Stevens Ferrone & Bailey
Engineering Company, Inc

Geotechnical Engineering
Engineering Geology
Storm Water Management
Construction Observation & Testing Services

September 29, 2022

**PRELIMINARY GEOTECHNICAL INVESTIGATION**
**1976 EDGEWATER ROAD**
**SACRAMENTO, CALIFORNIA**
***SFB PROJECT NO. 948-4***

*Prepared For:*

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PO Box 641651
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## 1.0 INTRODUCTION

This report presents the results of our preliminary geotechnical investigation for the proposed residential development located at 1976 Edgewater Road in Sacramento, California as shown on the Vicinity Map, **Figure 1**, and Site Plan, **Figure 2**. The purpose of our preliminary investigation was to evaluate the geological and geotechnical conditions at the site and provide preliminary recommendations regarding the geological and geotechnical engineering aspects of the project for planning and cost estimating purposes.

Based on the information provided by Redwood Residential, it is our understanding that the project will consist of developing two vacant parcels (APN Nos. 275-0231-011 & 275-0240-077) of about 7.3 acres in total area for a new residential development. An existing creek/drainage channel that bisects the site in a north-south direction will remain. The new development will likely consist of several multi-story, at-grade apartment buildings and associated structures. Open space areas, access roads, and parking areas are also anticipated. Some cut and fill grading will be need to create level building pads.

The preliminary conclusions and recommendations provided in this report are based upon the information presented above; Stevens, Ferrone & Bailey Engineering Company, Inc. (SFB) should be consulted if any changes to the project occur to assess if the changes affect the validity of this report.

## 2.0 SCOPE OF WORK

Our preliminary investigation of the site included the following scope of work:

- Reviewing published and unpublished geotechnical and geological literature relevant to the site;
- Reviewing historical topographic maps and aerial images of the site and surrounding area;
- Performing a field reconnaissance of the site and surrounding area;
- Performing a limited subsurface exploration program to log and sample two exploratory borings to a maximum depth of about 46-1/2 feet;
- Performing laboratory testing of soil samples retrieved from the borings;
- Performing preliminary engineering analysis of the field and laboratory data; and
- Preparing this report.

The data obtained and the analyses performed were for the purpose of providing feasibility level geological and geotechnical recommendations for preliminary planning and cost estimating purposes. In the future, a design-level geotechnical investigation will be necessary in order to provide detailed geotechnical design and construction criteria as well as to confirm the preliminary recommendation provided in this report. Evaluating the potential for corrosion and toxicity of onsite soils or groundwater (including mold) were beyond our scope of work. In addition, it was also beyond our scope to evaluate the site flooding potential.

# 3.0 SITE INVESTIGATION

## 3.1 Field Exploration

Our limited geotechnical field exploration program for the project consisted of performing two exploratory borings on September 20, 2022, to a maximum depth of about 46-1/2 feet. The approximate locations of the borings are shown on the Site Plan, **Figure 2**. The borings were performed by West Coast Exploration, Inc. of Escalon, California, using a truck-mounted Mobile B-24 drill rig equipped with 4-inch diameter, continuous flight, solid stem augers.

Our field engineer continuously logged the soils encountered in the borings. The soils were classified in general accordance with the Unified Soil Classification System (ASTM D2487 and D2488). Logs of the borings as well as a key for the classification of the soil (**Figure A-1**) are included in **Appendix A**. Upon completion of our field exploration, the borings were backfilled with lean cement grout in accordance with Sacramento County Environmental Management Department requirements.

The approximate locations of our borings were determined by pacing, measurements, and/or alignment from landmark references, and should be considered accurate only to the degree implied by the method used. Latitude and longitude of exploration locations shown on the exploration logs are estimated from online map data from Microsoft; actual locations were not surveyed.

Representative samples were obtained from our exploratory borings at selected depths appropriate to the investigation. Relatively undisturbed samples were obtained using a 3-inch O.D. Modified California split barrel sampler with liners, and disturbed samples were obtained using a 2-inch O.D. Standard Penetration Test (SPT) split spoon sampler without liners. All samples were transported to our geotechnical laboratory for evaluation and appropriate testing. Both sampler types are indicated in the "Sampler" column of the exploration logs as designated in **Figure A-1**.

Resistance blow counts (N-value) were obtained in our borings with the samplers by dropping a 140-pound safety hammer through a 30-inch fall with rope and cathead. The sampler was driven 18 inches and the number of blows were 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, or the number of inches indicated where hard resistance was encountered. Blow counts recorded on the boring logs have been converted to equivalent SPT field blow counts. A sampler barrel size correction factor of 0.6 was applied to the blow counts from the Modified California sampler. The recorded blow counts have not been corrected for other factors, such as hammer efficiency, borehole diameter, rod length, overburden pressure, and fines content.

It should be noted that changes in the surface and subsurface conditions can occur over time as a result of either natural processes or human activity and may affect the validity of the conclusions and recommendations in this report. In addition, our attached exploration logs and related information show our interpretation of the subsurface conditions at the dates and locations indicated, and it is not warranted that they are representative of subsurface conditions at other locations and times.

## 3.2 Laboratory Testing

Our laboratory testing program for the project was directed toward a quantitative and qualitative evaluation of the physical and mechanical properties of the soils underlying the site. This program included the following testing:

- Four moisture content and dry unit weight determinations per ASTM D2937.
- Two Atterberg Limits determinations (plastic and liquid limits) per ASTM D4318.
- One sieve and hydrometer test per ASTM D422.
- Two passing No. 200 sieve analyses per ASTM D1140.
- Two unconfined compressive strength tests per ASTM D2166.

All tests were performed by our geotechnical laboratory in Concord, California. The results of the testing are included on the exploration logs and plotted laboratory results are also included in **Appendix B**.

## 3.3 Surface Conditions and Site Development History

As shown on **Figure 2** and at the time of our investigation, the site was bounded by Edgewater Road and residential developments on the west, Expo Parkway South/Highway 160 access on the south, residential developments and Canterbury Road on the east, and Southgate Road on the north. A City of Sacramento well and pump facility (Well-110) has been reported to be located near the site's northeastern corner.

The site was irregular in shape and had a plan area of about 7.3 acres with maximum dimensions of about 800 feet by 700 feet. An existing creek/drainage channel bisected the site in a north-south direction. The site's surface grades to the west of the creek were generally level; the surface grades to the east of the creek sloped slightly downward toward the west and northwest.

At the time of our field exploration, the site was vacant except for a community garden that occupied the southwestern corner of the site. Storm drain manholes were also observed within the southwestern portion of the site. Most of the site's ground surface had been disked or tilled. The surface soils were dry and loose. Abundant large and small diameter trees were located throughout the area to west of the creek. Scattered trees were also located in the area to the east of the creek.

The existing southerly flowing creek/drainage channel was about 15 to 30 feet wide and 5 to 10 feet deep with steep embankment slopes. At the time of our field exploration, water ponded in portions of the channel. Heavy vegetation with various degrees of bank slumping, scouring, and erosion were observed within and along the channel.

Based on our review of historical topographic maps and aerial photographs of the site and vicinity, most of the existing developments surrounding the site were built between the 1950's and 1970's. The site does not appear to have had any previous developments in the past, other than possibly annual vegetation disking and tilling. The site and vicinity were generally used for agricultural farming prior to the 1950's. The existing creek/drainage channel might have been realigned to the current configuration at an unknown time before 1930's. The previous creek/drainage channel alignment may vary from the current configuration.

## 3.4 Subsurface Conditions

Our Boring B-1, located within the southwestern portion of the site, encountered stiff to hard sandy silts and clays that extend to a depth of about 17 feet below ground surface. Some thin to very thin silty sand lenses were also encountered within the silt layers. Below the silt and clay layers, medium dense to dense sands with various fine contents were encountered that extended to the maximum depth explored in this boring of about 46-1/2 feet.

