APPENDIX E.2

Geotechnical Report Update

UPDATED GEOTECHNICAL INVESTIGATION

FAIRMOUNT AVENUE FIRE STATION

San Diego, California

Prepared By:
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Providing Professional Engineering Services Since 1959

February 5, 2020

SCST No. 170446P4
Report No. 5

Charles Dellinger
RRM Design Group
3765 S. Higuera Suite 102
San Luis Obispo, California 93401

Subject: UPDATED GEOTECHNICAL INVESTIGATION
FAIRMOUNT AVENUE FIRE STATION
47^{TH} STREET AND FAIRMOUNT AVENUE
SAN DIEGO, CALIFORNIA

Dear Mr. Dellinger:

SCST, LLC (SCST), an Atlas company, is pleased to present our report describing the updated geotechnical investigation performed for subject project. Based on the results of our investigation, we consider the planned construction feasible from a geotechnical standpoint, provided the recommendations of this report are followed. If you have questions, please call us at 619.280.4321.

Respectfully submitted,
SCST, LLC

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EXECUTIVE SUMMARY

This report presents the results of the updated geotechnical and fault trench rupture hazard investigation SCST, LLC (SCST), an Atlas company, performed for the subject project. We understand that the project will consist of the construction of the new Fairmount Avenue Fire Station at the site. The planned construction will consist of a three-story building, retaining walls, and pavements for site access, drop-off, and parking. SCST previously performed a geotechnical investigation (SCST 2019); however, the location of the proposed building was subsequently changed. As such, the purpose of our work is to provide updated conclusions and recommendations regarding the geotechnical aspects of the project and to assess the site for the potential presence of an active fault capable of surface rupture.

We explored the subsurface conditions by excavating eight test pits to depths between about 3 to 12½ feet below the existing ground surface. An approximately 100-foot-long fault trench was also excavated across the site to a depth of about 8 feet. The test pits and trenches were dug using hand tools and a track-mounted excavator. An SCST engineer and geologist logged the test pits and fault trench and collected samples of the materials encountered for geotechnical laboratory testing. SCST tested select samples from the test pits and fault trench to evaluate pertinent soil classification and engineering properties and to assist in developing geotechnical conclusions and recommendations.

The materials encountered in the test pits and fault trench consisted of fill, alluvium, very old paralic deposits, and San Diego Formation. The fill and alluvium were encountered at the ground surface in each of the explorations and extended to depths ranging from about 1 to 12 feet below the existing ground surface. They consisted of a loose to medium dense mix of sand, silt, and gravel with organics, and are considered unacceptable in their current condition for support of structures or structural fill. The very old paralic deposits were encountered below the fill and alluvium in test pit TP-7, extended to the total depth explored of about 3 feet, and consisted of well-indurated sandy claystone. The San Diego Formation was encountered beneath the fill in TP-1 through TP-6, and TP-8 and extended to the full-explored depths of about 3 to 12½ feet. The San Diego Formation consisted of weakly to strongly cemented, silty sandstone and clayey sandstone, and well-indurated sandy claystone. The very old paralic deposits and San Diego Formation are considered acceptable for support of structures or structural fill. Groundwater was not encountered in the test pits.

The main geotechnical considerations affecting the planned development are the presence of potentially compressible material (fill and alluvium), cut/fill transitions, and expansive soils. Additionally, difficult excavation should be anticipated within the alluvium due to the presence of cobbles and boulders, as well as in the cemented very old paralic deposits and San Diego Formation. Caving in the alluvium was encountered during our explorations and should be expected. To reduce the potential for settlement, the existing fill and alluvium should be excavated

EXECUTIVE SUMMARY (Continued)

below the planned structures, settlement sensitive improvements, and new fill. Additionally, the planned buildings should not be underlain by cut/fill transitions or transitions from shallow fill to deep fill. Building footings and concrete slabs should be underlain by at least 2 feet of material with an expansion index of 20 or less. The planned buildings can be supported on shallow spread footings with bottom levels bearing entirely on compacted fill or formation (very old paralic deposits or San Diego Formation). The grading and foundation recommendations presented herein may need to be updated once final plans are developed.

1. INTRODUCTION

This report presents the results of the update geotechnical and fault rupture hazard investigation SCST, LLC (SCST), an Atlas company, performed for the subject project. We understand that the project will consist of the construction of the new Fairmount Avenue Fire Station. The planned construction will consist of a three-story building, retaining walls, and pavements for site access, drop-off, and parking. SCST previously performed a geotechnical investigation (SCST 2019); however, the location of the proposed building was subsequently changed. As such, the purpose of our work is to provide updated conclusions and recommendations regarding the geotechnical aspects of the project. Figure 1 presents a site vicinity map.

2. SCOPE OF WORK

2.1 FIELD INVESTIGATIONS

Our field investigation was limited by environmental constraints. We explored the subsurface conditions by excavating eight test pits to depths between about 3 and 12½ feet below the existing ground surface. An approximately 100-foot-long fault trench was also excavated across the site to a depth of about 8 feet. The test pits and trench were excavated using hand tools and a track-mounted excavator. An SCST engineer and geologist logged the test pits and fault trench and collected samples of the materials encountered for geotechnical laboratory testing. SCST tested select samples from the test pits and fault trench to evaluate pertinent soil classification and engineering properties and to assist in developing geotechnical conclusions and recommendations. Figure 2 shows the approximate locations of the test pits and fault trench. Logs of the explorations are presented in Appendix I. Soils are classified according to the Unified Soil Classification System illustrated on Figure I-1.

2.2 GEOTECHNICAL LABORATORY TESTING

Selected samples obtained from the test pits and the fault trench were tested to evaluate pertinent soil classification and engineering properties and enable development of geotechnical conclusions and recommendations. The laboratory tests consisted of particle-size distribution, sand equivalent, maximum density, expansion index, corrosivity, direct shear, and organic matter. The results of the laboratory tests and brief explanations of the test procedures are presented in Appendix II.

The results of the field and laboratory tests were evaluated to develop conclusions and recommendations regarding:

- Subsurface conditions beneath the site
- Potential geologic hazards
- Criteria for seismic design in accordance with the 2019 California Building Code (CBC)
- Site preparation and grading

- Appropriate alternatives for foundation support along with geotechnical engineering criteria for design of the foundations
- Resistance to lateral loads
- Estimated foundation settlements
- Support for concrete slabs-on-grade
- Lateral pressures for the design of retaining walls
- Pipeline support
- Pavement sections
- Soil corrosivity

3. SITE DESCRIPTION

The site is located north of the intersection of Fairmount Avenue and 47th Street in San Diego, California. Chollas Creek is approximately 550 feet north of the proposed development. Currently, the site consists of vacant land covered in vegetation. Outcrops of the San Diego Formation are exposed on the eastern portion of the site, adjacent to 47th Street. Outcrops of very old paralic deposits are observed south of the site, adjacent to 47th Street. The site generally slopes downward towards the north and west. Site elevations range from about 140 feet at the northern portion of the site to about 200 feet at the southeastern portion of the site.

4. GEOLOGY AND SUBSURFACE CONDITIONS

The site is located within the Peninsular Ranges Geomorphic Province of California, which stretches from the Los Angeles basin to the tip of Baja California. This province is characterized as a series of northwest-trending mountain ranges separated by subparallel fault zones and a coastal plain of subdued landforms. The mountain ranges are underlain primarily by Mesozoic metamorphic rocks that were intruded by plutonic rocks of the southern California batholith, while the coastal plain is underlain by subsequently deposited marine and non-marine sedimentary formations. The site is located within the coastal plain portion of the province and, per published mapping, is underlain by the Plio-Pleistocene-age San Diego Formation (Kennedy and Tan, 2008). However, based on our explorations, site soils consist of fill, alluvium, very old paralic deposits, and Plio-Pleistocene-age San Diego Formation. Figure 3 presents a geologic cross-section. Figure 4 presents the regional geology.

- **Fill/Alluvium:** For purposes of this report, the fill and alluvium are described together and are shown undifferentiated on the logs. The fill and alluvium were encountered at the ground surface in each of the test pits and extended to depths ranging from about 1 to 12 feet below the existing ground surface.

- **Very Old Paralic Deposits:** Very old paralic deposits were encountered beneath the fill in TP-7, extended to the total depth explored of about 3 feet, and consisted of well-indurated sandy claystone.

- **San Diego Formation:** The San Diego Formation was encountered beneath the fill in TP-1 through TP-6, and TP-8 and extended to the full-explored depths of about 3 to 12½ feet. The San Diego Formation consists of weakly to strongly cemented, silty sandstone and clayey sandstone, and well-indurated sandy claystone.

- **Groundwater:** Groundwater was not encountered in our explorations; however, water seepage was encountered in TP-1 at a depth of about 5½ feet. The groundwater table is expected to be below a depth that will influence planned construction. However, groundwater levels may fluctuate in the future due to rainfall, irrigation, broken pipes, or changes in site drainage. Because groundwater rise or seepage is difficult to predict, such conditions are typically mitigated if and when they occur.

5. GEOLOGIC HAZARDS

5.1 CITY OF SAN DIEGO SEISMIC SAFETY MAP

Figure 5 shows the site location on the City of San Diego Seismic Safety Study map (2008). The site is located within or adjacent to areas designated by the city as having Geologic Hazard Categories 12, 32, and 52. Geologic Hazard Category 12 is defined as faults that are potentially active, inactive, presumed inactive, or activity unknown. Category 32 is defined as areas with a low liquefaction potential with fluctuating groundwater and minor drainages. Geologic Hazard Category 52 is defined as level or sloping areas with favorable geologic structure and low risk.

5.2 FAULTING AND SURFACE RUPTURE

Figure 6 shows the site in relation to known active faults in the region. The closest known active fault is the Newport-Inglewood Rose Canyon (Offshore) fault zone located about 4½ miles west of the site. The closest mapped fault is an unnamed fault located across 47th Street, adjacent to the site (City of San Diego, 2008).

This fault is not known to have offset Holocene sediments, indicating it is not an active fault. The State of California does not consider this fault to be active, and an Alquist-Priolo earthquake fault zone has not been established for the fault. In addition, no evidence of faulting was found in our fault trench investigation on site. In our opinion and according to the guidelines of the State of California, the unnamed fault is not a potential source of seismic shaking or ground rupture. The site is not located in an Alquist-Priolo earthquake fault zone.

No active faults are known to underlie or project toward the site; therefore, the probability of fault rupture is low.

5.3 CBC SEISMIC DESIGN PARAMETERS

A geologic hazard likely to affect the project is ground shaking as a result of movement along an active fault zone in the vicinity of the subject site (USGS, 2020). Based on the subsurface conditions encountered during our investigation, the site may be classified as site class D.

For a site class D, a site-specific ground motion analysis is required to be performed in accordance with the requirements of 2019 CBC and ASCE 7-16. As part of the site-specific analysis, base ground motions were evaluated in conjunction with both a Probabilistic Seismic Hazard Analysis (PSHA) and a Deterministic Seismic Hazard Analysis (DSHA) to characterize earthquake ground shaking that may occur at the site during future seismic events.

The PSHA is based on an assessment of the recurrence of earthquakes on potential seismic sources in the region and on ground motion prediction models of different seismic sources in the region. The United States Geological Survey (USGS) unified hazard tool was used to develop a seismic hazard curve and the USGS risk targeted ground motion calculator used to analyze ground motions for corresponding periods. Maximum directional scale factors were applied to the results to develop the probabilistic ground motion model specific to this site.

The DSHA is represented by the 84th percentile of the spectral accelerations for different periods using Pacific Earthquake Engineering Research Center's (PEER) Next Generation Attenuation West-2, Ground Motion Prediction Equations (NGA West 2 GMPE) tool. Fault parameters including the magnitude and width required for the NGA West 2 GMPE tool were obtained from the USGS Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) model. After applying maximum directional scale factors appropriate for each period, the maximum directional deterministic model specific to the site was developed.

Based on the PSHA and DSHA models, the Site-Specific Risk-Targeted Maximum Considered Earthquake (MCER) was taken as the lesser of the spectral response accelerations from the PSHA and DSHA. The design response spectrum and design acceleration parameters were calculated in accordance with the procedures of ASCE 7-16. The site coefficients and maximum considered earthquake spectral response acceleration parameters are presented below. Tabulated values and graphical plots are included in Appendix III.

2019 California Building Code / ASCE 7-16 Seismic Parameters

Site Coordinates	
Latitude	**Longitude**
32.724925°	-117.093923°

Site Coefficients and Spectral Response Acceleration Parameters	Values
Site Class	D
Site Coefficients, F_a	1.063
Site Coefficients, F_v	2.500
Site-Specific Spectral Response Acceleration at Short Period, S_s	1.226g
Site-Specific Spectral Response Acceleration at 1-Second Period, S_1	0.407g
Site-Specific Design Spectral Acceleration at Short Period, S_{DS}	0.869g
Site-Specific Design Spectral Acceleration at 1-Second Period, S_{D1}	0.679g
Site Specific Peak Ground Acceleration, PGA	0.557g

5.4 LANDSLIDES AND SLOPE STABILITY

Evidence of landslides or slope instabilities was not observed or shown on the referenced geologic map.

5.5 LIQUEFACTION AND DYNAMIC SETTLEMENT

Liquefaction occurs when loose, saturated, generally fine sands and silts are subjected to strong ground shaking. The soils lose shear strength and become liquid; potentially resulting in large total and differential ground surface settlements, as well as possible lateral spreading during an earthquake. Provided the remedial grading recommendations of this report are followed and given the relatively dense formational materials underlying the site and the lack of shallow groundwater, the potential for liquefaction and dynamic settlement to occur is considered low.

5.6 TSUNAMIS, SEICHES, AND FLOODING

The site is not located within a mapped area on the State of California Tsunami Inundation Maps (CalEMA, 2009); therefore, damage due to tsunamis is considered negligible. Seiches are periodic oscillations in large bodies of water such as lakes, harbors, bays, or reservoirs. The site is not located adjacent to lakes or confined bodies of water; therefore, the potential for a seiche to affect the site is low.

We reviewed the Flood Insurance Rate Maps via the Federal Emergency Management Agency (FEMA) Flood Hazard Map online database to determine if the subject site location is located within an area susceptible to flooding. A portion of the project site is mapped as being within an area of flood hazard designated as a Zone X. Zone X designates a 0.2% annual chance flood hazard, areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile.

5.7 HYDRO-CONSOLIDATION

Hydro-consolidation can occur in recently deposited (less than 10,000 years old) sediments that were deposited in a semi-arid environment. Examples of such sediments are aeolian sands, alluvial fan deposits, and mudflow sediments deposited during flash floods. The pore space between particle grains can re-adjust when inundated by groundwater causing the material to consolidate. The alluvium at the project site is highly susceptible to hydro-consolidation. However, the recommendations within this report mitigate this geologic hazard. The relatively dense formational materials underlying the site are not susceptible to hydro-consolidation.

6. CONCLUSIONS

The main geotechnical considerations affecting the proposed development are the presence of potentially compressible soils (fill and alluvium), cut/fill transitions, and expansive soils. Additionally, difficult excavation should be anticipated within the alluvium due to the presence of cobbles and boulders, as well as in the cemented very old paralic deposits and San Diego Formation. Caving was encountered during our explorations and should be expected in loose fill and alluvium. Remedial grading will need to be performed to reduce the potential for adverse settlement and distress to the planned structures and improvements. Remedial grading recommendations are provided below. The planned buildings can be supported on shallow spread footings with bottom levels bearing entirely on compacted fill or formation (very old paralic deposits or San Diego Formation).

7. RECOMMENDATIONS

The remainder of this report presents recommendations regarding earthwork construction, as well as preliminary geotechnical recommendations for the design of the proposed structure and improvements. These recommendations are based on empirical and analytical methods typical of the standard-of-practice in southern California. If these recommendations appear not to address a specific feature of the project, please contact our office for additions or revisions to the recommendations.

7.1 EARTHWORK

Grading and earthwork should be conducted in accordance with the CBC and the recommendations of this report. The following recommendations are provided regarding specific aspects of the proposed earthwork construction. These recommendations should be considered subject to revision based on field conditions observed by our representative during grading.

7.1.1 Site Preparation

Site preparation should begin with the removal of existing improvements, topsoil, vegetation, and debris. Subsurface improvements that are to be abandoned should be removed, and the resulting excavations should be backfilled and compacted in accordance with the recommendations of this report. Pipeline abandonment can consist of capping or rerouting at the project perimeter and removal within the project perimeter. If appropriate, abandoned pipelines can be filled with grout or slurry as recommended by and observed by the geotechnical consultant.

