FUGRO CONSULTANTS, INC.

GEOTECHNICAL INVESTIGATION
REDWOOD CITY MOTOR POOL
REDWOOD CITY, CALIFORNIA

PREPARED FOR:
SAN MATEO COUNTY DEPARTMENT OF PUBLIC WORKS

December 2014

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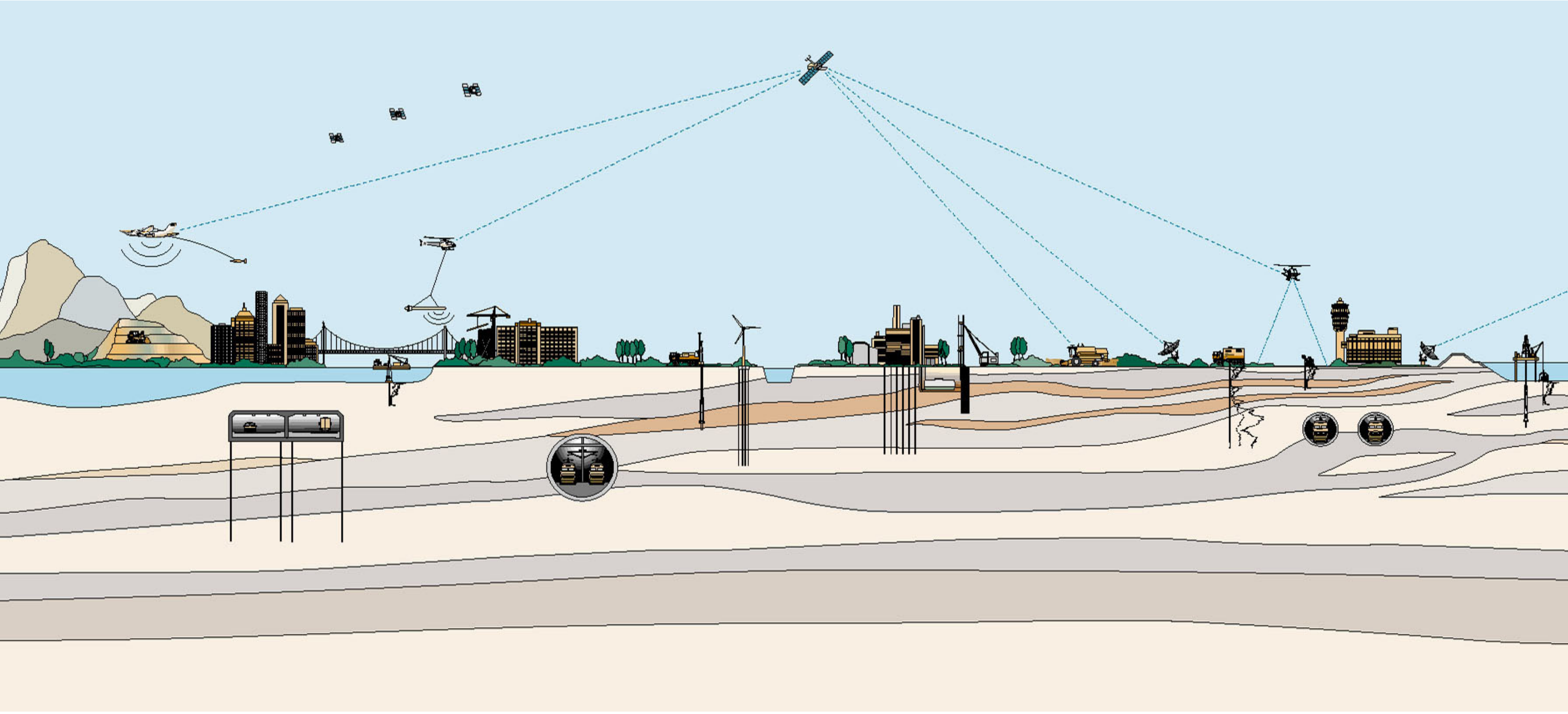

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December 4, 2014
Project No. 04.72140058

San Mateo County, Department of Public Works
555 County Center, Fifth Floor
Redwood City, California 94063

Attention: Ms. Rebecca Dickinson, Construction Manager

Subject: Geotechnical Study, Proposed Redwood City Motor Pool (Relocation), Redwood City, California

Dear Ms. Dickinson:

Fugro Consultants, Inc. is pleased to present this report providing the results of our geotechnical investigation for the proposed Redwood City Motor Pool (relocation) in Redwood City, California.

We thank you for the opportunity to be of service to the Public Works Department of the San Mateo County. If you should have any questions or require additional information on this report, please call the undersigned at (510) 267-4417.

Sincerely,

FUGRO CONSULTANTS, INC.

Matthew Bajuniemi
Project Engineer

Timothy Chi-To Wong, P.E., G.E.
Associate Engineer

MJB/CTW:mb

Copies Submitted: (1) Addressee

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1.0 INTRODUCTION

This report presents the results of a geotechnical investigation conducted by Fugro Consultants, Inc. (Fugro) for the San Mateo County Department of Public Works, Redwood City Motor Pool Project located at 752 Chestnut Street, Redwood City, California, as shown on the Vicinity Map, Plate 1. The project site is currently the County Corporation Yard. We understand the project is in its preliminary design and there will be a subsequent design phase. Therefore, some of our conclusions and recommendations presented in this report may not be applicable in the final design. Additional investigations and analyses are warranted.

1.1 PROJECT DESCRIPTION

The San Mateo County plans to relocate the existing Redwood City Motor Pool to a new location. The existing Motor Pool is located approximately 1 mile northwest of the new site. The project site is bounded by Chestnut Street to the west, Spring Street to the north, highway 84 to the east and residential areas to the south. The site is generally level at Elevation 14 feet (NAVD 88[1]). It is currently occupied by a one-story steel framed structure with interior wood partition walls and concrete slab-on-grade. Part of the structure has a lofted area. No existing foundation information is available when preparing this report.

The proposed project includes demolition the existing structure, construction of a new prefabricated steel building with a plan dimension of approximately 260 by 35 feet; the motor pool will be included as part of the new structure along with other facilities/storage areas. The proposed new structure would encompass a similar building footprint as the existing structure, but the width of the building will be extended 9 to 10 feet. In addition, there will be new asphalt paving in the vicinity of the planned improvements, but the actual extents are not known during this preliminary study. Considering the proposed structure will be relatively light, shallow foundations are anticipated to support the building.

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1.2 PURPOSE AND SCOPE OF WORK

The purpose of our work was to explore the subsurface conditions and provide preliminary recommendations for the geotechnical aspects of the project. The scope of services for our geotechnical investigation for the proposed improvements were presented in our proposals dated September 8, 2014. The scope of work of this investigation included a site reconnaissance, subsurface exploration, laboratory testing, geotechnical engineering analysis, and preparation of this report presenting our findings and recommendations.

[11] The datum in this report is referenced to 1988 North American Vertical Datum unless stated otherwise

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 FIELD EXPLORATION

Three exploratory borings were advanced to characterize the subsurface conditions at the proposed new motor pool site by Fugro's subcontractor, Exploration Geoservices, Inc. (EGI) of San Jose, California, on October 30, 2014, using a truck mounted drill rig equipped with 8-inch diameter hollow-stem augers. A Fugro engineer was on site to supervise the drilling and backfill operations. Our engineer also logged and visually classified the soils encountered during drilling in accordance with the Unified Soil Classification System. The samples were taken to our geotechnical laboratory in Oakland, California for further examination and testing.

The borings, designated as Borings B-01 through B-03, were advanced to depths of about 20 to 21 feet below ground surface (bgs). After the borehole was drilled to the specified depth, the sampler mounted on the drill rods was lowered to the bottom, seated, and driven into the soil with a hammer to retrieve a Modified California (MC) sample or a Standard Penetration Test (SPT) sample. The MC and SPT samplers were advanced using a 140-pound safety hammer with a free fall of 30 inches. The number of blows required to advance the sampler the last 12 inches was recorded as the penetration resistance (blows-per-foot).

After completion of the drilling and sampling, the borings were tremie backfilled with neat cement grout in accordance with San Mateo County regulations. Soil cuttings were collected in 55-gallon drums that were temporarily stored on site at a designated location. A composite sample was obtained from the drums for analytical testing and the results are pending when preparing this report. They will be disposed in accordance with the regulatory requirements once the analytical test results become available.

The approximate locations of the borings are shown on the Site Plan, Plate 2. Exploration locations were determined in the field with the aid of taping from adjacent landmarks. The locations should be considered accurate only to the degree implied by the methods used. Logs of exploratory borings as well as the details regarding the field investigation are included in Appendix A. The results of our laboratory test program are presented in Appendix B.

The surface and subsurface conditions encountered during our exploration and other site-specific geologic conditions are discussed below. It should be noted that changes in the surface and subsurface conditions of the site could occur over time as a result of either natural processes or human activity.

2.2 LABORATORY TESTING

Geotechnical laboratory testing was conducted on representative soil samples collected from the borings at Fugro's soil mechanics laboratory in Oakland, California. The geotechnical laboratory testing program included: gradation, Atterberg limits, water content, unit weight and R-value. The results of the laboratory tests are presented on the boring logs (Appendix A) at the appropriate sample depths, and in Appendix B.