Boring B-2, located within the northeastern portion of the site, encountered very stiff to hard clays that extended to the maximum depth explored in this boring of about 21 feet. A dense clayey sand layer was also encountered at depths between about 13 and 17-1/2 feet.

The upper about 2 to 3 feet of surficial soils at the site were dry to very dry, loose, and weak due to the annual disking and tilling. Based on the results laboratory testing of soil samples retrieved from the borings, the surficial silts and clays a medium plasticity and a moderate volumetric expansion and shrinkage potential. The underlying sandy soils are generally non-plastic or have a low plasticity.

Detailed descriptions of soils encountered in our borings are presented on the exploration logs in **Appendix A**. Results of laboratory testing of retrieved onsite soils are also included in the exploration logs as well as in **Appendix B**.

## 3.5 Groundwater

Groundwater was measured in Boring B-1 at a depth of about 46 feet at the end of drilling. No groundwater was encountered in Boring B-2 to the maximum depth explored in this boring of about 21 feet. It should be noted that our borings might not have been left open for a sufficient period of time to establish equilibrium groundwater conditions. Fluctuations in the groundwater level could also occur due to change in seasons, variations in rainfall, water infiltration from the existing creek/drainage channel, pumping of water wells in the surrounding area, and other factors.

According to the California Department of Water Resources (DWR) Sustainable Groundwater Management (SGMA) Data Viewer web application[1], the depth to groundwater in the site region was estimated to be at about 50 to 60 feet in the spring and fall of 2021.

## 3.6 Hydrologic Soil Group

The surface soils of the site have been mapped by the USDA Natural Resource Conservation Services (NRCS) Web Soil Survey (WSS)[2] and categorized into the following three map units:

a) Jacktone clay, drained, 0 to 2 percent slopes (Unit 161), within the northern portion of the site;
b) Columbia sandy loam, drained, 0 to 2 percent slopes (Unit 117), within the southwestern portion of the site; and
c) San Joaquin fine sandy loam, 0 to 3 percent slopes (Unit 211), within the southeastern portion of the site.

The Jacktone clay (Unit 161) and San Joaquin fine sandy loam (Unit 211) have been assigned by USDA, respectively, to Hydrologic Soil Group D and C, and are characterized as having very slow to slow water transmission rates (the estimated transmission rates were not provided). However, the Columbia sandy loam (Unit 117) was assigned to Hydrologic Soil Group A that is characterized as having high water transmission rates (estimated 2 to 6 inch per hour).

Based on results of our field borings and laboratory testing of retrieved onsite soil samples, we preliminarily recommend that onsite near-surface clayey and silty soils be assigned as Hydrologic Soil Group C. Soils in this group have a slow infiltration rate when thoroughly wet. This group of soils consists chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture.

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[1]DWR SGMA, https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels, accessed 9/28/2021.
[2]USDA NRCS, https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx, accessed 9/28/2021.

Actual field infiltration rates will depend on the in-situ soil type, moisture, relative density, gradation, fines content of soils, and whether any water impeding clay layers exist at shallow depth. If needed, we recommend SFB perform Double Ring Infiltrometer Tests (ASTM D3385) to evaluate the actual field infiltration rates. Sandy soil layers that have higher infiltration rates may potentially exist at or near the ground surface within the southern portion of the site.

## 3.7 Geology and Seismicity

According to Gutierrez (2011)[3], the western portion of the site (in lower elevations) is underlain by the Holocene alluvium deposits that consist of sand, gravel, and silt that are poorly to moderately sorted. The eastern portion of the site (in higher elevations) is mapped as underlain by Middle to Late Pleistocene Riverbank Formation that consists of arkosic alluvium composed of sands and silts, forming alluvial terraces, and dissected alluvial fans along streams.

The project site is located in the Sacramento Valley that is considered to be one of the most seismically active regions in the United States. Significant earthquakes that have occurred in the area are believed to be associated with crustal movements along a system of sub-parallel fault zones that generally trend in a northwesterly direction. The site is not located within an Alquist-Priolo Earthquake Fault Zone as designated by the State of California[4], therefore the potential for ground surface rupture due to a fault crossing the site is low.

Earthquake intensities will vary throughout region depending upon numerous factors including the magnitude of earthquake, the distance of the site from the causative fault, and the type of materials underlying the site. The region is subjected to occasional earthquakes that cause strong ground shaking.

According to 2019 CBC/ASCE 7-16, the site modified geometric mean peak ground acceleration ($PGA_M$) from a Maximum Considered Earthquake (MCE) event is estimated to be about 0.31g based on a stiff soil condition (Site Class D). The MCE peak ground acceleration generally has a 2% probability of being exceeded in 50 years (a mean return period of 2,475 years) except where deterministically capped along highly active faults.

According to the U.S. Geological Survey's Unified Hazard Tool and applying the Dynamic: Conterminous U.S. 2014 model (v4.2.0)[5], the resulting deaggregation calculations indicate that the site has a 10% probability of exceeding a peak ground acceleration of about 0.19g in 50 years

[3]Gutierrez, 2011, *Preliminary Geologic Map of the Sacramento 30'x 60' Quadrangle, California*, California Geological Survey.
[4]Bryant and Hart, 2018, Fault-Rupture Hazard Zones in California, CGS Special Publication 42, Revised 2018.
[5]USGS Unified Hazard Tool, https://earthquake.usgs.gov/hazards/interactive/, accessed 9/28/2022.

(a design earthquake ground motion based on a Site Class D with a mean return period of 475 years).
The actual ground surface acceleration might vary depending upon the local seismic characteristics of the underlying bedrock and the overlying soils.

## 3.8 Liquefaction and Lateral Spreading

Soil liquefaction is a phenomenon primarily associated with saturated cohesionless soil layers. These soils can dramatically lose strength due to increased pore water pressure during cyclic loading, such as imposed by earthquakes. During the loss of strength, the soils acquire mobility sufficient to permit both horizontal and vertical movements. Soils that are most susceptible to liquefaction are clean, loose, uniformly graded, saturated sands that lie close to the ground surface; although, liquefaction can also occur in fine-grained soils, such as low-plasticity silts. Lateral spreading occurs when soils liquefy during an earthquake event and the liquefied soils with the overlying soils move laterally to unconfined surfaces (i.e., the existing creek/drainage channel banks), which causes significant horizontal ground displacements.

As of the date of this report, the liquefaction potential of the site and surrounding area has not been evaluated by the State of California[6]. As described previously, groundwater was encountered in our boring B-1 at a depth of about 46 feet. In addition, according to the DWR SGMA Data Viewer web application, the depth to groundwater in the site region was estimated to be at about 50 to 60 feet in the spring and fall of 2021.

Based on our review of available literature and the results of exploratory borings and laboratory testing, it is our opinion that the potential for ground surface damage at the site resulting from liquefaction and/or lateral spreading is low due to the lack of saturated soils at the site within the upper about 46 feet, and the sandy soils encountered by our borings are generally medium dense to dense in consistency.

[6]Seismic Hazards Mapping Act, 1990.

## 4.0 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the preliminary geotechnical investigation, it is our opinion that the site is suitable for the proposed project from a preliminary geotechnical engineering standpoint. The following are the primary geological and geotechnical considerations for use in the preliminary planning, cost estimating, and design of the development.

**WEAK SURFACE SOILS:** The upper two to three feet of surface soils at site have been weakened due to annual vegetation disking and soil tilling, and seasonal volumetric changes caused by soil shrinkage and expansion. In order to reduce the potential for damaging differential settlement of overlying improvements (such as new fills, building foundations, driveways, exterior flatwork, and pavements), we recommend that these weak surface soils be over-excavated and re-compacted. We estimate the process can consist of over-excavating about 2 feet, scarifying and re-compacting the bottom 12 inches in-place, and replacing the excavation with compacted fill materials. Deeper removal may be needed in areas if thicker weak soils or fills are encountered during grading, such as within the buried previous creek/drainage channel alignment if it existed. The over-excavation should extend to depths where competent soil is encountered. There would be no need to over-excavate the soils within areas that do not support improvements, such as within open spaces.