7.1.2 Compressible Soils

The existing fill and alluvium should be excavated beneath the planned structures, settlement-sensitive improvements, and new fills. Based on the provided project plans (RRM Design Group, 2019), excavations up to 20 feet deep are anticipated. Horizontally, the excavations should extend at least 10 feet outside the planned perimeter foundations, at least 2 feet outside the planned hardscape and pavements, or up to existing improvements, whichever is less. An SCST representative should observe conditions exposed in the bottom of excavations to determine if additional removals are required.

7.1.3 Cut/Fill Transitions

The planned buildings should not be underlain by cut/fill transitions or transitions from shallow fill to deep fill. Where such transitions are encountered, the very old paralic deposits and/or San Diego Formation should be over-excavated and replaced with compacted fill to provide a relatively uniform thickness of compacted fill beneath the building and reduce the potential for differential settlement. The over-excavation depth should be at least 3 feet below the planned finished pad elevation, at least 2 feet below the deepest planned footing bottom elevation, or to a depth of H/2, whichever is deeper, where H is the greatest depth of fill beneath the structure. Horizontally, the over-excavation should extend at least 10 feet outside the planned footing perimeter or up to existing improvements, whichever is less. Where practical, the bottom of excavations should be sloped toward the fill portion of the site and away from its center. An SCST representative should observe the conditions exposed in the bottom of excavations to evaluate if additional excavation is recommended.

7.1.4 Expansive Soil

The on-site soils tested have expansion indices of 16 and 53. To reduce the potential for expansive heave beneath the building slabs-on-grade, soils with an expansion index of 20 or less should be placed from 3 feet below the deepest planned footing bottom level, or two feet below the proposed bottom of slab elevation, whichever is deeper, to the finished pad grade elevation. Horizontally, the low expansion potential soils should extend at least 5 feet outside the planned footing perimeter or up to existing improvements, whichever is less. Hardscape should be underlain by at least 2 feet of material with an expansion index of 20 or less. Horizontally, the very low expansion potential soils should extend at least 2 feet outside the planned hardscape or up to existing improvements, whichever is less. The on-site silty sands, poorly graded sands, and silty gravel are generally expected to meet the expansion index criteria. The on-site clayey sands and sandy clays are not expected to meet the expansion index criteria.

7.1.5 Compacted Fill

Fill should be moisture conditioned to near optimum moisture content and compacted to at least 90% relative compaction. Fill should be placed in horizontal lifts at a thickness appropriate for the equipment spreading, mixing, and compacting the material, but generally should not exceed 8 inches in loose thickness. The maximum dry density and optimum moisture content for evaluating relative compaction should be determined in accordance with ASTM D1557. Utility trench backfill beneath structures, pavements, and hardscape should be compacted to at least 90% relative compaction. The top 12 inches of subgrade beneath pavements should be compacted to at least 95%.

7.1.6 Imported Soil

Imported soil should consist of predominately granular soil free of organic matter and rocks greater than 6 inches. Imported soil should have an expansion index of 20 or less and should be inspected and, if appropriate, tested by SCST prior to transport to the site.

7.1.7 Excavation Characteristics

It is anticipated that excavations can be achieved with conventional earthwork equipment in good working order. However, difficult excavation should be anticipated within the alluvium due to the presence of cobbles and boulders, as well as in the cemented very old paralic deposits and San Diego Formation. Caving in the alluvium was encountered during our explorations and should be expected. Contract documents should specify that the contractor mobilize equipment capable of excavating and compacting oversized and strongly cemented materials.

7.1.8 Temporary Excavations

Temporary excavations 3 feet deep or less can be made vertically. Deeper temporary excavations in fill or alluvium should be laid back no steeper than 1:1 (horizontal:vertical) and in formational material no steeper than ¾:1 (horizontal:vertical). The faces of temporary slopes should be inspected daily by the contractor's Competent Person before personnel are allowed to enter the excavation. Zones of potential instability, sloughing, or raveling should be brought to the attention of the Engineer and corrective action implemented before personnel begin working in the excavation. Excavated soils should not be stockpiled behind temporary excavations within a distance equal to the depth of the excavation. SCST should be notified if other surcharge loads are anticipated so that lateral load criteria can be developed for the specific situation. If temporary slopes are to be maintained during the rainy season, berms are recommended along the tops of slopes to prevent runoff water from entering the excavation and eroding the slope faces. Slopes steeper than those described above will require shoring. Additionally, temporary excavations that extend below a plane inclined at 1½:1 (horizontal:vertical) downward from the outside bottom edge of existing structures or improvements will require shoring. A shoring system consisting of soldier piles and lagging can be used.

7.1.9 Temporary Shoring

For design of cantilevered shoring, an active soil pressure equal to a fluid weighing 40 pcf can be used for level retained ground or 65 pcf for 2:1 (horizontal:vertical) sloping ground. The surcharge loads on shoring from traffic and construction equipment adjacent to the excavation can be modeled by assuming an additional 2 feet of soil behind the shoring. For design of soldier piles, an allowable passive pressure of 350 psf per foot of embedment over twice the pile diameter up to a maximum of 5,000 psf can be used. Soldier piles should be spaced at least three pile diameters, center to center. Continuous lagging will be required throughout. The soldier piles should be designed for the full anticipated lateral pressure; however, the pressure on the lagging will be less due to arching in the soils. For design of lagging, the earth pressure can be limited to a maximum value of 400 psf.

7.1.10 Temporary Dewatering

Groundwater seepage was found in TP-1 at about 5½ feet and may occur locally due to broken pipes, local irrigation, or following heavy rain. Groundwater should be anticipated in the planned excavations.

7.1.11 Oversized Material

Excavations may generate oversized material. Oversized material is defined as rocks or cemented clasts greater than 6 inches in largest dimension. Oversized material should be broken down to no greater than 6 inches in largest dimension for use in fill, used as landscape material, or disposed of off site.

7.1.12 Slopes

Permanent slopes should be constructed no steeper than 2:1 (horizontal:vertical). Faces of fill slopes should be compacted either by rolling with a sheepsfoot roller or other suitable equipment or by overfilling and cutting back to design grade. Fills should be benched into sloping ground inclined steeper than 5:1 (horizontal:vertical). It is our opinion that cut slopes constructed no steeper than 2:1 (horizontal:vertical) will possess an adequate factor of safety against instability. An engineering geologist should observe cut slopes during grading to ascertain that no unforeseen adverse geologic conditions are encountered that need revised recommendations. Slopes are susceptible to surficial slope failure and erosion. Water should not be allowed to flow over the top of slope. Additionally, slopes should be planted with vegetation that will reduce the potential for erosion.

7.1.13 Surface Drainage

Final surface grades around structures should be designed to collect and direct surface water away from the structure and toward appropriate drainage facilities. The ground around the structure should be graded so that surface water flows rapidly away from the structure without ponding. In general, we recommend that the ground adjacent to the structure slope away at a gradient of at least 2%. Densely vegetated areas where runoff can be impaired should have a minimum gradient of at least 5% within the first 5 feet from the structure. Roof gutters with downspouts that discharge directly into a closed drainage system are recommended on structures. Drainage patterns established at the time of fine grading should be maintained throughout the life of the proposed structures. Site irrigation should be limited to the minimum necessary to sustain landscape growth. Should excessive irrigation, impaired drainage, or unusually high rainfall occur, saturated zones of perched groundwater can develop.

7.1.14 Grading Plan Review

SCST should review the grading plans and earthwork specifications to ascertain whether the intent of the recommendations contained in this report have been implemented and that no revised recommendations are needed due to changes in the development scheme.

7.2 FOUNDATIONS

7.2.1 Shallow Spread Footings

The planned building can be supported on shallow spread footings with bottom levels bearing entirely on compacted fill. As an alternative, shallow spread footings with bottom levels bearing entirely on competent formation can be used. To accommodate bearing on very old paralic deposits or San Diego Formation in areas of deep fills, concrete or 2-sack sand/cement slurry can be placed between the deposits and design bottom of footings.

Footings should extend at least 18 inches below lowest adjacent finished grade. Continuous footings should be at least 12 inches wide. Isolated or retaining wall footings should be at least 24 inches wide. An allowable bearing capacity of 2,500 psf can be used for footings bearing on compacted fill. An allowable bearing capacity of 4,000 psf can be used for footings bearing on formation. The allowable bearing capacity can be increased by 500 psf for each foot of depth below the minimum and 250 psf for each foot of width beyond the minimum up to maximums of 5,000 psf for footings bearing on compacted fill and 7,500 for footings bearing on very old paralic deposits. The bearing value can be increased by ⅓ when considering the total of all loads, including wind or seismic forces. Footings located adjacent to or within slopes should be extended to a depth such that a minimum horizontal distance of 7 feet exists between the lower outside footing edge and the face of the slope.

Lateral loads will be resisted by friction between the bottoms of footings and passive pressure on the faces of footings and other structural elements below grade. An allowable coefficient of friction of 0.35 can be used. Passive pressure can be computed using an allowable lateral pressure of 350 psf per foot of depth below the ground surface for level ground conditions. Reductions for sloping ground should be made. The passive pressure can be increased by ⅓ when considering the total of all loads, including wind or seismic forces. The upper 1 foot of soil should not be relied on for passive support unless the ground is covered with pavements or slabs.

7.2.2 Settlement Characteristics

Total foundation settlements are estimated to be less than 1 inch. Differential settlements between adjacent columns and across continuous footings are estimated to be less than ¾ inch over a distance of 40 feet. Settlements should be completed shortly after structural loads are applied.

7.2.3 Foundation Plan Review

SCST should review the foundation plans to ascertain that the intent of the recommendations in this report has been implemented and that revised recommendations are not necessary as a result of changes after this report was completed.

7.2.4 Foundation Excavation Observations

A representative from SCST should observe the foundation excavations prior to forming or placing reinforcing steel.

7.3 SLABS-ON-GRADE

7.3.1 Interior Slabs-on-Grade

The project structural engineer should design the interior concrete slabs-on-grade floor. However, we recommend that building slabs be at least 5 inches thick and reinforced with at least No. 4 bars at 18 inches on center each way.

Special consideration should be given to interior slabs on grade which will be used for fire truck parking and/or heavy equipment storage. We recommend that these slabs be at least 7½ inches thick. Reinforcement details should be designed by the project structural or civil engineer.

Moisture protection should be installed beneath slabs where moisture sensitive floor coverings will be used. The project architect should review the tolerable moisture transmission rate of the proposed floor covering and specify an appropriate moisture protection system. Typically, a plastic vapor barrier is used. Minimum 10-mil plastic is recommended. The plastic should comply with ASTM E1745. The vapor barrier installation should comply with ASTM E1643. Construction practice often includes placement of a 2-inch-thick sand cushion between the bottom of the concrete slab and the moisture vapor retarder/barrier. This cushion can provide some protection to the vapor retarder/barrier during construction and may assist in reducing the potential for edge curling in the slab during curing. However, the sand layer also provides a source of moisture to the underside of the slab that can increase the time required to reduce vapor emissions to limits acceptable for the type of floor covering placed on top of the slab. The slab can be placed directly on the vapor retarder/barrier.

7.3.2 Exterior Slabs-on-Grade

Exterior slabs should be at least 4 inches thick and reinforced with at least No. 3 bars at 18 inches on center each way. Slabs should be provided with weakened plane joints. Joints should be placed in accordance with the American Concrete Institute (ACI) guidelines. The project architect should select the final joint patterns. A 1-inch maximum size aggregate mix is recommended for concrete for exterior slabs. The corrosion potential of on-site soils with respect to reinforced concrete will need to be taken into account in concrete mix design. Coarse and fine aggregate in concrete should conform to the "Greenbook" Standard Specifications for Public Works Construction.

7.4 CONVENTIONAL RETAINING WALLS

7.4.1 Foundations

The recommendations provided in the foundation section of this report are also applicable to conventional retaining walls.

7.4.2 Lateral Earth Pressures

The active earth pressure for the design of unrestrained retaining walls with level backfill can be taken as equivalent to the pressure of a fluid weighing 40 pcf. The at-rest earth pressure for the design of restrained retaining walls with level backfills can be taken as equivalent to the pressure of a fluid weighing 60 pcf. These values assume a granular and drained backfill condition. Higher lateral earth pressures would apply if walls retain expansive clay soils. An additional 20 pcf should be added to these values for walls with a 2:1 (horizontal:vertical) sloping backfill. An increase in earth pressure equivalent to an additional 2 feet of retained soil can be used to account for surcharge loads from light traffic. The above values do not include a factor of safety. Appropriate factors of safety should be incorporated into the design. If other surcharge loads are anticipated, SCST should be contacted for the necessary increase in soil pressure.

Retaining walls should be designed to resist hydrostatic pressures or be provided with a backdrain to reduce the accumulation of hydrostatic pressures. Backdrains may consist of a 2-foot-wide zone of ¾-inch crushed rock. The backdrain should be separated from the adjacent soils using a non-woven filter fabric, such as Mirafi 140N or equivalent. Weep holes should be provided, or a perforated pipe should be installed at the base of the backdrain and sloped to discharge to a suitable storm drain facility. As an alternative, a geocomposite drainage system such as Miradrain 6000 or equivalent placed behind the wall and connected to a suitable storm drain facility can be used. The project architect should provide waterproofing specifications and details. Figure 7 presents typical conventional retaining wall backdrain details.

7.4.3 Seismic Earth Pressure

If required, the seismic earth pressure can be taken as equivalent to the pressure of a fluid weighing 27 pcf. This value is for level backfill and does not include a factor of safety. Appropriate factors of safety should be incorporated into the design. This pressure is in addition to the un-factored, static active earth pressure. The passive pressure and bearing capacity can be increased by ⅓ in determining the seismic stability of the wall.

7.4.4 Backfill

Wall backfill should consist of granular, free-draining material. Expansive or clayey soil should not be used. Additionally, backfill within 3 feet from the back of the wall should not contain rocks greater than 3 inches in dimension. We anticipate that a portion of the on-site soils will be suitable for wall backfill. Backfill should be compacted to at least 90% relative compaction. Backfill should not be placed until walls have achieved adequate structural strength. Compaction of wall backfill will be necessary to minimize settlement of the backfill and overlying settlement sensitive improvements. However, some settlement should still be anticipated. Provisions should be made for some settlement of concrete slabs and pavements supported on backfill. Additionally, utilities supported on backfill should be designed to tolerate differential settlement.

7.5 MECHANICALLY STABILIZED EARTH RETAINING WALLS

The following soil parameters can be used for design of mechanically stabilized earth (MSE) retaining walls.

MSE Wall Design Parameters

Soil Parameter	Reinforced Soil	Retained Soil	Foundation Soil
Internal Friction Angle	30°	30°	30°
Cohesion	0	0	0
Moist Unit Weight	120 pcf	120 pcf	120 pcf

The reinforced soil should consist of granular, free-draining material with a sand equivalent of 20 or more. The bottom of MSE walls should extend to such a depth that a total of 5 feet exists between the bottom of the wall and the face of the slope. Figure 7 presents a typical retaining wall backdrain detail. MSE retaining walls may experience lateral movement over time. The wall engineer should review the configuration of proposed improvements adjacent to the wall and provide measures to help reduce the potential for distress to these improvements from lateral movement.

7.6 PIPELINES

7.6.1 Thrust Blocks

For level ground conditions, a passive earth pressure of 350 psf per foot of depth below the lowest adjacent final grade can be used to compute allowable thrust block resistance. A value of 150 psf per foot should be used below groundwater level, if encountered.

7.6.2 Modulus of Soil Reaction

A modulus of soil reaction (E') of 1,400 psi can be used to evaluate the deflection of buried flexible pipelines. This value assumes that granular bedding material is placed adjacent to the pipe and is compacted to at least 90% relative compaction.

7.6.3 Pipe Bedding

Pipe bedding as specified in the "Greenbook" Standard Specifications for Public Works Construction can be used. Bedding material should consist of clean sand having a sand equivalent not less than 30 and should extend to at least 12 inches above the top of pipe. Alternative materials meeting the intent of the bedding specifications are also acceptable. Samples of materials proposed for use as bedding should be provided to the engineer for inspection and testing before the material is imported for use on the project. The on-site materials are not expected to meet "Greenbook" bedding specifications. The pipe bedding material should be placed over the full width of the trench. After placement of the pipe, the bedding should be brought up uniformly on both sides of the pipe to reduce the potential for unbalanced loads. No voids or uncompacted areas should be left beneath the pipe haunches. Ponding or jetting the pipe bedding should not be allowed.