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In addition, one representative soil sample was collected for corrosion testing performed by CERCO Analytical, Inc. of Concord, California. Results of the corrosion testing are discussed in Section 5.4. The results of the soil corrosion tests are included in Appendix C.

3.0 GEOLOGIC SETTING

3.1 REGIONAL GEOLOGY

Geologic formations in the San Francisco Bay Region range in age from Jurassic to Recent. The Franciscan Complex is the oldest, and underlies younger surficial deposits throughout San Francisco. The Franciscan Complex consists mainly of marine-deposited sedimentary and volcanic rocks in close association with bodies of serpentine. Following deposition, the Franciscan rocks were regionally uplifted and, in the process, extensively faulted and folded.

The Bay Area also experienced uplift and faulting in several episodes during late Tertiary time (about 25 to 2 million years ago). This produced a series of northwest-trending valleys and mountain ranges, including the Berkeley Hills, the San Francisco Peninsula, and the intervening San Francisco Bay. Uplifted areas were eroded and Pleistocene and recent marine sediments were deposited in the San Francisco Bay. Stream and marshland sediments were deposited in low-lying areas adjacent to the Bay.

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3.2 REGIONAL SEISMICITY

The San Francisco Bay Area lies along an active system of faults forming the boundary between the North American and Pacific Plates. Earthquakes in the Bay Area have their origin in the release of strain energy by the sudden movement of a fault. Most of this relative motion between the two plates across the Bay Area is accommodated by slips that occur during earthquakes episodically on relatively few faults. Additionally, seismic creep along surface fault traces is also common.

Active faults are defined as having surface displacement within the Holocene time and potentially active faults are defined as showing evidence of movement within Quaternary time. The active or potentially active faults of most significance to the project are the San Andreas, Hayward and San Gregorio faults. The Hayward fault lies on the west side of the East Bay hills in the eastern Bay Area and runs in a northwesterly direction. The San Andreas fault is located immediately west of the project area. It is predicted that these faults could produce an earthquake with a maximum moment magnitude of 6.7 to 7.9.

Earthquakes on these or other active faults (including unmapped faults) could cause strong ground shaking at the site. Earthquake intensities vary throughout the Bay Area depending upon the magnitude of the earthquake, the distance of the site from the causative fault, the type of materials underlying the site, and other factors.

The approximate distances of the site to the six closest known mapped active faults, based on the Program FRISKSP by Thomas F. Blake (Blake, 2000), are summarized in

Table 1. The FRISKSP program was run using the 2002 California Geological Survey (CGS) fault model (Blake, 2002). The project site is not located within an Alquist-Priolo Earthquake Fault Zone requiring special studies.

Table 1. Regional Faults and Seismicity

Fault	Approximate Distance from Site (miles)	Direction from Site	Maximum Moment Magnitude
San Andreas	4	Southwest	7.9
Monte Vista	5	South	6.8
San Gregorio	13	Southwest	6.7
Hayward	14	Northeast	7.3
Calaveras	21	Northeast	6.9

4.0 SEISMIC AND GEOLOGIC HAZARDS

4.1 GENERAL

The primary seismic hazard at the site is the potential strong to very strong ground shaking due to a seismic event on one of the nearby faults. On the basis of the results of our geotechnical investigation and available subsurface information, we conclude the potential for other geologic hazards at the project site is low. These hazards and other geotechnical issues as they pertain to the proposed improvements are discussed in the following sections.

4.2 FAULT RUPTURE

As discussed above, the major active faults in the area are the San Andreas fault, Hayward and San Gregorio faults. Historically, ground surface ruptures closely follow the trace of geologically young faults. The project site is not within an Earthquake Fault Zone (Plate 3), as defined by the Alquist-Priolo Earthquake Fault Zoning Act of 1972 and no known active or potentially active faults exist on the site. Therefore, we conclude the risk of fault offset at the site from a known active fault is negligible.

4.3 STRONG GROUND SHAKING

During a major earthquake on a segment of one of the nearby faults, strong to very strong shaking is expected to occur at the project site. The intensity of the earthquake ground motion at the site will depend upon the characteristics of the generating fault, distance to the earthquake epicenter, magnitude and duration of the earthquake, and specific site geologic conditions. Strong shaking during an earthquake can result in ground failure such as that associated with soil liquefaction and lateral spreading.

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4.4 LIQUEFACTION AND LATERAL SPREADING

Liquefaction is a phenomenon whereby soil deposits temporarily lose shear strength and collapse. This condition is caused by cyclic loading during earthquake shaking that generates high pore water pressures within the soil deposits. The soil type most susceptible to liquefaction is loose, cohesionless, granular soil below the water table and within about 50 feet of the ground surface. Liquefaction can result in a loss of foundation support and settlement of overlying structures, ground subsidence and translation due to lateral spreading, lurch cracking, and differential settlement of affected deposits. Lateral spreading occurs when a soil layer liquefies at depth and causes horizontal movement or displacement of the overlying mass on sloping ground or towards a free face such as a stream bank or excavation.

In addition, according to the CGS map, *State of California Seismic Hazard Zone, Palo Alto Quadrangle* (2006), the project site is located in a designated liquefaction hazard evaluation zone. According to the Association of Bay Area Governments (ABAG) liquefaction susceptibility interactive map found at http://gis.abag.ca.gov/website/liq/viewer.htm (ABAG 2013), the site is located in an area where the subsurface materials are considered to have a moderate susceptibility for liquefaction as shown in Plate 4.

The project site is generally underlain by cohesive materials below the ground water level which is about 10 feet bgs. In Boring B-1, there is a layer of medium dense clayey sand with gravel at a depth of about 19 feet bgs. We evaluated the liquefaction potential based on the Bray and Sancio (2006) procedures and the factor of safety against liquefaction is calculated to be about 1.0. Furthermore, considering this clayey sand layer is relatively thin (approximately 1.5 feet) and isolated (not encountered in Borings B-2 and B-3), and it is overlain by 19 feet of non-liquefiable material, we therefore judge the potential of liquefaction occurring at the site is low.

5.0 SITE CONDITIONS

5.1 SURFACE CONDITIONS

Surface elevation of the proposed new motor pool site is approximately 14 feet (NAVD 88). The ground surface is generally level and paved with asphalt concrete. Surface cracks of the asphalt in the vicinity of the building can be observed. The location of the proposed improvements is currently occupied by an existing steel frame structure which will be completely removed prior to construction.

5.2 SUBSURFACE CONDITIONS

Considering the boring locations and the existing building is very close, we assumed the soil condition is similar below the existing building. Additional investigations may be performed during future design phase to confirm the soil conditions beneath the existing building.

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The soils encountered in Borings B-01, B-02, and B-03 generally consisted of about 4 to 7 feet thick, stiff to very stiff, highly plastic clay (with a plasticity index of 48). This layer is underlain by stiff to very stiff clayey materials mixed with varying amounts of sand to the maximum explored depth of 21½ feet. In Boring B-1, medium dense to very dense clayey sand with gravel was encountered at a depth of 19 feet to the maximum depth explored (21½ feet). The gravel is approximately ¼ inch to ½ inch.

Detailed descriptions of the soils encountered in each of the exploratory borings are presented on the logs of borings in Appendix A. The logs of borings and related information depict location-specific subsurface conditions encountered during our field investigation. The passage of time could result in changes in the subsurface conditions and the soil condition between borings may vary in type, strength and other important properties. The approximate locations of the borings were determined by taping from existing landmarks. The locations should be considered accurate only to the degree implied by the method used.

5.3 GROUNDWATER

Groundwater was encountered at a depth of approximately 13 to 15 feet at the time of drilling. The borings were backfilled with cement grout per the requirements of San Mateo County immediately upon completion of drilling, and thus the borings might not have been left open for a sufficient period of time to establish groundwater equilibrium conditions. In addition, fluctuations in the groundwater level could occur due to change in seasons, variations in rainfall, and other factors.

5.4 CORROSION EVALUATION

As discussed above, a soil sample from Boring B-03 at a depth of about 4.5 to 5 feet was tested for sulfate content, chloride content, redox potential, pH, and resistivity. The soil corrosivity test was performed by Cerco Analytical, Inc. of Concord, California in accordance with ASTM standards. Corrosion potential was estimated based on the nominal resistivity measurement (100 percent saturation), electrical conductivity, chloride ion concentration, sulfate ion concentration, soluble sulfide concentration, pH, and redox potential.

Based on the resistivity measurement, the samples are described as “corrosive” to buried metals. All buried iron, steel, cast iron, ductile iron, galvanized steel, and dielectric coated steel or iron should be properly protected against corrosion, depending on the critical nature of the structure. The detailed analyses and recommendations regarding protection to concrete, steel reinforcement, and metals are presented in Appendix C.

For specific long-term corrosion control design recommendations, including recommendations for design of cathodic protection systems, we recommend that a registered professional corrosion engineer evaluate the corrosion potential of the soil environment on buried concrete structures, steel pipe coated with cement-mortar, and ferrous metals.

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6.0 GEOTECHNICAL ENGINEERING DISCUSSION AND CONCLUSIONS

We conclude that the proposed development is feasible from a geotechnical standpoint, provided that the conclusions and recommendations presented in this report are incorporated into the project design and specifications. The primary geotechnical concern for the project site is the presence of expansive soil.

