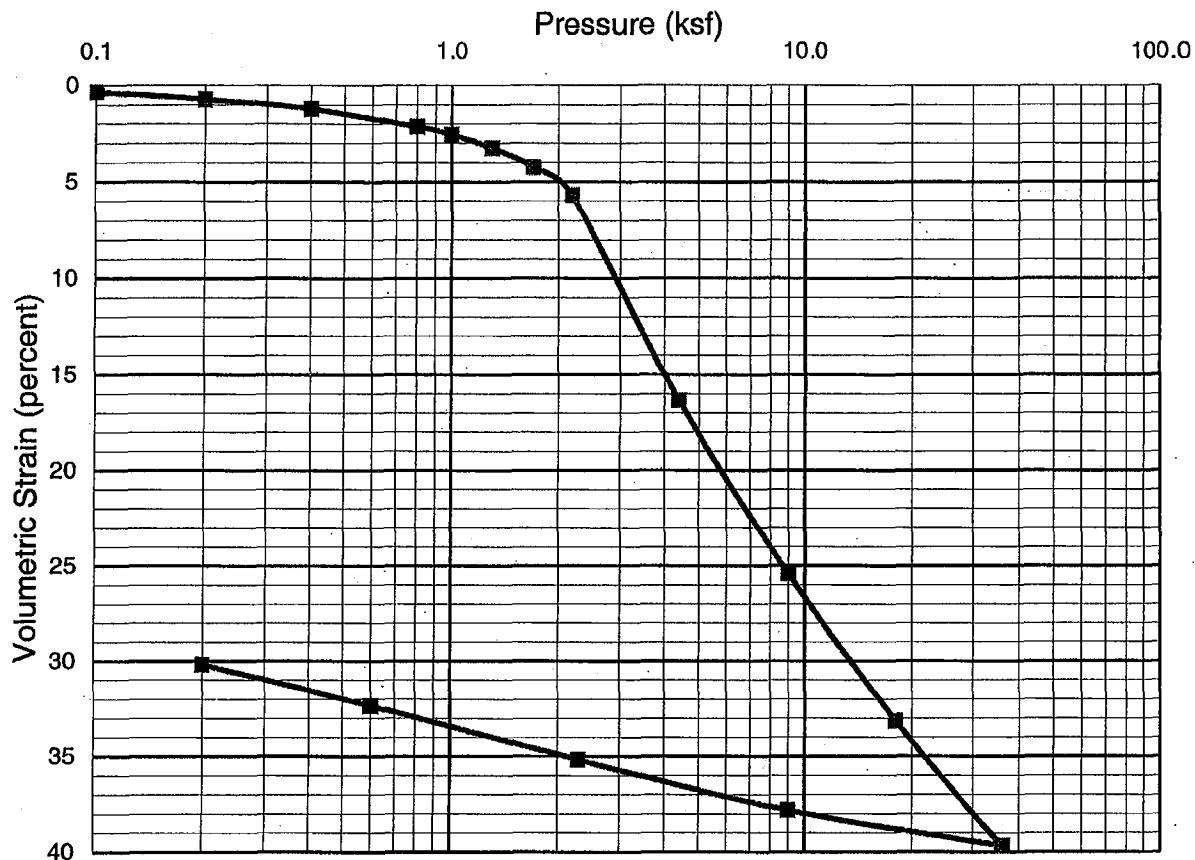
CLASSIFICATION CHART

Date 03/10/08 Project No. 3349.01 Figure C-3

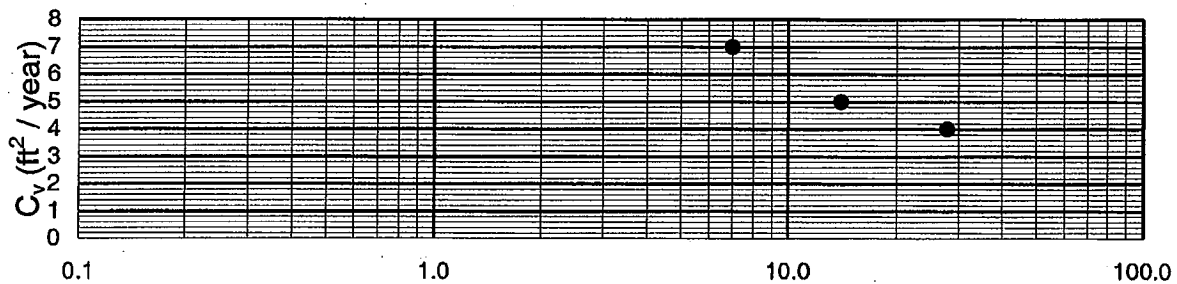
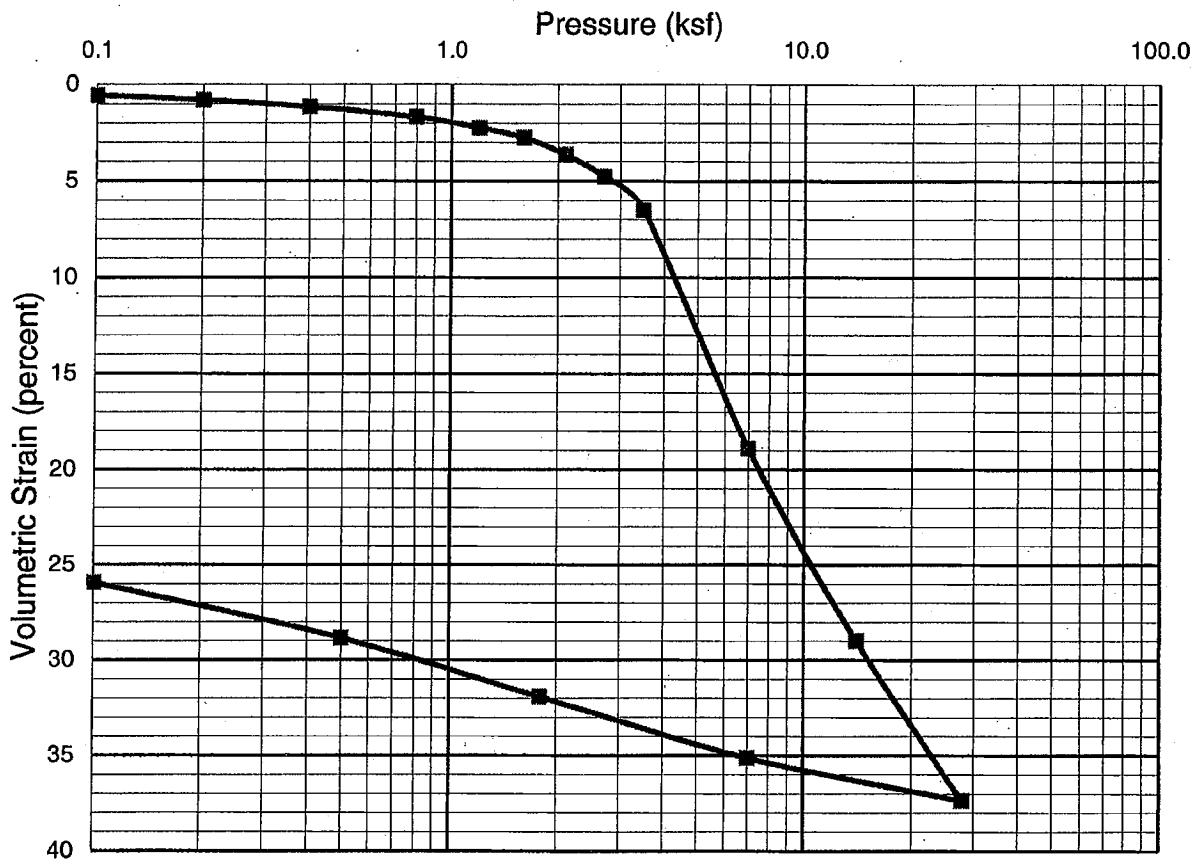
APPENDIX D
Laboratory Test Results from Current Investigation



Sampler Type: Shelby Tube (ST)				Condition	Before Test			After Test											
Diameter (in)		2.42		Height (in)		1.00		Water Content		w _o	47.3 %		w _f	29.8 %					
Overburden Pressure, p _o				1,200		psf		Void Ratio		e _o	1.31		e _f	0.78					
Preconsol. Pressure, p _c				2,000		psf		Saturation		S _o	98 %		S _f	100 %					
Compression Ratio, C _{ec}				0.22				Dry Density		γ _d	73 pcf		γ _d	95 pcf					
LL		--		PL		--		PI		--		G _s		2.70 (assumed)					
Classification CLAY (CH), olive gray								Source B34-1 at 12 feet											
BLOCKS 33-34 PUBLIC IMPROVEMENTS MISSION BAY San Francisco, California								CONSOLIDATION TEST REPORT											
Treadwell & Rollo								Date		04/29/08		Project No.		3349.01		Figure		D-1	



