Appendix D

Geotechnical Feasibility Study

NMG Geotechnical, Inc.

December 30, 2022

Project No. 21034-01

To: South Coast Plaza
3315 Fairview Road
Costa Mesa, California, 92626

Attention: Mr. Bryce Osborn, Director of Architecture and Planning

Subject: Updated Geotechnical Feasibility Study for Proposed Project at South Coast Plaza Village, Santa Ana, California

EXECUTIVE SUMMARY

At your request and authorization, NMG Geotechnical, Inc. (NMG) has performed a geotechnical feasibility study for the subject site located at the northeast corner of Bear Street and Sunflower Avenue. (See Site Location Map, Figure 1.) The primary purpose of our study was to provide a summary of the geologic and geotechnical conditions, along with an evaluation of the feasibility of the planned project with respect to identified geotechnical constraints.

Geotechnical Site Conditions: The site has the following conditions:

- Deep alluvium below the site consists of interlayered sands, silts and clays with the upper 15 to 20 feet being predominantly clays with relatively high expansion potential;
- Groundwater is on the order of 10 to 20 feet below existing ground surface, with artesian conditions (the water table in the sand layer below the clay is under some hydrostatic pressure);
- Site is not in an Alquist-Priolo Fault Zone with no faults mapped in the immediate vicinity;
- Site is in a mapped liquefaction hazard zone with confirmed liquefiable layers; and
- Site will experience seismic shaking from earthquakes on nearby active faults.

Geotechnical Constraints: Seismic shaking, liquefaction induced ground settlement, shallow groundwater, settlement of the heavier structures, and expansive soil are the primary geotechnical design constraints. Heavier structures (towers and multi-level parking structures) will require either deep pile foundations or mat slab (raft) foundations with ground improvement, such as rammed aggregate piers or stone columns. Conventional foundations may be feasible for intermediate structures with ground improvements. Lighter structures may be supported on stiff shallow foundations. Groundwater and wet soil conditions will require proactive measures, such as local dewatering and soft ground stabilization for excavations deeper than approximately 10 feet. Multi-level subterranean structures (as many as four levels below ground) will require significant construction shoring, dewatering, design for hydrostatic forces, subdrainage, waterproofing, and considerations of potential impacts to adjacent properties.

Conclusion: Based on our study, we conclude that the subject property is feasible for the planned development from a geotechnical viewpoint provided the recommendations herein are carried forward to the next phases of exploration, design, grading and construction.

If you have any questions regarding this report, please contact our office. We appreciate the opportunity to provide our services.

Respectfully submitted,

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ATTACHMENTS

1.0 INTRODUCTION

NMG Geotechnical, Inc. (NMG) has completed a geotechnical feasibility study for a proposed re-development of South Coast Plaza Village. As described in the following sections, the plans envision a mixed-use development project with multiple structures consisting of high- and mid-rise residential, mid- and low-rise commercial, with associated subterranean parking facilities. The purpose of our services was to sufficiently characterize the geotechnical conditions of the site in order to evaluate the feasibility of the planned project elements. Our findings and conclusions are summarized in this report along with preliminary geotechnical recommendations related to major design and construction considerations. Additional exploration and analyses will be necessary to build upon this study for the design phase of structures, construction elements such as shoring, and for the infrastructure associated with the project.

1.1 Scope of Services

Our scope of services for this study included the following:

- City of Santa Ana public archive search and review of acquired geotechnical reports;
- Research and review of published and unpublished data/maps and our recent experience of this locale pertaining to the geologic conditions, including underlying soil types, recent and historic groundwater levels, and impacts of shallow groundwater on construction;
- Review of available online historic aerial photographs and topographic maps dating back to 1952;
- Site reconnaissance to observe existing conditions, meet with South Coast Plaza (SCP) representatives and mark cone penetrometer (CPT) locations;
- Clearance of potential underground utility conflicts with CPT locations through DigAlert and SCP Village facilities staff;
- Advancement of six CPT probes to 50 and 120 feet below ground with shear wave velocity measurement in two 120-foot-deep probes;
- Geologic analysis and development of Cross-Section A-A';
- Site seismicity analysis;
- Liquefaction and settlement analyses using cone penetrometer (CPT) data;
- Conceptual foundation alternative analysis;
- Preparation of this report summarizing our findings, conclusions and recommendations.

This report was updated from our original feasibility report (NMG, 2021a) to include a summary of the groundwater wells that were subsequently installed at the site (NMG 2021b), and to address the potential for deeper subterranean levels for the proposed structures.

The references reviewed for this study are listed in Appendix A. The approximate CPT locations and historic borings by others are shown on Plate 1, the Boring and CPT Location Map (rear of text). Geologic Cross-Section A-A' is also included at rear of text (Plate 2). CPT and boring logs are included in Appendix B. Liquefaction and seismic settlement analyses from the CPT data are included in Appendix C. Seismic analysis is attached in Appendix D.

1.2 Site Description

The subject site, referred to as South Coast Plaza Village (the Village) is located north of the main South Coast Plaza shopping mall. The location is shown on Figure 1, Site Location Map. The site is approximately 17.2-acres, bounded by Bear Street on the west, Sunflower Avenue on the south, a retail property on the east, and a residential development on the north. The site is currently occupied by a central main cluster of restaurant and retail buildings, a stand-alone restaurant (Morton's Steakhouse) next to Sunflower Avenue, and a stand-alone theater at the southeast corner of the property. The theater and portions of the parking lot are separated from the main Village by South Plaza Drive, which traverses in a north-south direction through the eastern portion of the site. The remainder of the site is paved parking, driveways and landscape areas. These features are also shown on the aerial photograph used for our CPT and Boring Location Map, Plate 1.

1.3 Proposed Development

We understand that the proposed project will include demolition of the existing retail and commercial buildings in order to construct new multi-story, multi-family residential buildings, with a combination of podium parking and up to four levels of underground parking. Project concepts include four to five 25-story high-rise buildings. The exact location, configuration of the structures and other details of the project are in the conceptual stages. Site concepts we have reviewed show Plaza Drive remaining in its current general alignment.

2.0 FINDINGS

2.1 Historic Data and Geotechnical Reports

We researched three primary sources for historic data related to the site: published and internet data bases, NMG in-house archives, and City of Santa Ana public works archives. No reports were available from South Coast Plaza archives. Our research is summarized as follows.

- Published and internet data bases include those of the State of California Geologic Survey (CGS), United States Geologic Survey (USGS), Geotracker (environmental data), NETR Historic Aerials, among other sources.
- NMG archives yielded prior studies and reports related to demolition of the Planet Hollywood restaurant (current Morton's pad) and parking lot pavement rehabilitation. Parking lot related reports included both design and construction phase reports.
- City of Santa Ana archives yielded the original geotechnical investigation report for the entire site by LeRoy Crandall and Associates (Crandall, 1973); the design investigation and as-graded reports for Morton's Steakhouse (Giles, 2001a, and 2001b); and a pile design report for a Planet Hollywood portico feature (Law Crandall, 1992).

These data were used along with the CPT data to develop our site geologic model and understanding of the existing geotechnical conditions and constraints. The information is provided and referenced through this report. Appendix A has a complete listing of references.

2.2 Site History

The following site history is based on historic aerial photographs (NETR, 2021) and topographic maps (USGS, 2021b):

- Between 1892 and the 1950s, Sunflower Street and Bear Street were constructed. The 1892 topographic map shows a marsh to the south and southeast of the site, but not onsite. There was a house at the northwest corner of the property, just offsite. The site appears to be undeveloped or possibly used for row crops.
- The 1935 topographic map shows a ditch with water along the eastern property boundary.
- Between 1952 and 1963, the historic aerials show the site was still undeveloped and possibly planted with row crops, and the offsite house is still visible. Sunflower and Bear Streets were in place as two-lane roads and the ditch was along the eastern property boundary.
- The 1965 topographic map shows a building in the northwest corner of the subject property, to the southeast of the previously mentioned house.
- The 1972 aerial photo shows the site was being graded and buildings were being constructed. It appeared that the central and northeast portion of the site had lighter soils, possibly imported sandy soils to raise grades and/or replace unsuitable native soils. (See Figure 2, a historic aerial photograph.) It also shows the larger building in the northwest corner of the site.

- The 1972 topographic map shows some buildings were constructed onsite with Plaza Drive in between, as well as the buildings in South Coast Plaza and the retail center to the east of the subject site.
- By 1980, buildings for the Village were constructed in a similar configuration as today, except for the empty pad on the east side of South Plaza Drive (Figure 2), north of the theater. The large building in the northwest corner was still in place.
- By 1995, the building in the northwest corner had been removed and replaced with a parking lot and a building was constructed on the empty pad.
- By 2002, the building located along the southern central portion of the site had been replaced with the larger Morton's restaurant.
- In 2013, the building on the pad north of the theater was demolished to create an empty pad, currently covered with turf. The site has remained relatively unchanged since then to the present.

2.3 Summary of Geotechnical Conditions

2.3.1 Regional Geologic Setting

The subject site is located within the Peninsular Range Province of California, in the southeast portion of the Orange County Basin on the U.S. Geological Survey 7.5-minute Newport Beach Quadrangle. The site is underlain by 10 to 15 feet of Holocene-age alluvium on the order of 900 feet of Quaternary-age alluvium (CDMG, 1980).

2.3.2 Earth Units and Soil Characteristics

Prior studies at the Village have included borings to depths of 51 feet deep throughout the site and our CPTs were performed to depths of up to120 feet. The alluvium below the site consists primarily of clay and silt in the upper 15 to 20 feet, with local thin lenses of sandy alluvium. Below 20 feet, there is considerably more sand and sandy silt layers, with local thin layers of clay. The alluvium below a depth of 50 feet in the CPTs is similar to interlayered sand and silt with some clay, but is generally much denser with layers of very dense stiff soil.

Based on the U.S. Department of Agriculture soil mapping (1978), the near-surface native soils consist of the Omni Clay (CL/CH), which has a high shrink/swell potential, is highly corrosive to metals, and moderately corrosive to concrete. This soil is also categorized as having a low permeability and is in Hydrologic Group D. Please note there could be 2 to 3 feet of imported sandy soils overlying the native deposits that was placed during the original grading in the early 1970s.

2.3.3 Groundwater Conditions

Historic Data: Groundwater was encountered during the original investigation by LeRoy Crandall in borings drilled at the site in 1973 at depths of 10 and 20 feet (Crandall, 1973). The 50-foot-deep borings were drilled with a rotary wash boring that included the use of drilling mud, so groundwater could not be recorded. Borings LRB-1, -11, -16, -20, -23 and -26 were drilled to depths of 18 to 21 feet and left open for a period of time (1.5 to 15 hours), with groundwater levels rising between 2.5 to 5 feet. This indicates that the groundwater is under artesian pressures. The shallower borings, between 14 and 15 feet deep, encountered minor seepage at depths of 10 to 15 feet. The potentiometric groundwater surface (the level to which groundwater rises in a well or boring which penetrates an aquifer, also called a piezometric surface) is shown on Cross-Section A-A' (Plate 2). The clayey alluvium may also be saturated; however, the permeability of the clay is so low that it acts as a confining layer. Once borings are drilled into the sandy layers, the permeability of the sands and the aquifer pressure causes the groundwater in the borings to rise given sufficient time.

From our past experience at nearby sites, drilling into these sandy layers with artesian conditions can result in sand being forced up into the hollow drilling stem, causing the auger to seize up and bringing drilling to a standstill. To remove the auger, water needs to be added to the hollow-stem of the auger in order to create a sufficient hydraulic pressure head to counteract the hydraulic uplift and be able to remove sand out of the auger.

For Morton's, Giles drilled borings in 2001 that did not encounter groundwater to depths of 15 feet (Giles, 2001a). One boring, GB-5, was drilled to a depth of 50 feet and reported groundwater at a depth of 19.5 feet. However, they did not leave the boring open to allow any time-dependent rise in the water level.

Numerous borings and four groundwater wells were installed by Petroleum Industry Consultants (PIC) and Dames and Moore (D&M) for the former Sears Automotive Center at the north end of South Coast Plaza (PIC, 1989 and D&M, 1992a). Borings drilled by PIC to depths of 15 to 19 feet did not encounter groundwater and one boring drilled to a depth of 25 feet encountered groundwater at a depth of 20 feet. Approximately half of the twenty borings drilled by D&M (1992a) to depths of 20 to 21 feet, locally encountered groundwater at depths of 20 to 21 feet. The four wells were drilled and installed at depths of 31 to 32 feet. Groundwater was encountered during drilling at depths of 20 to 21 feet, and after a few days, the potentiometric groundwater levels in the wells were at 15 to 19 feet deep (a rise of up to 6 feet). The direction of groundwater flow during the D&M investigation had a slight gradient of 0.001 toward the southwest.

At another site located to the northeast of the subject site, numerous groundwater wells were installed and monitored between 1991 and 2015. The groundwater levels were found to fluctuate between 4 and 20.5 feet deep, with the shallowest levels being between December and March.

NMG was the consultant on a project with similar geologic conditions near the intersection of MacArthur Boulevard and Main Street in Santa Ana. This development included a seven-story parking structure with one subterranean level. During construction, groundwater wells were ineffective dewatering because of the very low permeability of the clays. A perimeter trench was excavated and filled with gravel and pumped at the four corners during construction. In addition, the 5-foot-deep shear wall footing had standing water and additional sump pumps had to be used for dewatering that excavation. The garage slab was a structural slab and the structural engineer calculated the hydrostatic uplift forces and found that dewatering around the perimeter of the building needed to continue until the seven stories were constructed.

Recent Groundwater Observation Wells: NMG installed eight groundwater observation wells at the site in early 2021. Four sets consisting of one shallow (14 to 15.5 foot deep) well and one deep well (25.5 to 31.5 feet deep), installed in the four corners of the site (Plate 1). Wells were installed using a 2-inch-diameter PVC slotted pipe with a 5-foot screened interval in the bottom five feet of the boring. The annulus around the pipe was backfilled with clean #2/12 Monterey sand. A 2-foot-thick bentonite seal was placed approximately 2 feet above the end of the screened interval. The remainder of the borings were backfilled with neat cement slurry and capped with an above-ground, lockable well cover. Approximately 4 days later the wells were developed by either hand-bailing and/or pumping at least five times the volume of water in the well pipe out of the well.

During drilling, groundwater was encountered in the deeper wells that penetrated the upper clay confining layer and rose quickly to near ultimate depths. The shallow wells generally encountered little to no free groundwater during drilling. The water within the shallow wells did slowly rise to near ultimate depths approximately two days after installation.

In general, when excavations do not extend below the clayey confining soils, groundwater will slowly rise to the elevations mentioned above, however at a relatively slow rate. When excavations do extend below the clayey confining soils, groundwater will rise to the same elevations but with much higher rates of recharge.