6.1 EXPANSIVE SOILS

Based on the results of our exploration, the top 5 to 6 feet of surficial soil is highly expansive (PI = 48). These surficial clays could be subject to volume changes during seasonal fluctuations in moisture content which can cause cracking of foundations and floor slabs. Therefore, foundations and slabs should be designed and constructed to resist the effects of the expansive soil. These effects can be mitigated by moisture conditioning the expansive soil, providing a sufficient thickness of select, non-expansive fill below interior floor slabs. Alternatively, the subgrade soil can be lime treated to reduce expansion potential.

6.2 FOUNDATION AND SETTLEMENT

Based on the field investigation results, the native black clay is capable of support the proposed structure but the foundation will need to be deepened below the zone of severe moisture change. The foundation loads are not available when preparing this report but considering the proposed structure will be single story, the loads should be relatively light. We therefore conclude the proposed building can be supported on individual interior spread footings and continuous perimeter footings.

We estimate total settlement of shallow foundations with allowable bearing capacity presented in subsequent section will be on the order of 1-inch with differential settlement of about ½ inch between conventionally spaced columns (approximately 15 to 20 feet). However, the settlement should be verified when the building loads becomes available in future design phase.

6.3 CONSTRUCTION DURING WET WEATHER CONDITIONS

If construction proceeds during or shortly after wet weather conditions, the moisture content of the on-site soils could be appreciable above optimum. Consequently, subgrade preparation, placement and/or reworking of the on-site soil as structural fill might not be possible. Alternative wet weather construction recommendations can be provided by the geotechnical engineer in the field at the time of construction, if appropriate.

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7.0 RECOMMENDATIONS

7.1 SEISMIC DESIGN CRITERIA

The proposed structure should be designed to resist the lateral forces generated by earthquake shaking in accordance the 2013 California Building Code (CBC). The site seismic design criteria were determined based on the site latitude and longitude using the public domain U.S. Seismic Design Maps, developed by the USGS. Based on the subsurface conditions encountered at the site and the "Site Class Definitions" per the 2013 CBC, Site Class D (Stiff Soil) should be assumed for design. Seismic design parameters are presented in Table 3.

Table 2. Seismic Design Parameters per 2013 California Building Code.

Parameter Description	Parameter	Value
Mapped MCE Spectral Acceleration Parameters (Site Class B)	S_s	1.652
	S_1	0.760
Site Coefficients	F_a	1.000
	F_v	1.500
MCE Spectral Acceleration Parameters	S_{MS}	1.652
	S_{M1}	1.140
Design Spectral Acceleration Parameters	S_{DS}	1.101
	S_{D1}	0.760

Site Coordinates: Latitude: 37.4835, Longitude: -122.2188

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7.2 SITE PREPARATION AND EARTHWORK

7.2.1 Clearing and Site Preparation

All concrete and asphalt pavements and other existing structural elements within new improvement areas should be removed during site demolition. Where practical, existing utilities to be abandoned should be removed or relocated. If pipes are too deep to be removed economically, we recommend they be filled with cement and sand grout or equivalent material that will prevent future collapse of the pipe. Existing foundation elements should be removed within a distance of at least three feet beneath new foundation elements. Holes resulting from the removal of underground obstructions extending below the proposed finish grades should be cleared and backfilled with properly compacted fill as described in Section 7.2.4 *Fill Placement and Compaction*. If contaminated materials are encountered, they should be properly disposed of offsite.

7.2.2 Subgrade Preparation

Following stripping and excavation, the exposed native soils beneath the proposed pavements, and exterior slabs-on-grade should be scarified to a depth of 8 inches, moisture conditioned to slightly above optimum water content (1 to 2 percent), and compacted to the requirements presented in Section 7.2.4 Fill Placement and Compaction. Within the structure footprint, and beneath interior slabs-on-grade, the highly expansive soils of the finished grade should be excavated and replaced with select fill as recommended in Section 7.4 Concrete Slabs-On-Grade. The select fill should extend at least 5 feet beyond the building footprint unless the adjacent surfaces are paved.

In order to achieve satisfactory compaction in the subgrade and any fill materials, it may be necessary to adjust the water content at the time of construction. This may require that water be added to soils that are too dry, or that scarification and aeration be performed in any soils that are too wet.

The compacted subgrade should be firm and unyielding, and should be protected from damages caused by construction activities, traffic or weather.

7.2.3 Fill Materials

The onsite fill and native sand excavated during site grading should be suitable for reuse as fill or backfill provided it contains no debris, organic material, or rocks greater than three inches in greatest dimension.

The native sandy lean clay or clay with sand below the highly expansive black clays (approximately 5 to 6 bgs) may be used as general fill except below the slabs-on-grade and/or footings where import fill is required. Import fill, if needed, should consist of non-hazardous soil, free of organic matter, that contains no rocks or lumps larger than three inches in greatest dimension, has a liquid limit less than 40 and plasticity index less than 12, and should be approved by the geotechnical engineer.

7.2.4 Fill Placement and Compaction

Structural fill below the footings and slabs-on-grade should be compacted to at least 95 percent relative compaction as determined by ASTM D-1557. The fill materials should be spread and compacted in lifts not exceeding 8 inches in uncompacted thickness. Fill deeper than five feet, or containing less than 10 percent fines should be compacted to at least 95 percent relative compaction. The native sandy lean clay, if used as fill materials (non-structural), should be moisture-conditioned to slightly above optimum moisture content, and compacted to about 90 percent relative compaction.

7.2.5 Utilities and Trench Backfill

Utility trenches should be excavated a minimum of four inches below the bottom of pipes or conduits and have clearances of at least four inches on both sides. Where necessary,

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trench excavations should be shored and braced to prevent cave-ins and in accordance with safety regulations. To provide uniform support, pipes or conduits should be bedded on a minimum of four inches of sand or fine gravel. After pipes and conduits are tested, inspected (if required), and approved, they should be covered with six inches of sand or fine gravel, which should then be mechanically tamped to at least 90 percent relative compaction.

Utility trenches should be backfilled with fill placed in lifts of approximately 8 inches in uncompacted thickness. If on-site soil is used as trench backfill, it should be compacted to at least 95 percent relative compaction by mechanical means only (no jetting shall be allowed). Imported sand can be used for trench backfill if it is compacted to at least 95 percent relative compaction, and sufficient water is added during backfilling operations to prevent the soil from "bulking" during compaction. Special care should be taken when backfilling utility trenches in pavement areas. Poor compaction may cause excessive settlements resulting in damage to the pavement section.

Where utility trenches backfilled with sand enter building pads, the trenches should be backfilled by an impermeable plug at the exterior wall foundation. The plugs can be composed of compacted clayey soil, compacted bentonite, or a bentonite-cement or sand-cement slurry mixture. The plugs should be at least 2 feet thick and should extend at least 2 feet beyond the edges and bottom of the trench to 'key in' the plug. The plug should also extend to within 1 foot of the lowest adjacent grade.

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7.2.6 Surface Drainage

Positive surface gradients of at least 2 percent should be provided adjacent to the building to direct surface water away from foundations and slabs toward suitable discharge facilities. Ponding of surface water should not be allowed adjacent to the structure or on pavements. Runoff water from roof downspouts should be collected in solid pipes and directed well away from all foundation systems and toward suitable discharge or collection points.

7.3 FOUNDATIONS

The new prefabricated steel structure can be supported on conventional isolated and strip footings bearing on the stiff to very stiff fat clay or the sandy lean clay 3 feet below the lowest adjacent soil subgrade. The deepened footing is to reduce the potential for movement due to shrinking and swelling of the expansive clay. The footings may be designed for allowable pressures as shown in Table 3.

Footings located adjacent to other existing footings or utility trenches should bear below an imaginary 1.5:1 (horizontal: vertical) plane projected upward from the bottom edge of the adjacent footing or utility trench.

Table 3. Allowable Bearing Pressures for Spread Footings

Load Conditions	Allowable Bearing Pressure (psf)
Dead Load	2,000
Dead plus Live Loads	3,000
Total Loads (including wind or seismic)	4,000

Lateral loads on the mat can be resisted by a combination of passive resistance acting against the vertical faces of the mat and friction along the base of the footing. Frictional resistance can be calculated as 0.35 times the vertical dead load on the base of the footing. A passive resistance determined using an equivalent fluid pressure of 300 pounds per square foot per foot of depth (psf/ft.) acting against the vertical face of the foundations could be used. The upper foot should be ignored unless it is confined by a slab.

The footing subgrade should be free of standing water, debris, and disturbed materials prior to placing concrete. Any visible cracks in the bottoms of the foundation excavation should be closed by wetting prior to construction of the foundations. We recommend that the foundation excavation be observed by geotechnical engineer prior to placing reinforcing steel or concrete to confirm the subgrade condition.

7.4 CONCRETE SLABS-ON-GRADE

Due to the highly expansive nature of the surficial black clays, we recommend that for interior slabs-on-grade be supported on a minimum of 30 inches of non-expansive fill (Section 7.2.3) compacted to 95 percent relative compaction. Slab reinforcing should be provided in accordance with the anticipated use and loading of the slab. Alternatively, a structural slab (e.g. post-tensioned) can be designed according to 2013 California Building Code Section 1808A.6.2 to resist the expansive nature of the soil with a plasticity index of 48.