7.6.4 Cutoff Walls

Where pipeline inclinations exceed 15 percent, cutoff walls may be necessary in trench excavations. Additionally, we do not recommend that open graded rock be used for pipe bedding or backfill because of the potential for piping erosion. The recommended bedding is clean sand having a sand equivalent not less than 30. Alternatively, 2-sack sand-cement slurry can be used for the pipe bedding. If sand-cement slurry is used for pipe bedding to at least 1 foot over the top of the pipe, cutoff walls are not considered necessary. The need for cutoff walls should be further evaluated by the project civil engineer designing the pipeline.

7.6.5 Backfill

Excavated material free of organic debris and rocks greater than 6 inches in dimension are generally expected to be suitable for use as pipe backfill. Imported material should not contain rocks greater than 4 inches in dimension or organic debris. Imported material should have an expansion index of 20 or less. SCST should observe and, if appropriate, test proposed imported materials before they are delivered to the site. Backfill should be placed in lifts 8 inches or less in loose thickness, moisture conditioned to optimum moisture content or slightly above, and compacted to at least 90% relative compaction. The top 12 inches of soil beneath pavement subgrade should be compacted to at least 95% relative compaction.

7.7 PAVEMENT SECTION RECOMMENDATIONS

Due to anticipated grading and importing of materials at the project site, on-site soils were not evaluated for pavement support characteristics. An R-value of 30 was assumed for design of preliminary pavement sections. The actual R-value of the subgrade soils should be determined after grading and final pavement sections are provided. Based on an R-value of 30, the following pavement structural sections are recommended for the assumed Traffic Indices.

Flexible Pavement Sections

Traffic Type	Traffic Index	Asphalt Concrete (inches)	Aggregate Base (inches)
Parking Stalls	4.5	3	5
Drive Lanes	6.0	4	7
Fire Lanes	7.0	5	8

Portland Cement Concrete Pavement Sections

Traffic Type	Traffic Index	Full-Depth PCC Pavement (inches)
Parking Stalls	4.5	6
Drive Lanes	6.0	7
Fire Lanes	7.0	7½

The top 12 inches of subgrade should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95% relative compaction. All soft or yielding areas should be removed and replaced with compacted fill or aggregate base. Aggregate base and asphalt concrete should conform to the Caltrans Standard Specifications or the “Greenbook” and should be compacted to at least 95% relative compaction. Aggregate base should have an R-value of not less than 78. All materials and methods of construction should conform to good engineering practices.

7.8 PERVIOUS PAVEMENT SECTION RECOMMENDATIONS

Pervious pavement section recommendations are based on Caltrans (2014) pavement structural design guidelines. The pavement sections below are based on the strength of the materials. However, the actual thickness of the sections may be controlled by the reservoir layer design, which the project civil engineer should determine.

Due to anticipated grading and importing of materials at the project site, on-site soils were not evaluated for pavement support characteristics. An R-value of 30 was assumed for design of preliminary pavement sections. The actual R-value of the subgrade soils should be determined after grading and final pavement sections are provided.

Pervious Asphalt Pavement

Traffic Type	Category	*Asphalt Treated Permeable Base (ATPB) (inches)	Class 4 Aggregate Base (inches)
Parking Stalls	B	5½	6
Drive Lanes	B	5½	8½
Fire Lanes	C	6	10½

***1¼ inches of an open-graded friction course (OGFC) should be placed on top of the ATPB.**

Pervious Concrete Pavement

Traffic Type	Category	Pervious Concrete (inches)	Class 4 Aggregate Base (inches)
Parking Stalls	B	6	6
Drive Lanes	B	6	8½
Fire Lanes	C	8½	8½

Permeable Interlocking Concrete Pavers (PICP)

Traffic Type	Category	PICP (inches)	Class 3 Permeable (inches)	Class 4 Aggregate Base (inches)
Parking Stalls	B	3⅛	4½	6
Drive Lanes	B	3⅛	4½	8½
Fire Lanes	C	3⅛	4½	24

The top 12 inches of subgrade should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95% relative compaction. All soft or yielding subgrade areas should be removed and replaced with compacted fill or permeable base. All materials and methods of construction should conform to good engineering practices and the minimum local standards.

We recommend installing deepened curbs or vertical cutoff membranes consisting of 30 mil HDPE or PVC at the edges of pervious pavements to reduce the potential for water-related distress to adjacent structures or improvements. The membrane should extend below the reservoir section. If infiltration is not used, the membrane should also be placed between the subgrade and pervious base, and a suitable subdrain system should be installed.

7.9 SOIL CORROSIVITY

A representative sample of the on-site soils were tested to evaluate corrosion potential. The test results are presented in Appendix II. The project design engineer can use the sulfate results in conjunction with ACI 318 to specify the water/cement ratio, compressive strength and cementitious material types for concrete exposed to soil. A corrosion engineer should be contacted to provide specific corrosion control recommendations.

7.10 PRELIMINARY INFILTRATION

Infiltration testing was not performed as part of our investigation. The infiltration rate of the actual soils that will be encountered at the bottom of stormwater retention basins could vary significantly subsequent to grading. Therefore, basin-specific testing is recommended for design purposes. An adequate safety factor should be applied to the infiltration rate during design of the proposed infiltration facilities. Site characteristics such as excessive slope of the drainage area, fine-grained soil types, and proximate location of the water table may preclude the use of an infiltration basin. Generally, infiltration basins are not suitable for areas with relatively impermeable soils containing clay and silt or in areas with fill. Further observation of the actual basin subgrade soils is recommended following grading. Additionally, infiltration basins will require periodic maintenance to function as intended.

8. GEOTECHNICAL ENGINEERING DURING CONSTRUCTION

SCST should review project plans and specifications prior to bidding and construction to check that the intent of the recommendations in this report has been incorporated. Observations and tests should be performed during construction. If the conditions encountered during construction differ from those anticipated based on the subsurface exploration program, the presence of our representative during construction will enable an evaluation of the exposed conditions and modifications of the recommendations in this report or development of additional recommendations in a timely manner.

9. CLOSURE

SCST should be advised of changes in the project scope so that the recommendations contained in this report can be evaluated with respect to the revised plans. Changes in recommendations will be verified in writing. The findings in this report are valid as of the date of this report. Changes in the condition of the site can, however, occur with the passage of time, whether they are due to natural processes or work on this or adjacent areas. In addition, changes in the standards of practice and government regulations can occur. Thus, the findings in this report may be invalidated wholly or in part by changes beyond our control. This report should not be relied upon after a period of two years without a review by us verifying the suitability of the conclusions and recommendations to site conditions at that time.

In the performance of our professional services, we comply with that level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions and in the same locality. The client recognizes that subsurface conditions may vary from those encountered at the exploration locations and that our data, interpretations, and recommendations are based solely on the information obtained by us. We will be responsible for those data, interpretations, and recommendations, but shall not be responsible for interpretations by others of the information developed. Our services consist of professional consultation and observation only, and no warranty of kind whatsoever, express or implied, is made or intended in connection with the work performed or to be performed by us, or by our proposal for consulting or other services, or by our furnishing of oral or written reports or findings.

10. REFERENCES

American Concrete Institute (ACI) (2014), Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary, dated September.

California Department of Conservation (2020), Fault Activity Map of California (2010), accessed January, maps.conservation.ca.gov/cgs/fam/

California Department of Transportation, Division of Design, Office of Stormwater Management (2014), Pervious Pavement Design Guidance, August.

California Emergency Management Agency, California Geological Survey, University of Southern California (Cal EMA) (2009), Tsunami Inundation Map for Emergency Planning, National City Quadrangle, June 1.

City of San Diego (2008), Seismic Safety Study, Geologic Hazards and Faults, Grid Tile: 18, Scale 1:800, April 3.

Federal Emergency Management Agency (2020), FIRM Flood Insurance Rate Map, San Diego County, Firm Panels 06073C1901G and 06073C1902G, accessed February, https://msc.fema.gov/portal/search

International Code Council (2018), 2019 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Based on the 2018 International Building Code, Effective January 1, 2020.

Kennedy, M.P. and Tan, S.S. (2008), Geologic Map of the San Diego 30’ x 60’ Quadrangle, California, California Geological Survey, Scale 1:100,000.

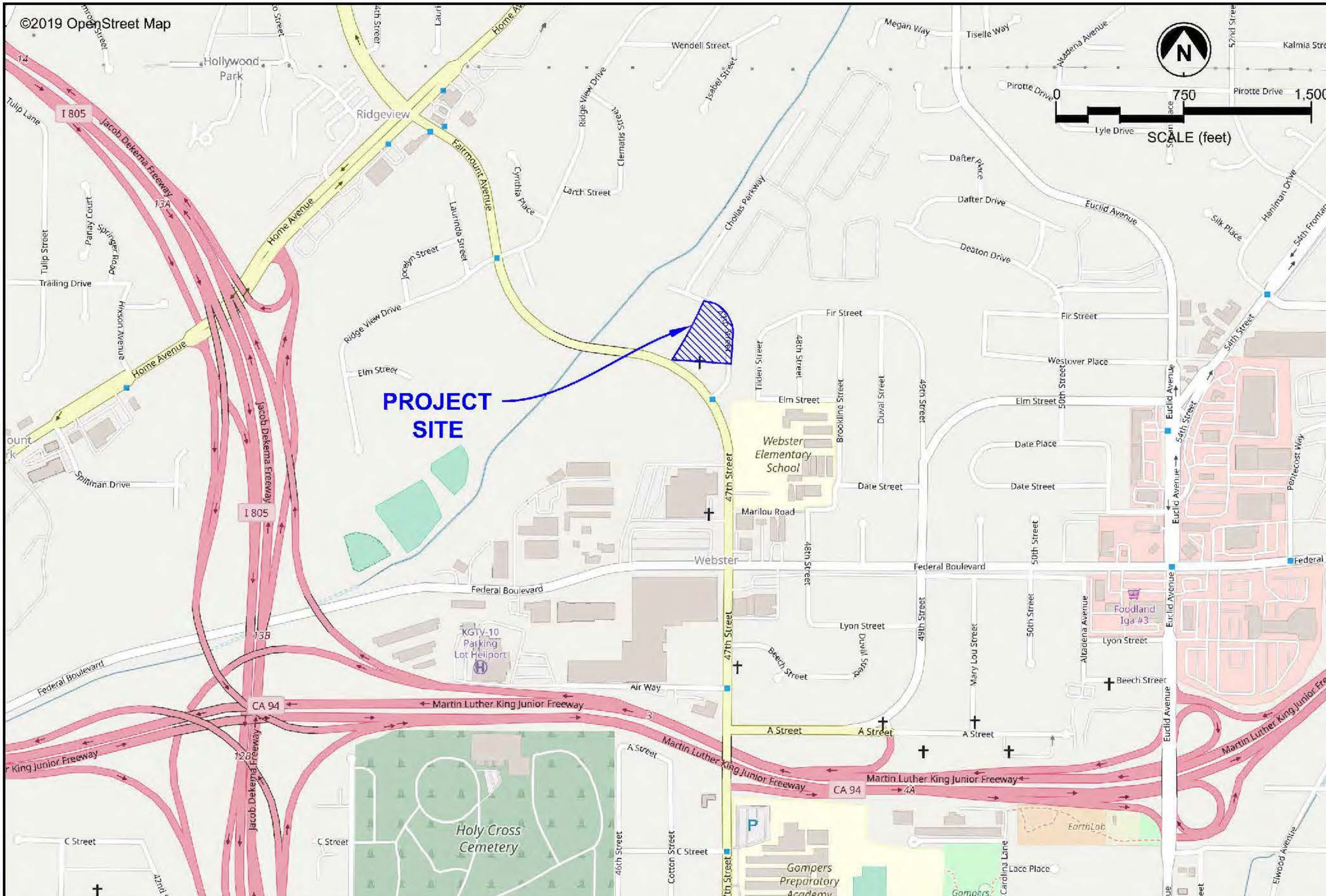
Public Works Standards, Inc. (2018), The "Greenbook," Standard Specifications for Public Works Construction, 2018 Edition.

RRM Design Group (2019), Fairmount Avenue Fire Station, Project Plans, 1950 47th Street, San Diego, CA, 92102, dated August 2.

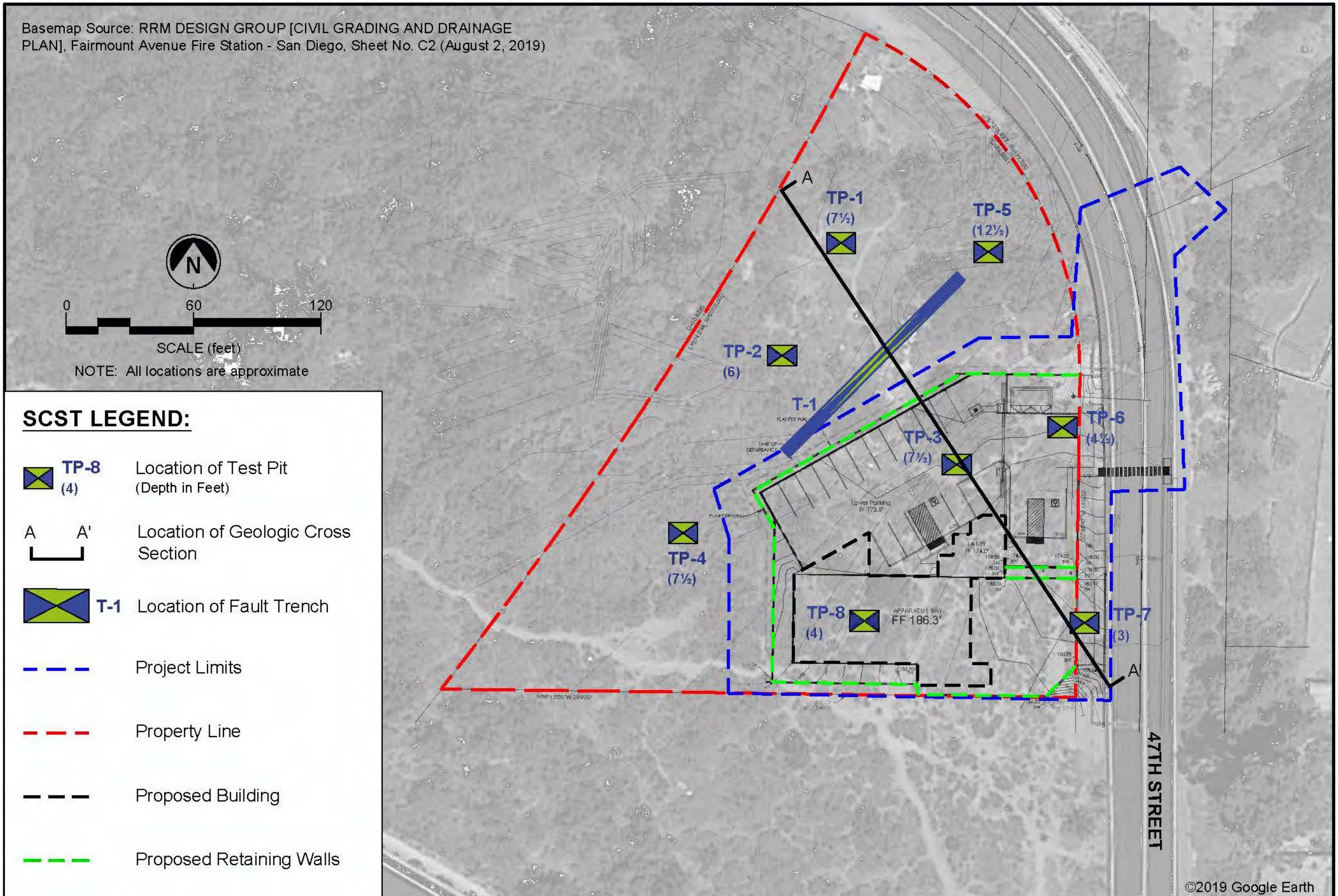
SCST (2019), Geotechnical Investigation, Fairmount Avenue Fire Station, 47th Street & Fairmount Avenue, San Diego, California, SCST No. 170446P4.1-01, dated March 15.

Structural Engineers Association of California (SEAOC) (2020), OSHPD Seismic Design Maps, accessed January, https://seismicmaps.org

United States Geological Survey (USGS) (2020), USGS Geologic Hazards Science Center, U.S. Quaternary Faults, accessed January, https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf.