NMG has performed monitoring of these wells over the past 2 years. The groundwater levels remain fairly constant with little fluctuation over time (generally less than 1 foot of fluctuation). P-5 had one reading that was up 1.51 feet.

2.3.4 Seismicity, Faulting, and Seismic Hazards

Based on background review, no known active faults are located within or adjacent to the subject site, nor is it located within an Alquist-Priolo Fault Rupture Hazard Zone (CGS, 2020). Therefore, the potential for primary ground rupture is considered very low at the site. The primary seismic hazard at the subject site is ground shaking due to a future earthquake on one of the major regional active faults and potential ground deformation due to liquefaction.

Using the USGS de-aggregation computer program (USGS, 2021a) and the site coordinates of 33.6956 degrees north latitude and -117.8908 degrees west longitude, the closest major active faults to the site are the San Joaquin Hills Blind Thrust Fault located 4 km (2.5 miles) south of the site and the Newport-Inglewood Fault, approximately 8.8 km (5.5 miles) southwest of the site. The San Joaquin Hills Blind Thrust Fault with a moment magnitude of 7.15 is considered the controlling fault for this site.

The site is not located within a zone of earthquake induced landslide as mapped by the State; however, the site is mapped as having potentially liquefiable soil (CDMG, 1997).

Tsunami and seiche are not considered secondary seismic hazards at this site due to the elevation and location.

2.3.5 Liquefaction

Liquefaction is a phenomenon when relatively loose granular soils below the water table "liquefy" during sufficiently strong seismic shaking or man-made ground vibrations. This can result in loss of bearing capacity, ground disturbance (sand boils), and/or ground settlement. For the design earthquake of magnitude 7.15, our liquefaction analysis using the CPT data indicates the site has low to moderate liquefaction potential. Total settlements on the order of 1 to 2 inches were calculated. The majority of sand layers with significant liquefaction potential which contribute to the calculated settlements are located between 20 and 45 feet below ground surface. The risk of bearing capacity loss and ground disturbance is low due to the clay layer that caps the site and the depth to the liquefaction prone layers.

2.3.6 Static Settlement

Preliminary settlement analysis for a conceptual 25-story residential tower was performed with software which uses the CPT data to estimate consolidation characteristics of the onsite soils. For the analysis, we assumed live and dead loads on the order of 125 to 150 pounds per square foot of floor area for the 25-story building with a 120-foot by 120-foot square footprint. With these assumptions, the analysis resulted in 1 to 2 inches of total settlements below a mat slab foundation. From our experience, settlements calculated using CPT data are very convenient and rapid but tend to underestimate total settlements compared to more conventional methods (borings to collect and test soil samples). However, for feasibility purposes, the order of magnitude values from these analyses are considered sufficient. If subterranean parking is included below structures, the unloading effect may result in reduced or elimination of settlements.

2.3.7 Storm Water Treatment/Storage

Predominantly, the subject site is underlain by fine-grained soil (clay and silt) in the upper 15 to 20 feet, with low permeabilities. The soils are categorized as Hydrologic Class D soils (USDA, 1978) and per the Orange County Technical Guidance Document for WQMP (2013), the site may be considered infeasible for infiltration. Because of the clay soils and the relatively shallow groundwater, the site is not suitable for treatment of storm water with onsite infiltration. Underground treatment and/or detention systems below approximately 15 to 20 feet may need to account for hydrostatic uplift (buoyant) forces due to the shallow groundwater.

2.3.8 Existing Asphalt Pavements and Fill

NMG has conducted a number of pavement studies for parking and driveway areas at the Village (NMG, 1995a, 1995b, 1996a, 1996b). The numerous shallow borings through the existing asphalt pavement sections determined the thickness of asphalt concrete (AC), aggregate base (AB), and where encountered, a sand subbase (SB) layer. AC thickness was generally 4 inches, with a few areas with as little as 2 inches and other areas with up to 7 inches. AB thicknesses were generally 4 to 6 inches, with as little as 3 inches and up to 9 inches is some areas. SB consisting of imported sand with relatively high R-values was encountered in many but not all areas of the parking lot. It was generally 8 to 12 inches thick but as thin as 1 inch and as thick as 32 inches in some areas.

In addition to the imported SB under certain areas of asphalt pavement, existing buildings and some areas of adjacent concrete flatwork reportedly have 2 to 4 feet of imported sand fill, which was recommended to mitigate the expansive clays (Crandall, 1973, Giles, 2001a).

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on our feasibility-level study, we conclude that the proposed development is feasible provided the geotechnical constraints described herein are mitigated. The primary geotechnical design constraints are potential settlements due to heavier structural loads, seismic shaking, seismically induced settlement, shallow groundwater, and near-surface clays with high expansion potential. The primary grading and construction phase issues will be the relatively shallow groundwater which will require local dewatering and inflow control for excavations deeper than approximately 15 to 20 feet (may vary across the site due to variation in geology). Seepage and saturated soil conditions will be encountered near or below 10 feet, which will require mitigation during construction. These and other conditions are discussed in more detail below.

3.1 Foundation Types and Remedial Measures

The site is underlain by moderately compressible soils as well as soil with low to moderate potential for seismically induced settlements. Structural foundation designs will depend on the structural loads, subterranean levels below the structures, and the settlement tolerances of the structures. Excavations for more than three levels of subterranean parking will remove a significant amount of the liquefiable sand layers and will greatly reduce the liquefaction potential and associated settlements. The near-surface soil is also generally clayey with high expansion potentials. The expansion potentials will primarily impact the more lightly loaded structures and slabs-on-grade. Foundation considerations for three structure categories are as follows.

3.1.1 High Rise Buildings and Multi-level Parking Structures

Structures with relatively large dead and live loads, such as the 25-story towers, will require settlement mitigation, both for static settlements on the order of several inches, and seismically induced settlements estimated to be on the order to 1 to 2 inches. The combined static and seismic settlements are expected to exceed the tolerances of such structures. Therefore, these structures will require either pile foundations on the order of 50 feet deep, or a mat/raft foundation over ground improvements. In-situ ground improvement options include rammed aggregate piers, stone columns, injection grouting, or deep soil mixing (lime or cement). Conceptually, ground improvements may need to extend approximately 30 feet below foundations. The planned underground parking will partially or fully mitigate structural settlements (unloading of soil weight), depending upon the size of the structure and the number of subterranean levels. The settlement constraints may also apply to parking structures with more than four levels above ground but could also be offset with subterranean parking levels.

3.1.2 Moderately Loaded Structures

Structures with more moderate loads, such as three- to five-story buildings or parking structures with 4 or less levels may be supported on mat slabs, shallower piles, or conventional foundations over ground improvements. As with the heavier structures, underground parking levels will partially or fully mitigate structural settlements, depending on how may levels. The feasibility of these foundation options will also depend on the structural loads and settlement tolerances of the structures.

3.1.3 Lightly Loaded Structures

One- to three-story structures generally will not have the same settlement constraints as heavier structures. However, they will be more susceptible to adverse impacts of the expansive soils if they are constructed on-grade. (Mitigation of expansive soil with respect to foundations and slabs-on-grade will not apply to structures over one level of subterranean parking.) Where necessary, expansive soils are typically mitigated with extra stiff post-tensioned slabs-on-grade, ribbed (waffle-type) slabs-on-grade, or removal of three to five feet of the clay soil and replacement with granular soils having very low expansion potential. For large areas, lime treatment of the upper 4 feet of soil is sometimes used to mitigate expansive soil.

As the project details regarding structural information become more established, your consulting team, including experienced general contractor or construction manager, architect, and structural engineer, should evaluate the various foundation alternatives. A geotechnical specialty contractor should also be engaged to evaluate the feasibility, suitability, and economics of various ground improvement options for the above discussed structures at this site.

3.2 Shallow Groundwater and Dewatering

The relatively shallow groundwater at the site may impact subterranean foundation and slab-on-grade design with respect to hydrostatic uplift forces for portions of structures below the design water table. If applicable, the forces are typically mitigated with the weight of structures and structural slabs. Floating slabs may not be feasible for subterranean structures if they are below the potentiometric groundwater surface.

Excavations deeper than approximately 10 to 15 feet are likely to encounter groundwater seepage, and excavations deeper than 15 feet may encounter artesian conditions. Measures to manage or prevent inflows of water into excavations during construction will be necessary. Local experience indicates that dewatering wells (well points) will not be effective due to the relatively low permeability of the majority of soils at the site. Gravel filled cutoff trenches around excavations for subterranean parking structures with sump pumps have been employed successfully on nearby projects. For larger and deeper excavations, some type of in-situ cutoff walls, such as sheet piling, jet grouting, or mixed in-place slurry or soil cement walls, may be desirable if pumping and discharge of large volumes of groundwater to local storm drain or sewer system is problematic.

At some point, we recommend pumping tests be performed for design of foundation excavation dewatering systems and to estimate potential dewatering discharge volumes. The potential for ground settlement and associated potential impacts to adjacent areas caused by a prolonged lowering of the water table should also be evaluated, as needed.

In our experience, groundwater dewatering for excavations that do not extend below the clayey soils at the site (less than 15 feet below existing grades) is anticipated to be manageable using sump pumps. If excavations do extend below the clayey soils, a more robust dewatering system may be required. A dewatering consultant/contractor is recommended to design a system that can manage the dewatering necessary for the proposed improvements to the site.

3.3 Wet Soil Conditions

Excavations within two to three feet of the groundwater table and deeper may encounter soft, wet soils which will require stabilization prior to construction of structures and heavier pipelines. Stabilization measures typically will involve a gravel layer on the order of one to several feet thick. Placing a geotextile or geogrid under the gravel will reduce the thickness of required gravel and also provide added bearing capacity for support of workers and equipment. Excavated soil may also be too wet for re-use as compacted fill without drying.

3.4 Subterranean Structures

The deeper below ground structures will require design against significant hydrostatic uplift forces due to the relatively shallow groundwater table. Naturally, waterproofing and back-up sump systems will be required. Permanent dewatering of the site may induce ground settlement at the site as well as potentially under adjacent properties. Therefore, it is not recommended.

Temporary dewatering and/or in-situ groundwater control measures such a grout curtains, sheet pile dams, and cut-off walls should be considered for both construction and permanent applications.

Various shoring alternatives are feasible, including but not limited to, soldier or sheet pile walls (for shallower excavations), braced walls, and tie-back walls (where space permits). Geotechnical specialty contractors should be engaged to evaluate the advantages and disadvantages of these alternatives, as well as those that can be constructed in-situ such as secant pile walls.

3.5 Seismicity

The seismic parameters provided herein were used for our liquefaction analysis. These parameters may also be used for structures that have a fundamental period (T) of less than 0.96 seconds (1.5 times T_s). The seismic response coefficient, G_s, should be determined per the parameters provided below and using the equation 12.8-2 in publication ASCE 7-16. For structures with fundamental periods of great than or equal to 0.96 seconds, ground motion hazard analysis per Section 21.2 of ASCE 7-16 will need to be performed. Time history analysis may also be needed based on discussions with and collaboration with the project structural engineer.

Selected Seismic Design Parameters from 2019 CBC/ASCE 7-16	*Seismic Design Values*	*Reference*
Latitude	33.6956 North	
Longitude	117.8908 West	
Controlling Seismic Source	San Joaquin Hills	USGS, 2021
Distance to Controlling Seismic Source	2.5 mi (4.1 km)	USGS, 2021
Site Class per Table 20.3-1 of ASCE 7-16	D	SEA/OSHPD, 2021
Spectral Acceleration for Short Periods (Ss)	1.29 g	SEA/OSHPD, 2021
Spectral Accelerations for 1-Second Periods (S_1)	0.46 g	SEA/OSHPD, 2021
Site Coefficient F_a, Table 11.4-1 of ASCE 7-16	1.0	SEA/OSHPD, 2021
Site Coefficient F_v, Table 11.4-2 of ASCE 7-16	1.8	
Design Spectral Response Acceleration at Short Periods (S_{DS}) from Equation 11.4-3 of ASCE 7-16	0.86 g	SEA/OSHPD, 2021
Design Spectral Response Acceleration at 1-Second Period (S_{D1}) from Equation 11.4-4 of ASCE 7-16	0.55 g	
T_S, S_{D1}/ S_{DS}, Section 11.4.6 of ASCE 7-16	0.64 sec	
T_L, Long-Period Transition Period	8 sec	SEA/OSHPD, 2021
Peak Ground Acceleration Corrected for Site Class Effects (PGA_M) from Equation 11.8-1 of ASCE 7-16	0.61 g	SEA/OSHPD, 2021
Seismic Design Category, Section 11.6 of ASCE 7-16	D	

3.6 Site Demolition

Existing buried structures, foundations, utilities and pipelines and prior backfill should be removed, with resulting excavations backfilled with engineered fill. Fourteen 4-foot-diameter concrete piles from the old Planet Hollywood building were cut off approximately 8 feet below ground prior to construction of Morton's. The remnants of the piles may be encountered in excavations deeper than 8 feet.

Aggregate derived from crushing concrete and existing AC, along with the existing AB from paved areas, may be suitable for stabilizing saturated excavation bottoms or as bedding under pipelines. Frequently, these materials can also be tested and classified for use as crushed miscellaneous base (CMB), which can be used for future pavements and below structural slabs-on-grade. However, onsite crushing and recycling is often not economical if onsite stockpile locations are not available. An experienced general contractor should be consulted in this matter.

3.7 Remedial Grading

Typically, three to five feet of newly compacted fill is recommended below structures at grade (not below ground), especially in areas where demolition activities may result in significant ground disturbance. Deeper remedial removals are not likely to add significant value from a structural design standpoint. For non-structural areas, less overexcavation and recompaction is generally recommended, on the order of two feet. Where deep utilities are to be removed, the backfill should be compacted with observation and testing by the geotechnical consultant.

3.8 Additional Exploration, Testing, and Analyses

Significant additional site exploration, soil testing, and analyses is recommended for design of the planned structures, other project elements, and for planning/estimating purposes. The recommended tasks, some of which have been mentioned in prior sections, are summarized as follows.

a) Groundwater pumping tests should be performed sometime before construction in order to estimate flows and assist in evaluating various groundwater control alternatives.

b) Additional CPT probes and small-diameter borings should be performed across the site to refine the geologic model of the interlayered soils. Some of the CPTs and borings should be sited specifically at the high-rise tower locations when the tower locations are finalized.

c) Soil samples collected from the borings should be tested for various engineering soil properties, especially with respect to settlement potential, to be used for structure specific settlement analysis. Tests to determine lateral earth pressures for underground structures, parameters for shallow and deep foundations, and soil properties for ground improvement analyses should also be performed.

d) More rigorous liquefaction analysis and settlement analyses will be necessary with the additional data, along with more precise foundation loads provided by the project structural engineer.

e) Additional seismic analysis will be necessary once more specific structure design information is available in order to provide the necessary parameters for structural design. Site specific seismic analysis may be required based on the 2022 California Building Code and the proposed building periods/specifics.

f) As alluded to in prior sections, a team of design and construction professionals should collaborate from very early in the planning process to evaluate the alternatives for foundations, ground improvement to mitigate settlement and liquefaction, temporary shoring, design of subterranean structures, and groundwater control.