**EXPANSION POTENTIAL:** The more clayey, moderately expansive, surface soil materials will be subjected to volume changes during seasonal fluctuations in moisture content. To reduce the potential for post-construction distress to the proposed structures resulting from swelling and shrinkage of these materials, we recommend that the proposed residential buildings be supported on a foundation system that is designed to reduce the impact of the expansive soils. It should be noted that special design considerations will be required for exterior slabs constructed on expansive soil subgrade.

Depending on the final grade design of the new development, the finished building pads may expose subgrade soils that vary from moderately expansive clays and silts to relatively non-expansive sands. To provide a more uniform subgrade with similar expansion potential for building foundation and surrounding flatwork, we preliminarily recommend a 3-foot thick well-blended, moisture-conditioned engineered fill layer be provided below building pads that are located in areas where exposed subgrade will consist of soils with variable expansion potential. We recommend the engineered fill layers extend at least 5 feet beyond building footprints. The actual extent of the well-blended, moisture-conditioned engineered fill layer should be further evaluated during the design-level geotechnical investigation.

**SETBACK FROM CREEK BANK SLOPES:** In order to reduce the potential for structure and improvement damage caused by scouring and erosion of the existing creek/drainage channel banks, appropriate setbacks should be used. We recommend setbacks be established by projecting a 3:1 (horizontal to vertical) imaginary line from the toe of the existing bank slopes upward toward the proposed development. Where the projected line intersects the finished ground surface, we recommend at-grade structures be setback from the intersection at least 10 feet or 10 feet from the top of slope, whichever is greater. Below-grade structures should be founded below the above described 3:1 imaginary line. Other improvements (such as flatwork and pavements) should be setback from the intersection 5 feet or at least 5 feet from the top of slope, whichever is greater. If it is impractical to setback structures and improvements, appropriate foundations (such as using deepened edges) should be used that are designed and constructed to resist potential downslope ground movements.

During a major earthquake, it should be anticipated that some ground movement toward the toe of the creek bank slopes will occur. We recommend the project's Civil Engineer determine the actual property, building, and improvement setback based upon the recommendations provided in this report, the final grading plans, California Building Code and local ordinances, and any other restrictions such as environmental regulations. Property located between the setback line and the creek may experience movement as a result of creek bank scouring and erosion, localized slumping, and other factors.

**FUTURE DESIGN-LEVEL GEOTECHNICAL ENGINEERING REPORT:** In order to provide detailed geotechnical engineering design and construction criteria for the project, we recommend additional borings be performed at the site. Soil samples should be retrieved for additional laboratory testing and analyses. The results of all subsurface explorations and laboratory testing will require thorough geotechnical engineering analyses, and a design-level geotechnical investigation report could then be prepared. This future report would provide all the necessary geotechnical criteria needed to design and construct the project.

## 4.1 Earthwork

The site should be cleared of all obstructions including designated trees and their root systems, and debris. Holes resulting from the removal of underground obstructions extending below the proposed finished grade should be cleared and backfilled with compacted fill materials. Wells (if they exist within the site) should be removed/abandoned in accordance the Sacramento County requirements. From a geotechnical engineering standpoint, any existing trench backfill materials, clay or concrete pipes, and concrete that are removed can be used as new fill onsite provided debris is removed and it is broken up it is broken up to meet the size requirement for fill material. Portions of the site containing vegetation should be disked a few weeks prior to grading; any remaining vegetation that is not removed during disking should be stripped to an appropriate depth to remove these materials.

Proposed grading may result in cut/fill transitions across building pads and differential fill thickness greater than 5 feet below building foundations. In order to reduce the potential for excessive differential movement across the proposed building foundations, we recommend that foundations bear entirely on an engineered fill layer and that no more than 5 feet of differential fill thickness occurs below foundations.

From a geotechnical and mechanical standpoint, onsite soils having an organic content of less than 3 percent by volume can be used as fill. Fill should not contain rocks or lumps larger than 6 inches in greatest dimension with not more than 15 percent larger than 2.5 inches. If needed, imported fill for general use should have a plasticity index of 20 or less. Imported, non-expansive fill should be predominantly granular, have a plasticity index not exceeding 12, and have a significant fines content.

New fill materials that consist of onsite clayey and silty soils will require compacting to between 88 to 92 percent relative compaction and moisture conditioned approximately 3 to 5 percent over optimum water content. The onsite non-expansive sandy soils when used for fills will require compacting to at least 90 percent relative compaction and moisture conditioned approximately 2 to 3 percent over optimum water content. Fill material should be spread and compacted in lifts not exceeding approximately 8 to 12 inches in uncompacted thickness.

Pipeline trenches should be backfilled with fill placed in lifts of approximately 8 to 12 inches in uncompacted thickness. Thicker lifts can be used provided the method of compaction is approved by SFB and the required minimum degree of compaction is achieved. Backfill should be placed by mechanical means only. Jetting is not permitted. The upper 3 feet of trench backfill in foundation, slab, and pavement areas should be entirely compacted to at least 95 percent relative compaction.

We recommend that exterior slabs (including patios, sidewalks, walkways, and driveways) be placed directly on the properly compacted fills. We do not recommend using aggregate base, gravel, or crushed rock below these improvements. If imported granular materials are placed below these elements, subsurface water can seep through the granular materials and cause the underlying soils to saturate, heave, or pipe. Prior to placing concrete, subgrade soils should be moisture conditioned to increase their moisture content to approximately 3 to 5 percent above laboratory optimum moisture (ASTM D-1557). We recommend reinforcing exterior slabs with steel bars in lieu of wire mesh.

## 4.2 Foundation Support

Proposed residential buildings can be supported on post-tensioned slab foundations or footings with interior slab foundations; either foundation type should be designed based on the expansion potential of the onsite soils and fills.

Post-tensioned slab foundations should be at least 10 inches in thickness; the actual slab thickness should be designed by the Structural Engineer. Post-tensioned slabs can be constructed directly on-grade without the need for imported fill or gravel below the post-tensioned slabs.

Footing foundations should be at least 12 inches wide, and bottom of footings should extend to at least 18 inches below the adjacent finished grade where non-expansive soils/fills exist and at least 24 inches below adjacent finished grade where moderately expansive soils/fills exist. Non-expansive fill would be required below interior slabs-on-grade where the slabs are placed over expansive soils/fills; we estimate the thickness of the non-expansive fill to be about 12 inches.

A vapor retarder must be placed between the subgrade soils and the bottom of post-tensioned slabs or interior slabs-on-grade (where footings are used). We recommend the vapor retarder consist of a single layer of Stego Wrap Vapor Barrier 15 mil Class A or equivalent. There is no need to place imported gravel or sand below the vapor retarder.

In order to reduce the potential for vapor transmission through the concrete slab, we recommend the concrete mix design for the slabs have a maximum water/cement ratio of 0.45. If a higher water/cement ratio is being considered, we recommend higher vapor transmission be taken into account in the design and construction of the structures. The actual water/cement ratio may need to be reduced if the concentration of soluble sulfates or chlorides in the supporting subgrade is detrimental to the concrete and/or reinforcing steel.