ATLAS SCST	**SITE VICINITY MAP** Fairmount Avenue Fire Station San Diego, California	Date: By: Job No.:	February 2020 NNW/ACF 170446P4-5	Figure: 1



SCST LEGEND:

TP-8 (4)	Location of Test Pit (Depth in Feet)
A A'	Location of Geologic Cross Section
T-1	Location of Fault Trench
	Project Limits
	Property Line
	Proposed Building
	Proposed Retaining Walls

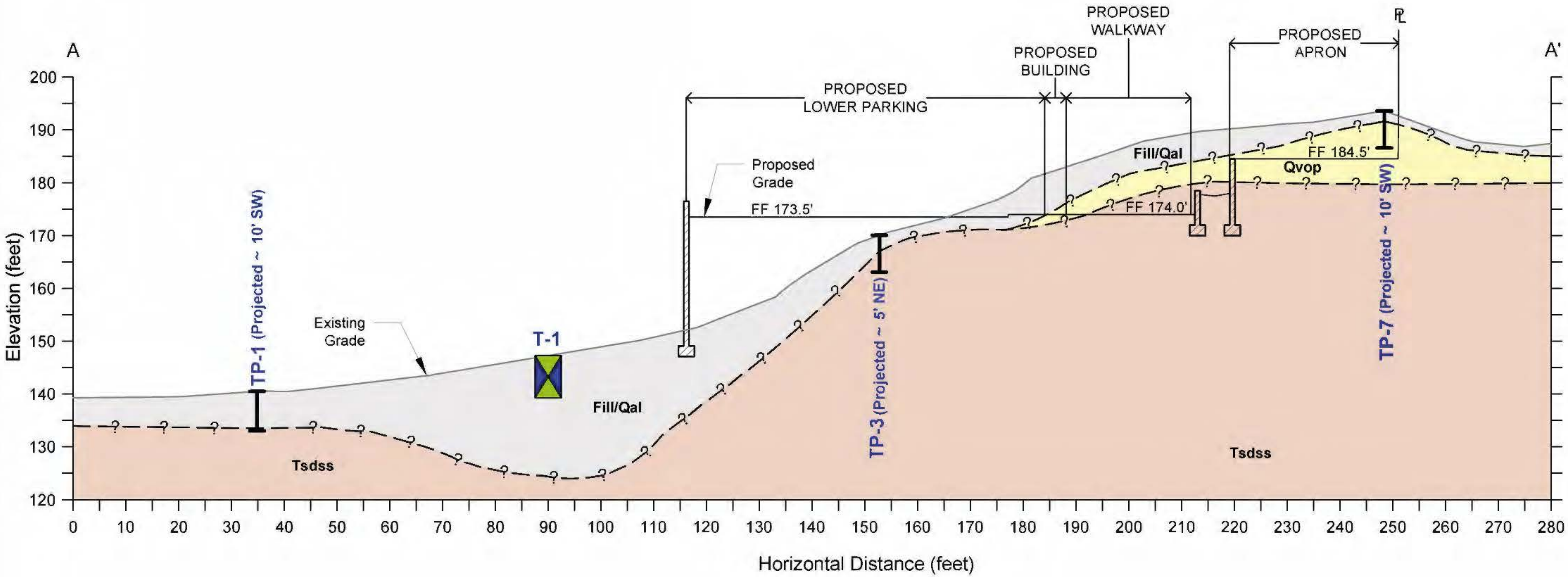
ATLAS SCST

GEOTECHNICAL MAP
Fairmount Avenue Fire Station
San Diego, California

Date: February 2020
By: NNW/ACF
Job No.: 170446P4-5

Figure: 2

Basemap Source: RRM DESIGN GROUP [CIVIL GRADING AND DRAINAGE PLAN], Fairmount Avenue Fire Station - San Diego, Sheet No. C2 (August 2, 2019)



SCST LEGEND:

TP-7 Location of Test Pit

Location of Proposed Retaining Wall

Fill/Qal — Fill/alluvium

Tsdss — San Diego Formation, marine sandstone

Qvop — Very old paralic deposits, undivided (middle to early Pleistocene)

—?—?— Geologic Contact, Queried Where Uncertain

T-1 Location of Fault Trench

NOTE: All locations and depths are approximate.

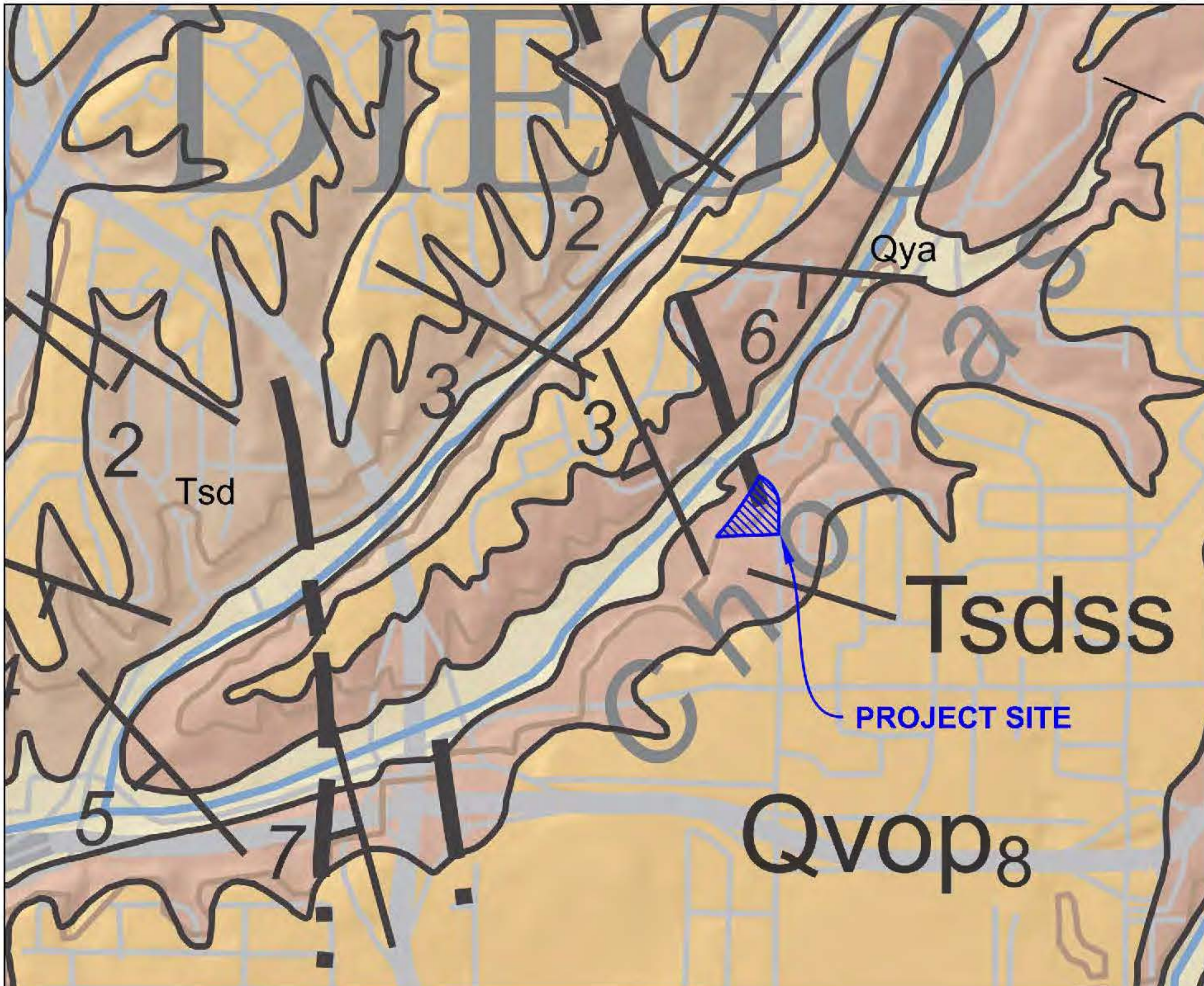
SCALE 1" = 20'

Date: February 2020
By: MAW/NNW
Job No.: 170446P4-5

GEOLOGIC CROSS-SECTION A-A'
Fairmount Avenue Fire Station
San Diego, California

ATLAS SCST

Figure: 3



EXPLANATION:

Qya	Young alluvial flood-plain deposits
$Qvop_8$	Very old paralic deposits, various
Tsd	San Diego Formation, undivided
Tsdss	San Diego Formation, marine sandstone

4

Strike and **dip** of beds

70 U D

Fault - Solid where accurately located; dashed where approximately located; dotted where concealed. U = upthrown block, D = downthrown block. Arrow and number indicate direction and angle of dip of fault plane.

N

0 2,000 4,000

SCALE (feet)

Reference:
Kennedy, M.P. and Tan, S.S. (2008), Geologic Map of the San Diego 30' x 60' Quadrangle, California, California Geological Survey, Scale 1:100,000

ATLAS

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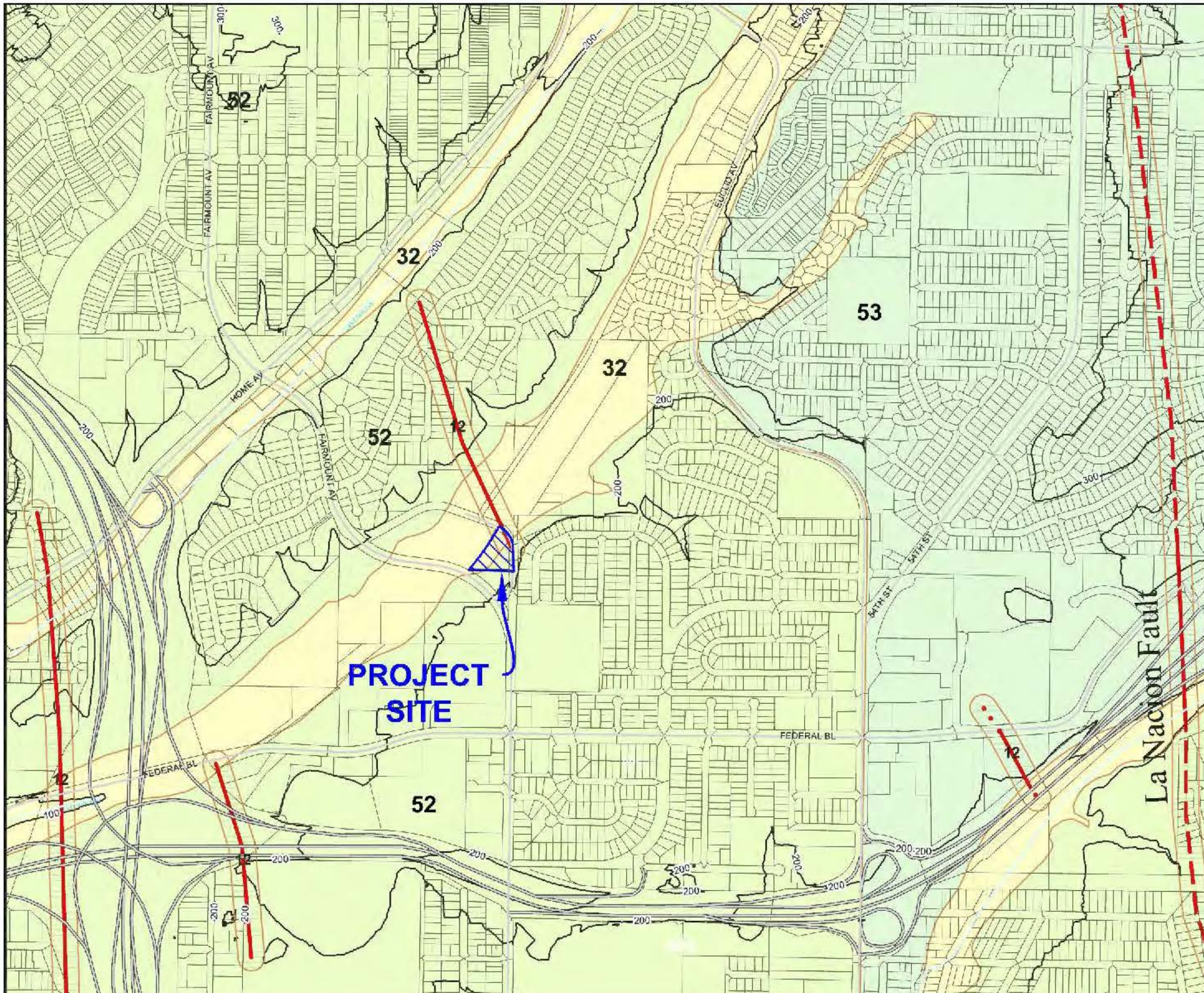
REGIONAL GEOLOGY MAP

Fairmount Avenue Fire Station
San Diego, California

Date:	February 2020
By:	NDK/NNW
Job No.:	170446P4-5

Figure:
4



EXPLANATION:

FAULT ZONES

12 — Potentially Active, Inactive, Presumed Inactive, or Activity Unknown

LIQUEFACTION

32 — Low Potential – fluctuating groundwater; minor drainages

OTHER TERRAIN

52 — Other level areas, gently sloping to steep terrain, favorable geologic structure; Low risk

53 — Level or sloping terrain, unfavorable geologic structure; Low to moderate risk

FAULTS

Fault

Inferred Fault

Concealed Fault

Shear Zone

N

0 1,250 2,500

SCALE (feet)

Reference:
City of San Diego (2008), Seismic Safety Study, Geologic Hazards and Faults, Grid Tile: 18, Development Services Department, April 3, Scale 1:800.

ATLAS

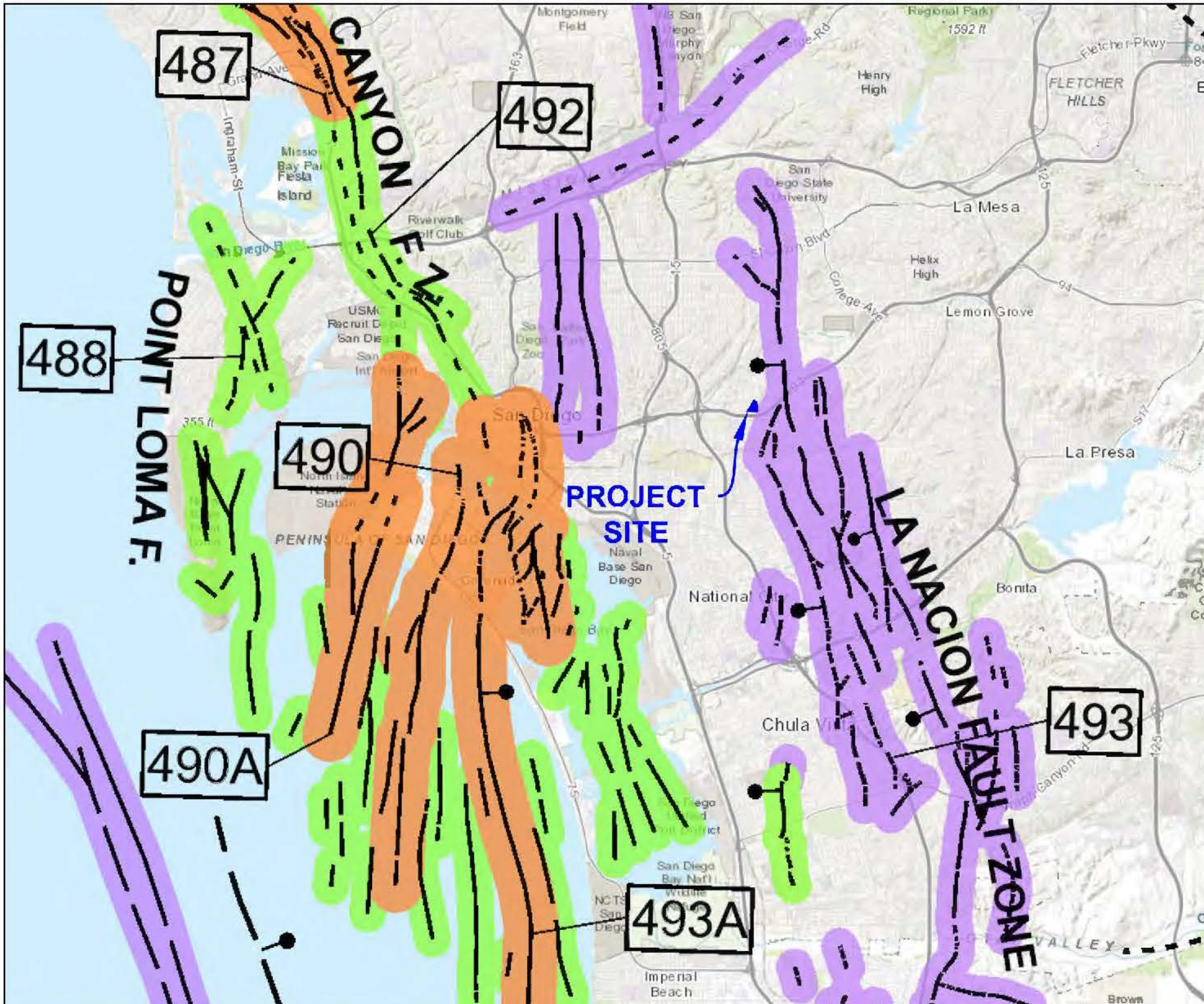
SC ST

CITY OF SAN DIEGO SEISMIC SAFETY MAP

Fairmount Avenue Fire Station
San Diego, California

Date:	February 2020
By:	NDK/NNW
Job No.:	170446P4-5

Figure: 5



EXPLANATION:

Holocene fault displacement (during past 11,700 years) without historic record.