The final soil subgrade beneath the select fill and slabs-on-grade should be scarified to a depth of eight inches; moisture conditioned to slightly above optimum moisture content, and compacted to about 90 percent relative compaction. The subgrade surfaces should be proof-rolled to provide a smooth, unyielding surface for slab support. Soft, disturbed materials should be excavated and removed during final subgrade preparation.

In the area where it is important to minimize the migration of moisture through the slab, particularly where floor coverings will be used, a moisture barrier should be provided between the slab and subgrade. We recommend that the moisture barrier consist of 4 inches of free-draining gravel or crush rock, such as ¾-inch, clean uniformly graded gravel or equivalent overlain by a minimum 10-mil thick, impermeable membrane that is placed between the subgrade soil and the slab. The membrane should be covered with 2 inches of sand for protection during construction and for concrete curing purposes. The sand overlying the membrane should be dry at the time concrete is placed. Excess water trapped in the sand

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could eventually be transmitted as vapor through the slab. If rain is forecast prior to pouring the slab, the sand should be covered with plastic sheeting to avoid wetting.

7.5 WINTERIZATION

If grading of the site is performed during the rainy season, lime treatment or placement of gravel fill may be required to provide a stable, workable subgrade for construction activities. Gravel fill is typically placed by overexcavating to a depth of 12 to 18 inches, placing a geotextile fabric, such as Mirafi 500x or equivalent at the bottom of the overexcavation and backfilling with a gravel material to stabilize it and bridge over the clayey soil. The gravel should consist of well-graded crushed rock or a free-draining aggregate base material.

7.6 FLEXIBLE PAVEMENT DESIGN

We expect the final soil subgrade in asphalt-paved areas will generally consist of compacted clay of high plasticity. California Department of Transportation (Caltrans) flexible pavement design method was used to develop the recommended flexible pavement sections. We assumed a Traffic Index (TI) of 4.5 to 6.5, the T.I. is representative of light traffic with occasional trucks. These Tis should be confirmed by the project civil engineer. For preliminary design purpose and based on the laboratory test results, an R-value of 7 was selected.

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Table 4. Flexible Pavement Designs

Traffic Index (T.I.)	Flexible Pavement Section – R-value 7	
	AC Thickness (inches)	Class 2 AB (R =78) Thickness (inches)
4.5	3.0	7.5
5.5	4.0	9.5
6.5	5.0	11.0

The upper six inches of soil subgrade should be scarified to a depth of at least six inches, moisture-conditioned to slightly above the optimum moisture content, compacted to about 90 percent relative compaction where native expansive soil is exposed at subgrade level, and at least 95 percent if import fill is used. The subgrade should be rolled to provide a smooth non-yielding surface. The aggregate base (AB) should conform to Section 26 of Caltrans Standard Specifications and be compacted to at least 95 percent relative compaction.

8.0 LIMITATIONS

Our services consist of professional opinions, conclusions, and recommendations that are made in accordance with generally accepted geotechnical engineering principles and practices. This representation is in lieu of all other warranties, either expressed or implied.

We understand this geotechnical study is for conceptual design, should changes be made during final design, the recommendations presented in this report may need to be updated and additional field investigations may be warranted. Variations may exist and conditions not observed or described in this report could be encountered during construction. Our conclusions and recommendations are based on the observed conditions. If conditions other than those described in this report are encountered, we should be notified so that additional recommendations, if warranted, can be provided.

This report has been prepared for the exclusive use of San Mateo County Department of Public Works and its consultants for specific application to the proposed Redwood City Motor Pool project, as described herein. In the event that there are any changes in the ownership, nature, design or location of the project, or if any future additions are planned, the conclusions and recommendations contained in this report should not be considered valid unless (1) the project changes are reviewed by Fugro Consultants, and (2) conclusions and recommendations presented in this report are modified or verified in writing. Reliance on this report by others (future design team) must be at their risk, unless we are consulted on its use or limitations. We cannot be responsible for the impacts of any changes in geotechnical standards, practices, or regulations subsequent to performance of our services without our further consultation. We can neither vouch for the accuracy of information supplied by others, nor accept consequences for unconsulted use of segregated portions of this report.

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9.0 REFERENCES

Association of Bay Area Government (ABAG) http://gis.abag.ca.gov/website/Hazards/?hlyr=cgsLndsldZones

Bray and Sancio, 2006, Assessment of the Liquefaction Susceptibility of Fine-Grained Soils, Journal of Geotechnical and Geoenvironmental Engineering, ASCE, in press.

California Building Code, 2013.

California Department of Transportation (Caltrans), 2012, Highway Design Manual dated May.

California Department of Transportation (Caltrans), 2010, Standard Specification.

California Geological Survey (2006), Seismic Hazard Zone Report for the Palo Alto 7.5-Minute Quadrangle, San Mateo and Santa Clara Counties, California.

Seed, R.B., K, O., Cetin, R.E.S., Moss, A., Kammerer, J., Wu, J.M., Pestana, M.F., Riemer, R.B., Sancio, J.D., Bray, R.E., Kayen, R.E., Faris, A. (2003), “Recent advances in soil liquefaction engineering: a unified and consistent framework”, Keynote Address, 26th Annual Geotechnical Spring Seminar, Los Angeles Section of the Geo-Institute, American Society of Civil Engineers, H.M.S. Queen Mary, Long Beach, CA.

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PLATES

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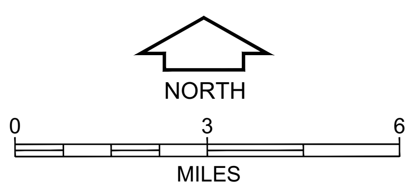
BASE MAP SOURCE: Vicinity Map is based on an image downloaded from Google Earth Pro, dated 11/20/2014



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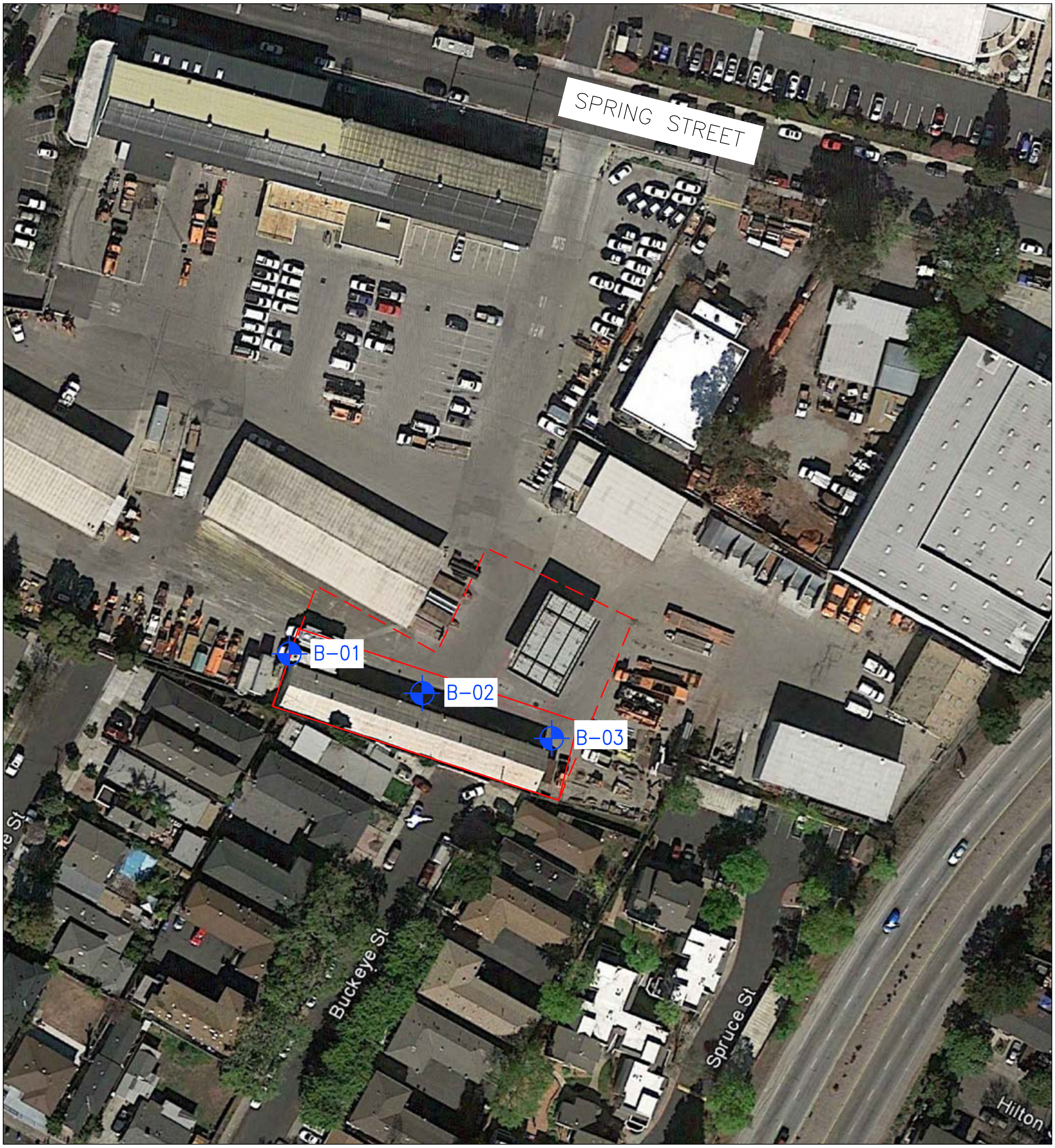
VICINITY MAP
Redwood City Motor Pool
Redwood City, California



