GEOTECHNICAL INVESTIGATION
21st STREET PARK AND DRAINAGE IMPROVEMENTS

21st and Court Street
Del Mar, California

Prepared By:
SCST, LLC
6280 Riverdale Street
San Diego, California 92120

Prepared For:
Mr. Joe Bride
Director of Public Works
City of Del Mar
2240 Jimmy Durante Boulevard
Del Mar, California 92014

Providing Professional Engineering Services Since 1959
September 20, 2019

Mr. Joe Bride
Director of Public Works
City of Del Mar
2240 Jimmy Durante Boulevard
Del Mar, California 92014

Subject: GEOTECHNICAL INVESTIGATION
21st STREET PARK AND DRAINAGE IMPROVEMENTS
21st AND COURT STREETS
DEL MAR, CALIFORNIA

Dear Mr. Bride:

SCST, LLC, an Atlas company, 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 agreement dated March 27, 2019. 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

Daniel Richardson, PE C89379
Project Engineer

Andrew K. Neuhaus, CEG 2591
Chief Geologist

DM: AKN: JPS: hu

(1) Addressee via e-mail: jbride@delmar.ca.us
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**ATTACHMENTS**

**FIGURES**

- Figure 1: Site Vicinity Map
- Figure 2: Subsurface Exploration Map
- Figure 3: Regional Geology Map

**APPENDICES**

- Appendix I: Field Investigation
- Appendix II: Laboratory Testing
1. INTRODUCTION

This report presents the results of the geotechnical investigation SCST, LLC (SCST), an Atlas company, performed for the 21st Street Park and Drainage Improvements project. We understand the project will consist of the design and construction of park and drainage improvements in Del Mar, California. Figure 1 presents a site vicinity map. The purpose of our work is to provide conclusions and recommendations regarding the geotechnical aspects of the project.

2. SCOPE OF WORK

2.1 FIELD INVESTIGATION

We explored the subsurface conditions by drilling four borings to depths between about 2½ and 5½ feet below the existing ground surface using hand tools. Figure 2 presents a subsurface exploration map. An SCST engineer logged the borings and test holes and collected samples of the materials encountered for laboratory testing. Appendix I presents logs of the borings. Soils are classified according to the Unified Soil Classification System illustrated on Figure I-1.

2.2 LABORATORY TESTING

Selected samples obtained from borings 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, Atterberg limits, and corrosivity. Appendix II presents the results of the laboratory tests and brief explanations of the test procedures.

2.3 ANALYSIS AND REPORT PREPARATION

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
- Groundwater levels and dewatering
- Temporary excavations and shoring
- Excavation characteristics
- Soil corrosivity
3. SITE DESCRIPTION

The site is located within a triangle-shaped developed area bound by Camino Del Mar on the southwest, 21st Street on the north, and North County Transit District train tracks on the east in the city of Del Mar, California. The site contains existing pavements, a drainage ditch, bridge, tennis courts, a basketball court, and associated public facilities. The site is characterized as generally level with elevations ranging from about 6 feet on the north to about 12 feet on the south. The drainage ditch elevations range from 6 feet above MSL on the west end to 2 feet MSL on the east end.

4. PROPOSED IMPROVEMENTS

The proposed improvements will consist of pavements, decomposed granite walkways, signs, benches, bike repair station, and drainage ditch improvements. Site grading should consist of cuts and fills between about 1 to 2 feet (MBI, 2019).

5. GEOLOGY AND SUBSURFACE CONDITIONS

The materials encountered in the borings consist of fill. Descriptions of the materials are presented below.

**Fill**: Fill up to roughly 5½ feet thick was encountered in our borings. The fill consists of loose to medium dense silty to clayey sand and soft sandy silt with varying amounts of gravel, vegetation, and debris.

**Groundwater**: Groundwater was encountered at approximately 1 foot above the ditch bottom in boring B-3 and at approximately 4½ feet below the ground surface in borings B-1 and B-4. The standing water at the site does not drain and appears to be in equilibrium with the groundwater table. However, groundwater levels may develop in drainage courses and fluctuate due to tides and 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. 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 adjusted maximum considered earthquake spectral response accelerations in accordance with the 2016 CBC are presented below:
Site Coordinates: Latitude 32.966913°
Longitude -117.265992°
Site Class: D
Site Coefficients,
\[ F_a = 1.02 \]
\[ F_v = 1.535 \]
Mapped Spectral Response Acceleration at Short Period, \( S_s = 1.201 \text{g} \)
Mapped Spectral Response Acceleration at 1-Second Period, \( S_1 = 0.465 \text{g} \)
Design Spectral Acceleration at Short Period, \( S_{DS} = 0.816 \text{g} \)
Design Spectral Acceleration at 1-Second Period, \( S_{D1} = 0.476 \text{g} \)
Site Peak Ground Acceleration, \( PGA_M = 0.513 \text{g} \)