4.0 LIMITATIONS

This feasibility report has been prepared for the exclusive use of our client, South Coast Plaza, within the specific scope of services requested by them for the South Coast Plaza Village project. This report or its contents should not be used or relied upon for other projects or purposes or by other parties without the written consent of South Coast Plaza and NMG. Our methodology for this study is based on local geotechnical standards of practice, care, and requirements of governing agencies for a given time. No warranty or guarantee, express or implied is given.

The findings, conclusions, and recommendations are professional opinions based on interpretations and inferences made from limited geologic and engineering data from specific locations and depths, observed or collected at a given time. By nature, geologic conditions can be very different in between data points, and can also change over time. As a feasibility study, our conclusions and recommendations are not comprehensive with respect to design of the project and should be viewed only as broadly representative of the primary geotechnical issues. As already stated, significant additional geotechnical work will be require to provide conclusions and recommendations suitable for design of specific project elements including structures, pavements, storm water treatment systems, utilities, etc.

NMG's expertise and scope of services did not include assessment of potential subsurface environmental contaminants or environmental health hazards.

TABLE 1
GROUNDWATER MONITORING WELL READINGS

South Coast Plaza Village, California

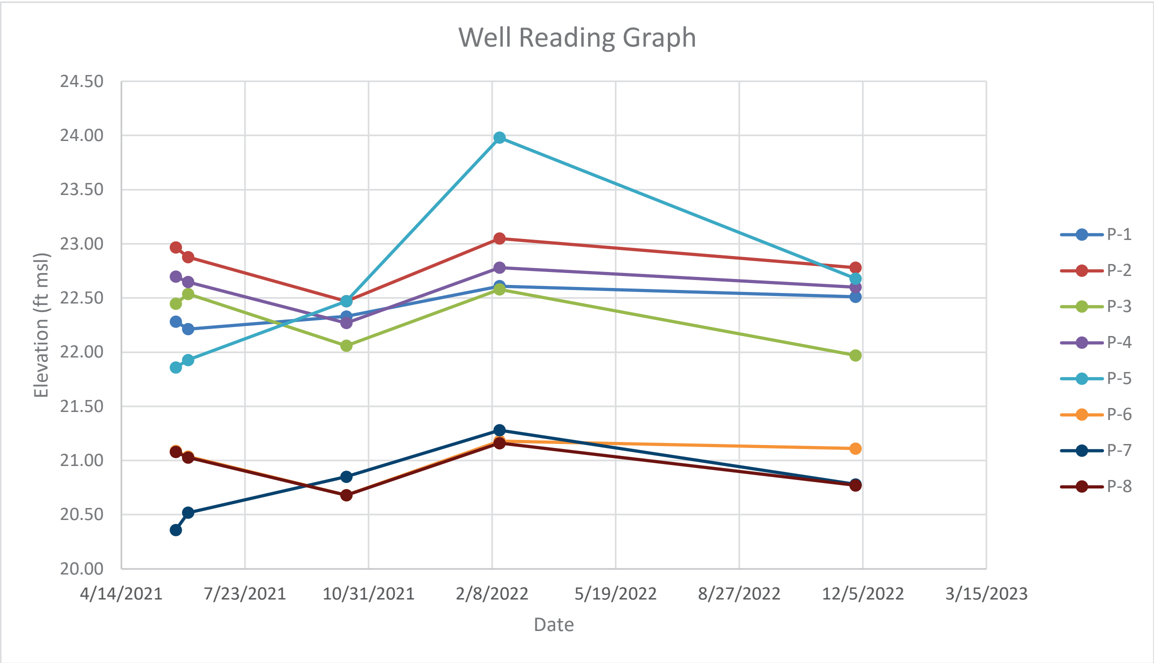
Well No.	Surface Elevation (ft msl)	Total Depth of Well (ft)	5/28/2021 Depth	5/28/2021 Elevation	6/7/2021 Depth	6/7/2021 Elevation	10/13/2021 Depth	10/13/2021 Elevation	2/14/2022 Depth	2/14/2022 Elevation	11/29/22 Depth	11/29/22 Elevation	
P-1	**35.5**	15	13.22	22.28	13.29	22.21	13.17	22.33	12.89	22.61	12.99	22.51	
P-2	**35.5**	31.5	12.53	22.97	12.62	22.88	13.03	22.47	12.45	23.05	12.72	22.78	
P-3	**35**	15	12.55	22.45	12.46	22.54	12.94	22.06	12.42	22.58	13.03	21.97	
P-4	**35**	25.5	12.30	22.70	12.35	22.65	12.73	22.27	12.22	22.78	12.40	22.60	
P-5	**35**	14	13.14	21.86	13.07	21.93	12.53	22.47	11.02	23.98	12.32	22.68	
P-6	**35**	27.5	13.91	21.09	13.96	21.04	14.32	20.68	13.82	21.18	13.89	21.11	
P-7	**35.5**	15.5	15.14	20.36	14.98	20.52	14.65	20.85	14.22	21.28	14.72	20.78	
P-8	**35.5**	25.5	14.42	21.08	14.47	21.03	14.82	20.68	14.34	21.16	14.73	20.77	

Notes: *Depth in Feet Below Existing Ground Surface; Elevation in Feet Above Mean Sea Level

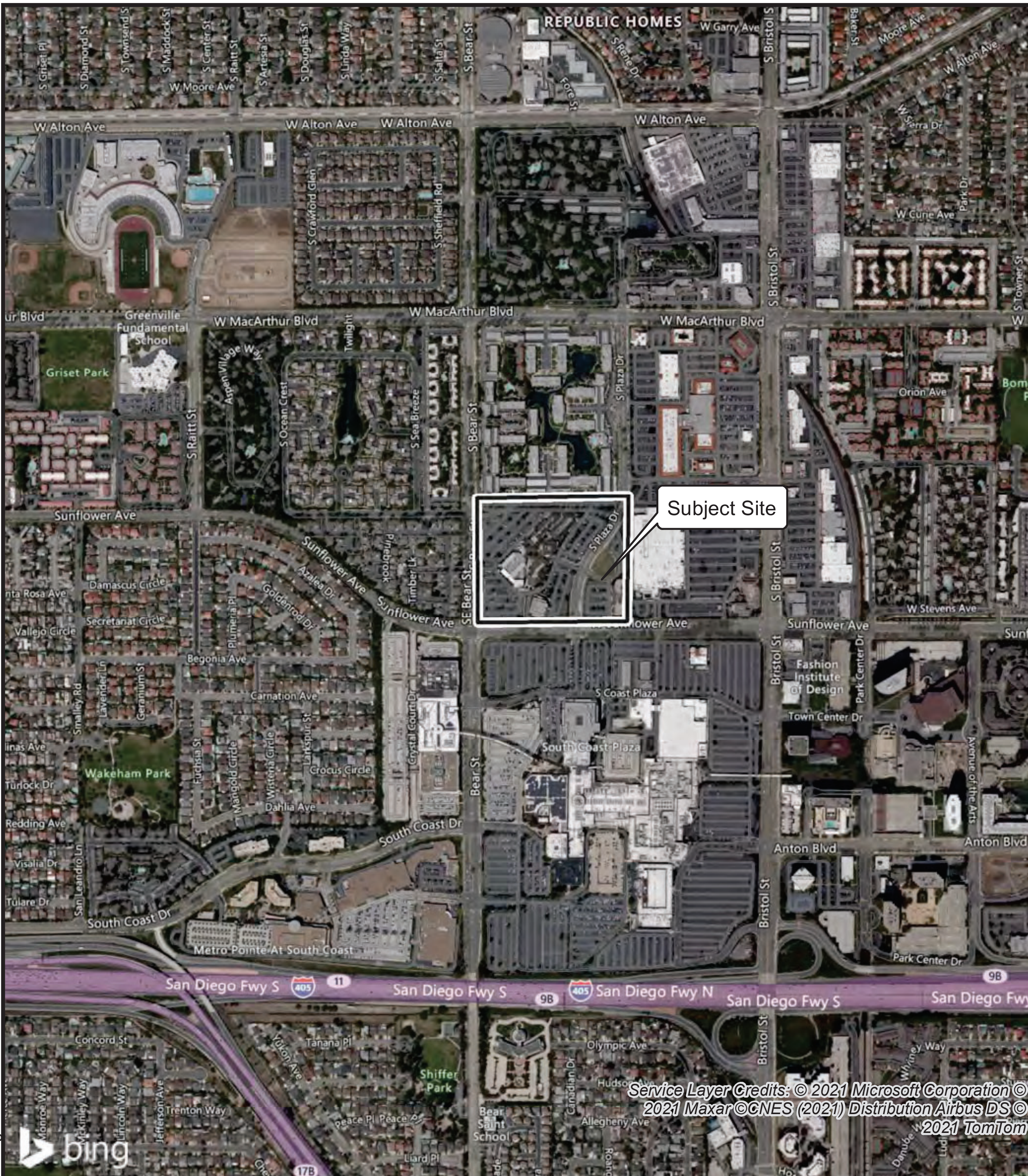
TABLE 1
GROUNDWATER MONITORING WELL READINGS

21034-01
December 30, 2022

South Coast Plaza Village, California



\\data\projects\2021\21034-01 SCPlaza SCPVillage\221230 Updated Feasibility\Well Reading TableReadings



0 500 1,000 Feet
1 inch = 1,000 feet
N

SITE LOCATION MAP

SOUTH COAST PLAZA VILLAGE
SANTA ANA, CALIFORNIA

Project Number: 21034-01 Project Name:SCPlaza/SCPVillage

By: TM/TW

Date: 12/30/2022

Figure 1

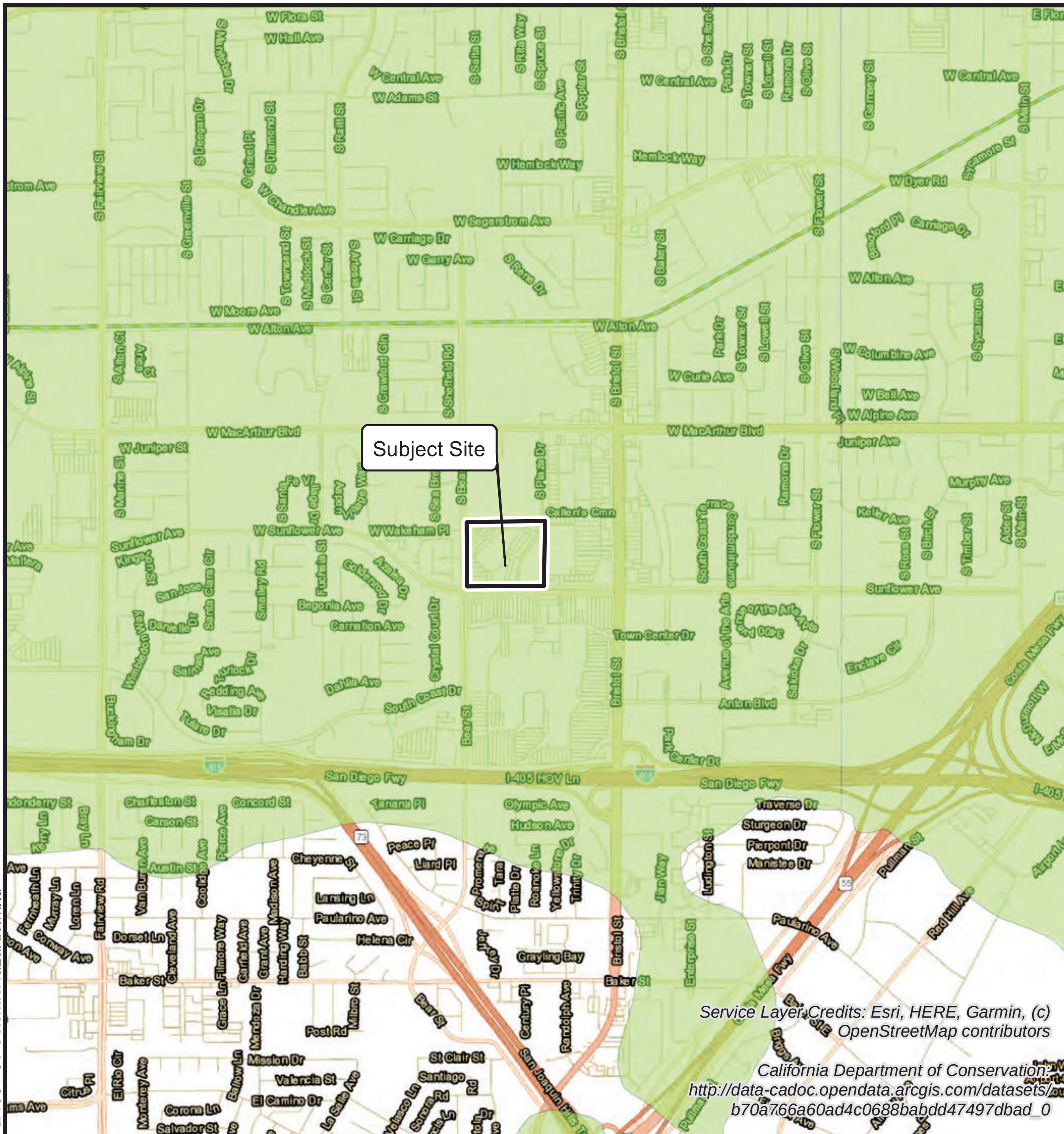
NMG

P:\2021\21034-01 SCPlaza SCPVillage\Drafting\GIS\21034-01 SiteLocation.mxd

1972 HISTORIC AERIAL PHOTO

N

SOUTH COAST PLAZA VILLAGE SANTA ANA, CALIFORNIA	Project Number: 21034-01 Project Name: SCPlaza/SCP Date: 12/30/2022 Figure No. 2	NMG Geotechnical, Inc.