## 4.3 Retaining Walls

Where walls retain soil, they must be designed to resist both lateral earth pressures and any additional lateral loads caused by surcharging such as building and roadway loads. For retaining walls that need to resist earthquake induced lateral loads from nearby foundations, walls that are to be designed to resist earthquake loads, and any retaining walls that are higher than 6 feet (as required by the 2019 California Building Code), we recommend the walls also be designed to resist seismic pressures developed from a design basis earthquake. Some movement of the walls may occur during moderate to strong earthquake shaking and may result in distress as is typical for all structures subjected to earthquake shaking. Walls should be fully-back drained to prevent the build-up of hydrostatic pressures.

Retaining walls and soundwalls can be supported on drilled, cast-in-place, straight shaft friction piers that develop their load carrying capacity in the materials underlying the site. Alternatively, walls can be supported by footing foundations.

## 4.4 Pavement

The onsite, near-surface, more clayey soils are estimated to have an R-values of 5 due to their expansion potential. We anticipate that roadway sections (Traffic Index of 5.0) will consist of approximately 3 inches of asphalt concrete over 11 inches of Caltrans Class 2 baserock. Collector roadways will have thicker pavement sections; the actual pavement thickness will depend upon the traffic indices required by governing agencies.

## 5.0 CONDITIONS AND LIMITATIONS

Future subsurface exploration, laboratory testing, and geotechnical engineering analyses will need to be performed in order to provide detailed geotechnical design and construction criteria for the project and to confirm the preliminary recommendations provided above. The future report should include detailed drainage, earthwork, building foundation, retaining wall and soundwall, flatwork, and pavement recommendations for use in the design and construction of the project. Once the future, detailed investigation is complete, we recommend SFB review the project's designs and specifications to verify that the recommendations presented in the future report have been properly interpreted and implemented in the design, plans, and specifications. We also recommend SFB be retained to provide consulting services and to perform construction observation and testing services during the construction phase of the project to observe and test the implementation of our recommendations, and to provide supplemental or revised recommendations in the event subsurface conditions are different than those described in our reports are encountered. We assume no responsibility for misinterpretation of our recommendations if we do not review the plans and specifications and are not retained during construction.

SFB is not responsible for the validity or accuracy of information, analyses, test results, or designs provided to SFB by others or prepared by others. The analysis, designs, opinions, and recommendations submitted in this report are based in part upon the data obtained from our field work and upon information provided by others. Site exploration and testing characterizes subsurface conditions only at the locations where the explorations or tests are performed; actual subsurface conditions between explorations or tests may be different than those described in this report. Variations of subsurface conditions from those analyzed or characterized in this report are not uncommon and may become evident during construction. In addition, changes in the condition of the site can occur over time as a result of either natural processes (such as earthquakes, flooding, or changes in ground water levels) or human activity (such as construction adjacent to the site, dumping of fill, or excavating). If changes to the site's surface or subsurface conditions occur since the performance of the field work described in this report, or if differing subsurface conditions are encountered, we should be contacted immediately to evaluate the differing conditions to assess if the opinions, conclusions, and recommendations provided in this report are still applicable or should be amended.

This report is a document that has been prepared in accordance with generally accepted geological and geotechnical engineering practices for the exclusive use of Redwood Residential and their consultants for specific application to the proposed residential development project located at 1976 Edgewater Road in Sacramento, California. This report is intended to only represent our preliminary recommendations to Redwood Residential for the project preliminary planning and cost estimating purposes.

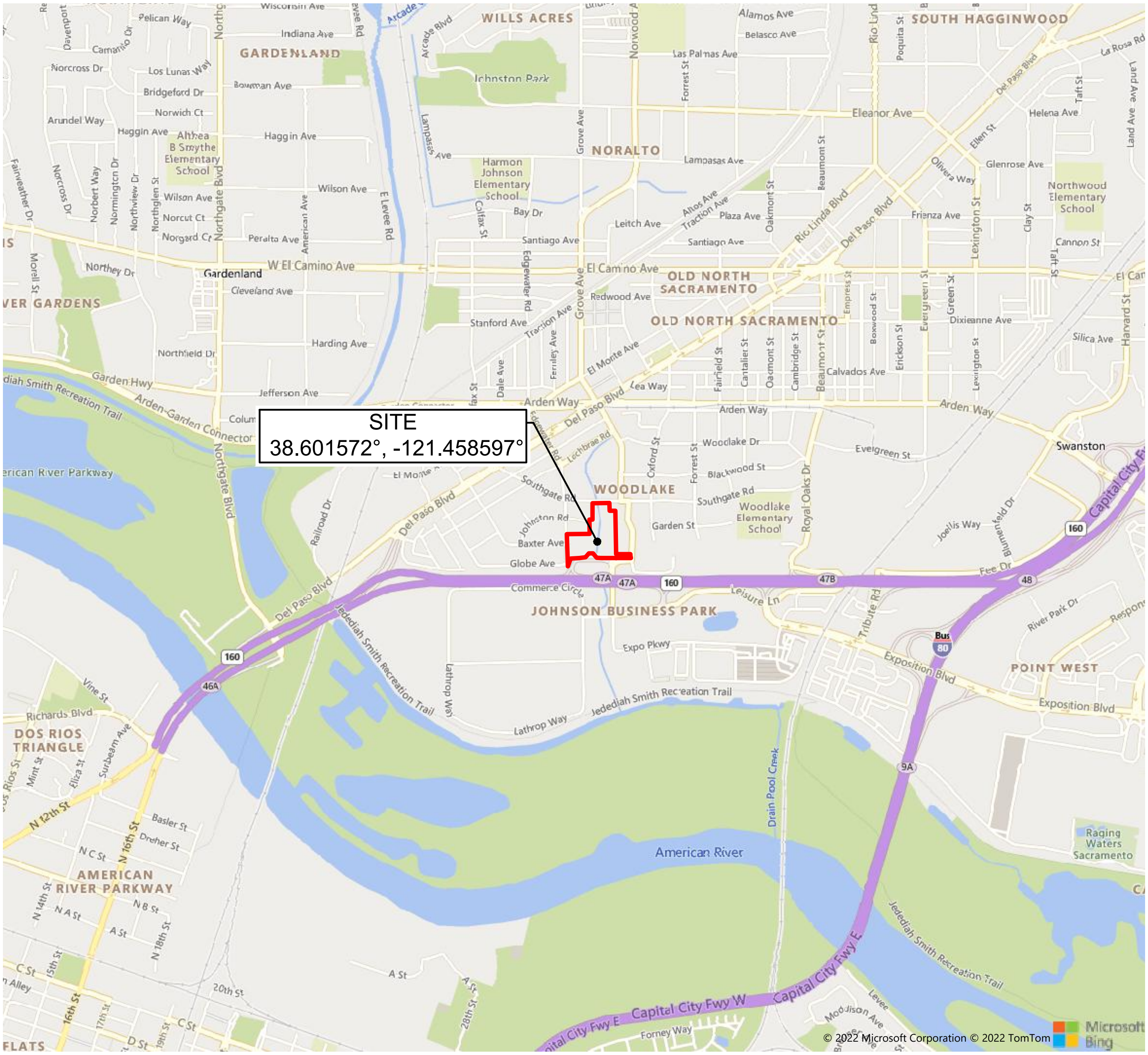
It should be understood that advancements in the practice of geotechnical engineering and engineering geology, or discovery of differing surface or subsurface conditions, may affect the validity of this report and are not uncommon. SFB strives to perform its services in a proper and professional manner with reasonable care and competence but we are not infallible. Geological engineering and geotechnical engineering are disciplines that are far less exact than other engineering disciplines; therefore, we should be consulted if it is not completely understood what the limitations to using this report are.

In the event that there are any changes in the nature or location of the project, as described in this report, the preliminary conclusions and recommendations contained in this report shall not be considered valid unless we are contacted in writing, the project changes are reviewed by us, and the preliminary conclusions and recommendations presented in this report are modified or verified in writing. The opinions, conclusions, and recommendations contained in this report are based upon the description of the project as presented in the introduction section of this report.