7. CONCLUSIONS

The main geotechnical considerations affecting the planned development are the presence of potentially compressible fill and shallow groundwater. Remedial grading recommendations are provided in Section 8.1.2 of this report. Varying amounts of gravel, vegetation, and oversized debris exist in the fill that may require special handling. Saturated materials and shallow groundwater should be expected. Contract documents should specify that the contractor mobilize equipment capable of excavating oversized debris and saturated materials below groundwater.

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

Potentially compressible materials (i.e. loose fill) should be excavated in their entirety or within 3 feet of the groundwater table as evaluated by an SCST representative beneath settlement sensitive improvements (i.e. planned seat walls, park sign, and concrete paving) and new fills if any. Horizontally, the excavations should extend a distance equal to the depth of excavation or up to the limits of grading, whichever is less. Prior to placing fill, we recommend placing a layer of Tensar TX5, or equivalent, reinforcing geogrid at the base of the excavation, as evaluated by an SCST representative. An SCST representative
should observe conditions exposed in the bottom of the excavation to evaluate if additional excavation is required.

If the base of the excavation is wet and yielding, it can be stabilized by placing a layer of ¾-inch crushed rock over the geogrid. A minimum 1-foot-thick layer of rock is typically needed. Prior to placing compacted fill, a layer of non-woven filter fabric (Mirafi 140N or equivalent) should surround the crushed rock to prevent fines from washing into the voids of the gravel, which would result in post-construction settlement.

8.1.3 Excavation Characteristics

It is anticipated that excavations in fill can generally be achieved with conventional earthwork equipment in good working order. However, oversized debris exists on-site, and difficult excavation should be anticipated. Contract documents should specify that the contractor mobilize equipment capable of excavating and compacting the materials with oversized debris.

8.1.4 Temporary Dewatering

Groundwater seepage may occur locally and should be anticipated in excavations. Dewatering can be accomplished by isolating the work area with sheet piles and 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.

8.1.5 Compacted Fill

Excavated material, except for vegetation, debris, and rocks greater than 6 inches can be used as 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 evaluated 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%.
8.1.6 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.

8.1.7 Slopes

Permanent fill slopes should be constructed no steeper than 2:1 (horizontal:vertical). Faces of fill slopes should be compacted either by rolling with a sheepfoot roller or other suitable compaction equipment or by overfilling and cutting back to design grade. An engineering geologist should observe cut slopes during grading to ascertain that no unforeseen adverse geologic conditions are encountered that require revised recommendations. Slopes are susceptible to surficial slope failure and erosion. Water should not be allowed to flow over the tops of slopes. Slopes should be protected or planted with vegetation that will reduce the potential for erosion.

8.1.8 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 SOIL CORROSIVITY

A representative sample of the on-site soils was 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 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 test pit 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 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

American Concrete Institute (ACI) (2012), Building Code Requirements for Structural Concrete (ACI 318-11) and Commentary, August.

County of San Diego (2012), SanGIS Interactive Map.


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

Artificial fill
Marine beach deposits
Paralic estuarine deposits
Young alluvial flood-plain deposits

Old paralic deposits (Qop)
Units 2-4

Very old paralic deposits (Qvop)
Unit 10

Torrey Sandstone
Delmar Formation
Undivided Eocene rocks in offshore region

Strike and dip of beds
Inclined

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.

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
Our subsurface exploration consisted of drilling four borings on July 5, 2019 to depths between about 2½ feet and 5½ feet below the existing ground surface using hand tools. Figure 2 shows the approximate locations of the borings. Our subsurface exploration was performed under the observation of an SCST engineer who also logged the borings and obtained samples of the materials encountered.

