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GEOTECHNICAL INVESTIGATION
PROPOSED TWO-STORY COMMERCIAL BUILDING
6176 FEDERAL BLVD
SAN DIEGO, CALIFORNIA

PREPARED FOR:

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Providing Professional Engineering Services Since 1959

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June 8, 2018

SCST No. 180126N
Report No. 1

Ms. Rebecca Berry
c/o Mr. Ben Peterson
5982 Gullstrand Street
San Diego, California 92122

Subject: GEOTECHNICAL INVESTIGATION
PROPOSED TWO-STORY COMMERCIAL BUILDING
6176 FEDERAL BOULEVARD
SAN DIEGO, CALIFORNIA

Dear Ms. Berry:

SCST, Inc. (SCST) is pleased to present our report describing the geotechnical investigation performed for the subject project. We conducted the geotechnical investigation in general conformance with the scope of work presented in our proposal dated July 10, 2017. 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 any questions, please call us at (619) 280-4321.

Respectfully submitted,
SCST, INC.

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EXECUTIVE SUMMARY

This report presents the results of the geotechnical investigation SCST, Inc. (SCST) performed for the subject project. We understand the project will consist of the design and construction of a two-story building and associated pavements, hardscape, underground utilities, and landscaping. The purpose of our work is to provide conclusions and recommendations regarding the geotechnical aspects of the project.

We explored the subsurface conditions by drilling 2 borings between about 9½ and 14 feet below the existing ground surface using a truck-mounted drill rig equipped with a hollow-stem auger. Auger refusal was encountered in both borings. An SCST engineer logged the borings and test holes and collected samples of the materials encountered for laboratory testing. SCST tested selected samples from the borings and test holes to evaluate pertinent soil classification and engineering properties to assist in developing geotechnical conclusions and recommendations.

The materials encountered in the borings consist of fill and Stadium Conglomerate. The fill extends to depths up to about 4 feet below the existing ground surface and consists of loose to medium dense clayey sand with gravel and cobbles. The Stadium Conglomerate consists of dense to very dense, weakly cemented sandy conglomerate. Groundwater was not observed in the borings.

The main geotechnical consideration affecting the planned construction is the presence of potentially compressible fill. To reduce the potential for settlement, the existing fill should be excavated in its entirety below the planned structure, settlement sensitive improvement, and new fills. Additionally, Stadium Conglomerate within 3 feet of the deepest planned footing bottom level should be excavated. Excavations up to 7 feet below the existing ground surface should be expected. We anticipate that the excavated material free of oversized cobbles and debris can be used as compacted fill. Material with an expansion index of 50 or less should be placed from 3 feet below the deepest planned footing bottom level to finished pad grade. Hardscape should be underlain by at least 2 feet of material with an expansion index less of 50 or less. The planned building can be supported on shallow spread footings with bottoms levels on compacted fill. The recommendations presented herein may need to be updated once final plans are developed.

1. INTRODUCTION

This report presents the results of the geotechnical investigation SCST, Inc. (SCST) performed for the subject project. We understand the project will consist of the design and construction of a two-story building and associated pavements, hardscape, underground utilities, and landscaping. The purpose of our work is to provide conclusions and recommendations regarding the geotechnical aspects of the project. Figure 1 presents a site vicinity map.

2. SCOPE OF WORK

2.1 FIELD INVESTIGATION

We explored the subsurface conditions by drilling 2 borings to depths between about 9½ and 14 feet below the existing ground surface using a truck-mounted drill rig equipped with a hollow-stem auger. Auger refusal was encountered in both borings. Figure 2 shows the approximate locations of the borings. An SCST engineer logged the borings collected samples of the materials encountered for laboratory testing. Logs of the borings are presented in Appendix I. Soils are classified according to the Unified Soil Classification System illustrated on Figure I-1.

2.2 LABORATORY TESTING

Selected samples obtained from the borings were tested to evaluate pertinent soil classification and engineering properties and enable development of geotechnical conclusions and recommendations. The laboratory tests consisted of in situ moisture and density, grain-size distribution, Atterberg limits, expansion index, and corrosivity. The results of the laboratory tests and brief explanations of the test procedures are presented in Appendix II.

2.3 ANALYSIS AND REPORT

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 2016 California Building Code (CBC)
- Site preparation and grading
- Foundation alternatives and geotechnical engineering criteria for design of the foundations
- Estimated foundation settlements

- Support for concrete slabs-on-grade
- Lateral pressures for the design of retaining walls
- Pavement sections
- Soil corrosivity

3. SITE DESCRIPTION

The subject site is located north of Federal Boulevard and south of State Route 94 in the Emerald Hills community of the City of San Diego, California. Existing site improvements consist of a commercial building and concrete paved hardscape. The site is bordered on the north, east, and west by construction equipment storage yards, and bounded to the south by an undeveloped lot. Site elevations range from 277 to 279 feet.

4. PROPOSED DEVELOPMENT

We understand the project will consist of the design and construction of a two-story building and associated pavements, hardscape, underground utilities, and landscaping. As currently planned, the building will have a finish floor elevation of 279.25 feet. Minor site grading will be needed to achieve finish site grades.

5. GEOLOGY AND SUBSURFACE CONDITIONS

The materials encountered in the borings consist of fill and Stadium Conglomerate. Descriptions of the materials are presented below. Figure 3 presents a geologic cross-section. Figure 4 presents the regional geology in the vicinity of the site.

Fill: Fill was encountered in both borings. The fill consists of medium dense clayey sand with gravel and cobbles. Bricks and concrete debris were encountered within the fill. The fill encountered in our borings extends to depths varying from about 3½ feet to 4 feet below the existing ground surface.

Stadium Conglomerate: The Stadium Conglomerate underlies the site and consists of dense to very dense, weakly cemented sandy conglomerate.

Groundwater: Groundwater was not encountered in the borings. 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.

6. GEOLOGIC HAZARDS

6.1 CITY OF SAN DIEGO SEISMIC SAFETY STUDY

Figure 5 shows the site location on the City of San Diego (2008) Seismic Safety Study map. The site is located in Geologic Hazard Category 32, which is defined as an area of low liquefaction potential. In our opinion, based on the dense, shallow formational material encountered in our borings, the risk for liquefaction to occur at the site is low.

6.2 FAULTING AND SURFACE RUPTURE

The closest known active fault is the Rose Canyon fault zone (Silver Strand fault) located about 5.9 miles (9.5 kilometers) west of the site. 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 at the site is low.