This report does not necessarily represent all of the information that has been communicated by us to Redwood Residential and their consultants during the course of this engagement and our rendering of professional services to Redwood Residential. Reliance on this report by parties other than those described above must be at their own risk unless we are first consulted as to the parties' intended use of this report and only after we obtain the written consent of Redwood Residential to divulge information that may have been communicated to Redwood Residential. We cannot accept consequences for use of segregated portions of this report.

Please refer to **Appendix C** for Geoprofessional Business Association (GBA) guidelines regarding use of this report.

# FIGURES





APPROXIMATE SCALE: 1" = 2,000'

0 2,000' 4,000'

NOTE: Basemap from Microsoft/TomTom 2022.

| DATE | Stevens Ferrone & Bailey Engineering Company, Inc | 1600 Willow Pass Court<br>Concord, CA 94520<br>Tel 925.688.1001<br>Fax 925.688.1005<br>www.SFandB.com | VICINITY MAP | FIGURE |
|---|---|---|---|---|
| September 2022 | | | 1976 EDGEWATER ROAD<br>Sacramento, California | 1 |
| PROJECT NO. | | | | |
| 948-4 | | | | |

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Printed: 9/26/2022


KEY

Exploratory Boring by SFB (9/20/2022)

Approximate Project Limit

NOTE: All locations shown are approximate.

N

NOTE: Base map from Sacramento County Assessor's Parcel Maps Book 275 Page 024 & Page 023. Aerial photo imagery from Microsoft 2022.

APPROXIMATE SCALE: 1" = 150'

0 150' 300'

DATE: September 2022

PROJECT NO.: 948-4

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SITE PLAN

1976 EDGEWATER ROAD

Sacramento, California

FIGURE 2

F:\PROJECT DOCUMENTS\CAD\GEOTECHNICAL INVESTIGATION\948-4\948-4, 1976 Edgewater Sacramento - September 2022.dwg
Printed: 9/26/2022

**APPENDIX A**

Field Exploration

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# KEY TO EXPLORATORY BORING LOGS

PROJECT:
**1976 EDGEWOOD ROAD**
Sacramento, CA

PROJECT NO: **948-4**

FIGURE NO: **A-1**

## UNIFIED SOIL CLASSIFICATION SYSTEM

| MAJOR DIVISIONS | | GRAPHIC LOG | GROUP SYMBOL | DESCRIPTION |
|---|---|---|---|---|
| COARSE-GRAINED SOILS (More than 50% of material is larger than #200 sieve) | CLEAN GRAVELS (Less than 5% fines) | | GW | Well-graded gravels or gravel-sand mixtures, little or no fines |
| | | | GP | Poorly-graded gravels or gravel-sand mixtures, little or no fines |
| | GRAVELS WITH FINES (More than 12% fines) | | GM | Silty gravels or gravel-sand-silt mixtures |
| | | | GC | Clayey gravels or gravel-sand-clay mixtures |
| | CLEAN SANDS (Less than 5% fines) | | SW | Well-graded sands or gravelly sands, little or no fines |
| | | | SP | Poorly-graded sands or gravelly sands, little or no fines |
| | SANDS WITH FINES (More than 12% fines) | | SM | Silty sands or sand-silt mixtures |
| | | | SC | Clayey sands or sand-clay mixtures |

| MAJOR DIVISIONS | | GRAPHIC LOG | GROUP SYMBOL | DESCRIPTION |
|---|---|---|---|---|
| FINE-GRAINED SOILS (More than 50% of material is smaller than #200 sieve) | SILTS AND CLAYS (Liquid Limit less than 50%) | | ML | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts of low to medium plasticity |
| | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays |
| | | | OL | Organic silts and clays of low plasticity |
| | SILTS AND CLAYS (Liquid Limit 50% or greater) | | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts of high plasticity |
| | | | CH | Inorganic clays of high plasticity, fat clays |
| | | | OH | Organic silts and clays of medium to high plasticity |
| HIGHLY ORGANIC SOILS | | | PT | Peat and other highly organic soils |

## GRAIN SIZES

U.S. STANDARD SERIES SIEVE — CLEAR SQUARE SIEVE OPENINGS

| | #200 | #40 | #10 | #4 | 3/4" | 3" | 12" |
|---|---|---|---|---|---|---|---|
| SILTS AND CLAYS | SANDS | | | GRAVELS | | COBBLES | BOULDERS |
| | Fine | Medium | Coarse | Fine | Coarse | | |

## RELATIVE DENSITY

| SANDS AND GRAVELS | BLOWS/FOOT* |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 - 10 |
| Medium Dense | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | Over 50 |

## CONSISTENCY

| SILTS AND CLAYS | BLOWS/FOOT* | UCS (KSF)** |
|---|---|---|
| Very Soft | 0 - 2 | 0 - 1/2 |
| Soft | 2 - 4 | 1/2 - 1 |
| Firm | 4 - 8 | 1 - 2 |
| Stiff | 8 - 16 | 2 - 4 |
| Very Stiff | 16 - 32 | 4 - 8 |
| Hard | Over 32 | Over 8 |

*Number of blows for a 140-pound hammer falling 30 inches to drive a 2" O.D. (1-3/8" I.D.) split spoon sampler.
**Unconfined Compressive Strength.

## SYMBOLS AND NOTES

- Standard Penetration Test Sampler (2" O.D. Split Barrel)
- Modified California Sampler (3" O.D. Split Barrel)
- California Sampler (2.5" O.D. Split Barrel)
- Shelby Tube
- Pitcher Barrel
- HQ Core
- Groundwater Level During Drilling
- Groundwater Level at End of Drilling

INCREASING VISUAL MOISTURE CONTENT

Saturated
Wet
Moist
Damp
Dry

| CONSTITUENT PERCENTAGE | |
|---|---|
| trace | < 5% |
| some | 5 - 15% |
| with | 16 - 30% |
| -y | 31 - 49% |

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# EXPLORATORY BORING B-1

| | |
|---|---|
| PROJECT NO: 948-4 | SURFACE ELEVATION: -- |
| LOGGED BY: R. Ceraolo | DATE STARTED: 09/20/22 |
| DRILL RIG: Mobile B-24 | DATE FINISHED: 09/20/22 |
| DRILLING METHOD: 4-inch Solid Flight Auger | DEPTH TO INITIAL WATER: 46 feet |
| HAMMER METHOD: Rope and Cathead | DEPTH TO FINAL WATER: 46 feet |
| HAMMER WEIGHT / DROP: 140 pounds / 30 inches | |
| BORING LOCATION: See Site Plan, Figure 2 (38.601490°, -121.459664°) | |

PROJECT:
**1976 EDGEWATER ROAD**
Sacramento, CA

| DESCRIPTION AND REMARKS | CONSIST | DEPTH (FEET) | SPT N-VALUE | WATER CONTENT (%) | DRY DENSITY (PCF) | UCS (KSF) | OTHER TESTS AND NOTES |
|---|---|---|---|---|---|---|---|
| SILT (ML), brown, some sand (fine- to medium-grained), with roots, dry to damp. | soft<br>stiff | 0 | 12 | 12.9 | 65.5 | 0.6 | At 2 Feet:<br>Liquid Limit = 45<br>Plasticity Index = 16<br>Passing #200 Sieve = 96% |
| SILT (ML), light brown, trace sand (fine-grained), dry.<br>Change color to mottled orange light brown, some sand (fine-grained), with large tree root at 2.5 feet. | stiff | | 8 | | | | |
| Interbedded with thin silty sand lenses (fine-grained) at 6 feet, dry. | | 5 | 11 | 10.1 | 73.9 | | At 6 Feet:<br>Passing #200 Sieve = 34% |
| Dry. | very stiff | 10 | 16 | | | | |
| CLAY (CL/CH), mottled orange gray dark brown, silty, trace sand (fine- to medium-grained), dry to damp. | very stiff | | | | | | |
| CLAY (CL), mottled gray light brown, sandy (fine- to medium-grained), silty, dry. | hard | 15 | 30/6" | | | | |
| SAND (SC), brown, fine- to medium-grained, with clay and silt, dry to damp. | dense | 20 | 34 | | | | |
| SAND (SM), brown, fine- to medium-grained, silty, dry. | dense | 25 | 40 | | | | |
| | | 30 | | | | | |