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-5.
### SUBSURFACE EXPLORATION LEGEND

#### UNIFIED SOIL CLASSIFICATION CHART

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

#### SAMPLE SYMBOLS
- Bulk Sample
- Modified California Sampler
- Undisturbed Chunk sample
- Maximum Size of Particle
- Shelby Tube
- Standard Penetration Test sampler

#### 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

#### GROUNDWATER SYMBOLS
- Water level at time of excavation or as indicated
- Water seepage at time of excavation or as indicated

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**SCST, LLC**

**21st Street Park and Drainage Improvements**

**Del Mar, California**

**By:** EMW  **Date:** September, 2019

**Job Number:** 140576P3.21-1R  **Figure:** I-1
## LOG OF BORING B-1

**Date Drilled:** 7/5/2019  
**Logged by:**  
**Equipment:** 6-inch Hand Auger  
**Elevation (ft):** Approx. 7 MSL  
**Reviewed by:**  
**Depth to Groundwater (ft):** 4½

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>USCS</th>
<th>SUMMARY OF SUBSURFACE CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SM</td>
<td><strong>FILL (Q):</strong> POORLY GRADED SAND with SILT and GRAVEL, loose to medium dense, brown, moist, fine grained, some asphalt debris.</td>
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<td>4</td>
<td>SM</td>
<td><strong>SILTY SAND,</strong> loose, brown, moist, fine to medium grained. Groundwater at 4½ Feet.</td>
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<td>6</td>
<td></td>
<td><strong>BORING TERMINATED AT 5½ FEET</strong></td>
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**LABORATORY TESTS**

<table>
<thead>
<tr>
<th>SAMPLES</th>
<th>DRIVEN BULK</th>
<th>DRIVING RESISTANCE (blows/ft of drive)</th>
<th>MOISTURE CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
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**21st Street Park and Drainage Improvements**  
**Del Mar, California**  
**By:** EMW  
**Date:** September, 2019  
**Job Number:** 140576P3.21-1R  
**Figure:** I-2
## LOG OF BORING B-2

**Date Drilled:** 7/5/2019  
**Equipment:** 6-inch Hand Auger  
**Elevation (ft):** Approx. 6 MSL  
**Logged by:**  
**Reviewed by:** DJM/NDK  
**Depth to Groundwater (ft):** Not Encountered  

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>USCS</th>
<th>SUMMARY OF SUBSURFACE CONDITIONS</th>
<th>SAMPLES</th>
<th>BULK</th>
<th>DRIVING RESISTANCE (blows/ft of drive)</th>
<th>MOISTURE CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>LABORATORY TESTS</th>
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<tbody>
<tr>
<td>1</td>
<td>SM</td>
<td>Fill (Qn): Silty sand, medium dense, brown, moist, fine to medium grained, some asphalt and concrete debris. Very dense.</td>
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<td>BORING REFUSAL AT 2½ FEET ON CONCRETE DEBRIS</td>
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</tr>
</tbody>
</table>

**21st Street Park and Drainage Improvements**  
Del Mar, California  
**By:** EMW  
**Date:** September, 2019  
**Job Number:** 140576P3.21-1R  
**Figure:** I-3
# LOG OF BORING B-3

Date Drilled: 7/5/2019  
Equipment: 6-inch Hand Auger  
Elevation (ft): Approx. 2 MSL  
Depth to Groundwater (ft): 1 Foot Above GS

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>USCS</th>
<th>SUMMARY OF SUBSURFACE CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SM</td>
<td><strong>FILL (Qf): SILTY SAND, loose, brown, wet, fine to medium grained.</strong></td>
</tr>
<tr>
<td>2</td>
<td>ML</td>
<td><strong>SANDY SILT, very soft, dark gray, wet, fine grained. SAND, some debris and organic material.</strong></td>
</tr>
<tr>
<td>3</td>
<td>SM</td>
<td><strong>SILTY SAND, loose, dark gray, wet, fine grained.</strong></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td><strong>BORING TERMINATED AT 5 FEET</strong></td>
</tr>
<tr>
<td>5</td>
<td>CAL</td>
<td>27.2</td>
</tr>
</tbody>
</table>

**LABORATORY TESTS**

<table>
<thead>
<tr>
<th>SAMPLES</th>
<th>DRIVEN</th>
<th>BULK</th>
<th>MOISTURE CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
<td></td>
<td>SA</td>
<td>AL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SA</td>
<td>AL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AL</td>
<td>AL</td>
</tr>
</tbody>
</table>

**MOISTURE CONTENT (%)**

**DRY UNIT WEIGHT (pcf)**

---

SCST, LLC  
21st Street Park and Drainage Improvements  
Del Mar, California  
By: EMW  
Date: September, 2019  
Job Number: 140576P3.21-1R  
Figure: I-4
LOG OF BORING B-4