Late Quaternary fault displacement (during past 700,000 years).

Quaternary fault (age undifferentiated).

Pre-Quaternary fault (older than 1.6 million years) or fault without recognized Quaternary displacement.

Bar and ball on downthrown side (relative or apparent).

487	Mission Bay Fault (concealed)
488	Point Loma Fault (certain)
490	Coronado Fault (certain)
490A	Spanish Bight Fault (certain)
492	Old Town Fault (concealed)
493	Sweetwater Fault (approximately located)
493A	Silver Strand Fault (certain)

N

0 15,000 30,000

SCALE (feet)

Reference:
California Department of Conservation, Fault Activity Map of California (2010), maps.conservation.ca.gov/cgs/fam; Accessed January 2020.

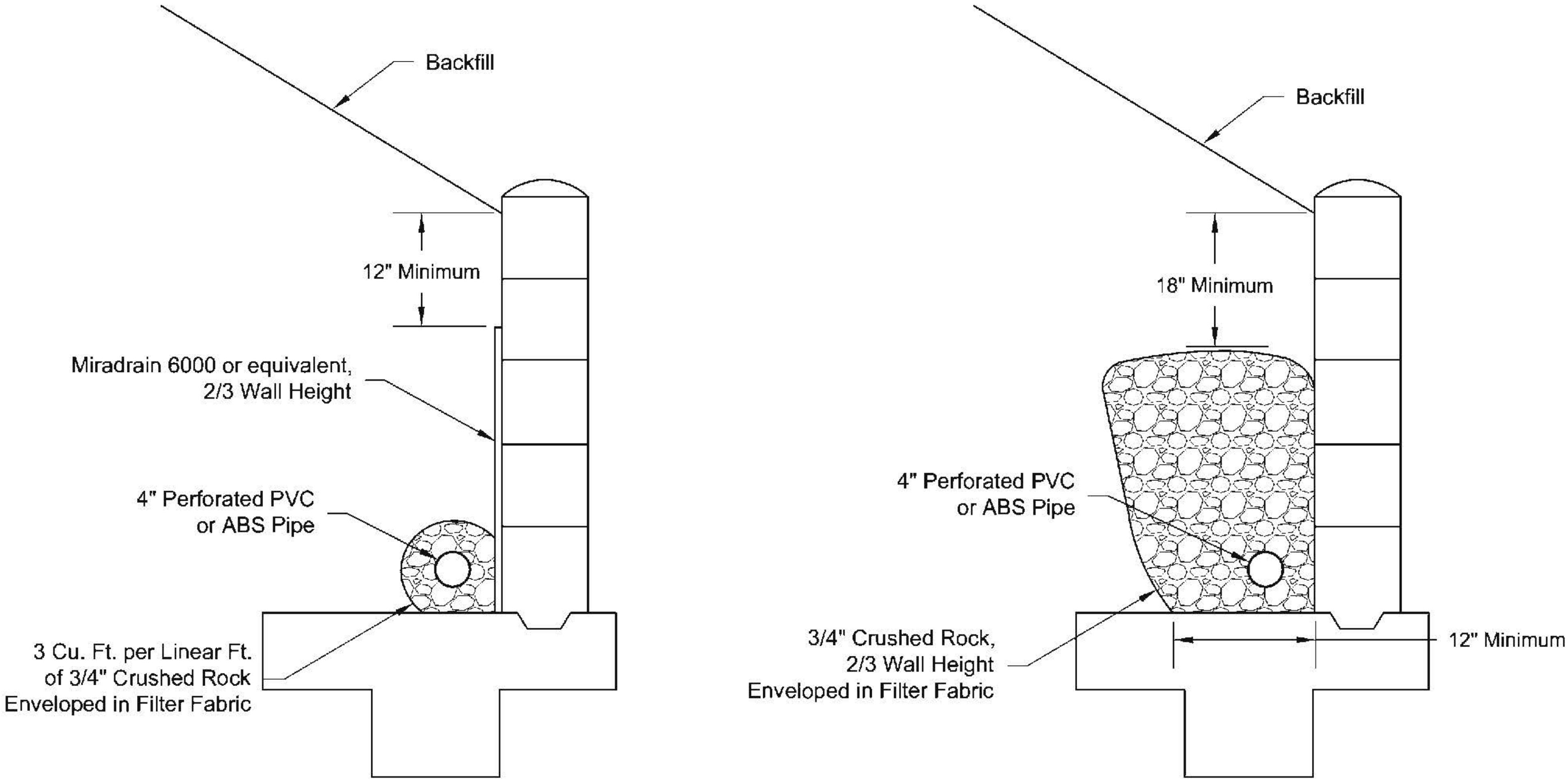
ATLAS

SC ST

FAULT MAP
Fairmount Avenue Fire Station
San Diego, California

Date: February 2020
By: NDK/NNW
Job No.: 170446P4-5

Figure: 6



NOT TO SCALE

NOTES:

1) Dampproof or waterproof back of wall following architect's specifications.
2) 4" minimum perforated pipe, SDR35 or equivalent, holes down, 1% fall to outlet. Provide solid outlet pipe at suitable locations.
3) Drain installation and outlet connection should be observed by the geotechnical consultant.

ATLAS / SCST	**TYPICAL RETAINING WALL BACKDRAIN DETAILS** Fairmount Avenue Fire Station San Diego, California	Date: February 2020 By: NNW/ACF Job No.: 170446P4-5	Figure: 7

APPENDIX I
FIELD INVESTIGATION

The soils are classified in accordance with the Unified Soil Classification System as illustrated on Figure I-1. Logs of the test pits are presented on Figures I-2 through I-10.

SUBSURFACE EXPLORATION LEGEND

UNIFIED SOIL CLASSIFICATION CHART

SOIL DESCRIPTION		GROUP SYMBOL	TYPICAL NAMES
I. COARSE GRAINED, more than 50% of material is larger than No. 200 sieve size.			
GRAVELS More than half of coarse fraction is larger than No. 4 sieve size but smaller than 3".	CLEAN GRAVELS	GW	Well graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels, gravel sand mixtures, little or no fines.
	GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		GC	Clayey gravels, poorly graded gravel-sand, clay mixtures.
SANDS More than half of coarse fraction is smaller than No. 4 sieve size.	CLEAN SANDS	SW	Well graded sand, gravelly sands, little or no fines.
		SP	Poorly graded sands, gravelly sands, little or no fines.
		SM	Silty sands, poorly graded sand and silty mixtures.
		SC	Clayey sands, poorly graded sand and clay mixtures.
II. FINE GRAINED, more than 50% of material is smaller than No. 200 sieve size.			
	SILTS AND CLAYS (Liquid Limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, sandy silt or clayey-silt-sand mixtures with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty clays or low plasticity.
	SILTS AND CLAYS (Liquid Limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity.
III. HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils.

SAMPLE SYMBOLS

- Bulk Sample
- CAL - Modified California Sampler
- CK - Undisturbed Chunk sample
- MS - Maximum Size of Particle
- ST - Shelby Tube
- SPT - Standard Penetration Test sampler

GROUNDWATER SYMBOLS

- Water level at time of excavation or as indicated
- Water seepage at time of excavation or as indicated

LABORATORY TEST SYMBOLS

- AL - Atterberg Limits
- CON - Consolidation
- COR - Corrosivity Tests (Resistivity, pH, Chloride, Sulfate)
- DS - Direct Shear
- EI - Expansion Index
- MAX - Maximum Density
- ORG - Organic Matter
- RV - R-Value
- SA - Sieve Analysis

SCST, LLC	Fairmount Avenue Fire Station San Diego, California			
	By:	PFL	Date:	February, 2020
	Job Number:	170446P4-5	Figure:	I-1

LOG OF TEST PIT TP-1

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): ± 142

Logged by: DJR
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
0–3	SM	**FILL (Qf) / ALLUVIUM (Qal):** SILTY SAND, loose, dark brown, moist, fine to medium grained. Light brown. Dark brown, organic rich, few coarse gravel.							
3.5–7	SP	**ALLUVIUM (Qal):** POORLY GRADED SAND, light brown, moist, fine to coarse grained.							
7–7.5		**SAN DIEGO FORMATION (Tsd):** SILTY SANDSTONE, gray, moist to wet, strongly cemented.							
		TEST PIT TERMINATED AT 7½ FEET, SIDEWALLS COLLAPSED.							

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	PFL	Date:	February, 2020
Job Number:	170446P4-5	Figure:	I-2

LOG OF TEST PIT TP-2

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): ± 143

Logged by: DJR
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
0–5	SM	**FILL (Qf) / ALLUVIUM (Qal):** SILTY SAND with GRAVEL, loose, brown, moist, organics, fine to coarse grained, some cobble. Dark brown, mostly cobble.							
		Medium dense, light brown.							ORG
5.5–6		**SAN DIEGO FORMATION (Tsd):** SILTY SANDSTONE, light brown and gray, wet, moderately cemented.							
		TEST PIT TERMINATED AT 6 FEET.							

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	PFL	Date:	February, 2020
Job Number:	170446P4-5	Figure:	I-3

LOG OF TEST PIT TP-3

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): ± 173

Logged by: KH
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
0–2	SC-SM	**FILL (Qf) / ALLUVIUM (Qal):** SILTY, CLAYEY SAND, loose, dark brown, moist, fine to coarse grained, organic rich, few cobbles.							
2–3	SM	SILTY SAND, loose, light brown, moist, fine to coarse grained.							
3		**SAN DIEGO FORMATION (Tsd):** SILTY SANDSTONE, light brown, moist, fine to coarse grained, weakly cemented.							
5		Moderately cemented.							
6		Few cobbles.							
7		Light gray.							DS
7½		**TEST PIT TERMINATED AT 7½ FEET.**							

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

ATLAS SCST
SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	PFL	Date:	February, 2020
Job Number:	170446P4-5	Figure:	I-4

LOG OF TEST PIT TP-4

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): ± 154

Logged by: KH
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
0–2.5	SM	**FILL(Qf) / ALLUVIUM (Qal):** SILTY SAND, loose, dark brown, moist, fine to coarse grained.							
2.5–7	GM	SILTY GRAVEL with SAND, brown, moist, medium to coarse grained, some cobbles.							
7–7½		**SAN DIEGO FORMATION (Tsd):** SILTY SANDSTONE, light brown and gray, moist, moderately cemented.							
		TEST PIT TERMINATED AT 7½ FEET.							

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	PFL	Date:	February, 2020
Job Number:	170446P4-5	Figure:	I-5

LOG OF TEST PIT TP-5

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): ± 153

Logged by: DJR
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
0	SM	**FILL (Qf):** SILTY SAND, loose, brown to light brown, moist, fine to medium grained, some roots (to 2 inches).							
3		Loose to medium dense, dark brown, moist, medium grained, few organics.							
5	GM	SILTY GRAVEL with SAND, loose, medium brown, moist, medium grained, mostly cobbles.							
12		**SAN DIEGO FORMATION (Tsd):** SILTY SANDSTONE, light brown and gray, moist, moderately cemented.							
12½		**TEST PIT TERMINATED AT 12½ FEET.**							

Depth scale (ft): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	PFL	Date:	February, 2020
Job Number:	170446P4-5	Figure:	I-6

LOG OF TEST PIT TP-6

Date Drilled: 1/3/2020
Equipment: Hand Tools
Elevation (ft): ± 165

Logged by: JRD
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
0–3	SC	**FILL (Qf) / ALLUVIUM (Qal)**: CLAYEY SAND with GRAVEL, loose to medium dense, brown, moist, fine to medium grained.		X					
3–4½		**SAN DIEGO FORMATION (Tsd)**: SILTY SANDSTONE, light brown and gray, moist to wet, moderately cemented.	CAL	X					
		TEST PIT TERMINATED AT 4½ feet							

Depth scale (ft): 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

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SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	JRD	Date:	February, 2020
Job Number:	170446P4-5	Figure:	I-7

LOG OF TEST PIT TP-7

Date Drilled: 1/3/2020
Equipment: Hand Tools
Elevation (ft): ± 193

Logged by: JRD
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
1	SC	**FILL (Qf) / ALLUVIUM (Qal)**: CLAYEY SAND, loose to medium dense, brown, moist, fine to medium grained, trace gravel.		X					
2		**VERY OLD PARALIC DEPOSITS (Qvop)**: SANDY CLAYSTONE, reddish-brown, moist, well indurated.							
3			CAL	X		0			
		TEST PIT TERMINATED AT 3 FEET							
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	JRD	Date:	February, 2020
Job Number:	170446P4-5	Figure:	I-8

LOG OF TEST PIT TP-8

Date Drilled: 1/3/2020
Equipment: Hand Tools
Elevation (ft): ± 173

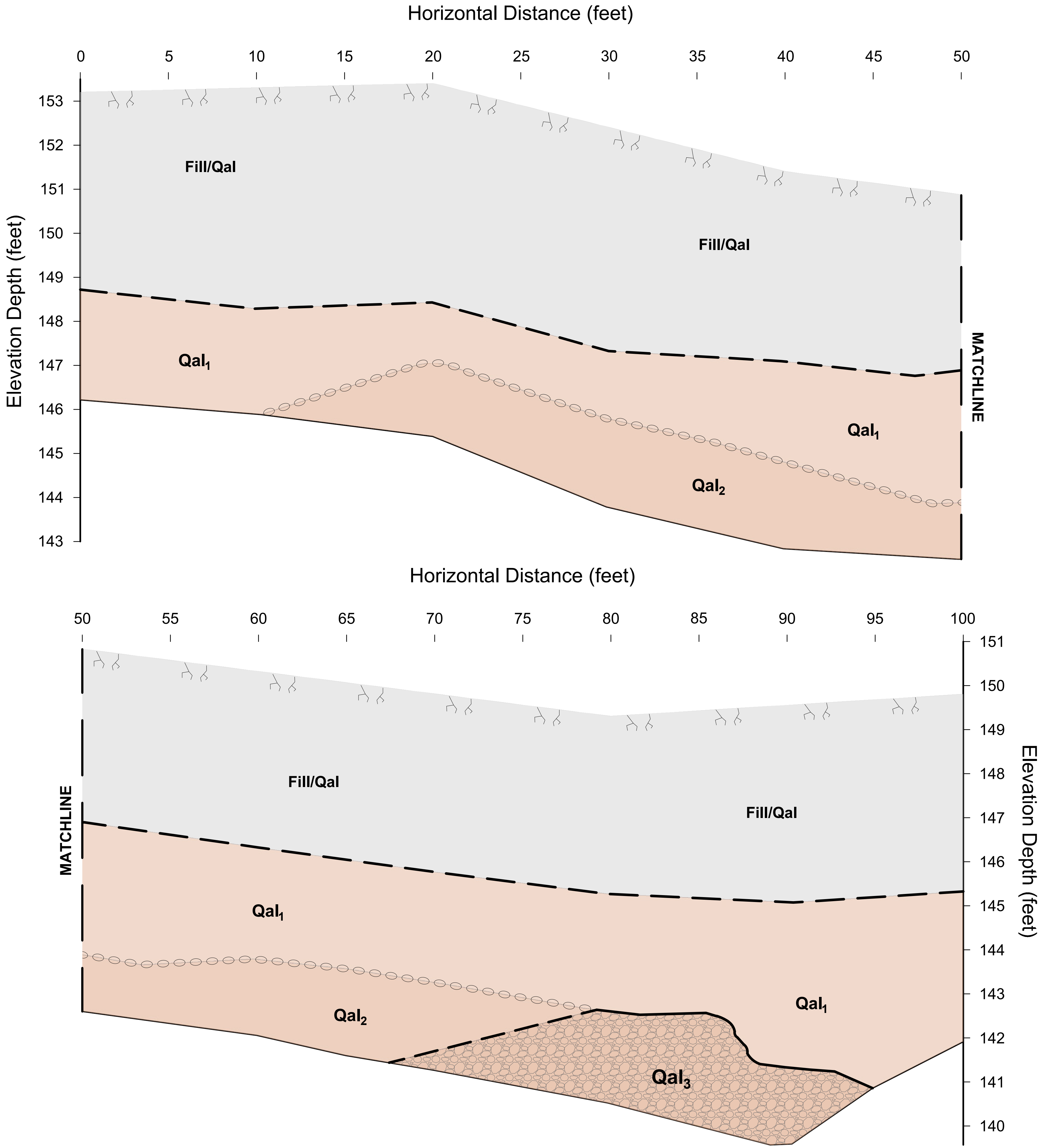
Logged by: JRD
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: DRIVEN	SAMPLES: BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
0–2	SC	**FILL (Qf) / ALLUVIUM (Qal)**: CLAYEY SAND, loose, brown, moist, fine to medium grained, trace gravel; organics, roots. Medium dense, no organics.		X (1–2)					
2–4		**SAN DIEGO FORMATION (Tsd)**: CLAYEY SANDSTONE, orangish-brown, moist, fine to medium grained, moderately cemented.	CAL	X (2–4)					EI DS
4		**TEST PIT TERMINATED AT 4 FEET**							

Depth scale: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

SCST, LLC

Fairmount Avenue Fire Station San Diego, California			
By:	JRD	Date:	February, 2020
Job Number:	170446P4-5	Figure:	I-9



SCST LEGEND:

—?— Geologic Contact, Queried Where Uncertain

Cobbles or Boulders

Roots

Fill/Qal: SILTY SAND, loose, brown, moist, fine to coarse grained, abundant organics including roots, few debris (glass, trash, etc.). Locally abundant cobbles (as shown). Predominantly silty sand; varying amounts of gravel.