Legend

- Earthquake-Induced Landslide Zones
- Liquefaction Zones

0 1,000 2,000 Feet

1 inch = 2,000 feet

N

SEISMIC HAZARDS AND FAULT ZONES MAP

Base: California Geological Survey, Earthquake Zones of Required Investigation, Newport Beach Quadrangle
Dated: April 15, 1998

SOUTH COAST PLAZA VILLAGE
SANTA ANA, CALIFORNIA

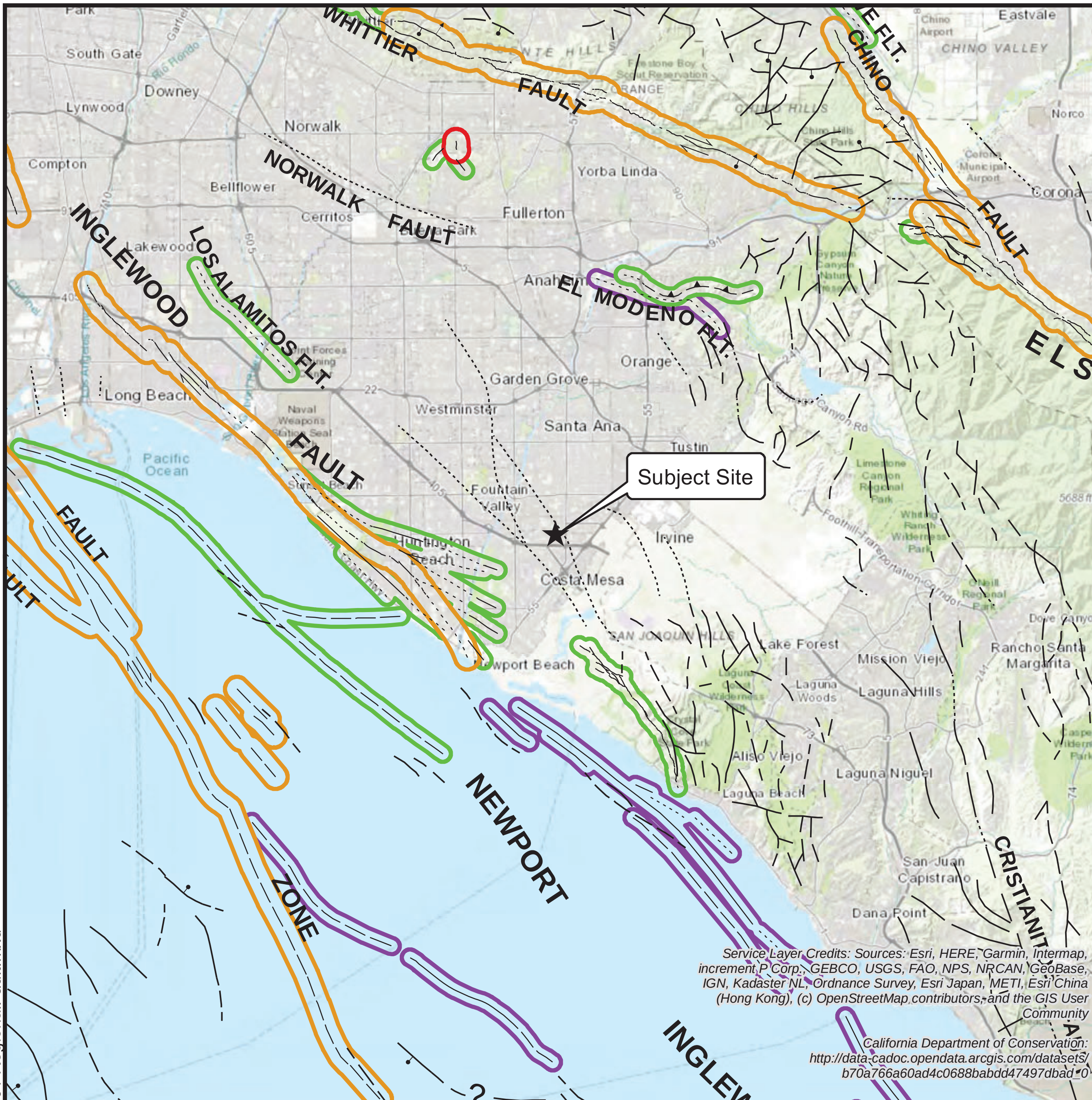
Project Number:21034-01 By: TM/TW

Project Name: SCPlaza/SCP

Date: 12/30/2022 Figure 3

NMG

P:\2021\21034-01 SCPVillage\Drafting\GIS\21034-01 SeismicHazards.mxd



Legend

Faults

- —— Certain
- – – Approximately Located
- ······ Concealed

Recency of Movement

- Historic
- Holocene
- Late Quaternary
- Quaternary

0 3 6 Miles

N

1 inch = 6 miles

REGIONAL FAULT MAP

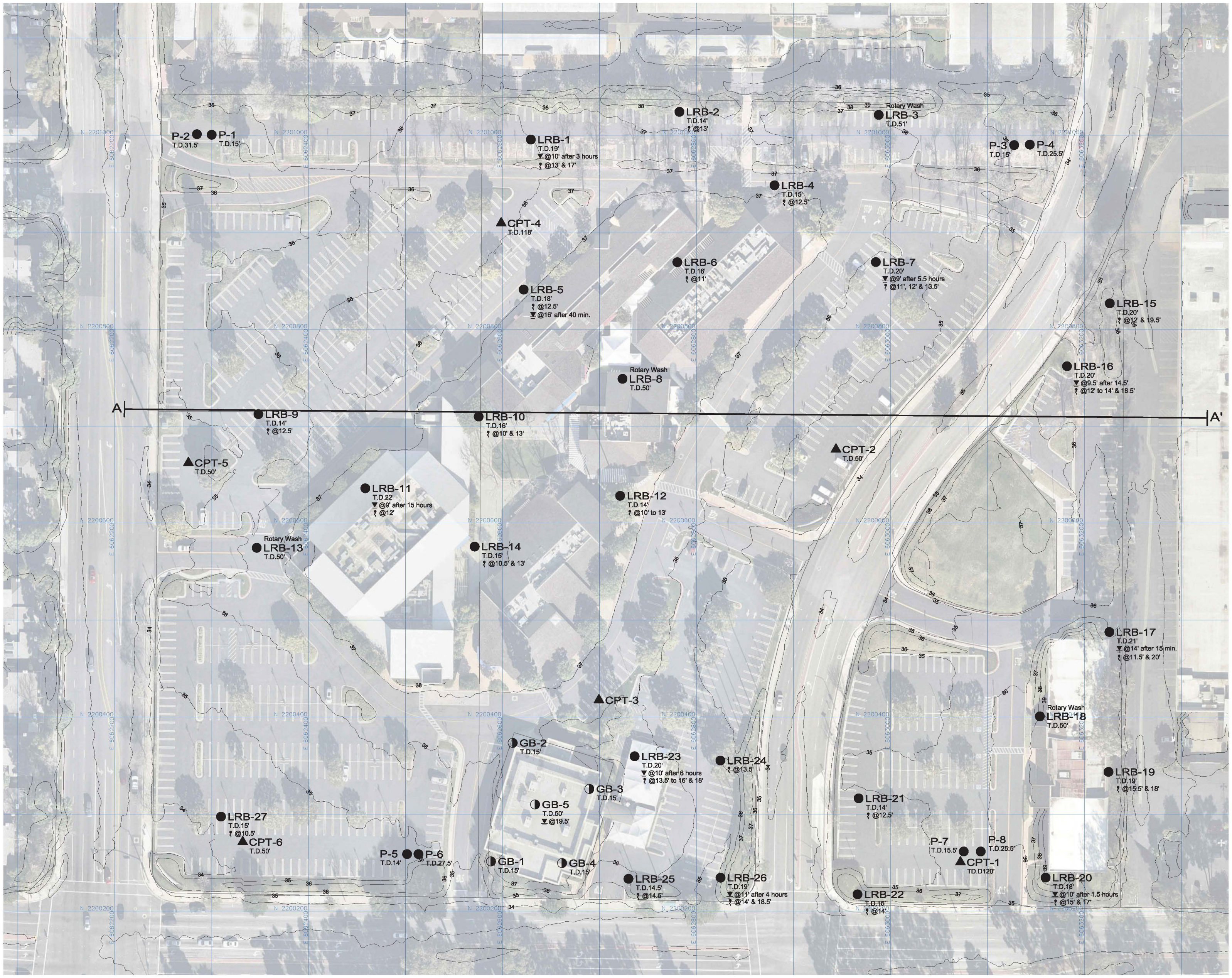
Base: California Geological Survey, Fault Activity Map of California, 2010

SOUTH COAST PLAZA VILLAGE
SANTA ANA, CALIFORNIA

Project Number: 21034-01 By: TM/TW
Project Name: SCPlaza/SCP
Date: 12/30/2022 Figure 4

NMG

P:\2021\21034-01 SCPlaza SCPVillage\Drafting\GIS\21034-01 RegionalFault.mxd



LEGEND

OTHER SYMBOLS - LOCATIONS ARE APPROXIMATE

Symbol	Description
● LRB-27 T.D.15' @10.5'	ROTARY WASH OR BUCKET-AUGER BORING BY LEROY CRANDALL (1973), SHOWING TOTAL DEPTH AND DEPTH TO SEEPAGE AND/OR GROUNDWATER
◑ GB-5 T.D.15' @19.5'	HOLLOW STEM AUGER BORING BY GILES (2001), SHOWING TOTAL DEPTH AND DEPTH TO GROUNDWATER
▲ CPT-6 T.D.50'	CONE PENETROMETER TEST BY NMG (2021), SHOWING TOTAL DEPTH
● P-8 T.D.25.5'	MONITORING WELL BY NMG (2021) SHOWING TOTAL DEPTH
A ⊢—⊣ A'	CROSS-SECTION

GRAPHIC SCALE

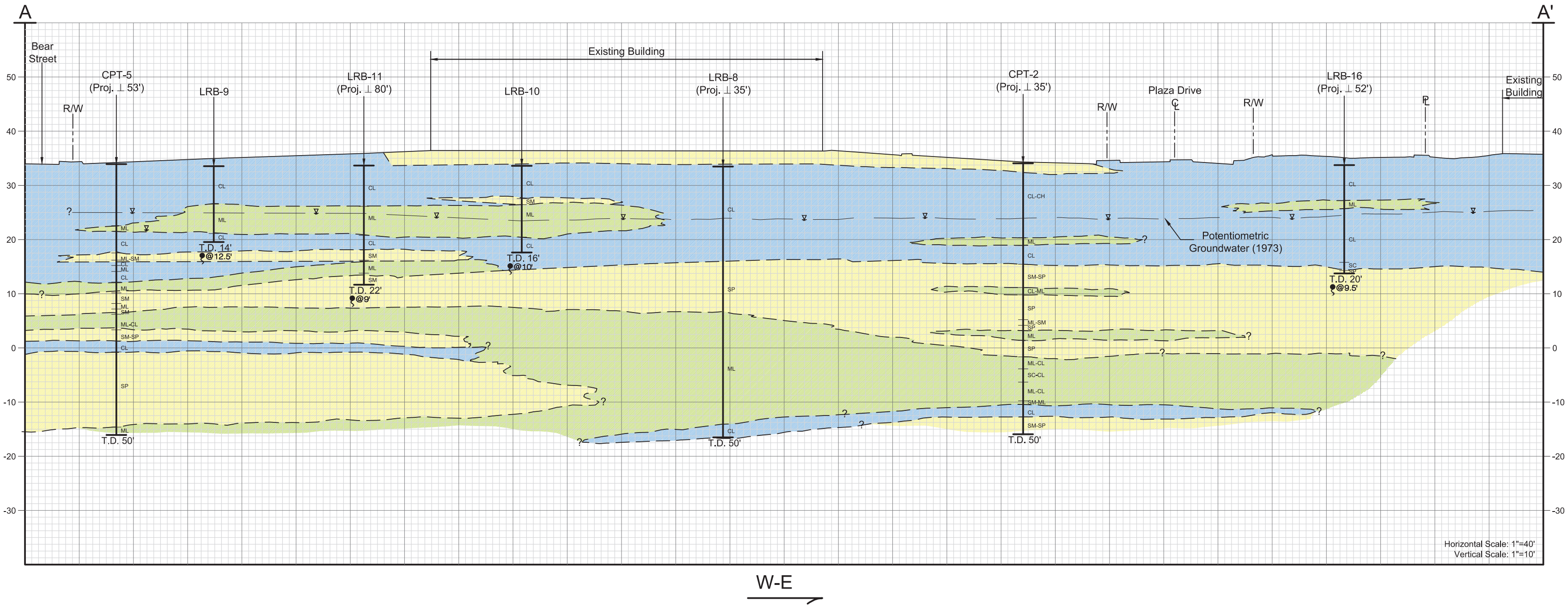
(IN FEET)
1 inch = 40 ft.

PLATE 1

BORING AND CPT LOCATION MAP
SOUTH COAST PLAZA VILLAGE
SANTA ANA, CALIFORNIA

Project No.: 21034-01 By:TM/TW
Project Name: SCPlaza/SCPVillage
Date: 12/30/2022 SCALE: 1" = 40'

NMG Geotechnical, Inc.



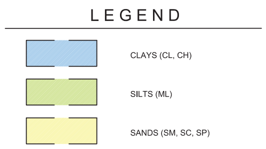


PLATE 2

Project No.: 21034-01	By:TM/TW	NMG Geotechnical, Inc.
Project Name: SCPlaza/SCPVillage		
Date: 12/30/2022	SCALE: 1" = 40'	