BASE MAP SOURCE: Site Plan is based on an image downloaded from Google Earth Pro, dated 11/20/2014

LEGEND

B–03 Approximate Boring location

Approximate Study Area

Approximate location of Proposed New Structure

NORTH

0 100

FEET

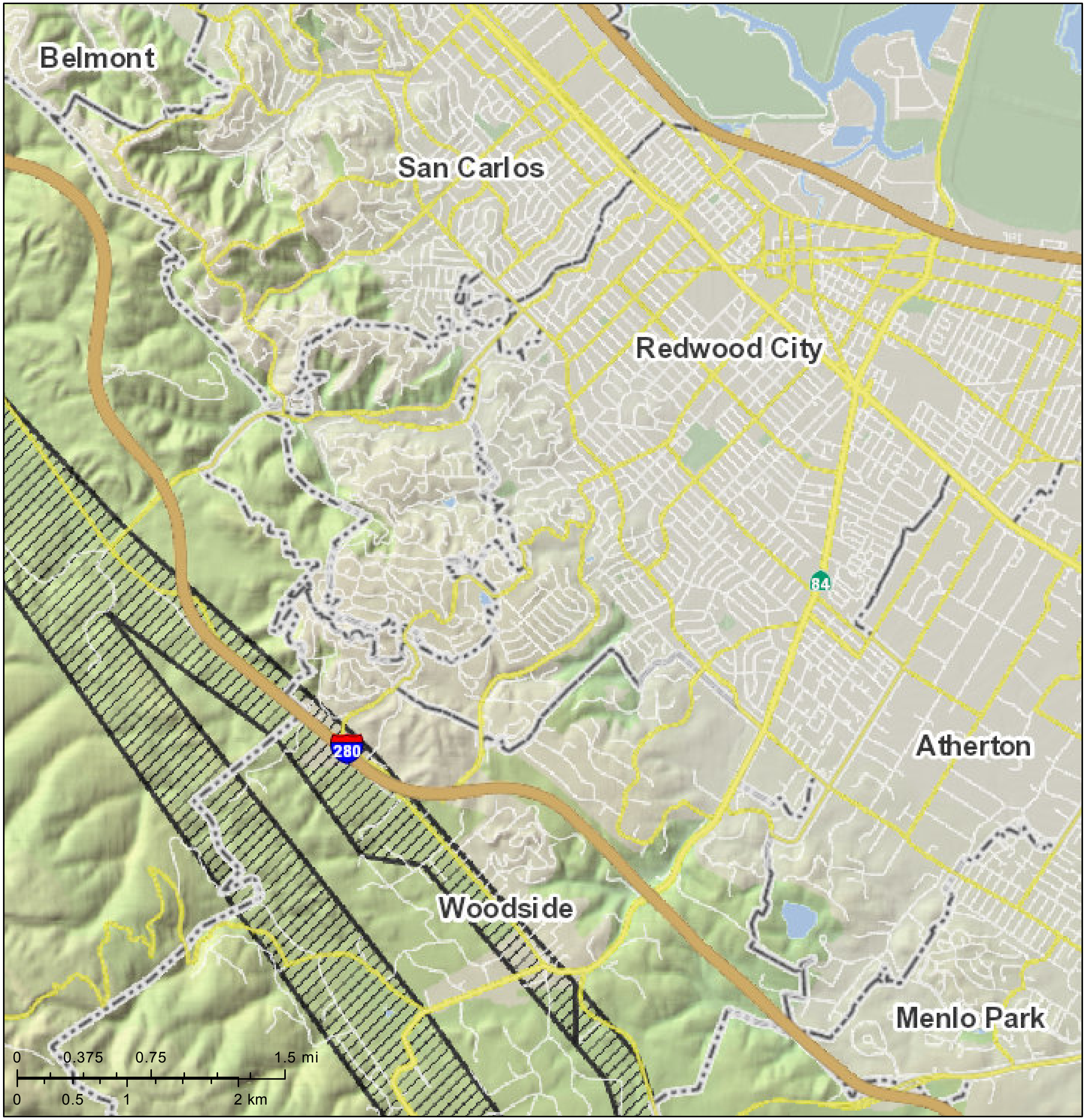
SITE PLAN
Redwood City Motor Pool
Redwood City, California

G:\jobdocs\04.72140058 Redwood City Motor Pool\Drawings\A04.72140058_Plate02.dwg 12-03-2014 - 5:03pm

San Francisco Bay Area Hazards

Legend

Alquist-Priolo Fault Zone



This map is intended for planning only and is not intended to be site specific. Rather, it depicts the general risk within neighborhoods and the relative risk from community to community.

earthquake and hazards program
Association of Bay Area Governments

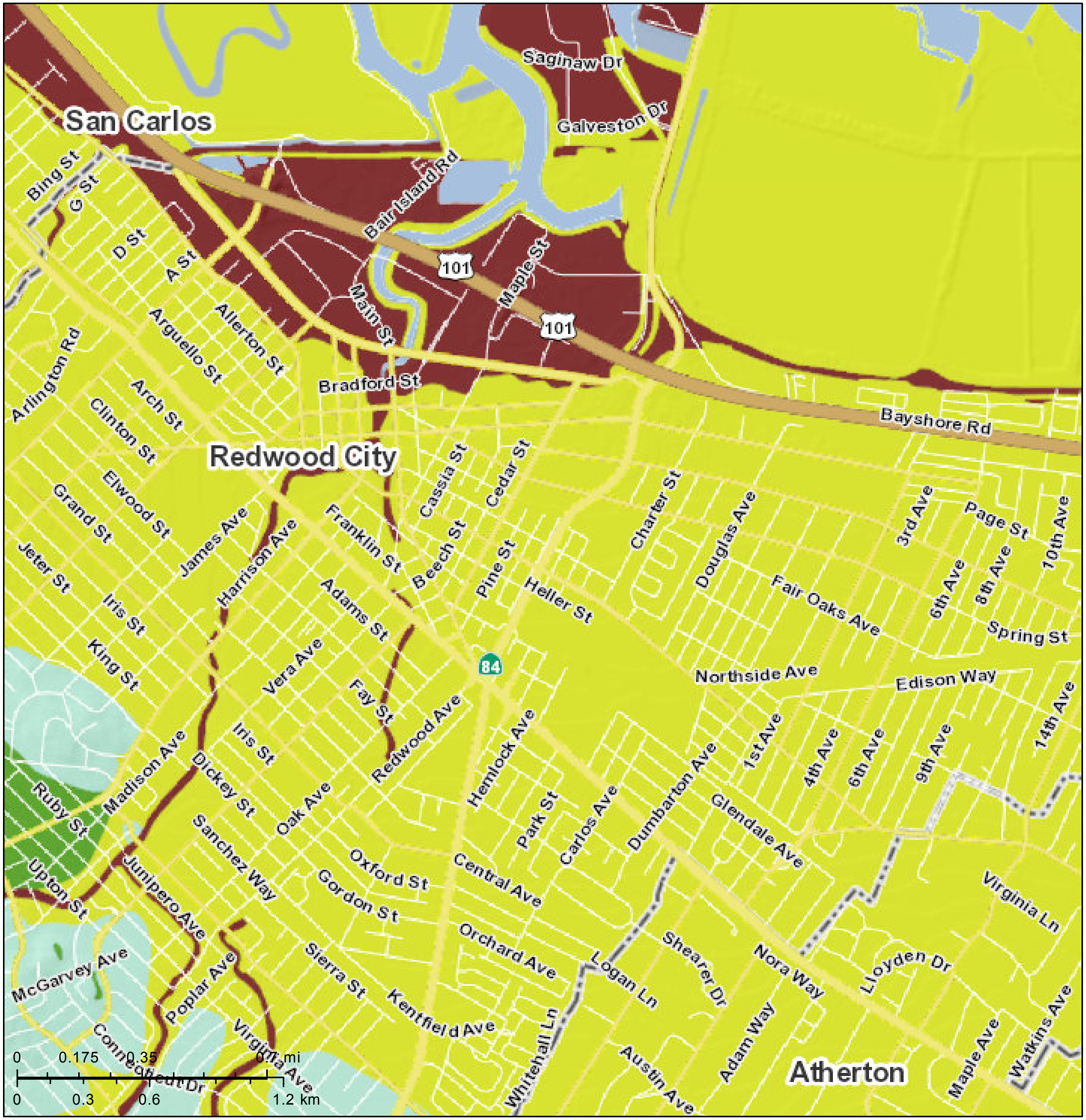
December 4, 2014

ABAG GIS

San Francisco Bay Area Hazards

Legend

- Alquist-Priolo Fault Zone
- Very High
- High
- Moderate
- Low
- Very Low
- Water Bodies



This map is intended for planning only and is not intended to be site specific. Rather, it depicts the general risk within neighborhoods and the relative risk from community to community.

earthquake and hazards program
Association of Bay Area Governments

December 4, 2014

ABAG GIS

APPENDIX A
FIELD INVESTIGATION

DRAFT

APPENDIX A
FIELD INVESTIGATION

Our field investigation consisted of a site reconnaissance and a subsurface exploration program including three exploration borings. The exploratory borings were performed by Exploration Geoservices, using a Mobile Drill B-53 track-mounted drill rig equipped with hollow stem augers. Three 8-inch diameter exploratory borings were drilled on October 30, 2014, to maximum depths of 21½ feet.