6.3 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. The site coefficients and maximum considered earthquake (MCE_R) spectral response acceleration parameters in accordance with the 2016 CBC are presented below:

Site Coordinates: Latitude 32.728936°
Longitude -117.064380°
Site Class: D
Site Coefficients, F_a = 1.124
F_v = 1.683
Mapped Spectral Response Acceleration at Short Period, S_s = 0.939g
Mapped Spectral Response Acceleration at 1-Second Period, S_1 = 0.359g
Design Spectral Acceleration at Short Period, S_{DS} = 0.704g
Design Spectral Acceleration at 1-Second Period, S_{D1} = 0.402g
Site Peak Ground Acceleration, PGA_M = 0.426g

6.4 LIQUEFACTION AND DYNAMIC SETTLEMENT

Liquefaction occurs when loose, saturated sands and silts are subjected to strong ground shaking. The soils lose shear strength and become liquid, resulting in large total and differential ground surface settlements and possible lateral spreading during an earthquake. Given the relatively dense nature of the materials beneath the site, and provided the recommended remedial grading is performed, the potential for liquefaction and dynamic settlement to occur at the site is low.

6.5 LANDSLIDES AND SLOPE STABILITY

Evidence of landslides or slope instabilities was not observed. The potential for landslides or slope instabilities to occur at the site is considered low.

6.6 TSUNAMIS, SEICHES, AND FLOODING

The site is not located within a mapped area on the State of California Tsunami Inundation Maps (Cal EMA, 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 any lakes or confined bodies of water; therefore, the potential for a seiche to affect the site is low. However, the southeast corner of the site is located within a 0.2% annual chance flood area (FEMA, 2012) associated with Chollas Creek.

6.7 SUBSIDENCE

The site is not located in an area of known subsidence associated with fluid withdrawal (groundwater or petroleum); therefore, the potential for subsidence due to the extraction of fluids is negligible.

6.8 HYDRO-CONSOLIDATION

Hydro-consolidation can occur in recently deposited sediments (less than 10,000 years old) 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 spaces between the particle grains can re-adjust when inundated by groundwater causing the material to consolidate. The relatively dense materials underlying the site are not considered susceptible to hydro-consolidation.

7. CONCLUSIONS

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. The main geotechnical consideration affecting the planned development is the presence of potentially compressible fill. Remedial grading will need to be performed to reduce the potential for distress to the planned building and improvements. Remedial grading recommendations are provided herein. The planned building can be supported on shallow spread footings with bottoms levels on compacted fill. The recommendations presented herein may need to be updated once final plans are developed.

8. RECOMMENDATIONS

8.1 SITE PREPARATION AND GRADING

8.1.1 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.

8.1.2 Remedial Grading

To reduce the potential for settlement, the existing fill should be excavated in its entirety beneath the planned building, settlement-sensitive improvements, and new fills. Additionally, Stadium Conglomerate formational materials within 3 feet of the deepest planned footing bottom level should be excavated. Excavations up to 7 feet below the existing ground surface should be anticipated. Horizontally, the excavations should extend at least 5 feet outside the planned perimeter foundations, at least 2 feet outside the planned hardscape and pavements, or up to existing improvements or the project boundary, whichever is less. An SCST representative should observe conditions exposed in the bottom of the excavation to determine if additional excavation is required.

8.1.3 Compacted Fill

Excavated material, except for roots, debris, and rocks greater than 6 inches, can be used as compacted fill. We expect that some of the existing fill will need to be screened to remove oversized rock and debris prior to being placed as compacted fill. Material with an expansion index of 50 or less determined in accordance with ASTM D4829 should be placed from 3 feet below the deepest planned footing bottom level to finished pad grade. Hardscape should be underlain by at least 2 feet of material with an expansion index of 50 or less.

Based on our laboratory test results, we expect that most of the onsite soils will not meet the expansion index criteria. Imported materials may be required.

The material exposed in the bottom of the excavation should be scarified to a depth of 6 to 8 inches, moisture conditioned, 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. Fill should be moisture conditioned to near optimum moisture content and compacted to at least 90% relative compaction. The maximum dry density and optimum moisture content for evaluating relative compaction should be determined in accordance with ASTM D 1557. 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%.

8.1.4 Expansive Soil

The onsite soils tested have a medium expansion potential. We expect that most of the onsite soils will not meet the very low to low expansion index criteria for foundations and slabs. Imported materials may be required.

8.1.5 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.

8.1.6 Excavation Characteristics

It is anticipated that excavations can be achieved with conventional earthwork equipment in good working order. Cobbles and debris should be anticipated in the fill. Difficult excavation should be anticipated in cemented zones within the Stadium Conglomerate.

8.1.7 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 offsite.

8.1.8 Temporary Excavation

Temporary excavations 3 feet deep or less can be made vertically. Deeper temporary excavations should be laid back no steeper than 1:1 (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. Any 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 or underpinning. Soldier piles and lagging, internally braced shoring or trench boxes could be used. If trench boxes are used, the soil immediately adjacent to the trench box is not directly supported. Ground surface deformations immediately adjacent to the pit or trench could be greater where trench boxes are used compared to other methods of shoring.

As an alternative to shoring/underpinning, maximum 10-foot-wide slots can be excavated and immediately backfilled adjacent to existing structures and improvement. Care should be taken to not undermine existing footings. Slot excavations should be filled prior to performing adjacent excavations.

8.1.9 Temporary Shoring

For design of cantilevered shoring, an active soil pressure equal to a fluid weighing 35 pcf can be used for level retained ground or 55 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 but can be limited to a maximum value of 400 psf.

8.1.10 Temporary Dewatering

Groundwater seepage may occur locally due to broken pipes, local irrigation or following heavy rain. Groundwater should be anticipated in the planned excavations. Dewatering can be accomplished by sloping the excavation bottom to a sump and pumping from the sump. A layer of gravel about 6 inches thick placed in the bottom of the excavation will facilitate groundwater flow and can be used as a working platform.

8.1.11 Slopes

All 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. An engineering geologist should observe all cut slopes during grading to ascertain that no unforeseen adverse geologic conditions are encountered that require revised recommendations. All 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.

8.1.12 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.

8.1.13 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.

8.2 FOUNDATIONS

8.2.1 Shallow Spread Footings

The planned building can be supported on shallow spread footings with bottoms levels on granular compacted fills with an expansion index of less than 50. Footings should extend at least 24 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. The 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 a maximum of 5,000 psf. 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.

8.2.2 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.

8.2.3 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.

8.2.4 Foundation Excavation Observations

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

8.3 SLABS-ON-GRADE

8.3.1 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.

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.

8.3.2 Exterior Slabs-on-Grade

Exterior slabs should be at least 5 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 onsite 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.

8.4 CONVENTIONAL RETAINING WALLS

8.4.1 Foundations

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

8.4.2 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 35 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 55 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 any 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 6 presents typical conventional retaining wall backdrain details.

8.4.3 Seismic Earth Pressure

If required, the seismic earth pressure can be taken as equivalent to the pressure of a fluid weighing 20 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.