APPENDIX A

APPENDIX A

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APPENDIX B

CPTs
THIS INVESTIGATION

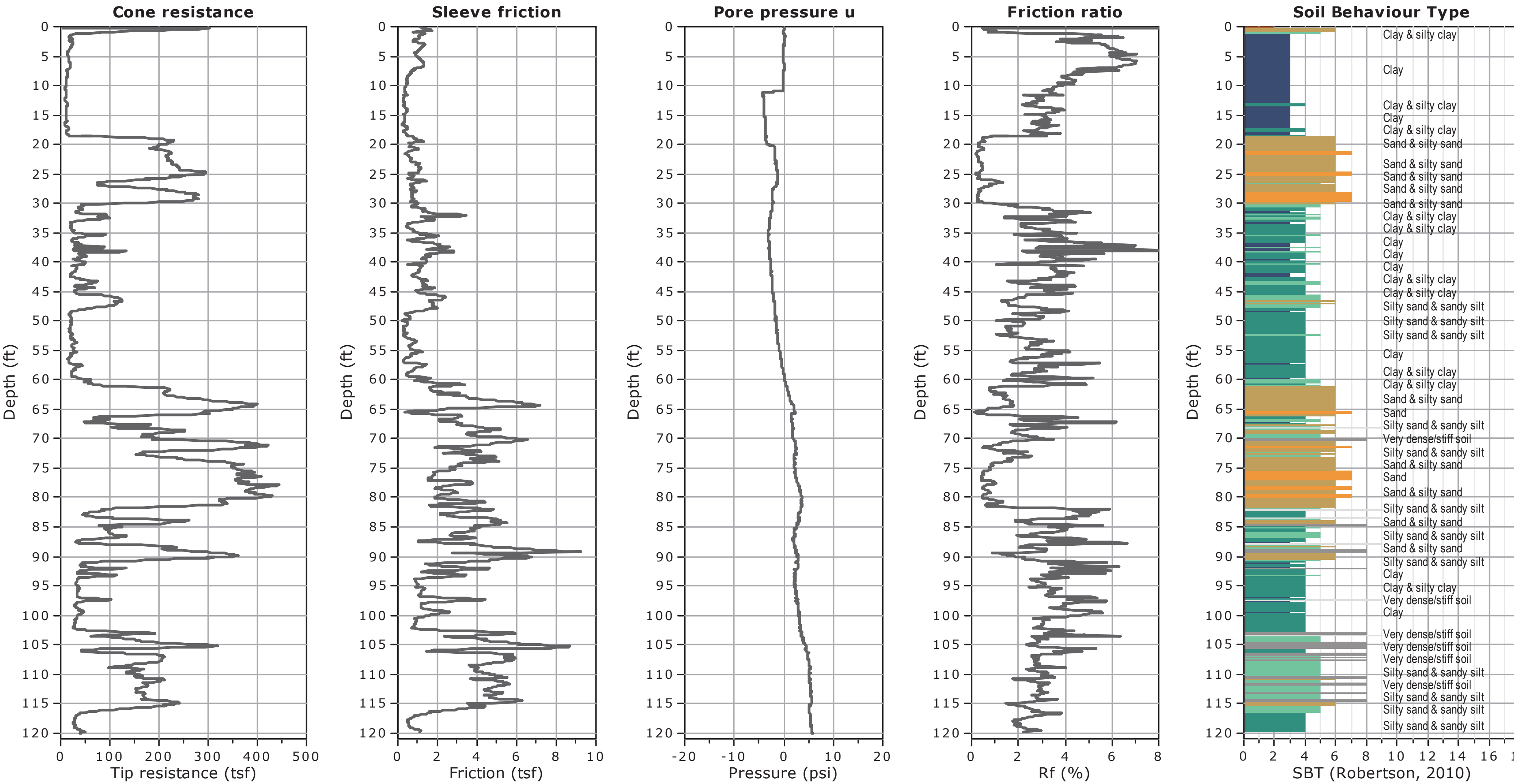
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **NMG Geotechnical / South Coast Plaza**

Location: **Costa Mesa, CA**

CPT-1

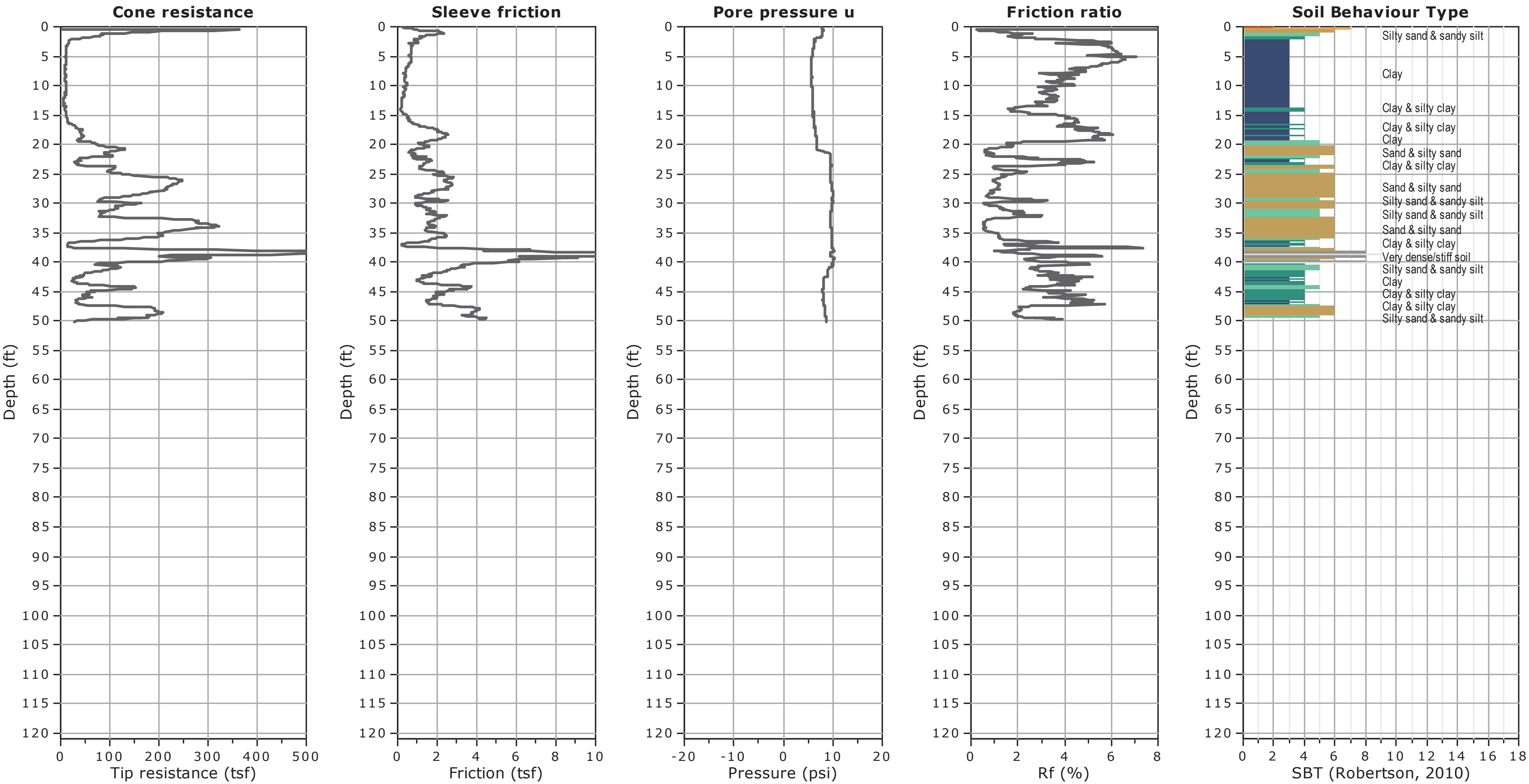
Total depth: 120.16 ft, Date: 4/14/2021



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: NMG Geotechnical / South Coast Plaza
Location: Costa Mesa, CA

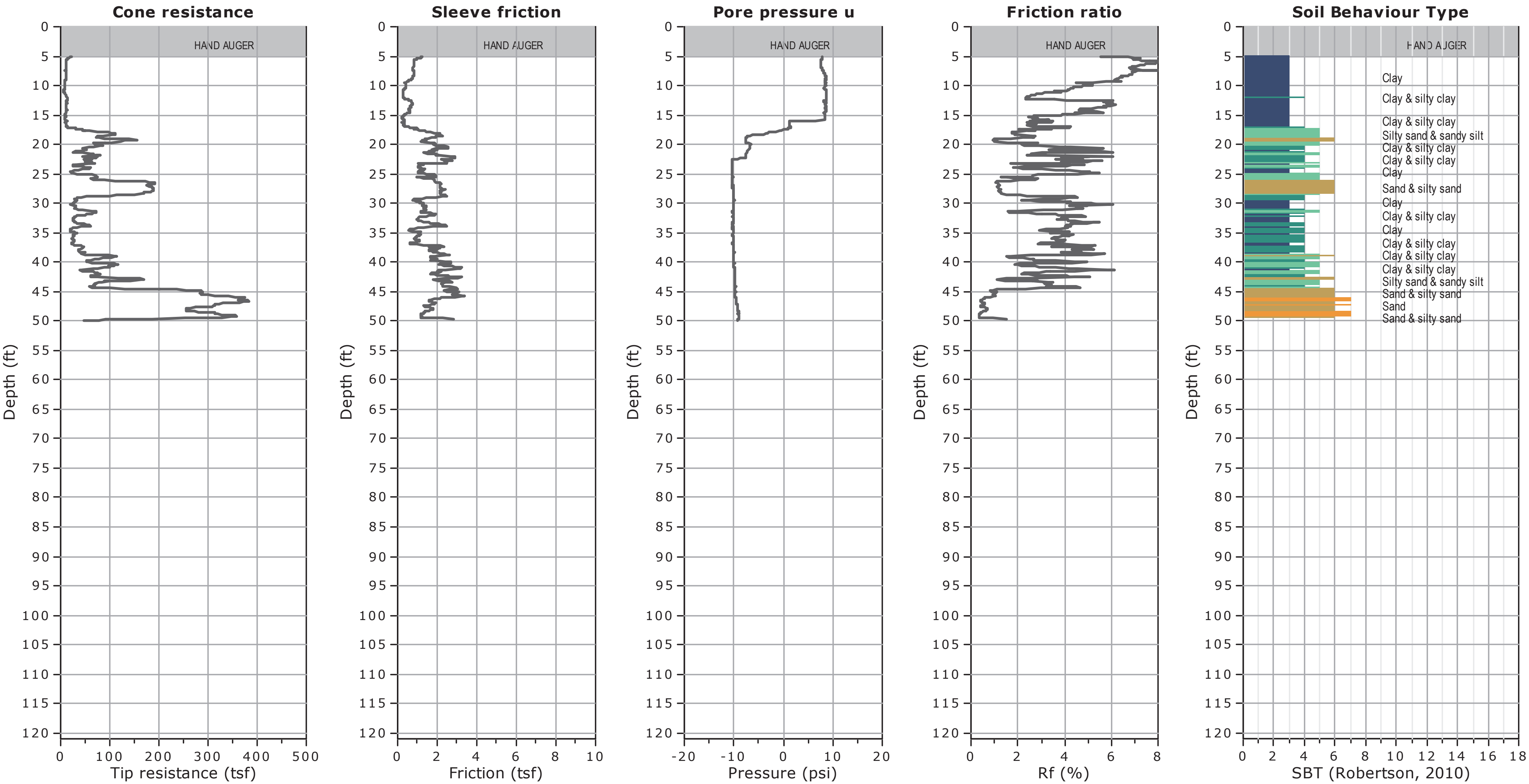
CPT-2
Total depth: 50.11 ft, Date: 4/14/2021



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **NMG Geotechnical / South Coast Plaza**
Location: **Costa Mesa, CA**

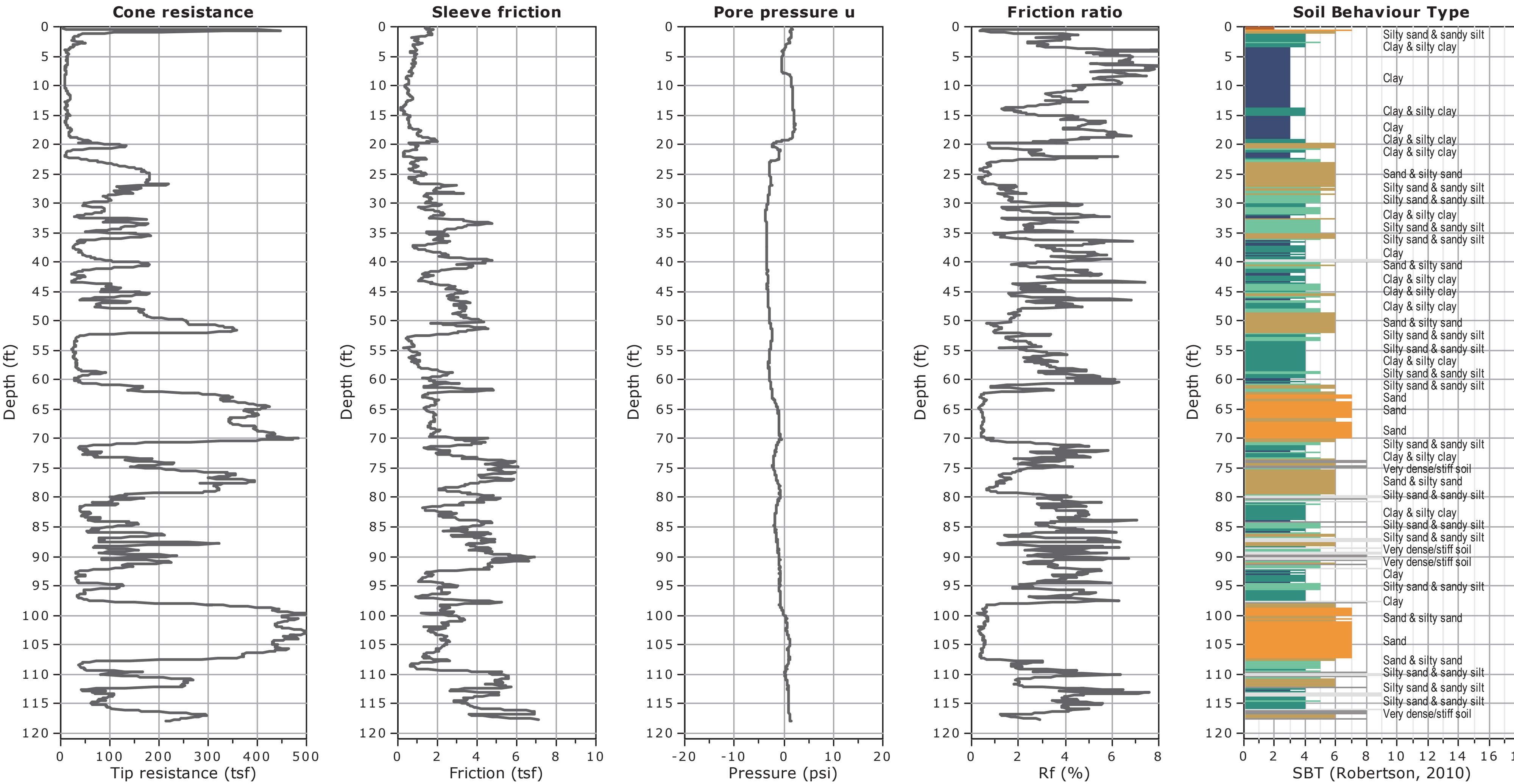
CPT-3
Total depth: 50.02 ft, Date: 4/14/2021



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: NMG Geotechnical / South Coast Plaza
Location: Costa Mesa, CA