Sampler Type: Shelby Tube (ST)		Condition		Before Test		After Test	
Diameter (in)	2.42	Height (in)	1.00	Water Content	w_o 84.9 %	w_f 50.3 %	
Overburden Pressure, p_o	1,600 psf			Void Ratio	e_o 2.41	e_f 1.38	
Preconsol. Pressure, p_c	2,100 psf			Saturation	S_o 95 %	S_f 98 %	
Compression Ratio, C_{ec}	0.35			Dry Density	γ_d 49 pcf	γ_d 71 pcf	
LL --	PL --	PI --		G_s	2.70 (assumed)		
Classification CLAY (CH), gray				Source BP24-1 at 19 feet			
BLOCK 33-34 PUBLIC IMPROVEMENTS MISSION BAY San Francisco, California				CONSOLIDATION TEST REPORT			
Treadwell & Rollo				Date	04/29/08	Project No.	3349.01
				Figure D-2			



Sampler Type: Shelby Tube (ST)		Condition		Before Test		After Test	
Diameter (in)	2.42	Height (in)	1.00	Water Content	w_o	88.3 %	w_f 58.1 %
Overburden Pressure, p_o	1,900	psf		Void Ratio	e_o	2.47	e_f 1.57
Preconsol. Pressure, p_c	3,300	psf		Saturation	S_o	96 %	S_f 100 %
Compression Ratio, C_{ec}	0.41			Dry Density	γ_d	49 pcf	γ_d 66 pcf
LL	--	PL	--	PI	--	G_s	2.70 (assumed)
Classification Olive gray silty clay				Source BP24-1 at 27 feet			
BLOCK 33-34 PUBLIC IMPROVEMENTS MISSION BAY San Francisco, California				CONSOLIDATION TEST REPORT			
Treadwell & Rollo				Date	04/29/08	Project No.	3349.01
						Figure	D-3

APPENDIX E
Soil Corrosion Test Results and Brief Evaluation

4 February, 2008

Job No.0801243
Cust. No.10727

3942-A Valley Avenue
Pleasanton, CA 94566-4715
925.462.2771 • Fax: 925.462.2775
www.cercoanalytical.com

Ms. Serena Jang
Treadwell & Rollo
555 Montgomery Street, Suite 1300
San Francisco, CA 94111

Subject: Project No.: 3349.01
Project Name: Blocks 33-34, Mission Bay
Corrosivity Analysis – ASTM Test Methods

Dear Ms. Jang:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on January 30, 2008. Based on the analytical results, a brief evaluation is enclosed for your consideration.

Based upon the resistivity and conductivity measurements, both samples are classified as "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 range from 16 to 53 mg/kg. Because the chloride ion concentrations are less than 300 mg/kg, they are determined to be insufficient to attack steel embedded in a concrete mortar coating.

The sulfate ion concentrations range from 33 to 140 mg/kg and are determined to be insufficient to damage reinforced concrete structures and cement mortar-coated steel at these locations.

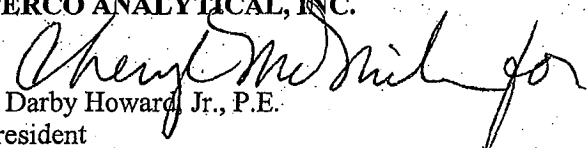
The pH of the soils range from 8.5 to 8.7 which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potential for both samples is 440-mV, which are indicative of aerobic soil conditions.

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

C E R C O

analytical, inc.

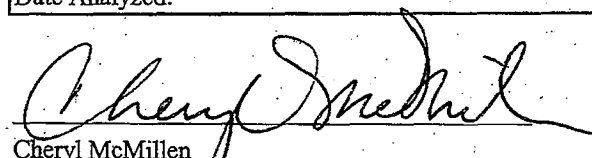
Client: Treadwell & Rollo
 Client's Project No.: 3349.01
 Client's Project Name: Blocks 33-34, Mission Bay
 Date Sampled: 25-Jan-08
 Date Received: 30-Jan-08
 Matrix: Soil
 Authorization: Signed Chain of Custody

3942-A Valley Avenue
 Pleasanton, CA 94566-4715
 925.462.2771 • Fax: 925.462.2775
 www.cercoanalytical.com

Date of Report: 4-Feb-2008

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
0801243-001	BP24-1, #1 @ 7'	440	8.5	-	1,200	-	16	140
0801243-002	B34-1, #2 @ 8'	440	8.7	550	-	-	53	33

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Detection Limit:	-	-	10	-	50	15	15
Date Analyzed:	31-Jan-2008	1-Feb-2008	1-Feb-2008	31-Jan-2008	-	1-Feb-2008	1-Feb-2008


 Cheryl McMillen
 Laboratory Director

* Results Reported on "As Received" Basis

DISTRIBUTION

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QUALITY CONTROL REVIEWER:


Lori A. Simpson
Geotechnical Engineer