8.4.4 Backfill

Wall backfill should consist of granular, free-draining material having an expansion index of 20 or less. The backfill zone is defined by a 1:1 plane projected upward from the heel of the wall. Expansive or clayey soil should not be used. We anticipate that most of the onsite soils will not be suitable for wall backfill. Additionally, backfill within 3 feet from the back of the wall should not contain rocks greater than 3 inches in dimension. 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, any utilities supported on backfill should be designed to tolerate differential settlement.

8.5 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 (degrees)	32°	32°	32°
Cohesion (psf)	0	0	0
Moist Unit Weight (pcf)	130	130	130

The reinforced soil should consist of granular, free-draining material with an expansion index of 20 or less. 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 MSE 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.

8.6 PIPELINES

8.6.1 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.

8.6.2 Modulus of Soil Reaction

A modulus of soil reaction (E') of 2,000 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.

8.6.3 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 onsite 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.

8.6.4 Backfill

Excavated materials free of organic debris and rocks greater than 6 inches in any dimension are generally expected to be suitable for use as utility trench backfill, unless beneath structures or hardscape. Imported material should not contain rocks greater than 3 inches in any dimension or organic debris. Imported material should have an expansion index of 20 or less. SCST should observe and, if appropriate, test proposed import 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.

8.7 SOIL CORROSIVITY

A representative sample of the onsite 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.

9. GEOTECHNICAL ENGINEERING DURING CONSTRUCTION

The geotechnical engineer 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 the geotechnical engineer 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.

10. CLOSURE

SCST should be advised of any 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 boring location 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 any 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.

11. REFERENCES

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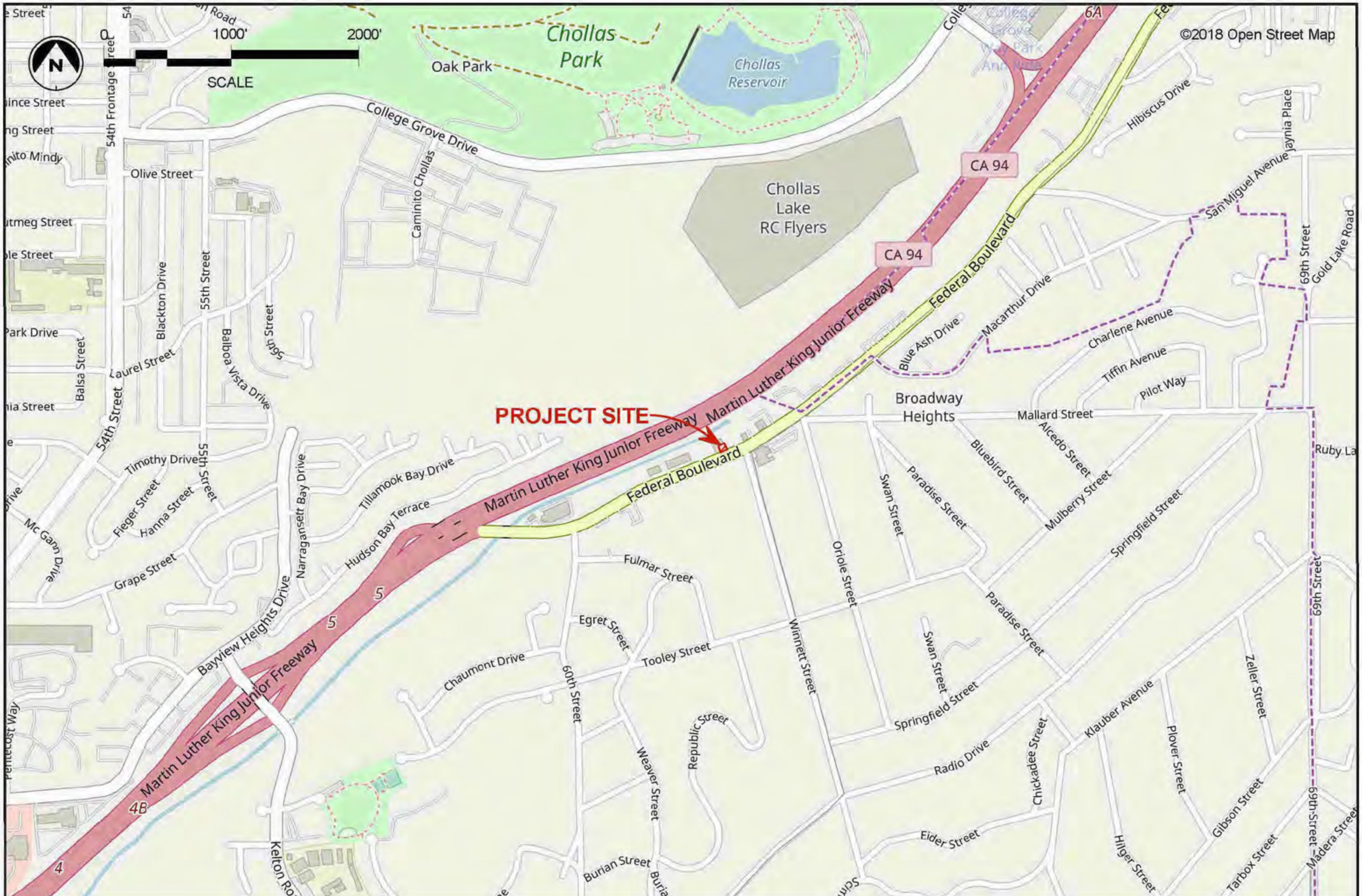
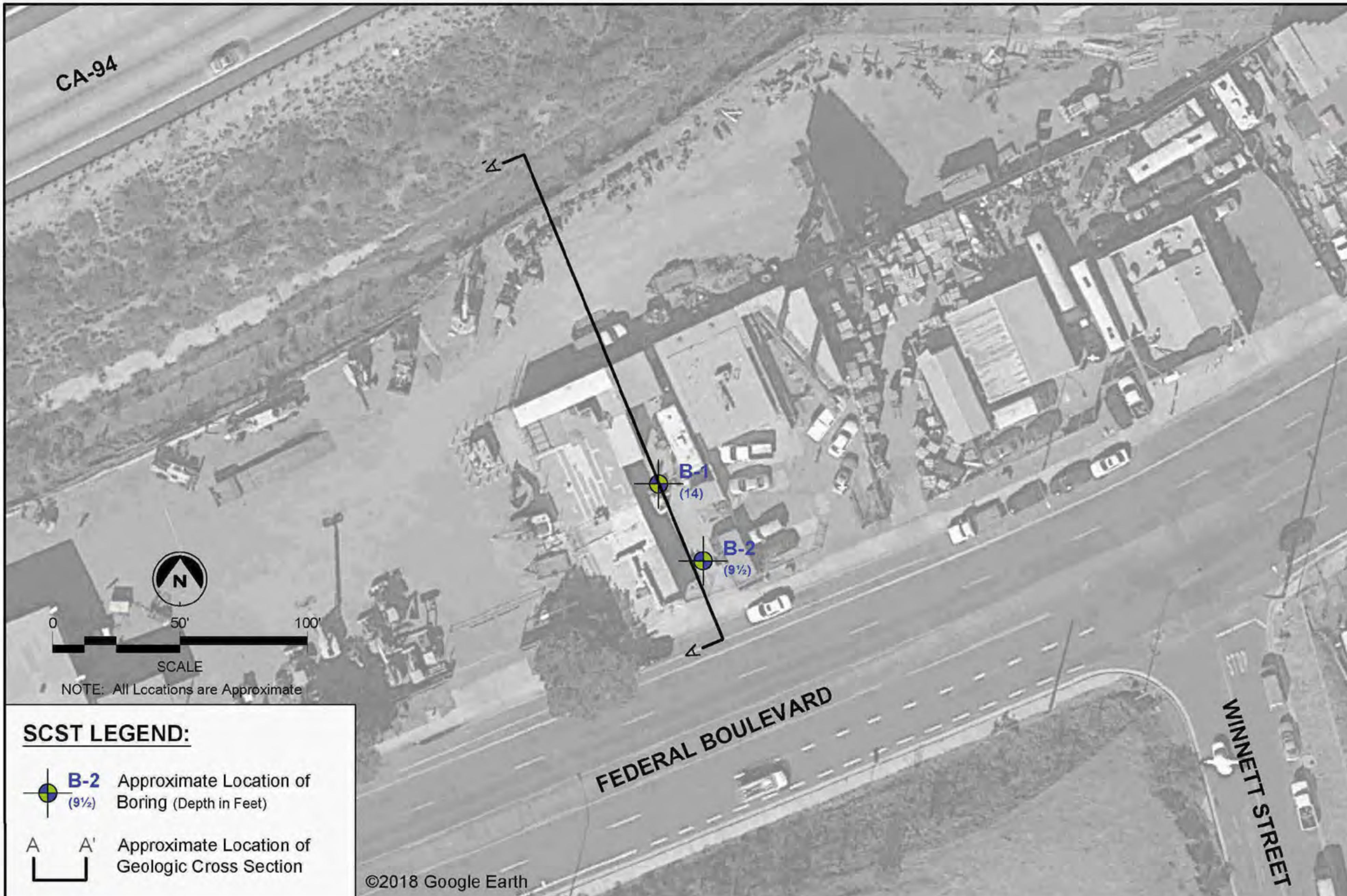