Qal_1: SILTY SAND, loose to medium dense, dark brown, moist, fine to medium grained, fewer organics (roots), few coarse gravel

Qal_2: SILTY SAND, medium dense, moist, light brown, moist, fine to medium grained.

Qal_3: SILTY GRAVEL with SAND, medium dense, brown, moist, fine to coarse grained.

Note: All locations, depths and elevations are approximate.

SCALE
AS SHOWN

Date: February 2020
By: NNW/ACF
Job No.: 170446P4-5

FAULT TRENCH LOG
Fairmount Avenue Fire Station
San Diego, California

ATLAS SCST

Figure:
I-10

APPENDIX II
LABORATORY TESTING

Laboratory tests were performed to provide geotechnical parameters for engineering analyses. The following tests were performed:

- **CLASSIFICATION:** Field classifications were verified in the laboratory by visual examination. The final soil classifications are in accordance with the Unified Soil Classification System.

- **PARTICLE-SIZE DISTRIBUTION:** The particle-size distribution was determined in accordance with ASTM D422.

- **EXPANSION INDEX:** The expansion indices were determined in accordance with ASTM D4829.

- **MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE**: The maximum dry density and optimum moisture content were determined in accordance with ASTM D1557.

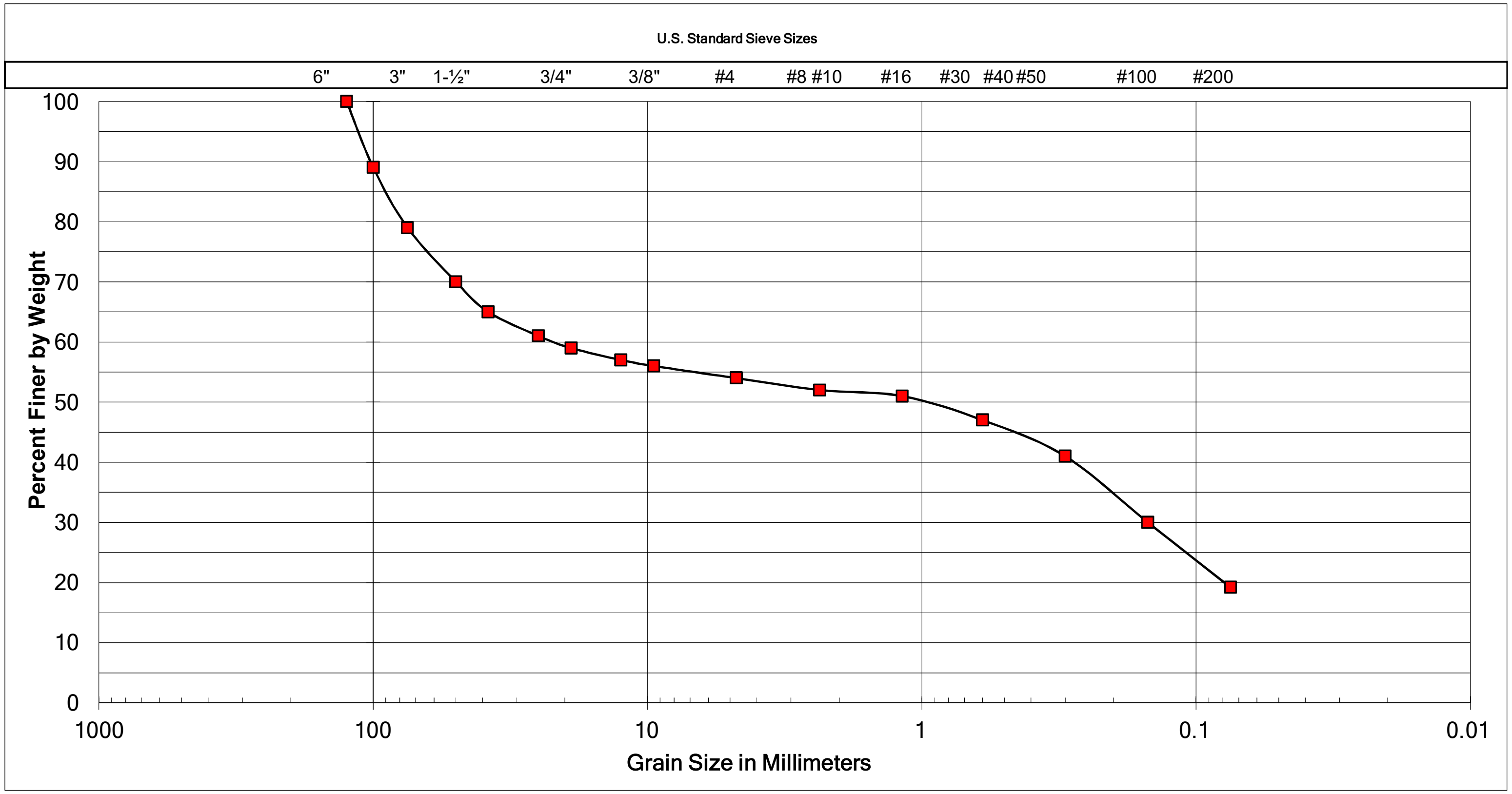
- **SAND EQUIVALENT:** The sand equivalent was determined in accordance with ASTM D2419.

- **ORGANIC MATTER:** The percentage of organic matter was determined in accordance with ASTM D2974.

- **CORROSIVITY**: Corrosivity tests were performed. The pH and minimum resistivity were determined in general accordance with California Test 643. The soluble sulfate content was determined in accordance with California Test 417. The total chloride ion content was determined in accordance with California Test 422.

- **DIRECT SHEAR:** Direct shear testing was performed on three samples in accordance with ASTM D3080. The shear stress was applied at a constant rate of strain of 0.003 inch per minute.

Soil samples not tested are now stored in our laboratory for future reference and analysis, if needed. Unless notified to the contrary, all samples will be disposed of 30 days from the date of this report.



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

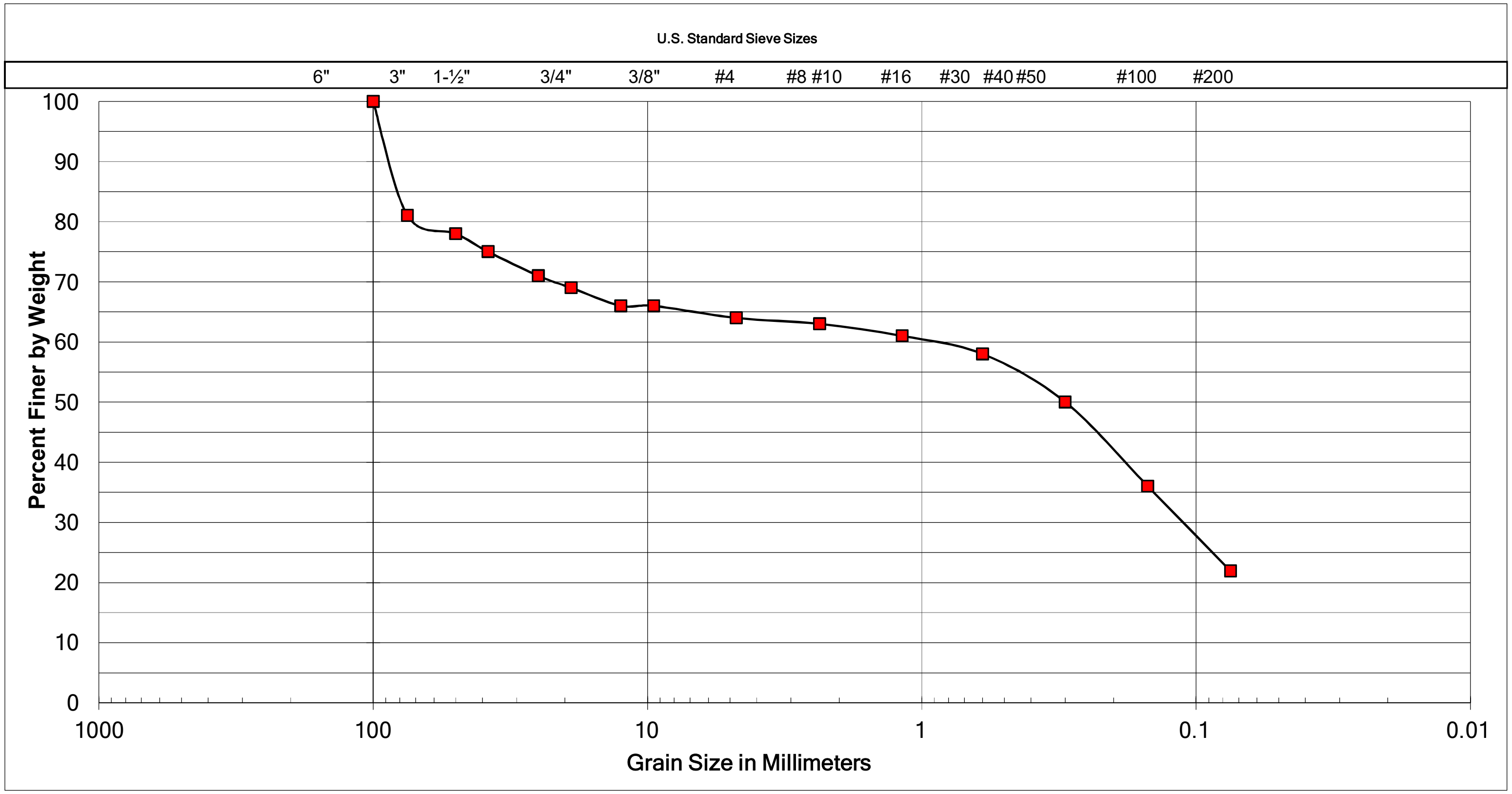
SAMPLE LOCATION
FT at 80', 3' to 6' depth
SAMPLE NUMBER
37989

UNIFIED SOIL CLASSIFICATION:	GM
DESCRIPTION	SILTY GRAVEL with SAND

ATTERBERG LIMITS	
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--

SCST, LLC

Fairmount Avenue Fire Station San Diego, California			
By:	CT	Date:	February, 2020
Job Number:	170446P4-5	Figure:	II-1



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

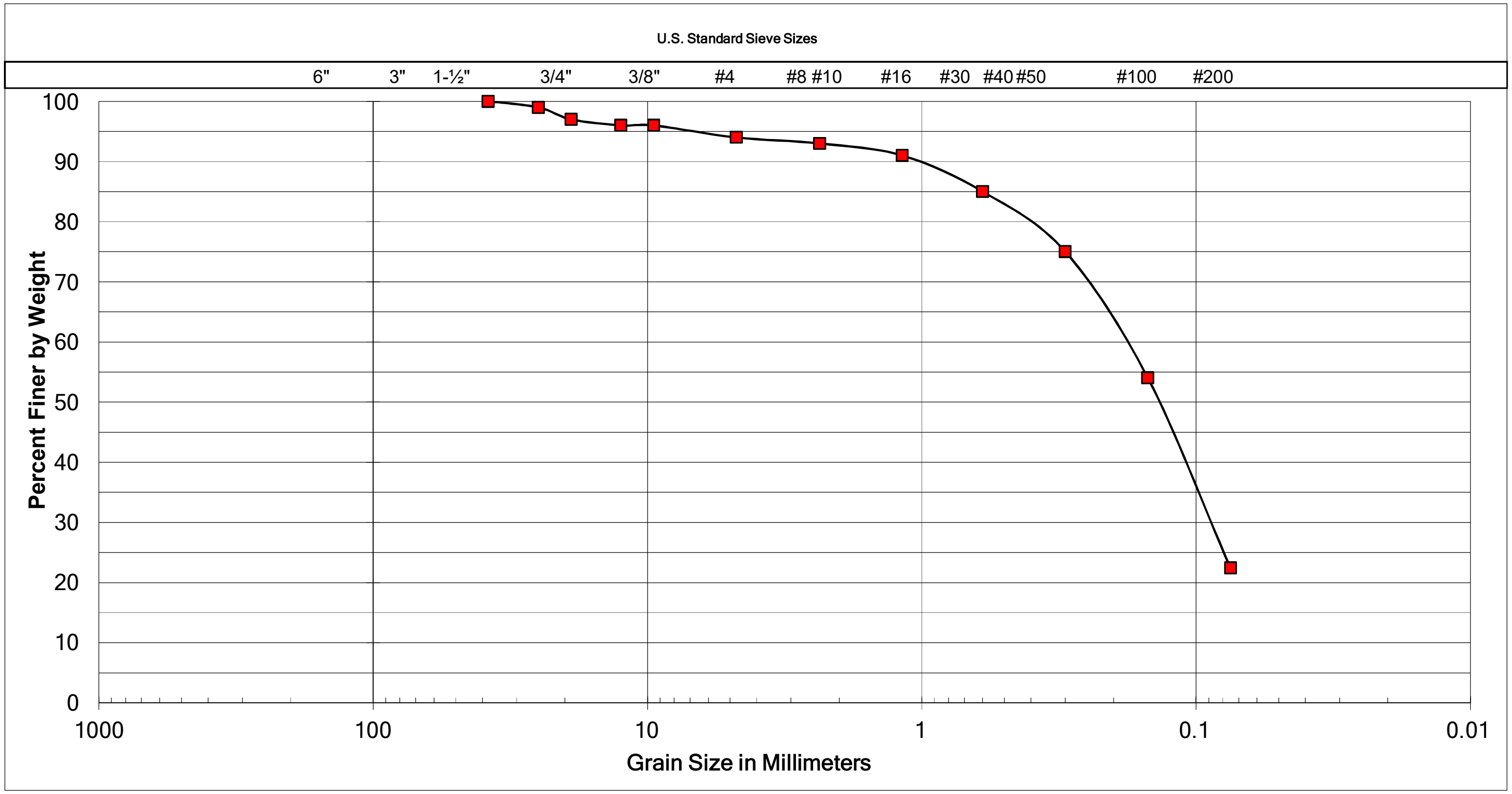
SAMPLE LOCATION
FT at various locations, at 0 to 2' depth
SAMPLE NUMBER
37990

UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--

SCST, LLC

Fairmount Avenue Fire Station San Diego, California			
By:	CT	Date:	February, 2020
Job Number:	170446P4-5	Figure:	II-2