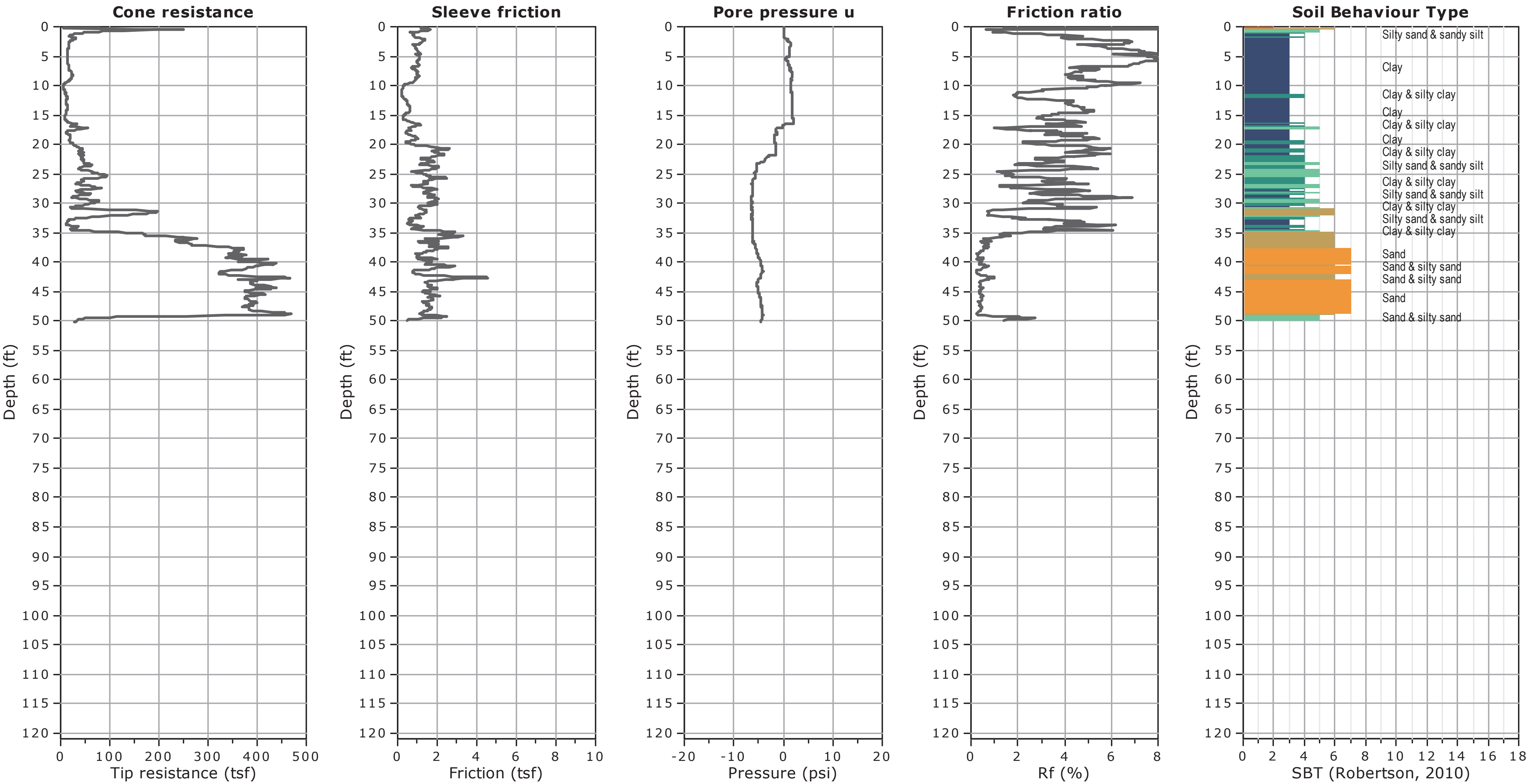
CPT-4
Total depth: 118.08 ft, Date: 4/14/2021



Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: **NMG Geotechnical / South Coast Plaza**
Location: **Costa Mesa, CA**

CPT-5
Total depth: 50.26 ft, Date: 4/14/2021



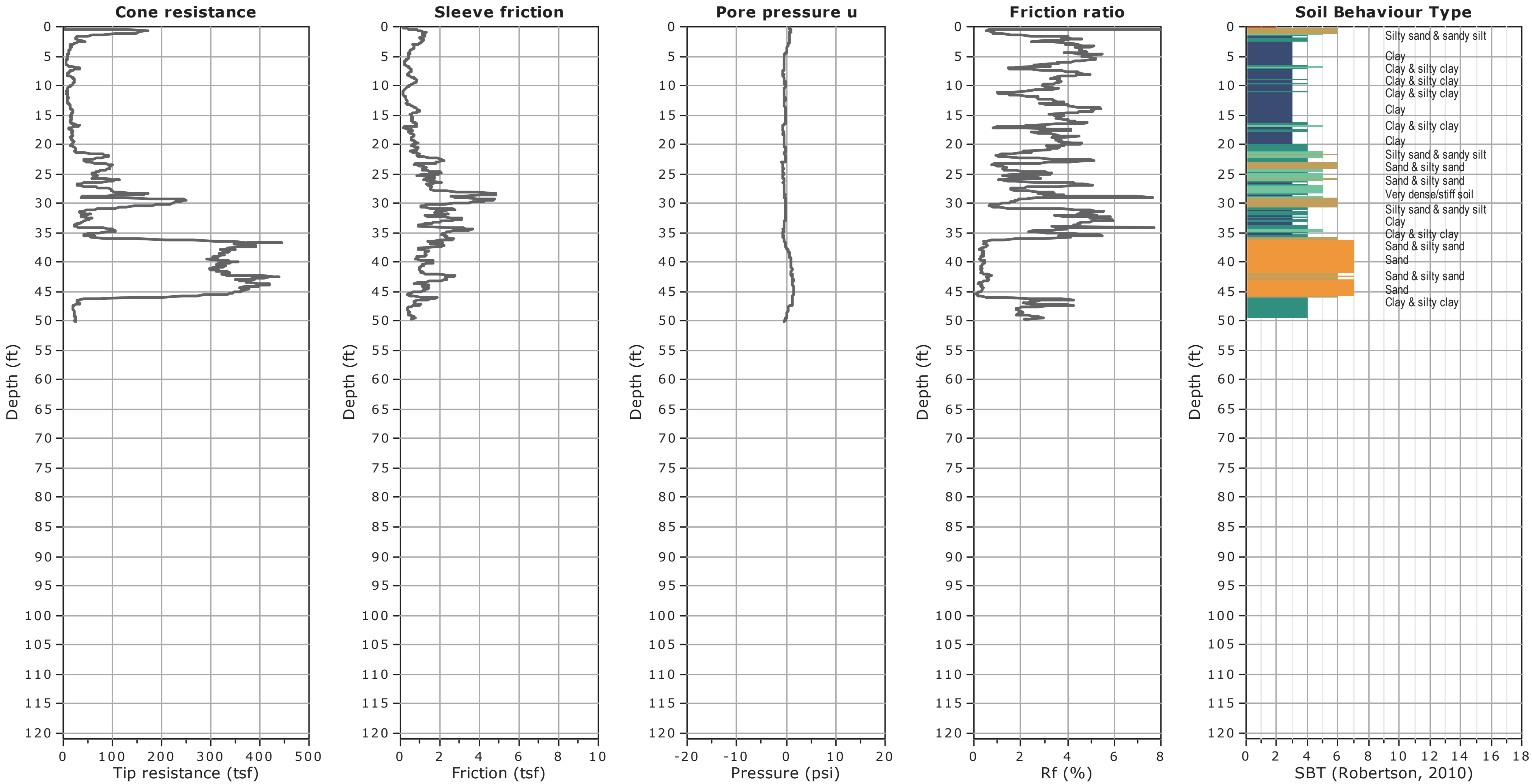
Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

Project: NMG Geotechnical / South Coast Plaza

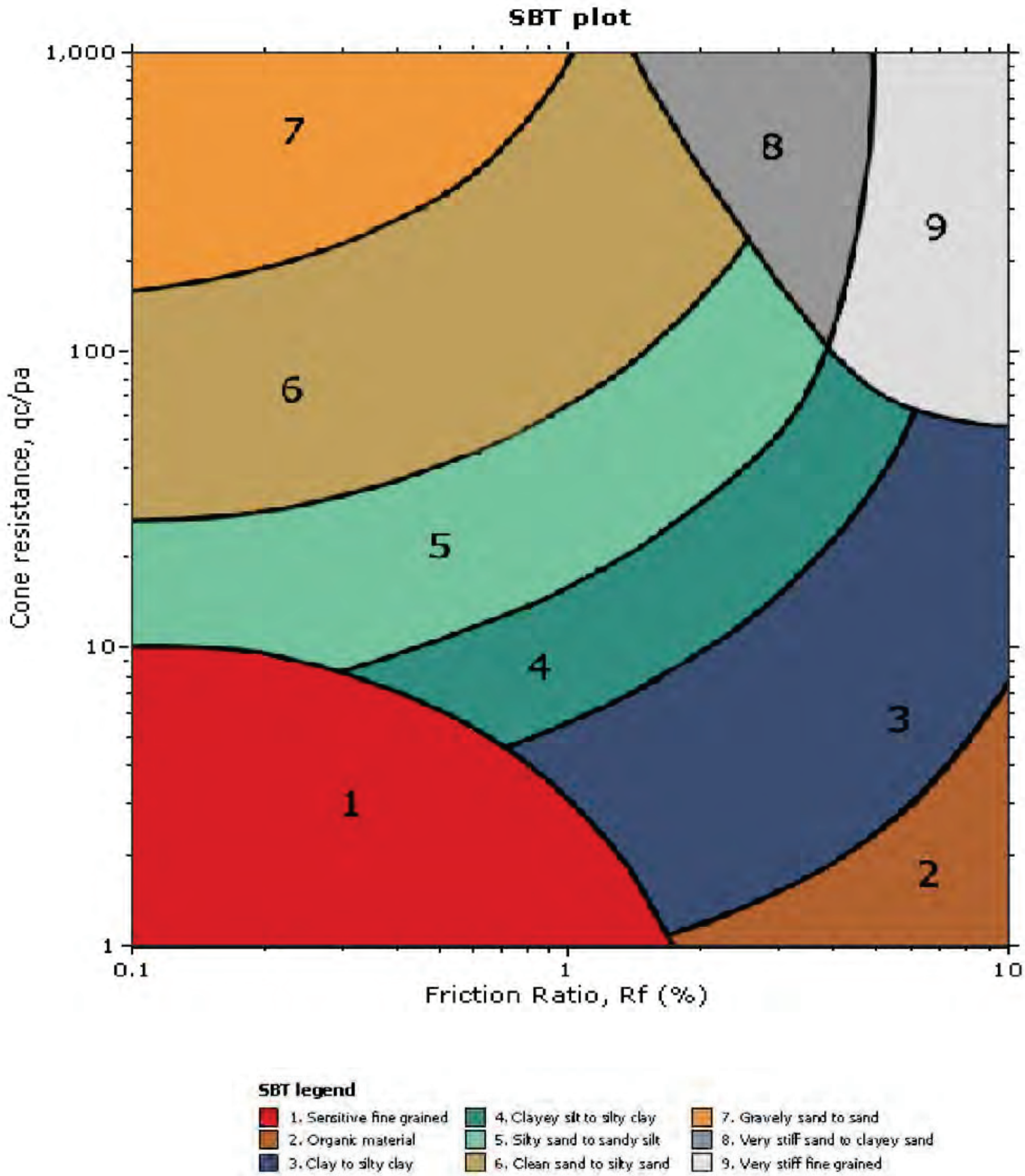
Location: Costa Mesa, CA

CPT-6

Total depth: 50.09 ft, Date: 4/14/2021



Kehoe Testing & Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com



NMG Geotechnical
South Coast Plaza
Costa Mesa, CA

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CPT-1	5.15	4.15	4.61	4.14	1113	
	10.20	9.20	9.41	15.96	590	407
	15.12	14.12	14.26	27.38	521	424
	20.05	19.05	19.15	36.18	529	556
	25.16	24.16	24.24	42.70	568	780
	30.22	29.22	29.29	48.04	610	945
	35.37	34.37	34.43	53.64	642	918
	40.22	39.22	39.27	59.20	663	871
	45.14	44.14	44.19	65.20	678	819
	50.10	49.10	49.14	70.66	695	908
	55.18	54.18	54.22	75.80	715	988
	60.30	59.30	59.33	81.56	727	888
	65.26	64.26	64.29	86.20	746	1068
	70.14	69.14	69.17	90.34	766	1178
	75.20	74.20	74.23	95.16	780	1049
	80.12	79.12	79.15	99.26	797	1200
	85.20	84.20	84.22	103.50	814	1198
	90.03	89.03	89.05	107.92	825	1092
	95.10	94.10	94.12	113.16	832	967
	100.16	99.16	99.18	118.40	838	965
	105.12	104.12	104.14	124.08	839	873
	110.07	109.07	109.09	127.78	854	1338
	115.03	114.03	114.05	132.12	863	1143
	120.11	119.11	119.13	136.40	873	1187

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

NMG Geotechnical
South Coast Plaza
Costa Mesa, CA

CPT Shear Wave Measurements

Location	Tip Depth (ft)	Geophone Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
CPT-4	5.09	4.09	4.55	4.18	1089	
	10.10	9.10	9.32	15.96	584	404
	15.12	14.12	14.26	26.24	543	481
	20.08	19.08	19.18	33.48	573	680
	25.03	24.03	24.11	39.92	604	765
	30.12	29.12	29.19	46.04	634	829
	35.10	34.10	34.16	51.48	664	914
	40.09	39.09	39.14	56.62	691	969
	45.14	44.14	44.19	61.70	716	993
	50.03	49.03	49.07	65.96	744	1147
	60.10	59.10	59.13	77.72	761	856
	65.09	64.09	64.12	82.64	776	1014
	70.11	69.11	69.14	87.56	790	1020
	75.13	74.13	74.16	92.48	802	1020
	80.05	79.05	79.08	96.80	817	1139
	85.24	84.24	84.26	101.80	828	1038
	90.06	89.06	89.08	106.84	834	956
	95.14	94.14	94.16	111.64	843	1058
	100.10	99.10	99.12	115.80	856	1192
	105.02	104.02	104.04	120.12	866	1139
	110.14	109.14	109.16	124.40	877	1196
	115.12	114.12	114.14	128.04	891	1368
	118.01	117.01	117.03	130.84	894	1032

Shear Wave Source Offset - 2 ft

S-Wave Velocity from Surface = Travel Distance/S-Wave Arrival
Interval S-Wave Velocity = (Travel Dist2-Travel Dist1)/(Time2-Time1)

BORINGS BY OTHERS

RECORD OF SUBSURFACE EXPLORATION

GILES ENGINEERING ASSOCIATES, INC.
Milwaukee Los Angeles
Madison Dallas Atlanta
Washington, D.C.