Date Drilled: 7/5/2019
Logged by: DJM/NDK
Equipment: 6-inch Hand Auger
Reviewed by: AKN
Elevation (ft): Approx. 7½ MSL
Depth to Groundwater (ft): 4½

<table>
<thead>
<tr>
<th>DEPTH (ft)</th>
<th>USCS</th>
<th>SUMMARY OF SUBSURFACE CONDITIONS</th>
<th>SAMPLES</th>
<th>DRIVEN</th>
<th>BULK</th>
<th>DRIVING RESISTANCE (blows/ft of drive)</th>
<th>MOISTURE CONTENT (%)</th>
<th>DRY UNIT WEIGHT (pcf)</th>
<th>LABORATORY TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SM</td>
<td>FILL (QF): SILTY SAND, loose to medium dense, brown, moist, fine to coarse grained SAND.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>SM</td>
<td>SILTY SAND, medium dense, brown, moist, fine to coarse grained, some gravel.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SP</td>
<td>POORLY GRADED SAND, loose, light brown, moist, fine grained. Groundwater at 4½ Feet.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BORING TERMINATED AT 5 FEET

21st Street Park and Drainage Improvements
Del Mar, California

SCST, LLC

By: EMW Date: September, 2019
Job Number: 140576P3.21-1R Figure: I-5
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 evaluated on four samples in accordance with ASTM D422.

- **ATTERBERG LIMITS:** The Atterberg limits were evaluated on one sample in accordance with ASTM D4318.

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

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

- **Liquid Limit**: -
- **Plastic Limit**: -
- **Plasticity Index**: -

### Unified Soil Classification:

**Sample Location:** B-1 at 0 to 4 Feet

**Sample Number:** 43830

**Description:**
- Poorly Graded Sand with Silty and Gravelly Materials

**Sample:**
- **Cobbles**
- **Gravel**
- **Sand**
- **Silt or Clay**
  - Coarse
  - Medium
  - Fine

**U.S. Standard Sieve Sizes**

<table>
<thead>
<tr>
<th>Grain Size in Millimeters</th>
<th>6&quot;</th>
<th>3&quot;</th>
<th>1-½&quot;</th>
<th>3/4&quot;</th>
<th>3/8&quot;</th>
<th>#4</th>
<th>#8</th>
<th>#10</th>
<th>#16</th>
<th>#30</th>
<th>#40</th>
<th>#50</th>
<th>#100</th>
<th>#200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent Finer by Weight</td>
<td>100</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

### Graph

- **X-axis:** Grain Size in Millimeters
- **Y-axis:** Percent Finer by Weight
- **Legend:**
  - Cobble
  - Gravel
  - Sand
  - Silt or Clay

---

**SCST, LLC**

21st Street Park and Drainage Improvements
Del Mar, California

**By:** AIS
**Date:** September, 2019
**Job Number:** 140576P3.21-1R
**Figure:** II-1
### UNIFIED SOIL CLASSIFICATION

**SAMPLE LOCATION:** B-2 at 0 to 2½ Feet  
**SAMPLE NUMBER:** 43830

**DESCRIPTION:** SILTY SAND

### ATTERBERG LIMITS

- **LIQUID LIMIT:** -
- **PLASTIC LIMIT:** -
- **PLASTICITY INDEX:** -

### GRAIN SIZE DISTRIBUTION

<table>
<thead>
<tr>
<th>U.S. Standard Sieve Sizes</th>
<th>Percent Finer by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>3&quot;</td>
</tr>
<tr>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

- **Cobbles:**  
  - Coarse  
  - Fine
- **Gravel:**  
  - Coarse  
  - Medium  
  - Fine
- **Sand:**  
  - Coarse  
  - Medium  
  - Fine
- **Silt or Clay:**  
  - 6"  
  - 3"  
  - 3/4"  
  - 1-½"  
  - 3/8"  
  - #4  
  - #8 #10  
  - #16  
  - #30 #40 #50  
  - #100  
  - #200