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

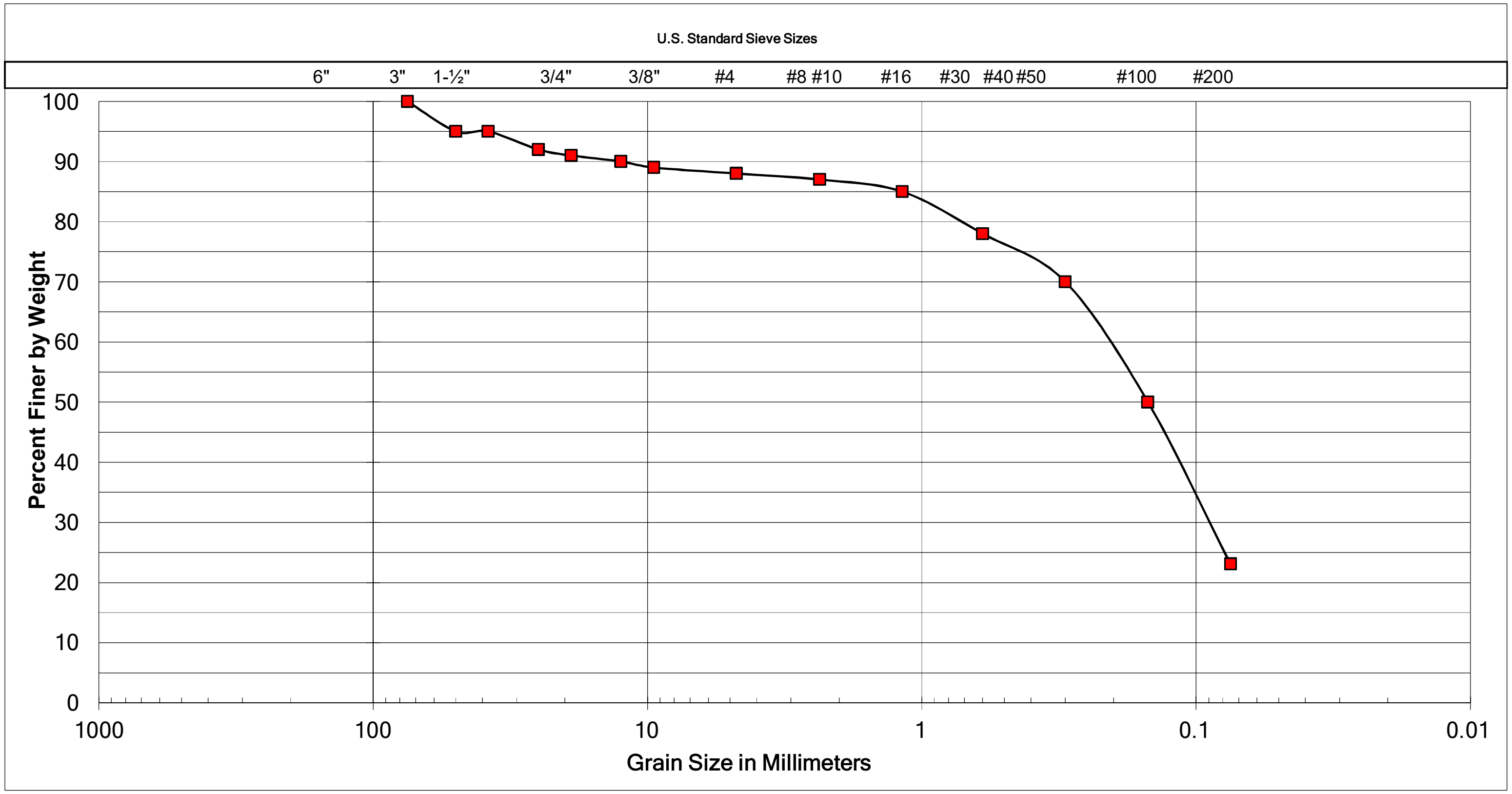
SAMPLE LOCATION
FT at 38', 2' to 4' depth
SAMPLE NUMBER
37991

UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--

SCST, LLC

Fairmount Avenue Fire Station San Diego, California			
By:	CT	Date:	February, 2020
Job Number:	170446P4-5	Figure:	II-3



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
FT at 40', 4.5 to 5.5' depth
SAMPLE NUMBER
37992

UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--

SCST, LLC

Fairmount Avenue Fire Station San Diego, California			
By:	CT	Date:	February, 2020
Job Number:	170446P4-5	Figure:	II-4

EXPANSION INDEX

ASTM D4829

SAMPLE	DESCRIPTION	EI
FT at 38', 2' to 4' depth	SILTY SAND	16
TP-8 at 2 to 4 feet	CLAYEY SANDSTONE	53

Classification of Expansive Soil [1]

EXPANSIVE INDEX	POTENTIAL EXPANSION
1-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

1. ASTM - D4829

MAXIMUM DENSITY AND OPTIMUM MOISTURE

ASTM D1557

SAMPLE	DESCRIPTION	MAXIMUM DENSITY (pcf)	OPTIMUM MOISTURE (%)
FT at 38', 2' to 4' depth	SILTY SAND	123.7	10.9

SAND EQUIVALENT

ASTM D2419

SAMPLE	DESCRIPTION	SE VALUE
FT at 38', 2' to 4' depth	SILTY SAND	14
FT at various , 0' to 2' depth	SILTY SAND with GRAVEL	12

ORGANIC MATTER

ASTM D2974

SAMPLE	DESCRIPTION	Organic Matter (%)
TP-2 at 3½ to 5 feet	SILTY SAND with GRAVEL	2.3

RESISTIVITY, pH, SOLUBLE CHLORIDE and SOLUBLE SULFATE

pH & Resistivity (Cal 643, ASTM G51)

Soluble Chlorides (Cal 422)

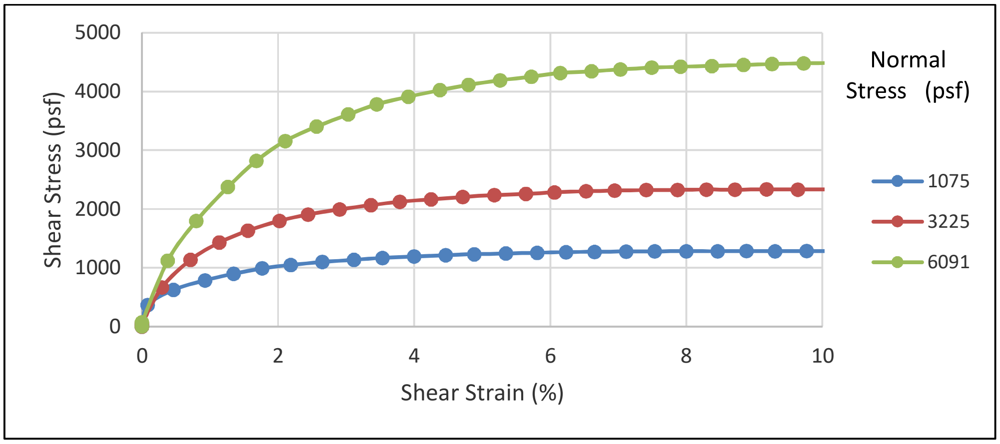
Soluble Sulfate (Cal 417)

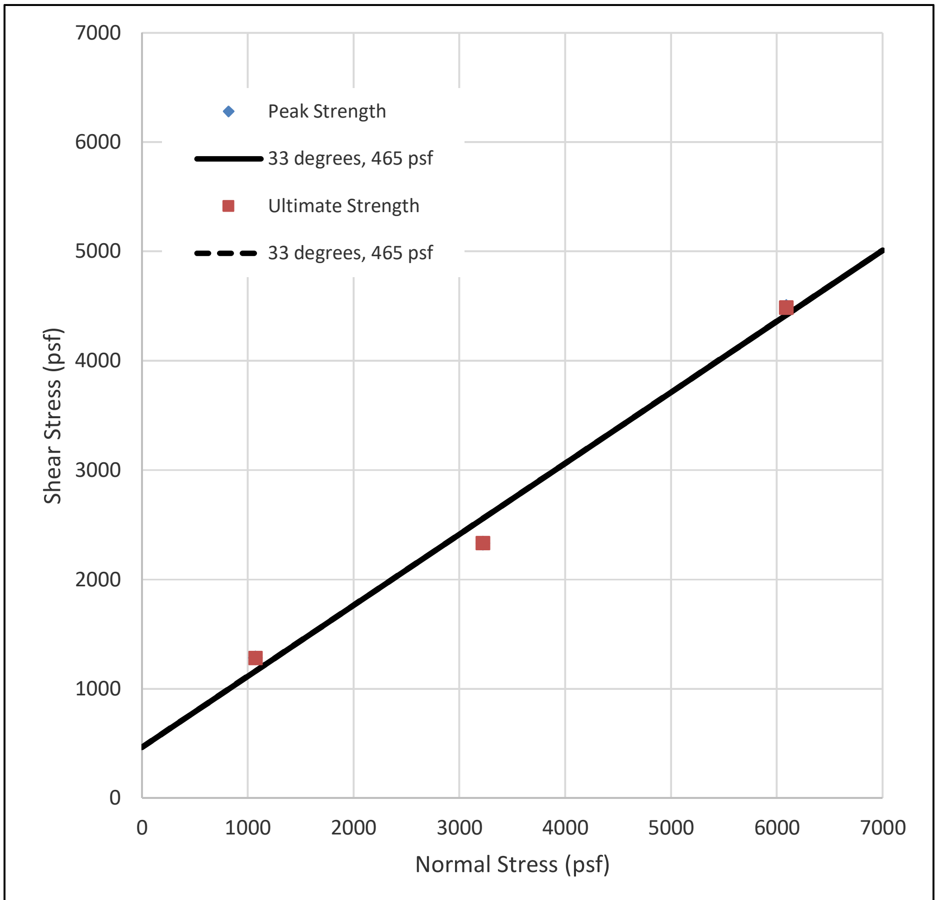
SAMPLE	RESISTIVITY (Ω-cm)	pH	CHLORIDE (%)	SULFATE (%)
FT at 38', 2' to 4' depth	1980	7.31	0.230	0.001

WATER-SOLUBLE SULFATE (SO_4^{2-}) EXPOSURE

Modified from ACI 318-14 Table 19.3.1.1 and Table 19.3.2.1

Water-soluble sulfate (SO_4^{2-}) in soil, percent by weight	Exposure Severity	Exposure Class	Cement Type (ASTM C150)	Max. w/cm	Min. f_c' (psi)
$SO_4^{2-} < 0.10$	Not applicable	S0	No type restriction	N/A	2,500
$0.10 \leq SO_4^{2-} < 0.20$	Moderate	S1	II	0.50	4,000
$0.20 \leq SO_4^{2-} < 2.00$	Severe	S2	V	0.45	4,500
$SO_4^{2-} > 2.00$	Very Severe	S3	V plus pozzolan or slag cement	0.45	4,500





SAMPLE ID: FT at 38', 2' to 4' depth

Silty Sand

NOTES: Remolded

Strain Rate: 0.003 in/min

Sample was consolidated and drained

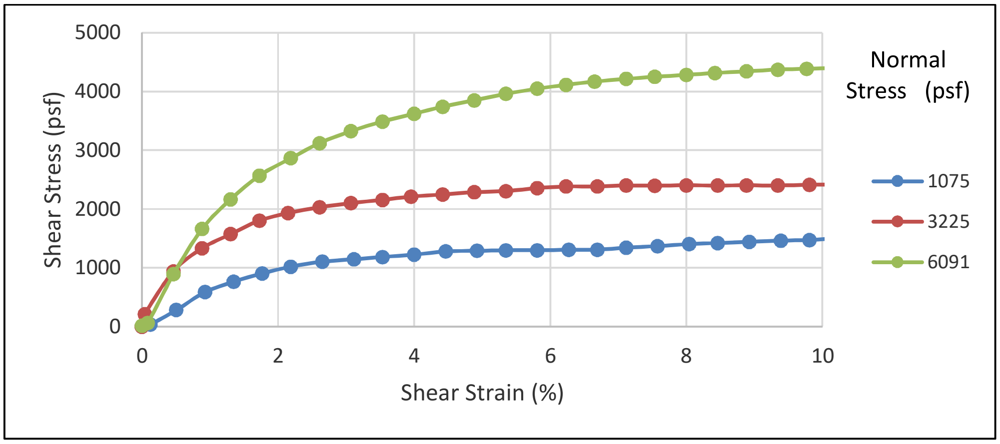
	Peak	Ultimate
Φ	33 °	33 °
c	465 psf	465 psf

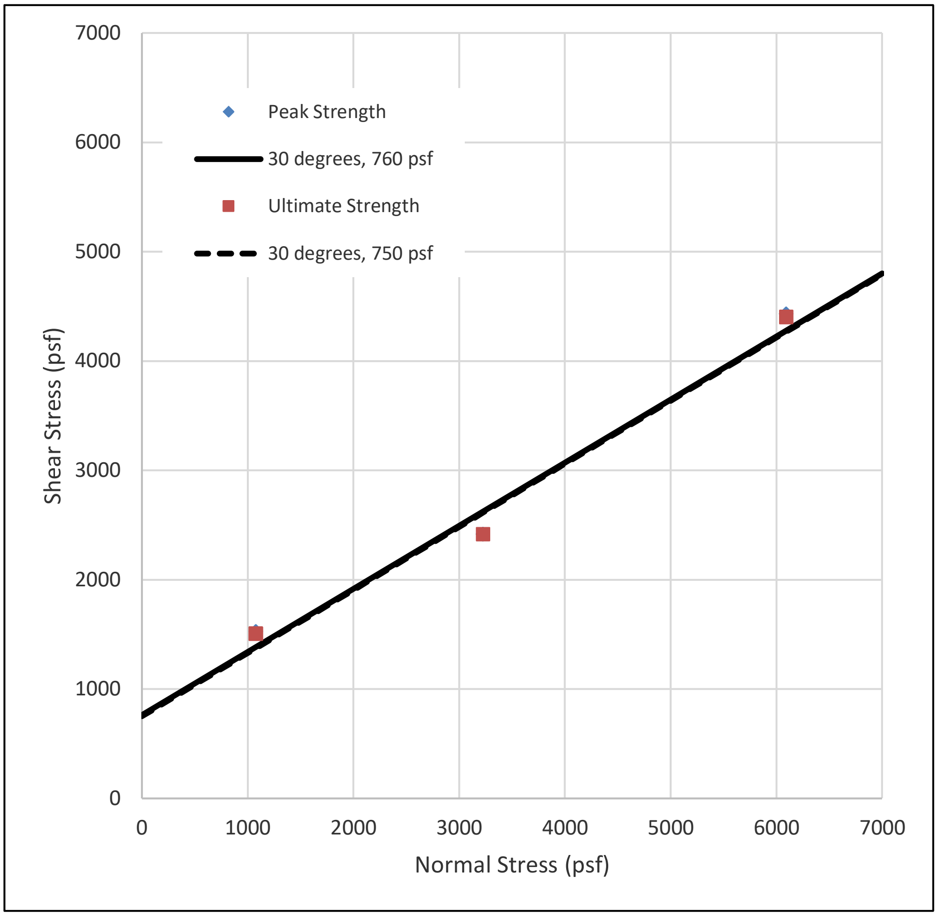
	Initial	Final
γ_d	111.4 pcf	111.4 pcf
w_c	11.2 %	16.5 %
Saturation	60 %	88 %