EXPLORATORY BORING LOG 948-4 B-1.ldat8 STEVENS FERRONE & BAILEY 9/28/2022

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# EXPLORATORY BORING B-1

| | |
|---|---|
| PROJECT NO: 948-4 | SURFACE ELEVATION: -- |
| LOGGED BY: R. Ceraolo | DATE STARTED: 09/20/22 |
| DRILL RIG: Mobile B-24 | DATE FINISHED: 09/20/22 |
| DRILLING METHOD: 4-inch Solid Flight Auger | DEPTH TO INITIAL WATER: 46 feet |
| HAMMER METHOD: Rope and Cathead | DEPTH TO FINAL WATER: 46 feet |
| HAMMER WEIGHT / DROP: 140 pounds / 30 inches | |
| BORING LOCATION: See Site Plan, Figure 2 (38.601490°, -121.459664°) | |

PROJECT:
**1976 EDGEWATER ROAD**
Sacramento, CA

| DESCRIPTION AND REMARKS | CONSIST | GRAPHIC LOG | DEPTH (FEET) | SAMPLER | SPT N-VALUE | WATER CONTENT (%) | DRY DENSITY (PCF) | UCS (KSF) | OTHER TESTS AND NOTES |
|---|---|---|---|---|---|---|---|---|---|
| SAND (SM), continued, with to silty, dry. | medium dense | | | | 24 | | | | |
| SAND (SP), light brown, fine- to medium-grained, trace silt, dry. | dense | | 35 | | 43 | | | | |
| | | | 40 | | | | | | |
| SAND (SM), grayish brown, fine- to medium-grained, silty, moist. | dense | | 45 | | 42 | | | | |
| Bottom of Boring = 46.5 feet<br>Notes: Stratification is approximate, variations must be expected. Blow counts converted to SPT N-values. See report for additional details. | | | 50 | | | | | | |
| | | | 55 | | | | | | |
| | | | 60 | | | | | | |

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# EXPLORATORY BORING B-2

| | |
|---|---|
| PROJECT NO: 948-4 | SURFACE ELEVATION: -- |
| LOGGED BY: R. Ceraolo | DATE STARTED: 09/20/22 |
| DRILL RIG: Mobile B-24 | DATE FINISHED: 09/20/22 |
| DRILLING METHOD: 4-inch Solid Stem Auger | DEPTH TO INITIAL WATER: Not Encountered |
| HAMMER METHOD: Rope and Cathead | DEPTH TO FINAL WATER: Not Encountered |
| HAMMER WEIGHT / DROP: 140 pounds / 30 inches | |
| BORING LOCATION: See Site Plan, Figure 2 (38.602499°, -121.458211°) | |

PROJECT:
**1976 EDGEWATER ROAD**
Sacramento, CA

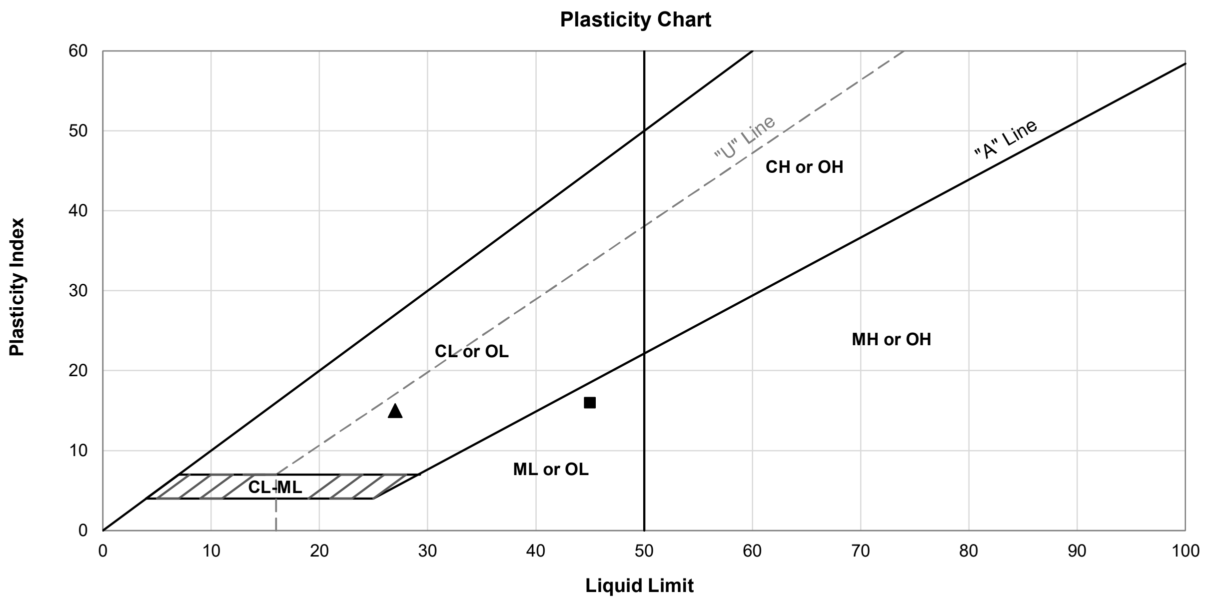
| DESCRIPTION AND REMARKS | CONSIST | GRAPHIC LOG | DEPTH (FEET) | SAMPLER | SPT N-VALUE | WATER CONTENT (%) | DRY DENSITY (PCF) | UCS (KSF) | OTHER TESTS AND NOTES |
|---|---|---|---|---|---|---|---|---|---|
| CLAY (CL), mottled gray brown, silty, sandy (fine- to medium-grained), with roots, dry. | soft | | 0 | | | | | | |
| | | | | | 22 | 7.1 | 104.8 | 6.6 | At 2 Feet: Liquid Limit = 27; Plasticity Index = 15; Medium Sand = 10%; Fine Sand = 30%; Fines = 60% |
| Change color to mottled orange gray dark brown at 2.5 feet. | very stiff | | | | 38 | 8.4 | | | |
| Dry. | hard | | 5 | | 30/6" | | | | |
| CLAY (CL), mottled gray light brown, silty, sandy (fine-grained), trace carbonates, dry to damp. | very stiff | | 10 | | 32 | | | | |
| SAND (SC), grayish brown, fine- to medium-grained, some coarse-grained, with clay and silt, trace gravel (fine, subrounded), dry to damp. | dense | | 15 | | 41 | | | | |
| CLAY (CL), grayish brown, silty, sandy (fine- to medium-grained), damp. | hard | | 20 | | 50/5" | | | | |
| Bottom of Boring = 20.9 feet<br>Notes: Stratification is approximate, variations must be expected. Blow counts converted to SPT N-values. See report for additional details. | | | 25 | | | | | | |
| | | | 30 | | | | | | |