SCST, Inc.	**SITE VICINITY MAP** 6176 Federal Boulevard San Diego, California	Date: May, 2018 By: PFL Job No.: 180126N-1	Figure: 1

Trial Ex. 124-021



SCST LEGEND:

B-2 (9½) Approximate Location of Boring (Depth in Feet)

A A' Approximate Location of Geologic Cross Section

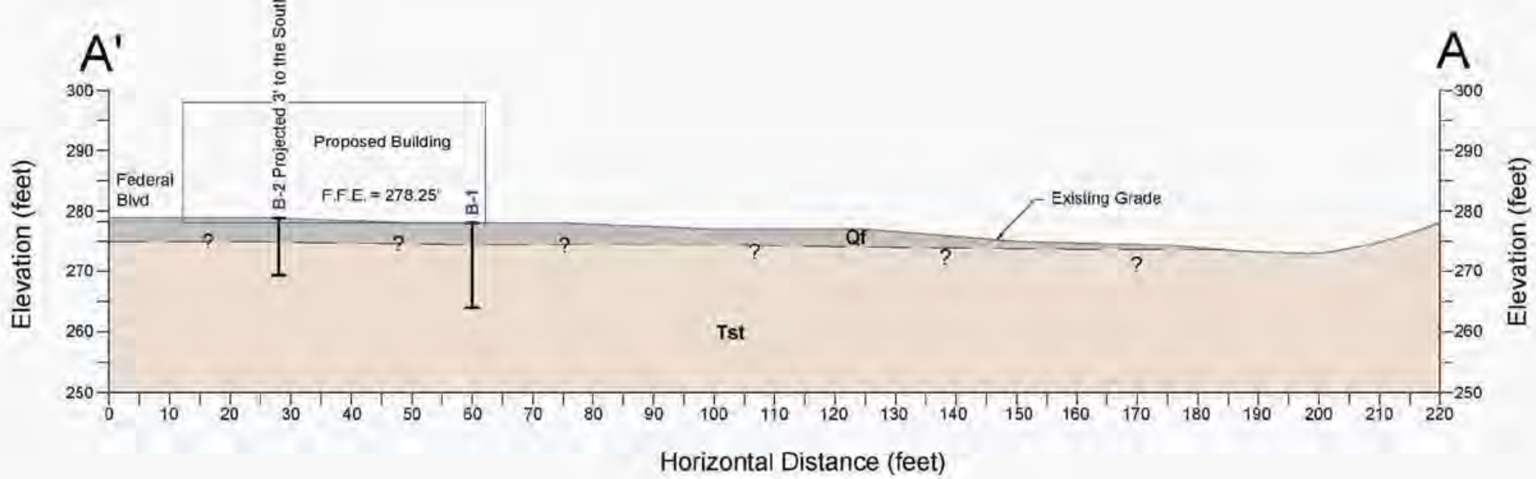
SCST, Inc.

SUBSURFACE EXPLORATION MAP
6176 Federal Boulevard
San Diego, California

Date: May, 2018
By: PFL
Job No.: 180126N-1

Figure: 2

Trial Ex. 124-022



SCST LEGEND:

Approximate Location of Geologic Contact
Queried Where Uncertain

Qf Fill

Tst Stadium Conglomerate

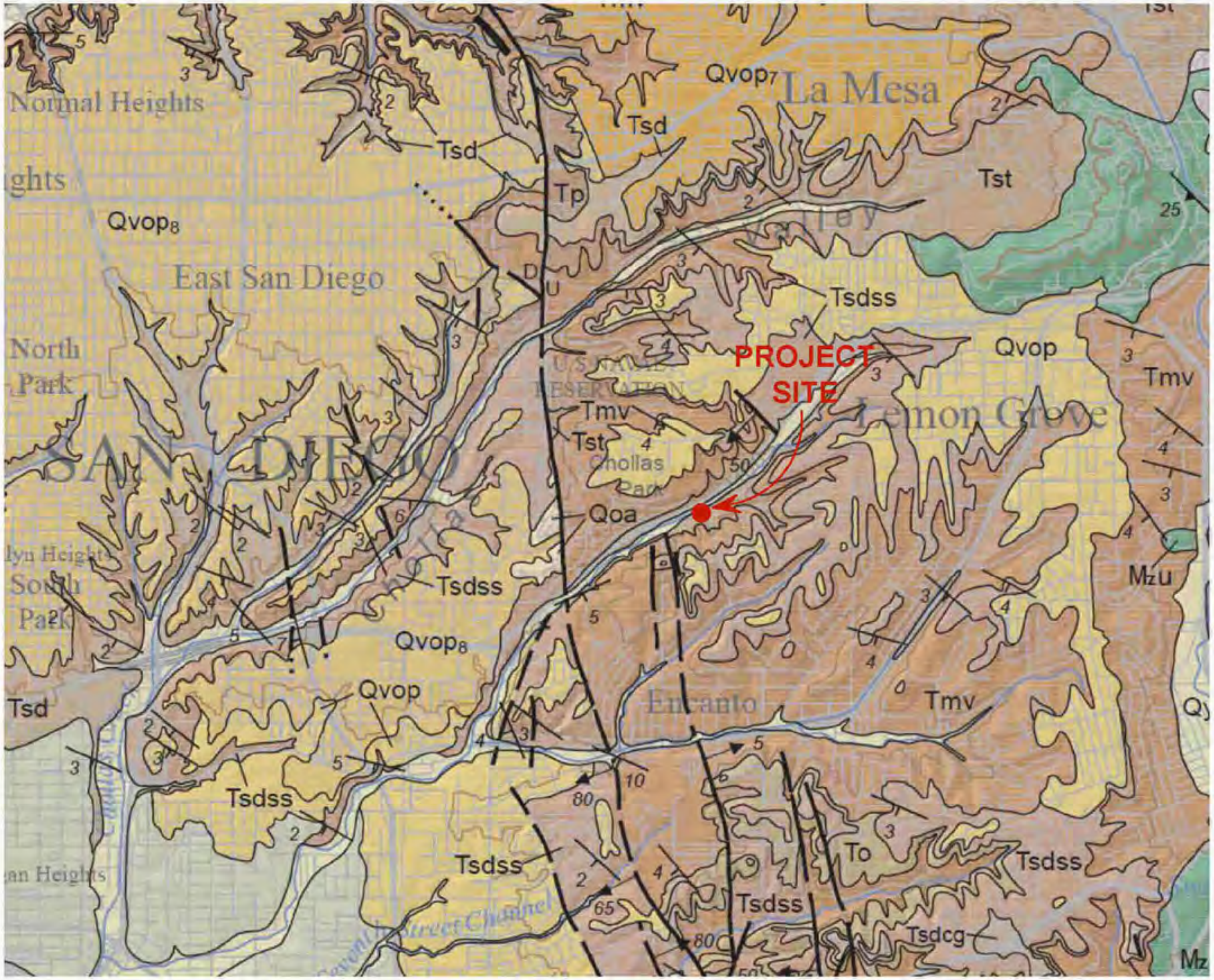
SCALE: 1"=20'

Figure: 3

Date: May, 2018
By: PFL
Job No.: 180126N-1

GEOLOGIC CROSS SECTION
6176 Federal Boulevard
San Diego, California

SCST, Inc.



EXPLANATION:

Qoa	Old alluvial flood-plain deposits, undivided (late to middle Pleistocene)
Qvop	Very old paralic deposits, undivided (middle to early Pleistocene)
$Qvop_7$	Very old paralic deposits, undivided (middle to early Pleistocene), Unit 7
$Qvop_8$	Very old paralic deposits, undivided (middle to early Pleistocene), Unit 8
Tsd	San Diego Formation (early Pleistocene and late Pliocene), undivided
Tsdss	San Diego Formation (early Pleistocene and late Pliocene), Marine Sandstone
Tsdcg	San Diego Formation (early Pleistocene and late Pliocene), Transitional marine and nonmarine pebble and cobble conglomerate
Tp	Pomerado Conglomerate (middle Eocene)
Tmv	Mission Valley Formation (middle Eocene)
Tst	Stadium Conglomerate (middle Eocene)

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.

Landslide - Arrows indicate principal direction of movement. Queried where existence is questionable.