SCST, LLC

Fairmount Ave Fire Station
San Diego, California

By:	DRB	Date:	February, 2020
Job Number:	170446P4-5	Figure:	II-6



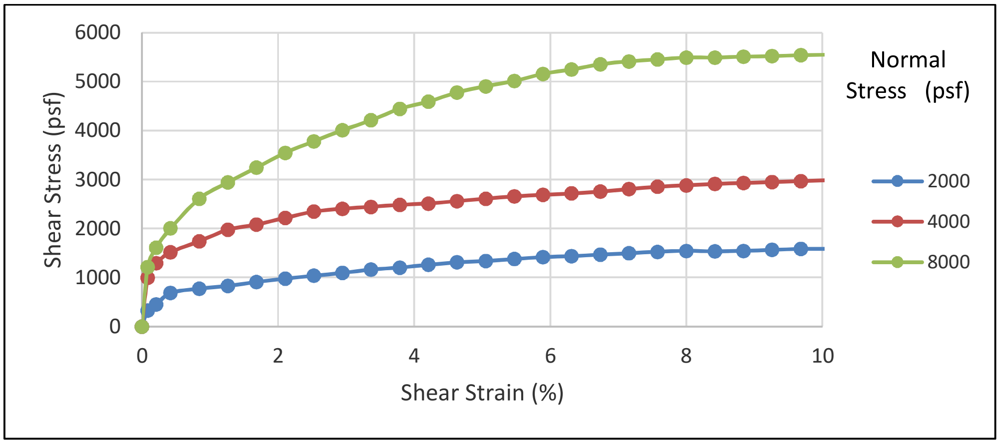


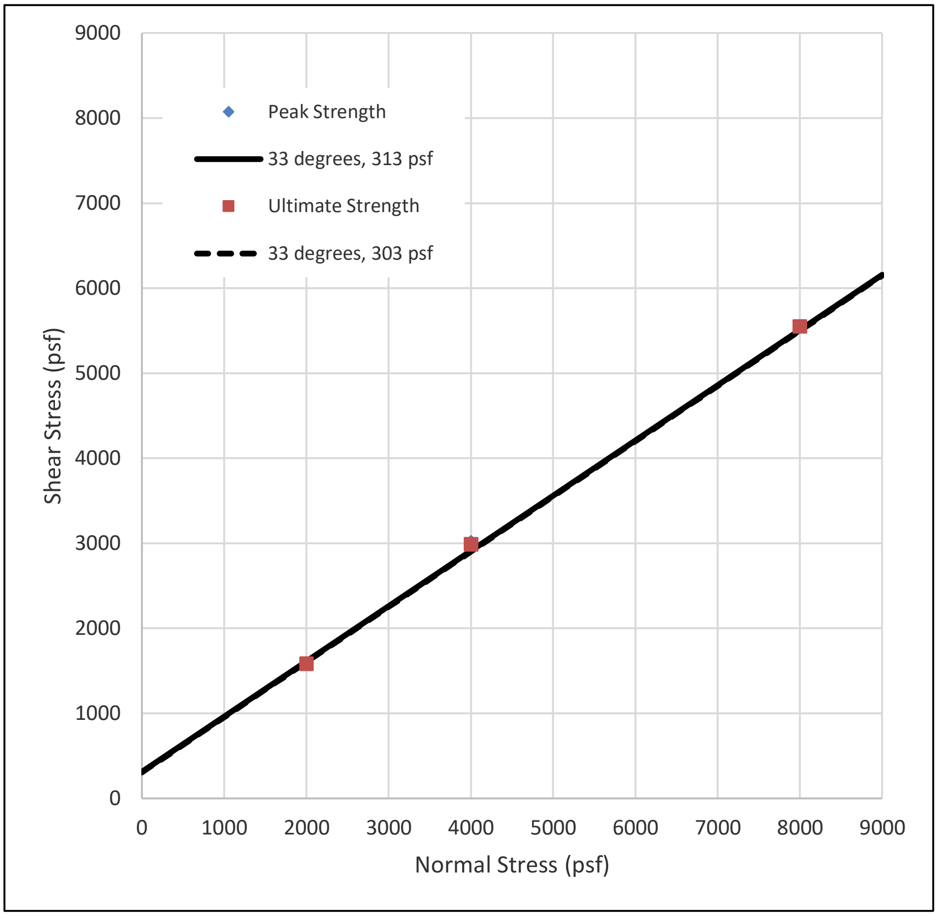
			Peak	Ultimate
SAMPLE ID:	TP-3 at 6 to 7½ feet	Φ	30 °	30 °
		c	760 psf	750 psf
Silty Sandstone, San Diego Formation				

		Initial	Final
NOTES: Remolded	γ_d	107.8 pcf	107.8 pcf
Strain Rate: 0.003 in/min	w_c	9.3 %	17.5 %
Sample was consolidated and drained	Saturation	45 %	85 %

ATLAS
SCST, LLC

Fairmont Ave Fire Station San Diego, California			
By:	DRB	Date:	February, 2020
Job Number:	170446P4-5	Figure:	II-7





SAMPLE ID: TP-8 at 3 to 3½ feet

Clayey Sandstone, San Diego Formation

NOTES: Insitu
Strain Rate: 0.003 in/min
Sample was consolidated and drained

	Peak	Ultimate
Φ	33 °	33 °
c	313 psf	303 psf

	Initial	Final
γ_d	106.4 pcf	109.3 pcf
w_c	8.7 %	20.7 %
Saturation	41 %	97 %

SCST, LLC

Fairmount Avenue Fire Station San Diego, California			
By:	SR	Date:	February, 2020
Job Number:	170446P4-5	Figure:	II-8

APPENDIX III
SITE-SPECIFIC GROUND MOTION ANALYSIS

SITE SPECIFIC GROUND MOTION ANALYSIS (ASCE 7-16)

Project:	Fairmount Avenue Fire Station	**Latitude:**	32.724925	deg	**Calculated:**	GLC
Client:	RRM Design Group	**Longitude:**	-117.093923	deg	**Checked:**	IC
Job No:	170446P4	**Vs_{30}:**	259	m/s	**Date:**	2/3/20

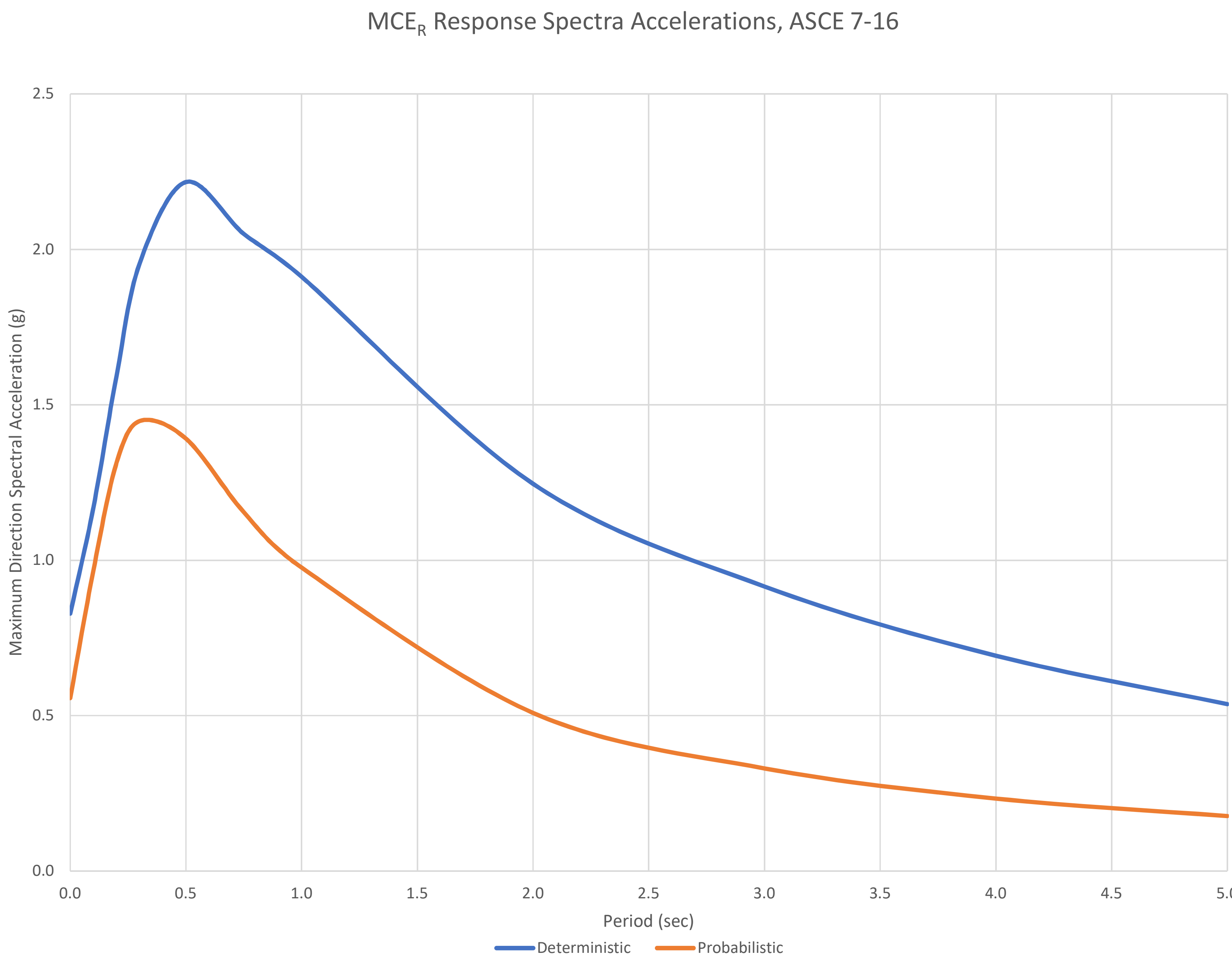
Period T (sec)	PROBABILISTIC ANALYSIS				DETERMINISTIC ANALYSIS			CODE-BASED (LOWER LIMIT)			DESIGN RESPONSE SPECTRUM		
	Uniform Hazard Ground Motion (g)	Risk Targeted Ground Motion (g)	Maximum Direction Scale Factor	Maximum Direction RTGM (g)	84th percentile Spectral Accelaration (g)	Maximum Direction Scale Factor	Maximum Directional Deterministic Sa (g)	Design S_a (g)	Code Based S_a (g)	80% of Code Based S_a (g)	Design S_{aM} (g)	Design S_a (g)	T x S_a (T>1s)
PGA	0.557	0.506	1.1	0.557	0.753	1.1	0.828	0.371	0.310	0.248	0.557	0.371	---
0.10	0.960	0.879	1.1	0.967	1.063	1.1	1.169	0.645	0.597	0.478	0.967	0.645	---
0.20	1.297	1.194	1.1	1.313	1.448	1.1	1.593	0.876	0.774	0.619	1.313	0.876	---
0.30	1.424	1.287	1.125	1.448	1.738	1.125	1.955	0.965	0.774	0.619	1.448	0.965	---
0.50	1.309	1.184	1.175	1.391	1.887	1.175	2.217	0.927	0.774	0.619	1.391	0.927	---
0.75	1.037	0.933	1.2375	1.155	1.656	1.2375	2.050	0.770	0.774	0.619	1.155	0.770	---
1.00	0.835	0.751	1.3	0.976	1.471	1.3	1.912	0.651	0.625	0.500	0.976	0.651	0.651
2.00	0.419	0.377	1.35	0.509	0.923	1.35	1.246	0.339	0.313	0.250	0.509	0.339	0.679
3.00	0.260	0.236	1.4	0.330	0.654	1.4	0.916	0.220	0.208	0.167	0.330	0.220	0.661
4.00	0.178	0.161	1.45	0.233	0.478	1.45	0.693	0.156	0.156	0.125	0.233	0.156	0.623
5.00	0.132	0.118	1.5	0.177	0.358	1.5	0.537	0.118	0.125	0.100	0.177	0.118	0.590

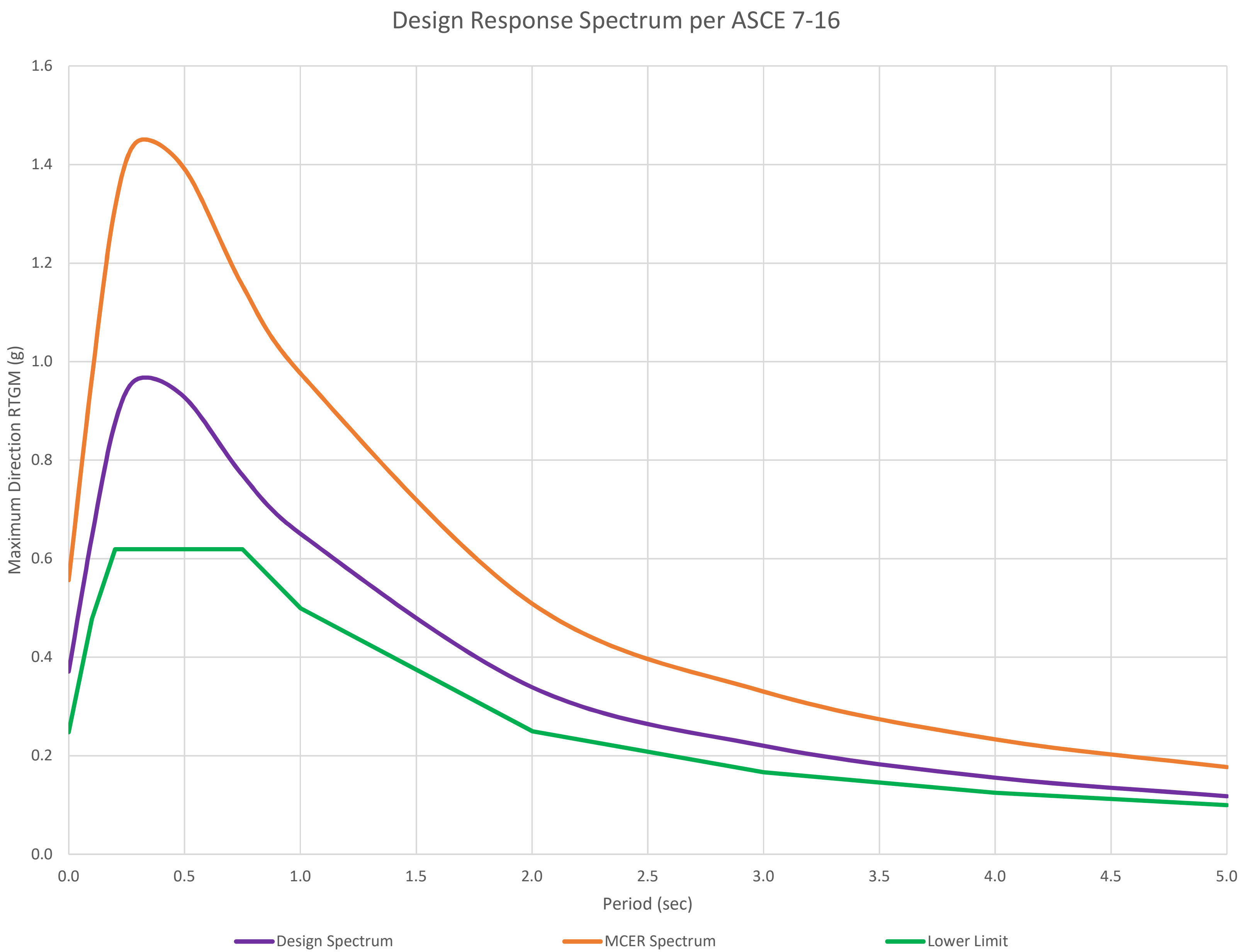
INPUT PARAMETERS - SEAOC (https://seismicmaps.org/)

Site Class=	D	
F_a=	1.063	Short Period Site Coefficient
S_S=	1.091	Mapped MCE_R, 5% Damped at T=0.2s
S_1=	0.375	Mapped MCE_R, 5% Damped at T=1s
S_{DS}=	0.774	Design, 5% Damped at Short Periods
T_L (sec)=	8	Long Period Transition (Sect 11.4.6)
F_{PGA} (g)=	1.115	Site Coefficient for PGA
PGA_M (g)=	0.541	Site Coefficient for PGA
S_{M1}=	0.938	The MCE_R, 5% Damped at T=1s
S_{D1}=	0.625	Design, 5% Damped at T=1s
T_o (sec)=	0.161	Defined in ASCE 7-16 Sect 11.4.6
T_S (sec)=	0.807	Defined in ASCE 7-16 Sect 11.4.6

SITE-SPECIFIC DESIGN PARAMETERS

S_{DS}=	**0.869**	90% of max S_a (ASCE 7-16 Sect 21.4)	
S_{MS}=	**1.303**	MCE_R, 5% Damped, adjusted for Site Class	
S_{D1}=	**0.679**	Design, 5% Damped, at T=1s (Sect 11.4.5)	
S_{M1}=	**1.018**	MCE_R, 5% Damped, at T=1s, adjusted for Site	
F_a=	**1.063**	Short Period Site Coefficient	
F_v=	**2.500**	Long Period Site Coefficient (7-16 Sect 21.3)	
S_S=	**1.226**	MCE_R, 5% Damped at T=0.2s	
S_1=	**0.407**	MCE_R, 5% Damped at T=1s	
$PGA_{Probabilistic}$ (g)=	**0.557**	Peak Ground Acceleration, Probabilistic	
$PGA_{Deterministic}$ (g)=	**0.753**	Peak Ground Acceleration, Deterministic	
F_{PGA} (g)=	**1.115**	Site Coefficient for PGA	
0.5*F_{PGA} (g)=	**0.5575**	OK	(Check $PGA_{Deterministic} > 0.5 \times F_{PGA}$)
Site Specific PGA (g) =	**0.557**	OK	(Check $PGA_{Site\ Specific} > 0.8 \times PGA_M$)


MCE$_R$ Response Spectra Accelerations, ASCE 7-16
Maximum Direction Spectral Acceleration (g)
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Period (sec)
Deterministic
Probabilistic


Design Response Spectrum per ASCE 7-16
Maximum Direction RTGM (g)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Period (sec)
Design Spectrum
MCER Spectrum
Lower Limit