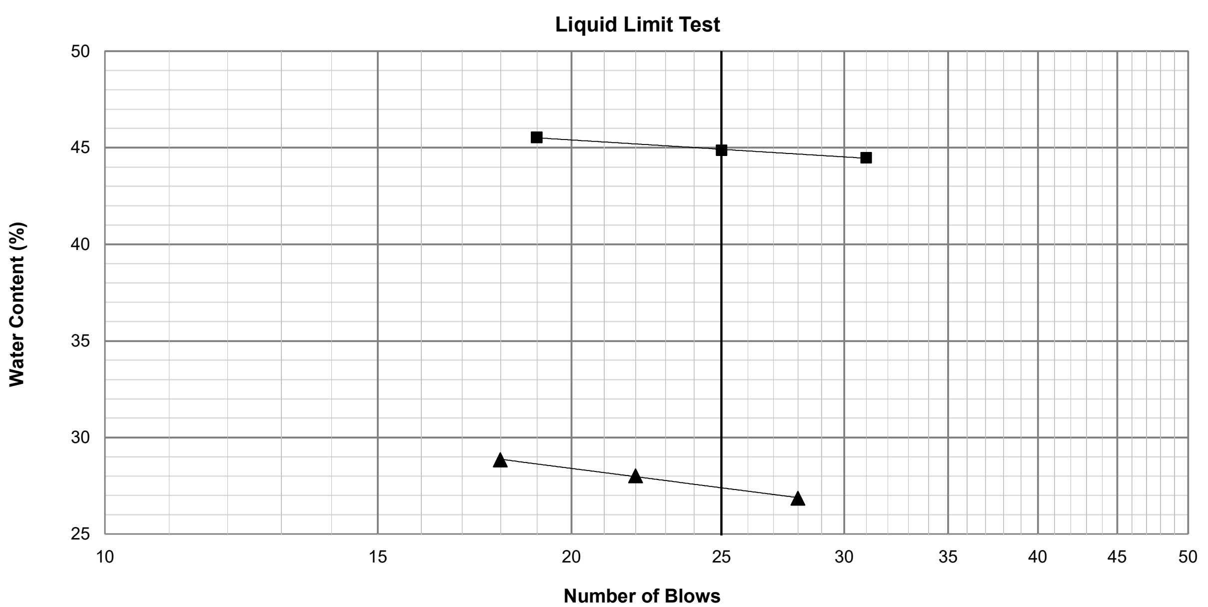
# APPENDIX B

Laboratory Testing

# ATTERBERG LIMITS

**ASTM D4318**




**Test Results**

| Symbol | Sample Source | Sample Description | LL | PL | PI | %≤ #200 | USCS |
|---|---|---|---|---|---|---|---|
| ■ | B-1 at 2 ft | Light brown SILT trace sand | 45 | 29 | 16 | 96.4 | ML |
| ▲ | B-2 at 2 ft | Brown sandy silty CLAY | 27 | 12 | 15 | 60.1 | CL |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Project Info**

Project Number: 948-4

Test Report Date: 9/26/2022

Project Name: 1976 Edgewater Road

Project Location: Sacramento, CA

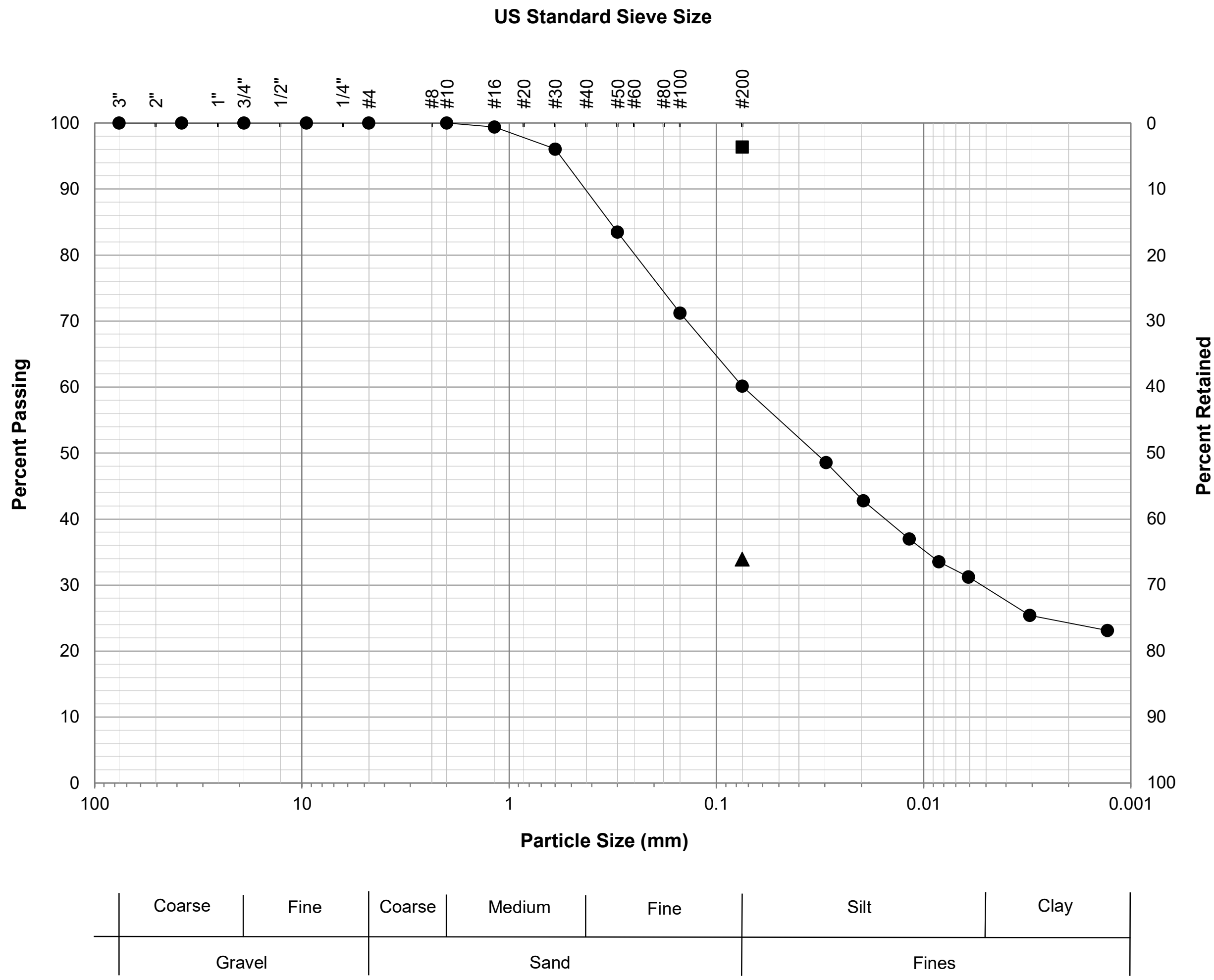
Tested by: R. Tuazon

Checked by: T. Chen

Stevens Ferrone & Bailey Engineering Company, Inc

# PARTICLE SIZE DISTRIBUTION

**ASTM C136, D422 & D1140**




**Test Results**

| Symbol | % >3" | % Gravel Coarse | % Gravel Fine | % Sand Coarse | % Sand Medium | % Sand Fine | % Fines Silt | % Fines Clay | $D_{60}$ | $D_{30}$ | $D_{10}$ | $C_u$ | $C_c$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ■ | | | | | | | 96.4 | | | | | | |
| ▲ | | | | | | | 33.9 | | | | | | |
| ● | 0.0 | 0.0 | 0.0 | 0.0 | 10.2 | 29.7 | 60.2 | | 0.074 | 0.005 | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

**Sample Info**

| Symbol | Sample Source | Sample Description | USCS |
|---|---|---|---|
| ■ | Boring B-1 at 2 ft | Light brown SILT trace sand | ML |
| ▲ | Boring B-1 at 6 ft | Light brown silty SAND | SM |
| ● | Boring B-2 at 2 ft | Brown sandy silty CLAY | CL |
| | | | |
| | | | |