Strike and **dip** of sedimentary joints Vertical

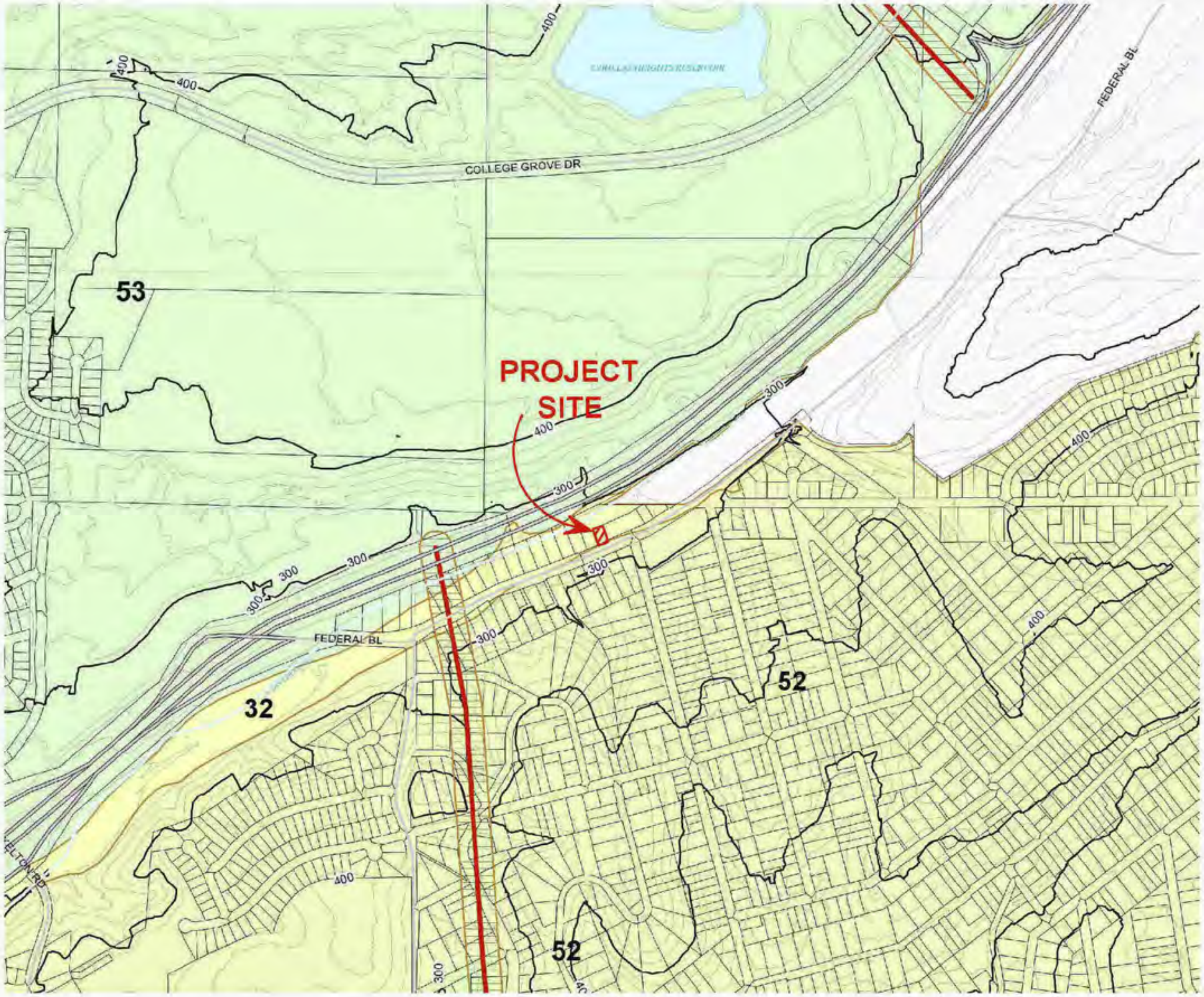
N

0 5,000' 10,000'

SCALE

Reference:
Geologic Map of the San Diego 30' x 60' Quadrangle
By Kennedy, M.P. and Tan, S.S. (2008)

SCST, Inc.	**REGIONAL GEOLOGY MAP** 6176 Federal Boulevard San Diego, California	Date: May, 2018 By: PFL Job No.: 180126N-1	Figure: 4



EXPLANATION:

32	**LIQUEFACTION:** Low Potential -- fluctuating groundwater minor drainages
52	**OTHER TERRAIN:** Other level areas, gently sloping to steep terrain, favorable geologic structure, low risk
53	**OTHER TERRAIN:** Level or sloping terrain, unfavorable geologic structure, low to moderate risk

N

0 1,000' 2,000'
SCALE

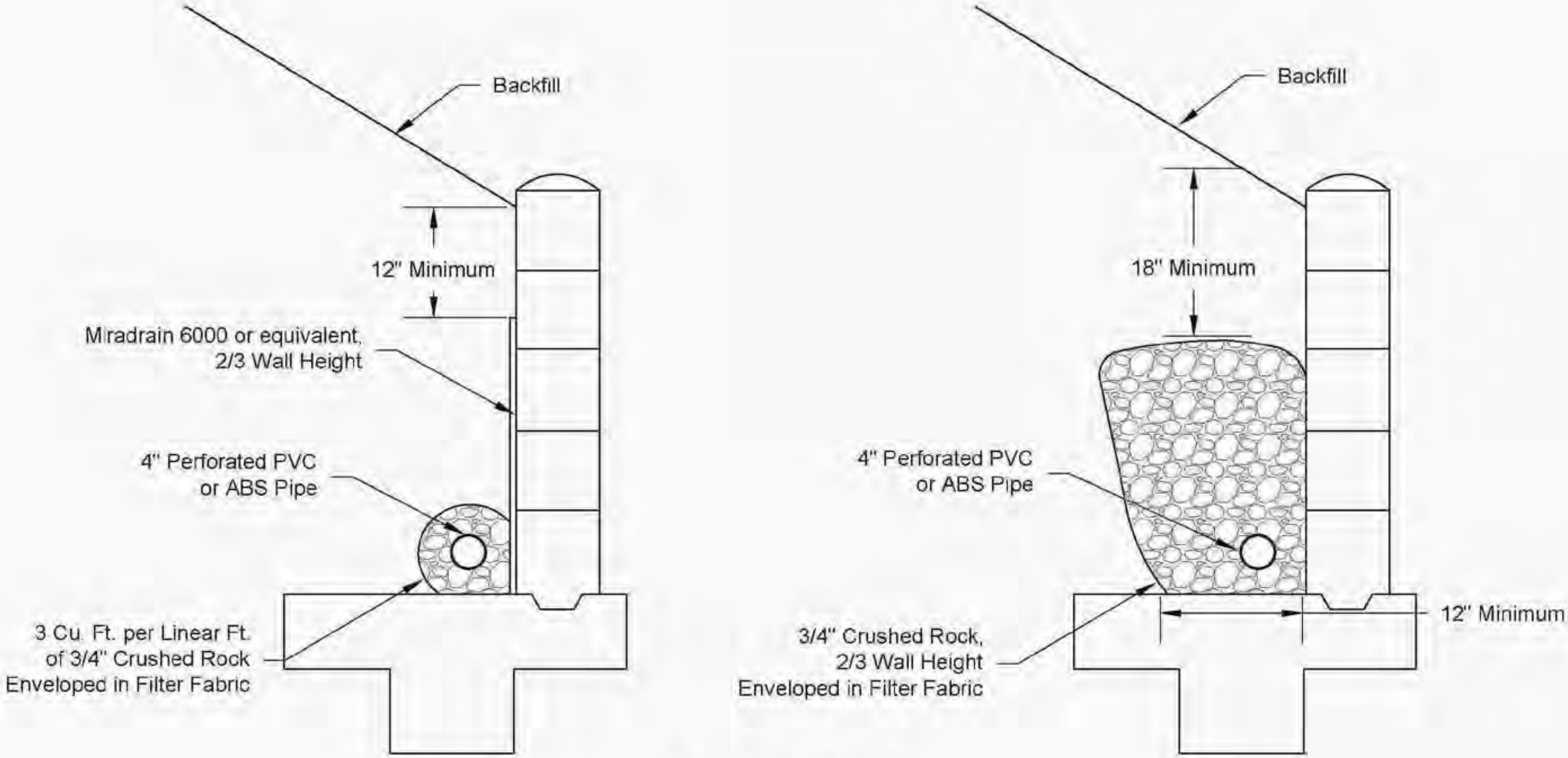
Reference:
City of San Diego (2008), Seismic Safety Study, Geologic Hazards and Faults, Grid Tile: 18, Development Services Department, April 3.

SCST, Inc.