BORING NO. & LOCATION: 1 - Southwest Building
SURFACE ELEVATION: 101.5
COMPLETION DATE: 2/2/01
FIELD REPRESENTATIVE: Rich Koester

PROJECT: Proposed Morton's Restaurant
PROJECT LOCATION: Plaza Drive, Costa Mesa, California

GILES PROJECT NUMBER: 2G-0102001

MATERIAL DESCRIPTION	Feet Below Surface	Sample No. & Type	N	q_u (tsf)	q_p (tsf)	q_s (tsf)	W (%)	PID	NOTES
Dark Brown Silty fine Sand, trace Clay (Fill)-Moist		1-AU	--						
		2-CS	12					BDL	
Brown Clayey fine to medium Sand (Fill)-Moist		3-CS	11					BDL	
Dark Gray fine to medium Sand, trace Silt (Fill)-Moist	5								
Gray and Brown mottled Silty Clay-Moist		4-CS	11		4.5+		27	BDL	
		5-CS	9		2.8		30	BDL	
Gray Silty Clay-Moist	10	6-CS	9					BDL	
Gray and Brown mottled Silty Clay-Moist		7-SS	8	2.5	2.3			BDL	
	15								

Boring terminated at 15 feet

WATER OBSERVATION DATA

- WATER ENCOUNTERED DURING DRILLING: None
- WATER LEVEL AFTER REMOVAL: None
- CAVE DEPTH AFTER REMOVAL: 13.2 ft.
- WATER LEVEL AFTER HOURS:
- CAVE DEPTH AFTER HOURS

REMARKS

CS (California Sampler): N-value does not correlate directly to Standard Penetration Test (SS)

RECORD OF SUBSURFACE EXPLORATION

BORING NO. & LOCATION:	PROJECT:
2 - Northwest Building	Proposed Morton's Restaurant
SURFACE ELEVATION: 101.6	PROJECT LOCATION: Plaza Drive, Costa Mesa, California
COMPLETION DATE: 2/2/01	
FIELD REPRESENTATIVE: Rich Koester	GILES PROJECT NUMBER: 2G-0102001

GILES ENGINEERING ASSOCIATES, INC.
Milwaukee Los Angeles
Madison Dallas Atlanta
Washington, D.C.

MATERIAL DESCRIPTION	Feet Below Surface	Sample No. & Type	N	q_u (tsf)	q_p (tsf)	q_s (tsf)	W (%)	PID	NOTES
Brown Clayey fine Sand, some Gravel (Possible Fill)-Very Moist		1-AU	--						
		2-SS	7		1.0	0.5	28	BDL	
Dark Brown and Gray mottled Silty Clay-Moist		3-SS	8	4.0	3.2		27	BDL	
	5								
Brown and Gray mottled Silty Clay-Moist		4-SS	9	2.5	2.1		33	BDL	
Gray Silty Clay-Moist		5-SS	6	1.9	1.7		34	BDL	
	10								
Gray and Brown mottled Silty Clay, little fine Sand-Moist		6-SS	9	2.9	2.8		16	BDL	
	15								
Boring terminated at 15 feet									

WATER OBSERVATION DATA	REMARKS
WATER ENCOUNTERED DURING DRILLING: None	
WATER LEVEL AFTER REMOVAL: None	
CAVE DEPTH AFTER REMOVAL: 13.1 ft.	
WATER LEVEL AFTER HOURS:	
CAVE DEPTH AFTER HOURS:	

RECORD OF SUBSURFACE EXPLORATION

BORING NO. & LOCATION: 3 - Northeast Building	PROJECT: Proposed Morton's Restaurant
SURFACE ELEVATION: 102.1	PROJECT LOCATION: Plaza Drive
COMPLETION DATE: 2/2/01	Costa Mesa, California
FIELD REPRESENTATIVE: Rich Koester	GILES PROJECT NUMBER: 2G-0102001

GILES ENGINEERING ASSOCIATES, INC.
Milwaukee Los Angeles
Madison Dallas Atlanta
Washington, D.C.

MATERIAL DESCRIPTION	Feet Below Surface	Sample No. & Type	N	q_u (tsf)	q_p (tsf)	q_s (tsf)	W (%)	PID	NOTES
Brown fine to medium Sand, little Clay (Fill)-Moist		1-AU	--						
		2-CS	15					BDL	
Dark Brown Silty fine to medium Sand (Fill)-Moist		3-CS	13					BDL	
	5	4-CS	15		3.7		31	BDL	
Gray and Brown mottled Silty Clay-Moist		5-CS	13		3.0		34	BDL	
		6-CS	7		1.8	0.8	34	BDL	
Dark Gray Silty Clay-Moist	10								
Brown and Gray mottled Silty Clay, trace fine Sand-Moist		7-SS	8	2.5	3.0		18	BDL	
Boring terminated at 15 feet	15								

WATER OBSERVATION DATA	REMARKS
WATER ENCOUNTERED DURING DRILLING: None	CS (California Sampler): N-value does not correlate directly to Standard Penetration Test (SS).
WATER LEVEL AFTER REMOVAL: None	
CAVE DEPTH AFTER REMOVAL: 13.1 ft.	
WATER LEVEL AFTER HOURS:	
CAVE DEPTH AFTER HOURS:	

RECORD OF SUBSURFACE EXPLORATION

BORING NO. & LOCATION: 4 - Southeast Building
SURFACE ELEVATION: 101.5
COMPLETION DATE: 2/2/01
FIELD REPRESENTATIVE: Rich Koester

PROJECT: Proposed Morton's Restaurant
PROJECT LOCATION: Plaza Drive, Costa Mesa, California
GILES PROJECT NUMBER: 2G-0102001

GILES ENGINEERING ASSOCIATES, INC.
Milwaukee Los Angeles
Madison Dallas Atlanta
Washington, D.C.

MATERIAL DESCRIPTION	Feet Below Surface	Sample No. & Type	N	q_u (tsf)	q_p (tsf)	q_s (tsf)	w (%)	PID	NOTES
Dark Brown Silty fine Sand (Fill)-Moist		1-AU	--						
Brown fine to medium Sand, trace Clay (Fill)-Moist		2-SS	8					BDL	
		3-SS	11	4.1	4.2		27	BDL	
Dark Gray Silty Clay-Moist	5								
		4-SS	9		3.4		28	BDL	
Gray and Brown mottled Silty Clay-Moist									
Dark Gray Silty Clay-Moist		5-SS	7	2.6	2.2		26	BDL	
	10								
Gray-Brown Silty Clay, little fine Sand-Moist		6-SS	10	2.2	3.4		17	BDL	
	15								

Boring terminated at 15 feet

WATER OBSERVATION DATA	REMARKS
WATER ENCOUNTERED DURING DRILLING: None	
WATER LEVEL AFTER REMOVAL: None	
CAVE DEPTH AFTER REMOVAL: 13.0 ft.	
WATER LEVEL AFTER HOURS.	
CAVE DEPTH AFTER HOURS.	

RECORD OF SUBSURFACE EXPLORATION

BORING NO & LOCATION: 5 - Center of Building	PROJECT: Proposed Morton's Restaurant	**GILES ENGINEERING ASSOCIATES, INC.** Milwaukee Los Angeles Madison Dallas Atlanta Washington, D.C.
SURFACE ELEVATION: 102.0	PROJECT LOCATION: Plaza Drive Costa Mesa, California	
COMPLETION DATE: 2/2/01		
FIELD REPRESENTATIVE: Rich Koester	GILES PROJECT NUMBER: 2G-0102001	

MATERIAL DESCRIPTION	Feet Below Surface	Sample No. & Type	N	q_u (tsf)	q_p (tsf)	q_s (tsf)	w (%)	PID	NOTES
Dark Brown Clayey Silt, little fine Sand, trace Organic Matter (Fill)-Moist		1-AU	--						
		2-SS	5					BDL	
Brown Clayey fine to medium Sand (Fill)-Moist		3-SS	13		4.4		24	BDL	See Figure 2
Dark Gray-Brown Silty Clay-Moist	5								
Gray and Brown mottled Silty Clay-Moist		4-SS	6	2.3	2.5		33	BDL	
Dark Gray Silty Clay-Moist	10	5-SS	6	2.9	2.4		35	BDL	
Gray and Brown mottled Silty Clay-Moist	15	6-SS	8	2.2	2.8		20	BDL	
Gray and Brown mottled Silty Clay, little fine Sand-Moist	∇ 20	7-SS	3	1.7	1.3	0.6	20	BDL	
Brown fine to medium Sand-Wet	25	8-SS	4					BDL	P200 = 7%
Brown and Gray Silt, some fine Sand-Moist	30	9-SS	11					BDL	P200 = 60%
Brown and Gray Silty Clay-Moist	35	10-SS	6				25	BDL	
Brown and Gray mottled Clayey Silt, little fine Sand, trace Gravel-Moist	40	11-SS	13				24	BDL	
Brown and Gray mottled Clayey Silt, some fine Sand-Moist	45	12-SS	12				22	BDL	
		13-SS	37					BDL	P200 = 12%
Brown fine to medium Sand-Moist	50								
Boring terminated at 50 feet									

WATER OBSERVATION DATA	REMARKS
∇ WATER ENCOUNTERED DURING DRILLING: 19.5 ft.	
WATER LEVEL AFTER REMOVAL:	
CAVE DEPTH AFTER REMOVAL:	
WATER LEVEL AFTER HOURS:	
CAVE DEPTH AFTER HOURS:	

SUBSURFACE EXPLORATION 2G010201.GPJ GIL_CORP.GDT 2/16/01

BORING 1

DATE DRILLED: January 11, 1971
EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 100.4*

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	SAMPLE	CLASS	DESCRIPTION
100		26.5	95	■	CL	SILTY CLAY - dark greyish-brown
		29.7	72	■		Dark grey
95	5	28.4	86	■		
		24.9	96	■		
						Some organic matter
90	10	35.4	84	■		
						Layer of Clayey Silt - reddish-brown
					CL	SILTY CLAY - reddish-brown and grey
		18.6	111	■		
85	15					
					ML	CLAYEY SILT - reddish-brown and grey
						Layer of Silty Sand
	20	16.8	114	■		

NOTE: Water seepage encountered at 13' and below $17\frac{1}{2}$'. Water level at a depth of 10' 3 hours after completion of drilling. No caving.

Soils classified in accordance with the Unified Soil Classification System.

* Elevations refer to assumed datum; see Plate 1.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 2

DATE DRILLED January 8, 1971

EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 100.0

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu. ft)	SAMPLE	
		28.5	90	■	CL SILTY CLAY - dark greyish-brown
		31.7	72	■	Dark grey
95	5	32.0	83	■	Few cemented nodules
		27.4	91	■	Layer of Clayey Silt - mottled brown and grey
90	10	30.0	90	■	
					Layer of Clayey Silt - some fine sand, reddish-brown and grey
		20.6	107	■	Reddish-brown
85	15				

NOTE: Slight seepage encountered at 13'. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 3

DATE DRILLED: January 6, 1971

EQUIPMENT USED: 5"-Diameter Rotary Wash

ELEVATION 99.9

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu ft.)	SAMPLE		
					CL	SILTY CLAY - some organic matter, rootlets, dark greyish-brown
		33.6	71	■		
		32.8	72	■		Nodules
95	5					
		33.2	86	■		Dark grey Mottled grey and brown
		42.4	78	■		
90	10					
		18.3	112	■		Reddish-brown and grey
85	15	20.3	108	■		
					SP	SAND - fine, some clay and silt, light brown
80	20	14.7	113	■		
75	25	25.9	99	■	SM	SILTY SAND - fine to very fine, light brown
						SILT - light brown
70	30	22.4	106	■		
					SP	SAND - very fine to fine, light brown
65	35					

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 3 (CONTINUED)

DATE DRILLED January 6, 1971

EQUIPMENT USED: 5"-Diameter Rotary Wash

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs/cu ft.)	SAMPLE		
		22.1	103	■		
					ML	SANDY SILT - brown
60	40	26.8	97	■	ML	SILT - some fine sand, grey
55	45	32.8	90	■		
					SP	SAND - fine, light grey
50	50	29.5	94	■		
45	55					

NOTE: Water level not established. Drilling mud used in drilling porcess. Boring cased from 7' to 11' due to loss of circulation.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 4

DATE DRILLED January 8, 1971

EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 99.8

ELEVATION (ft)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs/cu ft.)	SAMPLE		DESCRIPTION
					CL	SILTY CLAY - dark greyish-brown
		29.7	89	■		
						Dark grey
		32.2	76	■		
95	5					
		27.9	91	■		Greyish-brown
						Layer of Clayey Silt, brown
		31.8	87	■		
90	10					
		33.1	88	■		
						Layer of Clayey Silt, reddish-brown and grey
85	15	19.7	109	■		

NOTE: Water seepage encountered at $12\frac{1}{2}$'. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 5

DATE DRILLED: January 8, 1971

EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 100.3

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu. ft.)	SAMPLE		Description
100		27.0	90	■	CL	SILTY CLAY - dark greyish-brown
		28.5	74	■		Less Silty, mottled dark grey and brown
		26.9	81	■		
95	5					
		24.3	96	■		
						Layer of Clayey Silt, mottled grey and brown
90	10	33.4	86	■		
						Reddish-brown and grey
		20.7	105	■		
85	15					
					SM	SILTY SAND - fine, reddish-brown and grey
		21.4	106	■	ML	CLAYEY SILT - brownish-grey
	20					

NOTE: Slight seepage encountered at $12\frac{1}{2}$'. Water level measured at a depth of 16', 40 minutes after completion of drilling. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 6

DATE DRILLED: January 8, 1971
EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 99.9

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	SAMPLE		DESCRIPTION
					CL	SILTY CLAY - dark greyish-brown
		28.8	93	■		Less Silty, dark grey
				■		
95	5					
		25.6	93	■		Layer of Clayey Silt, few cemented nodules, greyish-brown
		34.4	84	■		Traces of organic matter, dark grey to black
90	10					
		22.4	104	■	ML	CLAYEY SILT - very clayey, reddish-brown and grey
85	15	19.8	109	■		
80	20					

NOTE: Slight water seepage encountered at 11'. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 7

DATE DRILLED: January 8, 1971
EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 99.9

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu ft)	SAMPLE
		28.8	91	■
		33.0	73	■
95	5			
		32.9	84	■
		32.4	88	■
90	10			
		36.4	83	■
85	15	21.9	106	■
80	20	16.5	111	■

CL — SILTY CLAY - dark greyish-brown

Less silty, dark grey

Layer of Clayey Silt

ML — CLAYEY SILT - very clayey, reddish-brown and grey

SC — CLAYEY SAND - fine, reddish-brown and grey

SP — SAND - fine, reddish-brown and grey

NOTE: Water seepage encountered at 11', 12', and 13½'. Water level at depth of 9' 5½ hours after completion of drilling.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 8

DATE DRILLED January 7, 1971

EQUIPMENT USED: 5"-Diameter Rotary Wash

ELEVATION 99.8

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	SAMPLE		Description
					CL	SILTY CLAY - rootlets, some organic matter, dark greyish-brown
		30.3	89	■		
		26.8	93	■		Mottled grey and brown
95	5					
		23.8	94	■		Very silty
		39.4	78	■		Layer of Clay - grey
90	10					Light brown
		23.4	103	■		
						Cemented nodules
85	15	24.8	99	■		
					SP	SAND - fine to very fine, some silt, greyish-brown
80	20	23.9	101	■		
75	25	22.1	104	■		

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 8 (CONTINUED)