The approximate locations of the borings are shown on the Site Plan, Plate 2. Soils encountered in the borings were continuously logged in the field by our staff engineer. The soils are classified in accordance with the Unified Soil Classification System (ASTM D 2487). The logs of borings (A1) are included in this appendix.

Representative soil samples were obtained from the borings at selected depths. The samples were obtained using either a Modified California sampler (3.0-inch outside diameter (O.D.), 2.5-inch inside diameter (I.D.)) or a Standard Penetration Test (SPT) sampler (2.0-inch O.D., 1.4-inch I.D.) split-spoon sampler (ASTM D 1586). In the laboratory, we reexamined the samples from the borings and selected appropriate specimens for physical property testing. We also checked our field classifications and made corrections, as appropriate

Resistance blow counts were obtained with the samplers by dropping a 140-pound hammer through a 30-inch free fall using an automatic hammer system. The sampler was driven 18 inches, and the number of blows was recorded for each 6 inches of penetration. The blows-per-foot recorded on the boring logs represent the accumulated number of blows that were required to drive the last 12 inches. Due to the large diameter of the Modified California sampler, and the use of the automatic hammer system, the blow counts recorded for this sampler are not standard penetration resistance (N) values.

DRAFT

CLASSIFICATION AND MATERIAL SYMBOLS

MAJOR DIVISIONS PER ASTM D2488-06			MAJOR GROUP NAMES AND MATERIAL SYMBOLS	
COARSE-GRAINED SOILS More than 50% retained on the No. 200 sieve	GRAVELS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	Clean gravels less than 5% fines	GW	Well-Graded GRAVEL
			GP	Poorly Graded GRAVEL
		Gravels with more than 12% fines	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SANDS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	Clean sand less than 5% fines	SW	Well-Graded SAND
			SP	Poorly Graded SAND
		Sands with more than 12% fines	SM	SILTY SAND
			SC	CLAYEY SAND
FINE-GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid Limit Less than 50%		ML	SILT
			CL	Lean CLAY
			OL	ORGANIC SILT
	SILTS AND CLAYS Liquid Limit Greater than 50%		MH	Elastic SILT
			CH	Fat CLAY
			OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			PT	Peat or Highly Organic Soils

Notes:
Classification of soils on the boring logs is in general accordance with ASTM D2488, or D2487 if appropriate laboratory data are available.
The geologic formation is noted in bold font at the top of interpreted interval on the boring logs.

OTHER MATERIAL SYMBOLS

- Debris or Mixed Fill
- Pavement with Aggregate Base

SAMPLER TYPE

SPT (Driven) 1-3/8" ID 2" OD	Modified California (Driven) 2-3/8" ID 3" OD	Modified California (Driven) 1-7/8" ID 2-1/2" OD
Shelby Tube (Pushed) 2-7/8" ID 3" OD	Pitcher Barrel (Rotary-cut) 2-7/8" ID	Osterberg (Piston) 2-7/8" ID
101 Geobarrel (Rotary-cut) 2-7/8" ID	Rock Core (Rotary-cut) See log for size	Vibracore (Vibrated) See log for size
Push-core (Pushed) See log for size	Collected from Auger	Other See log for details

Note: Refer to text of report for additional details or other sampler types.

BLOW COUNT

Number of blows required to drive sampler each of three 6-in. intervals, as measured in the field (uncorrected). An SPT hammer (140 lb., falling 30-in.) was used unless otherwise noted on the boring log. For example:

Blow Count	Description
5 7 8	5, 7, and 8 blows for first, second, and third interval, respectively.
35 50/3"	35 blows for the first interval. 50 blows for the first 3 inches of the second interval. Lack of third value implies that driving was stopped 3 inches into the second interval.
WOH WOH 5	"WOH" indicates that the weight of the hammer was sufficient to advance the sampler over the first two intervals. 5 blows were required to advance the sampler over the third interval.

N-VALUE

The N-Value represents the blowcount for the last 12 inches of the sample drive if three 6-inch intervals were driven. N-value presented is independant of impact energy. If 50 hammer blows were insufficient to drive through either the second or the third interval, the total number of blows and total length driven are reported (excluding the first interval). "ref" (refusal) indicates that 50 blows were insufficient to drive through the first 6-inch interval.

Parenthesis indicate that an approximate correction has been applied for non-SPT drive samplers. For example, a factor of 0.63 is commonly used to adjust blow counts obtained using a 3-inch outside diameter modified California sampler to correspond to Standard Peneteration Test.

UNDRAINED SHEAR STRENGTH

A value of undrained shear strength is reported. The value is followed by a letter code indicating the type of test that was performed, as follows:

U - Unconfined Compression
Q - Unconsolidated Undrained Triaxial
T - Torvane
P - Pocket Penetrometer
M - Miniature Vane
F - Field Vane
R - R-value

OTHER TESTS

Field or laboratory tests without a dedicated column on the boring log are reported in the Other Tests column. A letter code is used to indicate the type of test. For certain tests, a value representing the test result is also provided. Typical letter codes are as follows. Additional codes may be used. Refer to the report text and the laboratory testing results for additional information.

k - Permeability (cm/s)
Consol - Consolidation
Gs - Specific Gravity
MA - Particle Size Analysis
EI - Expansion Index
OVM - Organic Vapor Meter

WATER LEVEL SYMBOLS

- Initial water level
- Final water level
- Seepage encountered

INCREASING MOISTURE CONTENT

Dry
Moist
Wet

CONSISTENCY OF COHESIVE SOIL

CONSISTENCY	UNDRAINED SHEAR STRENGTH (KIPS PER SQUARE FOOT)
Very Soft	< 0.25
Soft	0.25 to 0.50
Medium Stiff	0.50 to 1.0
Stiff	1.0 to 2.0
Very Stiff	2.0 to 4.0
Hard	> 4.0

Note: In absence of test data, consistency has been estimated based on manual observation.

APPARENT DENSITY OF COHESIONLESS SOIL

APPARENT DENSITY	N-VALUE
Very Loose	0 to 4
Loose	5 to 9
Medium Dense	10 to 29
Dense	30 to 49
Very Dense	> 49

TERMS AND SYMBOLS USED ON BORING LOGS

PLATE A-1

LOCATION:
Redwood City, CA
N 37.48351667 W 122.2192528
SURFACE EL: 15.0 ft +/- (rel. MSL datum)

DEPTH, ft	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
					7.2" Asphalt							
					14" Aggregate Base Material							
					Fat CLAY (CH): stiff to very stiff, black, dry							
5		10 12 15	17	18/18"	Lean CLAY with SAND (CL): stiff to very stiff, olive brown, dry, fine to medium grain, low plasticity transition to light brown		17					
10		5 6 8	9	18/18"			22	80				MA
15		5 7 9	10	18/18"	SANDY Lean CLAY (CL): stiff, light brown, moist to wet, fine to medium grain, low to medium plasticity	102	25	66				MA
20		13 15 17	20	18/18"	CLAYEY SAND with GRAVEL (SC): medium dense to very dense, brown, wet, gravel size quarter of an inch, medium-large grain sands		12	13				MA
		19 27 36	63	18/18"								

NOTES:
1. Terms and symbols defined on Plate A-1.

FCLP STANDARD LOG G:\JOBDOCS\04.72140058 REDWOOD CITY MOTOR POOL\FIELD\BORINGS\4DECEMBER2014 0472140058.GPJ OGEM_LIB_JAN2012.GLB 12/4/14 12:06 p

BORING DEPTH: 21.5 ft
BACKFILL: Grout
DEPTH TO WATER: 13.0 ft
FIELDWORK DATE: October 30, 2014
DRILLING METHOD: 8-in. dia. Hollow Stem Auger

HAMMER TYPE: Wire-Line
RIG TYPE: Mobile Drill B-53
DRILLED BY: Exploration Geoservices, Inc.
LOGGED BY: H Stadem
CHECKED BY: T. Wong

LOG OF BORING NO. B-01
Redwood City Motor Pool
Redwood City, California

LOCATION:

Redwood City, CA
N 37.48343056 W 122.2189611
SURFACE EL: 15.0 ft +/- (rel. MSL datum)

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
						7.2" Asphalt							
						14" Aggregate Base Material							
						Fat CLAY (CH): stiff to very stiff, black, dry to moist							
5			8 10 14	15	7/18"		95	29	90	62	48		
						SANDY Lean CLAY (CL): very stiff, light brown, dry to moist, fine to medium grained sand, low plasticity, with black spots							
10			9 10 11	13	15/18"								
15			5 6 6	8	18/18"	medium stiff, wet (groundwater at 13.0 ft)							
						Fat CLAY (CH): soft to medium stiff, light brown, wet							
20			7 3 4	4	15/18"	transition to gray							
			7 9 11	20	18/18"	transition to light brown							

NOTES:
1. Terms and symbols defined on Plate A-1.