SEISMIC SAFETY STUDY
6176 Federal Boulevard
San Diego, California

Date: May, 2018
By: PFL
Job No.: 180126N-1

Figure:
5

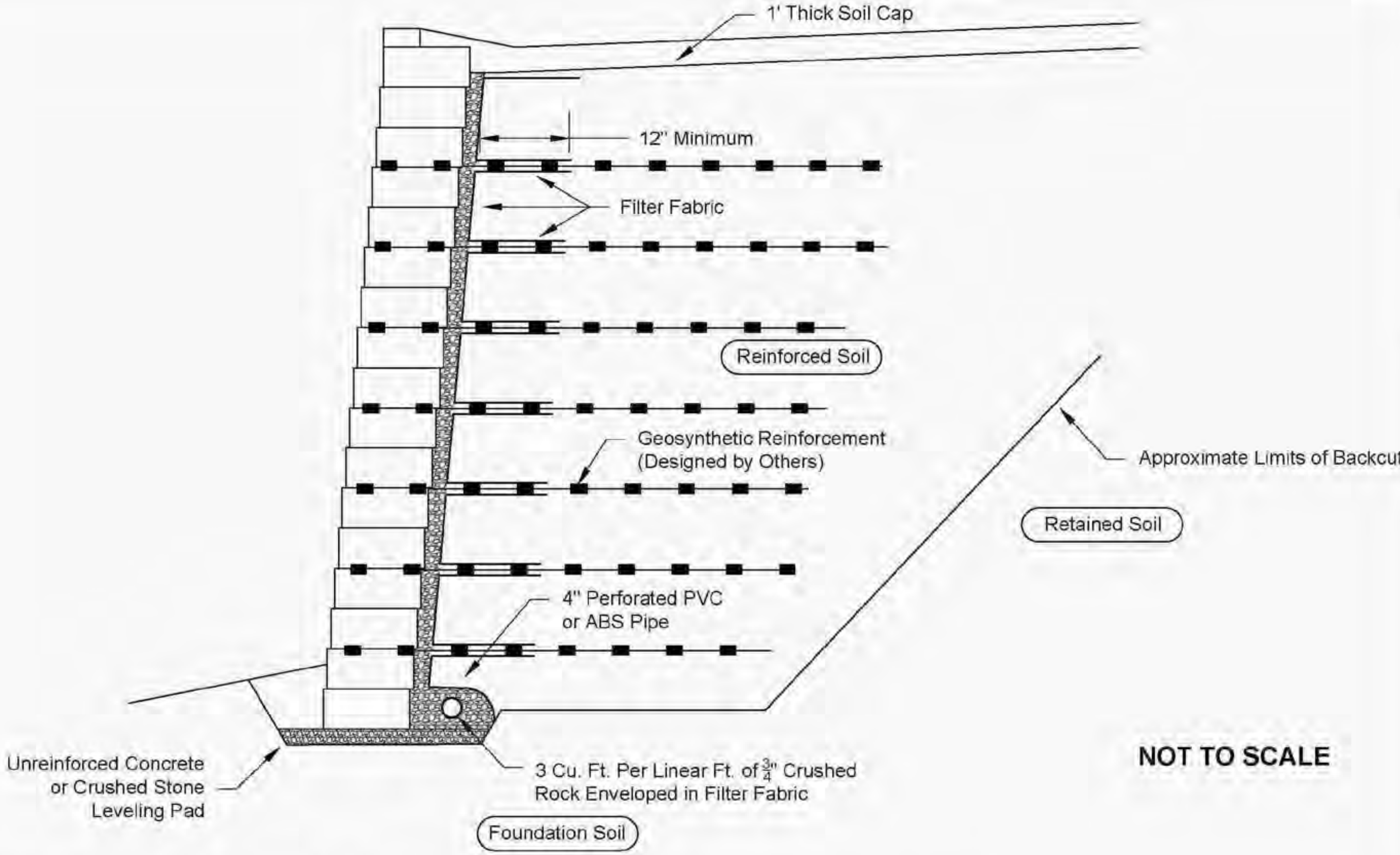


NOT TO SCALE

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.

SCST, Inc.	**TYPICAL RETAINING WALL BACKDRAIN DETAILS** 6176 Federal Boulevard San Diego, California	Date: May, 2018 By: PFL Job No.: 180126N-1	Figure: 6



NOT TO SCALE

NOTES:

1) Backcut as recommended by the geotechnical report or field evaluation
2) Additional drain at excavation backcut may be recommended base on conditions observed during construction.
3) Filter fabric should be installed between crushed rock and soil. Filter fabric should consist of Mirafi 140N or equivalent. Filter fabric should be overlapped approximately 6 inches.
4) Perforated pipe should outlet through a solid pipe to an appropriate gravity outfall. Perforated pipe and outlet pipe should have a fall of at least 1%.

SCST, Inc.	TYPICAL MSE RETAINING WALL DETAIL 6176 Federal Boulevard San Diego, California	Date: May, 2018 By: PFL Job No.: 180126N-1	Figure: 7

APPENDIX I
FIELD INVESTIGATION

Our field investigation consisted of drilling 2 borings May 11, 2017 to depths between about 9½ and 14 feet below the existing ground surface using a truck-mounted drill rig equipped with a hollow-stem auger. Auger refusal was encountered in both of the borings. Figure 2 shows the approximate locations of the borings. The field investigation was performed under the observation of an SCST engineer who also logged the borings and obtained samples of the materials encountered.

Relatively undisturbed samples were obtained using a modified California (CAL) sampler, which is a ring-lined split tube sampler with a 3-inch outer diameter and 2½-inch inner diameter. Standard Penetration Tests (SPT) were performed using a 2-inch outer diameter and 1⅜-inch inner diameter split tube sampler. The CAL and SPT samplers were driven with a 140-pound weight dropping 30 inches. The number of blows needed to drive the samplers the final 12 inches of an 18-inch drive is noted on the boring logs as "Driving Resistance (blows/ft. of drive)." SPT and CAL sampler refusal was encountered when 50 blows were applied during any one of the three 6-inch intervals, a total of 100 blows was applied, or there was no discernible sampler advancement during the application of 10 successive blows. The SPT penetration resistance was normalized to a safety hammer (cathead and rope) with a 60% energy transfer ratio in accordance with ASTM D6066. The normalized SPT penetration resistance is noted on the boring logs as "N60." Disturbed bulk samples were obtained from the SPT sampler and the drill cuttings.

The soils are classified in accordance with the Unified Soil Classification System as illustrated on Figure I-1. Logs of the borings and test holes are presented on Figures I-2 through I-3.

SC
ST

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
- RV - R-Value
- SA - Sieve Analysis

SCST, Inc.	6176 Federal Boulevard San Diego, California		
By:	EMW	Date:	June, 2018
Job Number:	180126N-1	Figure:	I-1

LOG OF BORING B-1

Date Drilled: 5/11/2018
Equipment: CME-95 w/ 8-inch HSA
Elevation (ft): 278

Logged by: EMW
Reviewed by: DAS
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
		5½ inches of Concrete Pavement							
1	SC	**FILL (Qf):** CLAYEY SAND with GRAVEL, medium dense, brown, moist, fine to coarse grained, trace cobble. Bricks and trash encountered.		X					AL SA
2				X					
3		Light brown.							
4		**STADIUM CONGLOMERATE (Tst):** SANDY CONGLOMERATE, dense, reddish brown, moist, fine to coarse grained.							
5									
6			SPT		32	42			
7									
8									
9									
10									
11			CAL		50/2"	42			
12									
13									
14			SPT		50/2"	42			
		BORING REFUSAL AT 14 FEET ON COBBLE							
15									
16									
17									
18									
19									
20									

SCST, Inc.	6176 Federal Boulevard San Diego, California
By: EMW	Date: June, 2018
Job Number: 180126N-1	Figure: I-2

LOG OF BORING B-2

Date Drilled: 5/11/2018
Equipment: CME-95 w/ 8-inch HSA
Elevation (ft): 279

Logged by: EMW
Reviewed by: DAS
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
		5½ inches of Concrete Pavement							
1	SC	**FILL (Qf):** CLAYEY SAND with GRAVEL, medium dense, brown, moist, fine to coarse grained, trace cobble. Bricks and trash encountered.		X					
2									EI COR
3		Light brown.							
4		**STADIUM CONGLOMERATE (Tst):** SANDY CONGLOMERATE, dense, reddish brown, moist, fine to coarse grained.							
5									
6			CAL		50/4"	42			
7									
8									
9		Very dense.	SPT		50/5"	65			
		BORING REFUSAL AT 9¾ FEET ON COBBLE							
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, Inc.