**21st Street Park and Drainage Improvements**  
**Del Mar, California**

**By:** AIS  
**Date:** September, 2019

**Job Number:** 140576P3.21-1R  
**Figure:** II-2
**Sample Location:** B-3 at 1 to 1½ Feet

**Sample Number:** 43831

**UNIFIED SOIL CLASSIFICATION:** SM

**DESCRIPTION:** SILTY SAND

**ATTERBERG LIMITS**

- Liquid Limit: NP
- Plastic Limit: NP
- Plasticity Index: NP

**21st Street Park and Drainage Improvements**

Del Mar, California

**By:** AIS

**Date:** September, 2019

**Job Number:** 140576P3.21-1R

**Figure:** II-3

**SCST, LLC**
UNIFIED SOIL CLASSIFICATION: ML
DESCRIPTION: SANDY SILT

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

SAMPLE LOCATION:
- B-3 at 1½ to 2½ Feet

SAMPLE NUMBER:
- 43832

Grain Size in Millimeters

<table>
<thead>
<tr>
<th></th>
<th>100</th>
<th>90</th>
<th>80</th>
<th>70</th>
<th>60</th>
<th>50</th>
<th>40</th>
<th>30</th>
<th>20</th>
<th>10</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>40</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Percent Finer by Weight

Cobbles | Gravel | Sand | Silt or Clay
---|---|---|---
Coarse | Fine | Coarse | Medium | Fine

21st Street Park and Drainage Improvements
Del Mar, California

By: AIS Date: September, 2019
Job Number: 140576P3.21-1R Figure: II-4
**UNIFIED SOIL CLASSIFICATION:** SM

**DESCRIPTION:** SILTY SAND

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

**SAMPLE LOCATION**
B-4 at 0 to 2 Feet

**SAMPLE NUMBER**
43835

**21st Street Park and Drainage Improvements**
Del Mar, California

**By:** AIS
**Date:** September, 2019
**Job Number:** 140576P3.21-1R
**Figure:** II-5
EXPANSION INDEX
ASTM D2489

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>DESCRIPTION</th>
<th>EI</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-2 at 0 to 2½ Feet</td>
<td>SILTY SAND</td>
<td>1</td>
</tr>
<tr>
<td>B-4 at 0 to 2 Feet</td>
<td>SILTY SAND</td>
<td>1</td>
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</tbody>
</table>

Classification of Expansive Soil

<table>
<thead>
<tr>
<th>EXPANSIVE INDEX</th>
<th>POTENTIAL EXPANSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-20</td>
<td>Very Low</td>
</tr>
<tr>
<td>21-50</td>
<td>Low</td>
</tr>
<tr>
<td>51-90</td>
<td>Medium</td>
</tr>
<tr>
<td>91-130</td>
<td>High</td>
</tr>
<tr>
<td>Above 130</td>
<td>Very High</td>
</tr>
</tbody>
</table>

RESISTIVITY, pH, SOLUBLE CHLORIDE and SOLUBLE SULFATE
pH & Resistivity (Cal 643, ASTM G51)
Soluble Chlorides (Cal 422)
Soluble Sulfate (Cal 417)

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>RESISTIVITY (Ω-cm)</th>
<th>pH</th>
<th>CHLORIDE (%)</th>
<th>SULFATE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-2 at 0 to 2½ Feet</td>
<td>1550</td>
<td>8.22</td>
<td>0.042</td>
<td>0.006</td>
</tr>
<tr>
<td>B-4 at 0 to 2 Feet</td>
<td>4420</td>
<td>8.25</td>
<td>0.013</td>
<td>0.000</td>
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</tbody>
</table>

WATER-SOLUBLE SULFATE (SO₄²⁻) EXPOSURE
Modified from ACI 318-14 Table 19.3.1.1 and Table 19.3.2.1

<table>
<thead>
<tr>
<th>Water-soluble sulfate (SO₄²⁻) in soil, percent by weight</th>
<th>Exposure Severity</th>
<th>Exposure Class</th>
<th>Cement Type (ASTM C150)</th>
<th>Max. w/cm</th>
<th>Min. f_c’ (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO₄²⁻ &lt; 0.10</td>
<td>Not applicable</td>
<td>S0</td>
<td>No type restriction</td>
<td>N/A</td>
<td>2,500</td>
</tr>
<tr>
<td>0.10 ≤ SO₄²⁻ &lt; 0.20</td>
<td>Moderate</td>
<td>S1</td>
<td>II</td>
<td>0.50</td>
<td>4,000</td>
</tr>
<tr>
<td>0.20 ≤ SO₄²⁻ &lt; 2.00</td>
<td>Severe</td>
<td>S2</td>
<td>V</td>
<td>0.45</td>
<td>4,500</td>
</tr>
<tr>
<td>SO₄²⁻ &gt; 2.00</td>
<td>Very Severe</td>
<td>S3</td>
<td>V plus pozzolan or slag cement</td>
<td>0.45</td>
<td>4,500</td>
</tr>
</tbody>
</table>