FCLP STANDARD LOG G:\JOBDOCS\04.72140058 REDWOOD CITY MOTOR POOL\FIELD\BORINGS\4DECEMBER2014 0472140058.GPJ OGEM_LIB_JAN2012.GLB 12/4/14 12:06 p

BORING DEPTH: 21.5 ft
BACKFILL: Grout
DEPTH TO WATER: 13.0 ft
FIELDWORK DATE: October 30, 2014
DRILLING METHOD: 8-in. dia. Hollow Stem Auger

HAMMER TYPE: Wire-Line
RIG TYPE: Mobile Drill B-53
DRILLED BY: Exploration Geoservices, Inc.
LOGGED BY: H Stadem
CHECKED BY: T. Wong

LOG OF BORING NO. B-02
Redwood City Motor Pool
Redwood City, California

LOCATION:

Redwood City, CA
N 37.483369444 W 122.218725
SURFACE EL: 15.0 ft +/- (rel. MSL datum)

DEPTH, ft	MATERIAL SYMBOL	SAMPLER TYPE	BLOW COUNT OR PRESSURE, psi	N VALUE OR RQD%	RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT, pcf	WATER CONTENT, %	% PASSING #200 SIEVE	LIQUID LIMIT, %	PLASTICITY INDEX	UNDRAINED SHEAR STRENGTH, S_u, ksf	OTHER TESTS
						6" Asphalt							
						12' Aggregate Base Material							
						Fat CLAY (CH): very stiff, black, dry, gas odor							
5			6 10 15	16	9/18"								
						SANDY Lean CLAY (CL): stiff, grayish brown, dry to moist, low to medium plasticity, fine to medium grain							
10			6 9 10	12	18/18"	gray streaks from 9'-9.5'	102	24					
						Fat CLAY with SAND (CH): stiff to very stiff, brown, wet, fine to medium grain, with gray streaks							
15			5 6 8	9	18/18"								
20			11 14 16	19	18/18"								

NOTES:
1. Terms and symbols defined on Plate A-1.

FCLP STANDARD LOG G:\JOBDOCS\04.72140058 REDWOOD CITY MOTOR POOL\FIELD\BORINGS\4DECEMBER2014 0472140058.GPJ OGEM_LIB_JAN2012.GLB 12/4/14 12:07 p

BORING DEPTH: 20.0 ft
BACKFILL: Grout
DEPTH TO WATER: 15.0 ft
FIELDWORK DATE: October 30, 2014
DRILLING METHOD: 8-in. dia. Hollow Stem Auger

HAMMER TYPE: Wire-Line
RIG TYPE: Mobile Drill B-53
DRILLED BY: Exploration Geoservices, Inc.
LOGGED BY: H Stadem
CHECKED BY: T. Wong

LOG OF BORING NO. B-03
Redwood City Motor Pool
Redwood City, California

DRAFT

APPENDIX B
LABORATORY TESTING

APPENDIX B
LABORATORY INVESTIGATION

The laboratory testing program was directed towards an evaluation of the physical and mechanical properties of the soils underlying the site.

The natural water content was determined on 4 samples of the materials recovered from the borings in accordance with ASTM Test Designation D2216. These water contents are recorded on the boring logs at the sample depths.

Dry density determinations were performed on 3 samples to evaluate their physical properties. The results of these tests are shown on the boring logs at the sample depths.

The percent of materials passing the #200 sieve was determined on 1 sample to aid in the classification of the soil. The test was performed in accordance with ASTM Test Designation D1140. Gradation analyses, including the #200 sieve, were performed on 2 additional samples. The results of these tests are shown on the boring logs at the sample depths and Laboratory Analysis B-2 through B-4.

Gradation tests were performed on 2 samples of the subsurface soils in accordance with ASTM Test Designation D422. These tests were performed to assist in the classification of the soils and to determine their grain size distribution. The results of these tests are presented on Plate B-2.

Atterberg Limits determinations were performed on 1 sample of the subsurface soils to determine the range of water contents over which this material exhibits plasticity. The Atterberg Limits were determined in accordance with ASTM Test Designation D4318. These values are used to classify the soil in accordance with the Unified Soil Classification System and to indicate the soil's compressibility and expansion potentials. The results of these tests are presented on the boring logs at the appropriate sample depth and Laboratory Analysis Figure B-3.

DRAFT

DRILL HOLE	DEPTH, ft	SAMPLE NUMBER	MATERIAL DESCRIPTION	UWW pcf	UDW pcf	MC%	FINES %	ATTERBURG LIMITS LL	ATTERBURG LIMITS PI	COMPACTION TEST MAX DD pcf	COMPACTION TEST OPT MC %	DIRECT SHEAR C ksf	DIRECT SHEAR PHI deg	COMPRESSIVE STRENGTH TESTS Qu, ksf	COMPRESSIVE STRENGTH TESTS S_u (Cell Prs.) ksf	CORROSIVITY TESTS R	CORROSIVITY TESTS pH	CORROSIVITY TESTS Cl	CORROSIVITY TESTS So_4	R-VALUE	EXPANSION INDEX	SAND EQUIVALENT (SE)	TEST LISTING
B-01	6.0	2	Lean CLAY with SAND (CL) - Olive Brown			17																	M
B-01	9.5	4	Lean CLAY with SAND (CL) - Olive Brown			22	80																M, S
B-01	14.5	6	SANDY Lean CLAY (CL) - Light Olive Brown	128	102	25	66																T, S
B-01	19.0	7	CLAYEY SAND with GRAVEL (SC) - Olive Brown			12	13																M, S
B-02	4.5	1	Fat CLAY (CH) - Black	122	95	29	90	62	48														T, A, F
B-03	9.5	3	SANDY Lean CLAY (CL) - Dark Grayish Brown	127	102	24																	T

Classification Tests
UWW = Unit Wet Weight
UDW = Unit Dry Weight
MC = Moisture Content
Fines = % Passing #200 Sieve
LL = Liquid Limit
PI = Plasticity Index

Direct Shear Test
C = Assigned Cohesion, ksf
PHI = Assigned Friction Angle, degrees

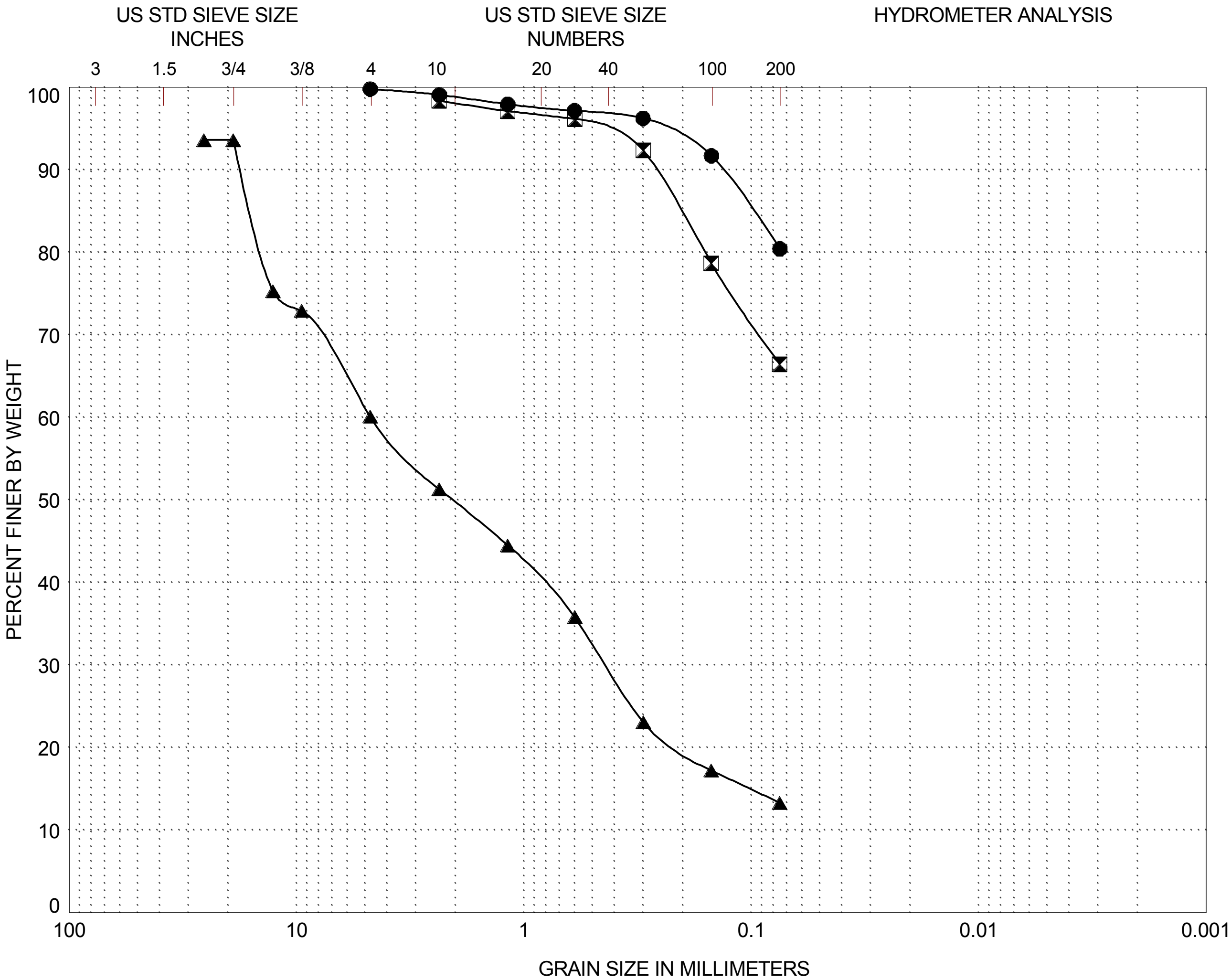
Compaction Test
MAX DD = Maximum Dry Density
OPT MC = Optimum Moisture Content