6176 Federal Boulevard
San Diego, California

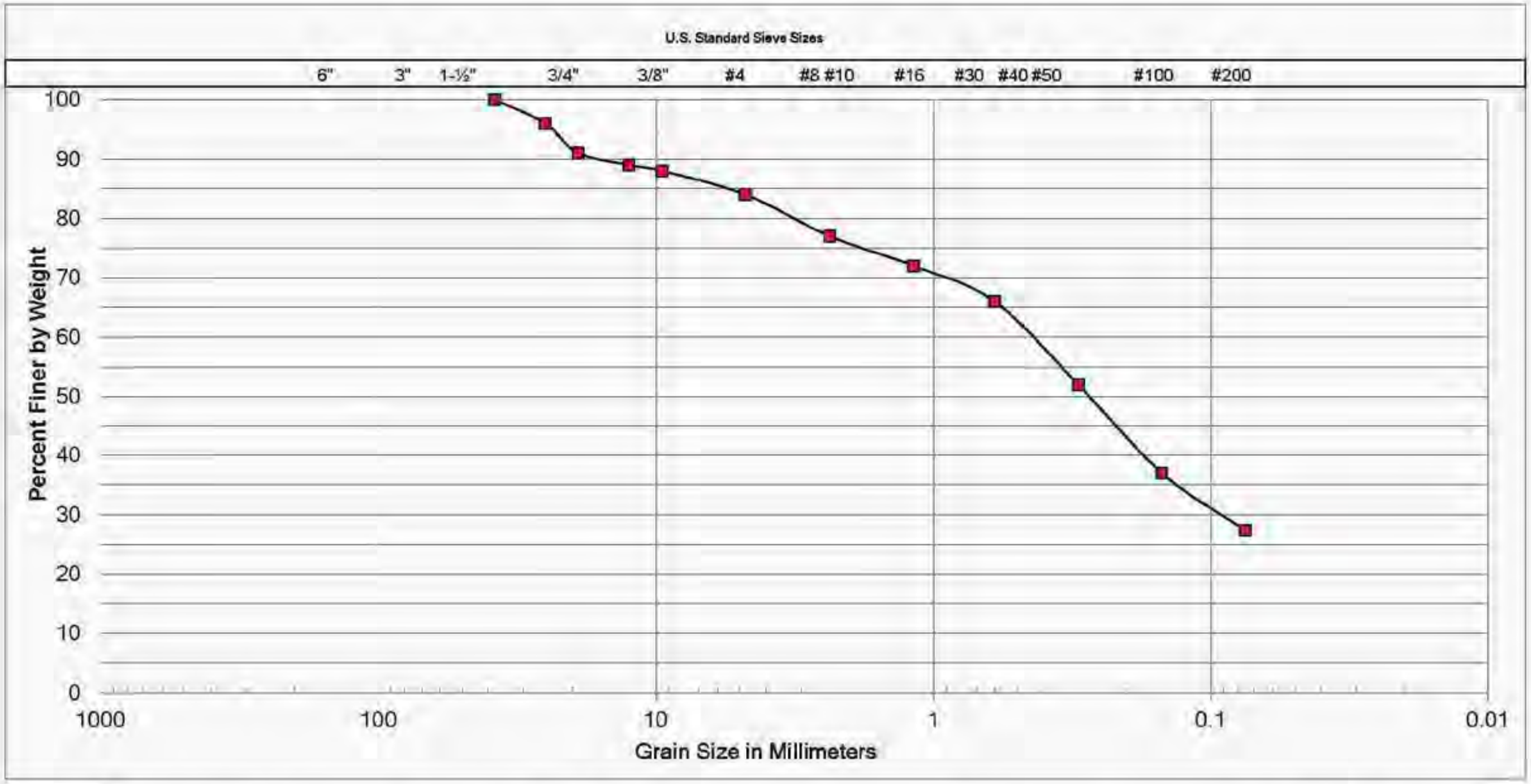
By:	EMW	Date:	June, 2018
Job Number:	180126N-1	Figure:	I-3

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.
- **GRAIN-SIZE DISTRIBUTION:** The grain-size distribution was determined on one sample in accordance with ASTM D422. Figure II-1 presents the test results.
- **ATTERBERG LIMITS:** The Atterberg limits were determined on one soil sample in accordance with ASTM D4318. Figure II-1 presents the test results.
- **EXPANSION INDEX:** The expansion index was determined on one soil sample in accordance with ASTM D4829. Figure II-2 presents the test results.
- **CORROSIVITY**: Corrosivity tests were performed on one soil sample. 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. Figure II-2 presents the test results.

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
B-1 at 0 to 3 feet

UNIFIED SOIL CLASSIFICATION:	SC
DESCRIPTION	CLAYEY SAND w/GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	28
PLASTIC LIMIT	17
PLASTICITY INDEX	11

SCST, Inc.

6176 Federal Boulevard San Diego, California			
By:	EMW	Date:	June, 2018
Job Number:	180126N-1	Figure:	II-1

Trial Ex. 124-033

EXPANSION INDEX

ASTM D2489

SAMPLE	DESCRIPTION	EI
B-2 at 0 to 4 feet	CLAYEY SAND with GRAVEL	59

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

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 (%)
B-2 at 0 to 4 feet	1010	7.68	0.011	0.003

Sulphate Exposure Classes [2]

CLASS	SEVERITY	WATER-SOLUBLE SULFATE (SO_4) IN SOIL, PERCENT BY MASS
S0	Not applicable	$SO_4 < 0.10$
S1	Moderate	$0.10 \leq SO_4 < 0.20$
S2	Severe	$0.20 \leq SO_4 \leq 2.00$
S3	Very Severe	$SO_4 > 2.00$

2. ACI 318, Table 19.3.1.1

SCST, Inc.	6176 Federal Boulevard San Diego, California		
By:	EMW	Date:	June, 2018
Job Number:	180126N-1	Figure:	II-2