**Project Info**

Project Number: 948-4  Test Report Date: 9/26/2022

Project Name: 1976 Edgewater Road

Project Location: Sacramento, CA

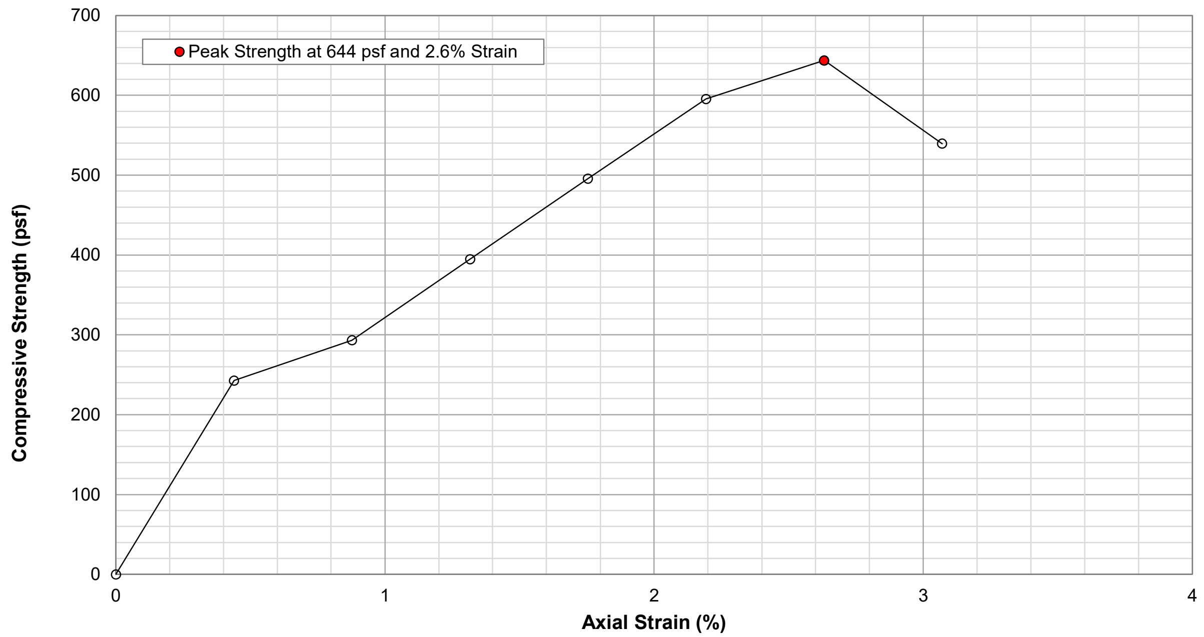
Tested by: R. Tuazon

Checked by: T. Chen

Stevens Ferrone & Bailey Engineering Company, Inc

# UNCONFINED COMPRESSIVE STRENGTH

**ASTM D2166**




**Sample Images**

Before Test

After Test

After Test

**Sample Properties**

| | | |
|---|---|---|
| Sample Description: | Light brown SILT trace sand | |
| Diameter: | 2.42 | in |
| Height: | 5.7 | in |
| Height/Diameter: | 2.36 | |
| Wet Unit Weight: | 74.0 | pcf |
| Water Content: | 12.9 | % |
| Dry Unit Weight: | 65.5 | pcf |

**Test Results**

| | | |
|---|---|---|
| Test Date: | 9/22/2022 | |
| Compressive Strength: | 644 | psf |
| Axial Strain at Failure: | 2.6 | % |
| Test Strain Rate: | 0.05 | in/min |
| Test Time to Failure: | 3 | min |

Remarks: Large tree root within the sample.

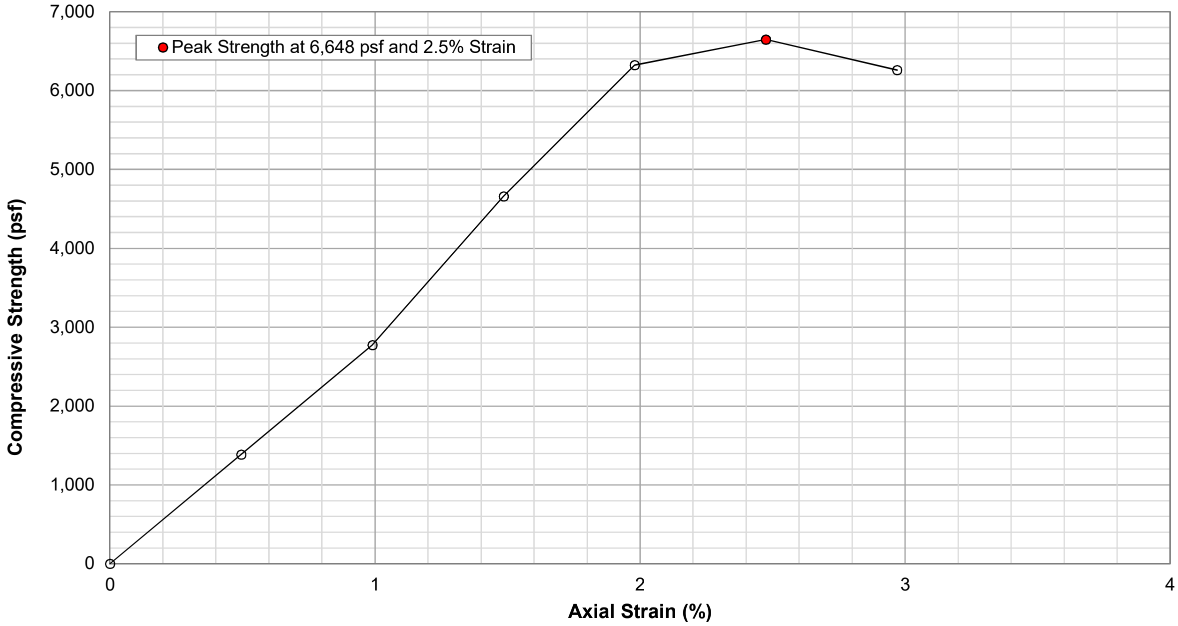
**Project Info**

| | |
|---|---|
| Project Number: | 948-4 |
| Project Name: | 1976 Edgewater Road |
| Project Location: | Sacramento, CA |
| Sample Source/No.: | Boring B-1 |
| Sample Depth: | 2 ft |
| Tested by: | R. Tuazon |
| Checked by: | T. Chen |

Test Report Date: 9/22/2022

# UNCONFINED COMPRESSIVE STRENGTH

**ASTM D2166**




**Sample Images**

Before Test

After Test

After Test

**Sample Properties**

| | | |
|---|---|---|
| Sample Description: | Brown sandy silty CLAY (CL) | |
| Diameter: | 2.42 | in |
| Height: | 5.05 | in |
| Height/Diameter: | 2.09 | |
| Wet Unit Weight: | 112.2 | pcf |
| Water Content: | 7.1 | % |
| Dry Unit Weight: | 104.8 | pcf |

**Test Results**

| | | |
|---|---|---|
| Test Date: | 9/22/2022 | |
| Compressive Strength: | 6,648 | psf |
| Axial Strain at Failure: | 2.5 | % |
| Test Strain Rate: | 0.05 | in/min |
| Test Time to Failure: | 2.5 | min |
| Remarks: | | |

**Project Info**

| | |
|---|---|
| Project Number: | 948-4 |
| Project Name: | 1976 Edgewater Road |
| Project Location: | Sacramento, CA |
| Sample Source/No.: | Boring B-2 |
| Sample Depth: | 2 ft |
| Tested by: | R. Tuazon |
| Checked by: | T. Chen |

Test Report Date: 9/22/2022

## APPENDIX C

GBA Guidelines for Geotechnical Report

# Important Information about This

# Geotechnical-Engineering Report

**Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.**

**While you cannot eliminate all such risks, you can manage them. The following information is provided to help.**

**The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.**

## Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

## Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

*Do not rely on this report* if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

## Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

## You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

## Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

## This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

## This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

## Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

## Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

## Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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