Compressive Strength Tests
Qu = Unconfined Compression
Su = Undrained Shear Strength
u = Unconsolidated Undrained
p = Pocket Penetrometer
t = Torvane
m = Miniature Vane

Corrosivity Tests
R = Resistivity, ohm-cm, satur.
pH = pH
Cl = Chloride, ppm
SO_4 = Sulfate, ppm

Test Listing Abbreviations
M = Moisture Content
T = Total & Dry Unit Weight
S = Sieve Analysis
FC = % Passing #200 Sieve
H = Hydrometer Analysis
A = Atterberg Limits
P = Compaction Test
D = Direct Shear Test
C = Consolidation Test
Co = Corrosivity Tests
CU = CU Triaxial
U = UU Triaxial
R = R-Value
SE = Sand Equivelant

SUMMARY OF LABORATORY TEST RESULTS
Redwood City Motor Pool
Redwood City, California

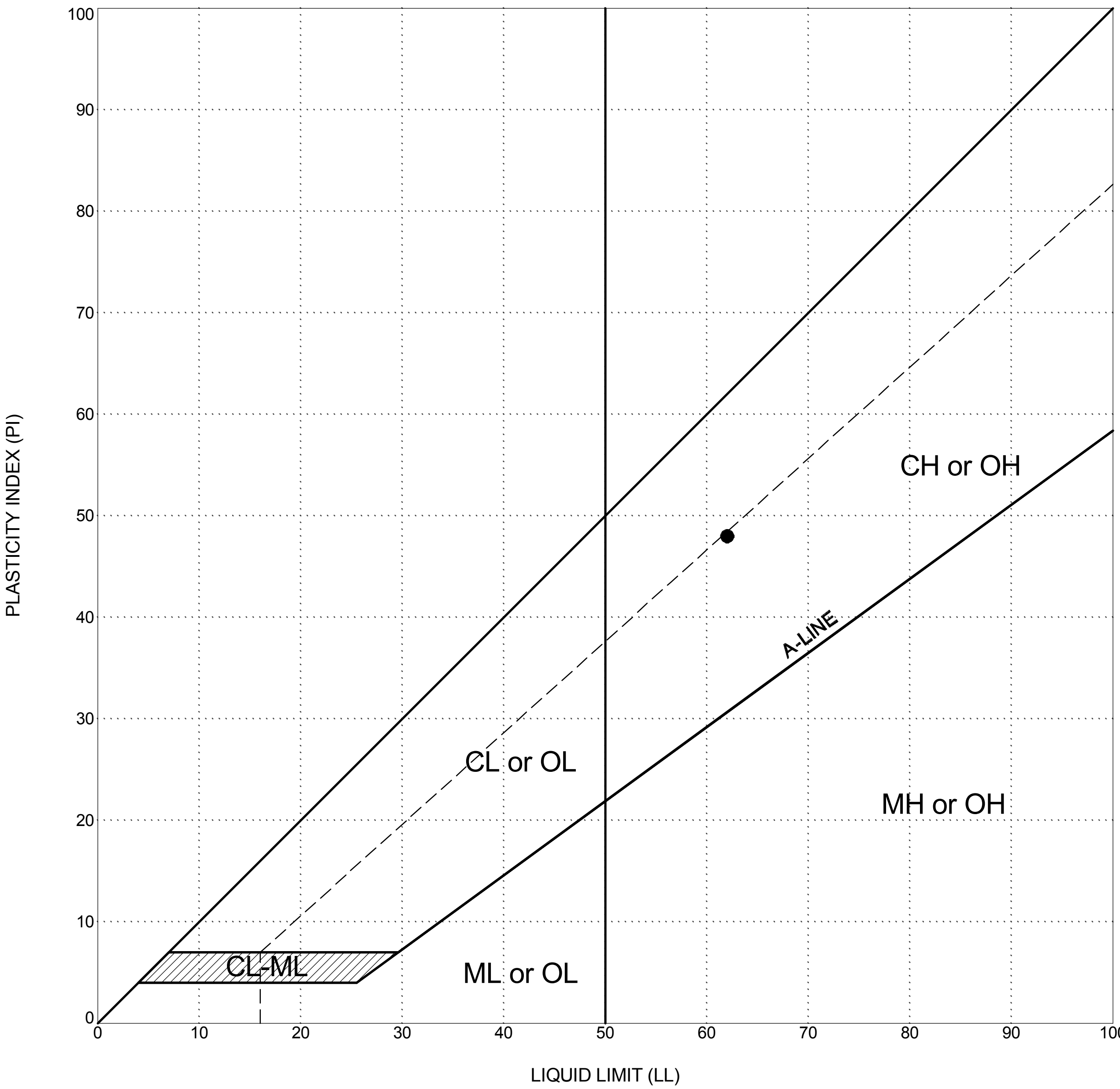


GRAVEL		SAND			SILT or CLAY
Coarse	Fine	Coarse	Medium	Fine	

LEGEND (location)	(depth,ft)	CLASSIFICATION	Cc	Cu	D10	D30	D60
● B-01	9.5	Lean CLAY with SAND (CL) - Olive Brown					
⧗ B-01	14.5	SANDY Lean CLAY (CL) - Light Olive Brown					
▲ B-01	19.0	CLAYEY SAND with GRAVEL (SC) - Olive Brown				0.44	4.71

GRAIN SIZE CURVES
Redwood City Motor Pool
Redwood City, California

PLATE B-2



ATTERBERG LIMITS TEST RESULTS

LEGEND location	depth, ft	CLASSIFICATION	LIQUID LIMIT(LL)	PLASTIC LIMIT(PL)	PLASTICITY INDEX (PI)
● B-02	4.5	Fat CLAY (CH) - Black	62	14	48

PLASTICITY CHART
Redwood City Motor Pool
Redwood City, California

PLATE B-3

SUMMARY OF LABORATORY TEST RESULTS

Project:	Redwood City Motor Pool	**Job Number:**	04.72140058
Address:	Redwood City, California	**Date:**	11/10/2014
Clent:	County of San Mateo		

Sample Number: Bulk #1
Sample Depth: N/A
Sample Description: Black Lean/Fat CLAY w/ Sand (CL/CH)
Source: Onsite/Native
Location Sampled: B-01
Date Sampled: 10/30/2014
Sample By: H. Stadem
Test Methods: ASTM D2844, CT301

RESISTANCE VALUE DATA SUMMARY

Initial Moisture Content: 19.4%

Dry Unit Weight (pcf)	Water Content (%)	Exudation Pressure (psi)	Expansion Pressure (psf)	R-Value
95.5	27.1	288	0	7
99.0	24.7	485	0	10
101.1	22.9	710	0	11

R-value at Exudation Pressure of 300 psi: **7**
R-value by Expansion Pressure: TI = 4 **N/A**

Remarks: R-value by stabilometer controls.
75.3% Passing The #200 Sieve

Distribution:

Fugro Consultants, Inc.

Andrew Bajuniemi / Laboratory Supervisor

APPENDIX C
CORROSION TEST RESULTS

California State Certified Laboratory No. 2153

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

14 November 2014

Job No.1411038
Cust. No.11608

Mr. Matthew Bajuniemi
Fugro Consultants
1000 Broadway, Suite 440
Oakland, CA 94607

Subject: Project No.: 04.72140058
Project Name: Redwood City Motor Pool, Redwood City
Corrosivity Analysis – ASTM Test Methods with Brief Evaluation

Dear Mr. Bajuniemi:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on November 06, 2014. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity 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 ranged from none detected to 39 mg/kg and are determined to be insufficient to attack steel embedded in a concrete mortar coating.

The sulfate ion concentrations ranged from none detected to 68 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 ranged from 8.42 to 8.67, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials ranged from 130 to 240-mV. Sample No.001 is indicative of potentially "moderately corrosive" soils and Sample No.002 is indicative of potentially "slightly corrosive" soils resulting from anaerobic 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

California State Certified Laboratory No. 2153

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

Client: Fugro West, Inc.
Client's Project No.: 04.72140058
Client's Project Name: Redwood City Motor Pool, Redwood City
Date Sampled: 5-Nov-14
Date Received: 6-Nov-14
Matrix: Soil
Authorization: Signed Chain of Custody

Date of Report: 14-Nov-2014

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)*
1411038-001	B-3/1 @ 4.5-5	130	8.67	-	800	-	N.D.	N.D.
1411038-002	B-8/1 @ 4-4.5	240	8.42	-	590	-	39	68

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	13-Nov-2014	11-Nov-2014	-	10-Nov-2014	-	11-Nov-2014	11-Nov-2014

* Results Reported on "As Received" Basis

N.D. - None Detected

Cheryl McMillen
Laboratory Director

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