DATE DRILLED January 7, 1971

EQUIPMENT USED 5"-Diameter Rotary Wash

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu ft)	SAMPLE
70	30	28.5	96	■
65	35	25.0	101	■
60	40	28.6	94	■
55	45	34.7	85	■
50	50	27.2	93	■

ML SANDY SILT - some clay, light brown

CL SILTY CLAY - light brown

NOTE: Water level not established. Drilling mud used in drilling process. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 9

DATE DRILLED January 8, 1971
EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 99.9

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	SAMPLE	Soil	Description
		30.0	90	■	CL	SILTY CLAY - mottled dark grey and brown
		38.2	78	■		
						Grey
95	5	31.6	89	■		
		29.4	88	■	ML	CLAYEY SILT - mottled grey and reddish-brown
90	10	34.6	85	■		
					CL	SILTY CLAY - reddish-brown and grey
85	15	20.3	108	■		

NOTE: Slight water seepage encountered at 12½'.
No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

PLATE A-11

BORING 10

DATE DRILLED: January 11, 1971

EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 100.0

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	SAMPLE		
					CL	SILTY CLAY - dark greyish-brown
						Grey
		32.0	86	■		
		30.3	92	■		
95	5					
		31.3	87	■	SM	SILTY SAND - fine, reddish-brown and grey
					ML	SANDY SILT - reddish-brown and grey
		35.5	83	■		
90	10				ML	CLAYEY SILT - some fine sand, reddish brown and grey
		17.1	114	■		
					CL	SANDY CLAY - reddish-brown and grey
85	15	17.3	114	■		
80	20					

NOTE: Slight water seepage encountered at 10' and 13½'.
No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 11

DATE DRILLED: January 7, 1971
EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 99.9

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	SAMPLE		DESCRIPTION
					CL	SILTY CLAY - dark greyish-brown
		25.5	98	■		
		26.0	80	■		Grey
95	5	23.9	92	■		
		18.2	87	■		
					ML	SANDY SILT - mottled light brown and grey
						Layer of Clayey Silt, dark grey
90	10	15.8	113	■		
					CL	SILTY CLAY - very silty, reddish-brown and grey
85	15	22.1	104	■		
					SM	SILTY SAND - fine, reddish-brown and grey
					ML	CLAYEY SILT - some fine sand, reddish-brown and grey
80	20	19.4	108	■		
					SM	SILTY SAND - fine, light greyish-brown
75	25					

NOTE: Slight water seepage encountered at 12'. Water level measured at a depth of 9' 15 hours after completion of drilling. Sloughing below 19½'.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 12

DATE DRILLED: January 11,1971
EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 99.7

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu ft)	SAMPLE		Description
		29.6	88	■		SILTY CLAY - dark greyish-brown
		32.3	84	■		Dark grey
95	5	30.8	84	■		
		20.4	85	■	ML	CLAYEY SILT - very clayey, mottled brown and grey
						Layer of Silty Clay - dark grey
90	10	38.3	82	■		Grey
						Layer of Silty Clay - reddish-brown and grey
		21.8	104	■	ML	SANDY SILT - fine, light grey
85	15					

NOTE: Slight water seepage encountered from 10½' to 12' and at 13'. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 13

DATE DRILLED January 7, 1971
EQUIPMENT USED: 5"-Diameter Rotary Wash

ELEVATION 99.8

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu. ft)	SAMPLE		
					CL	SILTY CLAY - rootlets, some organic matter, dark greyish-brown
		29.0	90	■		
		20.4	89	■		
					ML	SANDY SILT - fine, brown
95	5	32.0	91	■		
		21.3	105	■		Clayey
90	10					
		23.4	103	■		
					SM	SILTY SAND - fine to very fine, brown
85	15	18.3	113	■		Layer of Sand, fine, brown
						Cemented nodules
80	20	25.8	99	■		
75	25	30.9	91	■		

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 13 (CONTINUED)

DATE DRILLED January 7, 1971

EQUIPMENT USED: 5"-Diameter Bucket

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	SAMPLE
70	30	18.4	111	■
65	35			
60	40	14.7	115	■
55	45	24.6	103	■
50	50	28.5	95	■

SP SAND - fine, light brown

CL SILTY CLAY - light brown

SP SAND - fine, about 25% gravel, light brown

CL SILTY CLAY - grey

NOTE: Water level not established. Drilling mud used in drilling process.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

PLATE A-16

BORING 14

DATE DRILLED: January 11, 1971

EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 100.1

Elevation (ft.)	Depth (ft.)	Moisture (% of dry wt.)	Dry Density (lbs./cu. ft.)	Sample	Symbol	Description
100					CL	SILTY CLAY - dark greyish-brown
		31.9	87	■		
		31.6	86	■		Mottled grey and brown
95	5	27.6	93	■		Layer of Silty Sand, fine, reddish-brown and grey
		23.8	93	■	ML	CLAYEY SILT - reddish-brown and grey Layer of Sandy Silt, reddish-brown and grey
90	10	21.0	108	■	CL	SILTY CLAY - very silty, reddish-brown and grey
					SC	CLAYEY SAND - fine, reddish-brown and grey
	15	17.4	113	■	SM	SILTY SAND - fine, reddish-brown and grey

NOTE: Slight water seepage encountered at 10½' and 13'. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 15

DATE DRILLED: January 6, 1971
EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 100.3

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu. ft.)	SAMPLE		Description
100					CL	SILTY CLAY - dark greyish-brown
		27.1	95	■		
		24.5	88	■		Grey
95	5	33.0	81	■		Layer of Sandy Silt, fine, brown
		41.9	76	■		Dark greyish-brown
90	10	34.3	85	■		Few nodules Traces of organic matter
85	15	30.5	92	■		
					CL	SANDY CLAY - fine, reddish-brown and grey
	20	13.7	122	■	SC	CLAYEY SAND - fine, light greyish-brown

NOTE: Slight water seepage at 12' and 19½'.
No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 16

DATE DRILLED January 6, 1971
EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 100.1

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs/cu ft)	SAMPLE		DESCRIPTION
100		27.8	92	■	CL	SILTY CLAY - mottled dark greyish-brown
		30.2	89	■		
						Few cemented nodules, dark grey
95	5	31.6	86	■		
		20.0	90	■		Layer of Silt, some clay and sand, brown
						Very silty, traces of organic matter
90	10	41.2	78	■		
		22.4	103	■		
					CL	SANDY CLAY - reddish-brown and grey
85	15					
		17.3	114	■	SC	CLAYEY SAND - fine, reddish-brown and grey
					SP	SAND - fine, light greyish-brown
	20					

NOTE: Moderate water seepage encountered at 12' to 14' and at 18½'. Water level at a depth of 9½' 14½ hours after completion of drilling. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 17

DATE DRILLED January 6, 1971

EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 100.3

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)	SAMPLE		
100					CL	SILTY CLAY - dark grey
		26.6	95	■		
		32.0	72	■		
95	5					Mottled brown and grey
						Layer of Clayey Silt, mottled brown and grey
		26.0	94	■		
		22.0	92	■		Layer of Sandy Silt, brown
						Grey
90	10					
		44.7	75	■		
						Layer of Clayey Silt, reddish-brown and grey
85	15	21.5	107	■	CL	SANDY CLAY - reddish-brown and grey
					SC	CLAYEY SAND - fine, reddish-brown and grey
80	20	18.5	111	■	SP	SAND - fine, light greyish-brown
	25					

NOTE: Slight water seepage encountered at 11½'. Heavy flow of water at 20'. Water at a depth of 14', 15 minutes after completion of drilling. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 18

DATE DRILLED January 6, 1971

EQUIPMENT USED 5"-Diameter Rotary Wash

ELEVATION 100.0

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu ft)	SAMPLE		DESCRIPTION
					CL	SILTY CLAY - dark greyish-brown
						Mottled brown and grey
		33.1	84	■		
		19.7	98	■		
95	5					
		21.2	98	■		
		39.8	80	■		Greyish-brown
90	10					
		18.4	111	■		
85	15	21.9	104	■		
					SP	SAND - fine, few fine gravel, light brown
80	20	15.9	118	■		
						25% gravel
75	25	13.1	122	■		

(CONTINUED ON FOLLOWING PLATE)

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 18 (CONTINUED)

DATE DRILLED January 6, 1971

EQUIPMENT USED: 5"-Diameter Rotary Wash

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs/cu ft)	SAMPLE	
					SILT - some fine sand, light greyish-brown
70	30	19.3	109	■	
65	35	25.9	99	■	
60	40	26.5	97	■	Sandy
55	45	33.4	89	■	
					Clayey
					CL CLAY - grey
50	50	29.1	94	■	

NOTE: Water level not established. Drilling mud used in drilling process.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 19

DATE DRILLED January 6, 1971

EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 100.1

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs / cu ft)	SAMPLE		
100		25.7	94	■	CL	SILTY CLAY - mottled grey and brown
		29.2	83	■		Dark brownish-grey
95	5	25.0	88	■		
		24.0	99	■		
90	10	37.4	81	■		Few cemented nodules, traces of organic matter
						Reddish-brown and grey
		21.5	105	■		Sandy
85	15					
					SC	CLAYEY SAND - fine, reddish-brown and grey
					SP	SAND - fine, light brown
		13.7	114	■		
	20					

NOTE: Water seepage encountered at $15\frac{1}{2}$' and 18'.
No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 20

DATE DRILLED January 6, 1971
EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 99.7

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs/cu ft)	SAMPLE		Description
		27.6	93	■	CL	SILTY CLAY - dark greyish-brown
		27.2	90	■		Dark grey
95	5					Mottled dark grey and brown
		26.9	91	■		
		38.3	79	■	CL	CLAY - greyish-brown
90	10					
		32.2	88	■		Dark grey
						Reddish-brown and grey
						Traces of organic matter
85	15	23.3	102	■		
					ML	SANDY SILT - few cemented nodules, light grey
					SP	SAND - fine, light greyish-brown
80	20					

NOTE: Slight water seepage encountered at 15' and 17'. Water level measured at a depth of 10' 1½ hours after completion of drilling. Heavy caving below 17'.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 21

DATE DRILLED January 7, 1971

EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 99.7

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs/cu ft.)	SAMPLE		
		29.4	84	■	CL	SILTY CLAY - dark greyish-brown
		29.1	90	■		
						Mottled grey and brown
95	5	25.3	89	■		
		22.8	97	■	ML	SANDY SILT - some clay, mottled brown and grey
					CL	SILTY CLAY - few cemented nodules, traces of organic matter, dark grey
90	10	40.5	77	■		
						Reddish-brown and grey
		21.5	105	■		
85	15					

NOTE: Slight water seepage encountered at $12\frac{1}{2}$'.
No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 22

DATE DRILLED January 7, 1971
EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 100.1

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu ft.)	SAMPLE		
100					CL	SILTY CLAY - dark greyish-brown
		21.3	103	■		
		26.0	81	■		
95	5					
		23.5	95	■		Layers of Sandy Silt, some clay, light brown
		26.5	91	■		
						Dark grey
90	10					
		18.1	112	■		Reddish-brown and grey
					ML	CLAYEY SILT - some fine sand, few cemented nodules, traces of organic matter, grey
	15	20.8	107	■		

NOTE: Slight water seepage encountered at 14'. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 23

DATE DRILLED January 7, 1971

EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 99.6

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs/cu ft.)	SAMPLE		DESCRIPTION
					CL	SILTY CLAY - dark greyish-brown
		31.6	89	■		
		27.5	76	■		Few cemented nodules, dark grey
95	5					
		26.8	92	■		Layers of Clayey Silt
		26.1	95	■		
90	10					Reddish-brown and grey
		20.8	107	■		
					ML	CLAYEY SILT - very clayey, reddish-brown and grey
85	15	31.3	90	■		Layer of Silty Sand
					SM	SILTY SAND - fine, reddish-brown and grey
	20	26.2	99	■		Layer of Clayey Silt

NOTE: Moderate water seepage at 13½' to 16' and below 18'. Water level measured at a depth of 10' 6 hours after completion of drilling. Slight sloughing from 14' to 16½'.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 24

DATE DRILLED January 7, 1971

EQUIPMENT USED: 24"-Diameter Bucket

ELEVATION 99.5

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs/cu ft)	SAMPLE		Description
		29.9	90	■	CL	SILTY CLAY - dark greyish-brown
		34.1	83	■		
95	5	28.1	89	■		Grey
		17.4	97	■		Layer of Clayey Silt, light brown and grey
						Dark grey
90	10	25.7	98	■		Traces of organic matter, reddish-brown and grey
					ML	CLAYEY SILT - very clayey, reddish-brown and grey
85	15	21.0	107	■	SM	SILTY SAND - fine, grey and brown

NOTE: Slight water seepage at $13\frac{1}{2}$'. No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 25

DATE DRILLED January 7, 1971

EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 99.7

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu. ft.)
		28.0	91
		30.1	91
95	5	27.3	89
		8.5	90
90	10	14.3	114
85	15	18.6	111

CL SILTY CLAY - dark greyish-brown

Layer of Clayey Silt

Layer of Silty Sand, fine, light grey and brown

Dark grey

Layer of Clayey Silt, reddish-brown and grey

Reddish-brown and grey

CL SANDY CLAY - reddish-brown and grey

NOTE: Slight water seepage encountered at 14½'.
No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 26

DATE DRILLED January 7, 1971

EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 100.1

ELEVATION (ft)	DEPTH (ft)	MOISTURE (% of dry wt)	DRY DENSITY (lbs./cu.ft.)	SAMPLE		
100					CL	SILTY CLAY - dark greyish-brown
		31.1	89	■		
		25.2	86	■		Grey
95	5					
		30.5	81	■		Layer of Silty Sand
		33.8	83	■		Dark grey
90	10					Reddish-brown and grey
		24.4	100	■		
					SM	SILTY SAND - fine, grey and reddish-brown
85	15	14.5	118	■		
					SP	SAND - fine, light greyish-brown
		21.0	104	■		
	20					

NOTE: Water seepage encountered at 14' and 18½'. Water level measured at a depth of 11' 4 hours after completion of drilling. Caving below 18'.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

BORING 27

DATE DRILLED January 11, 1971
EQUIPMENT USED 24"-Diameter Bucket

ELEVATION 99.3

ELEVATION (ft.)	DEPTH (ft.)	MOISTURE (% of dry wt.)	DRY DENSITY (lbs./cu ft.)	SAMPLE		Description
					CL	SILTY CLAY - dark greyish-brown
		29.3	87	■		
		26.8	86	■		
95	5	27.8	93	■		Layer of Sandy Silt
						Layer of Clayey Silt
		37.1	79	■		
90	10					Layer of Sandy Silt
		19.3	110	■		Reddish-brown and grey
					ML	CLAYEY SILT - greyish-brown
85	15	21.5	105	■		

NOTE: Slight water seepage encountered at $10\frac{1}{2}$'.
No caving.

LOG OF BORING

LEROY CRANDALL AND ASSOCIATES

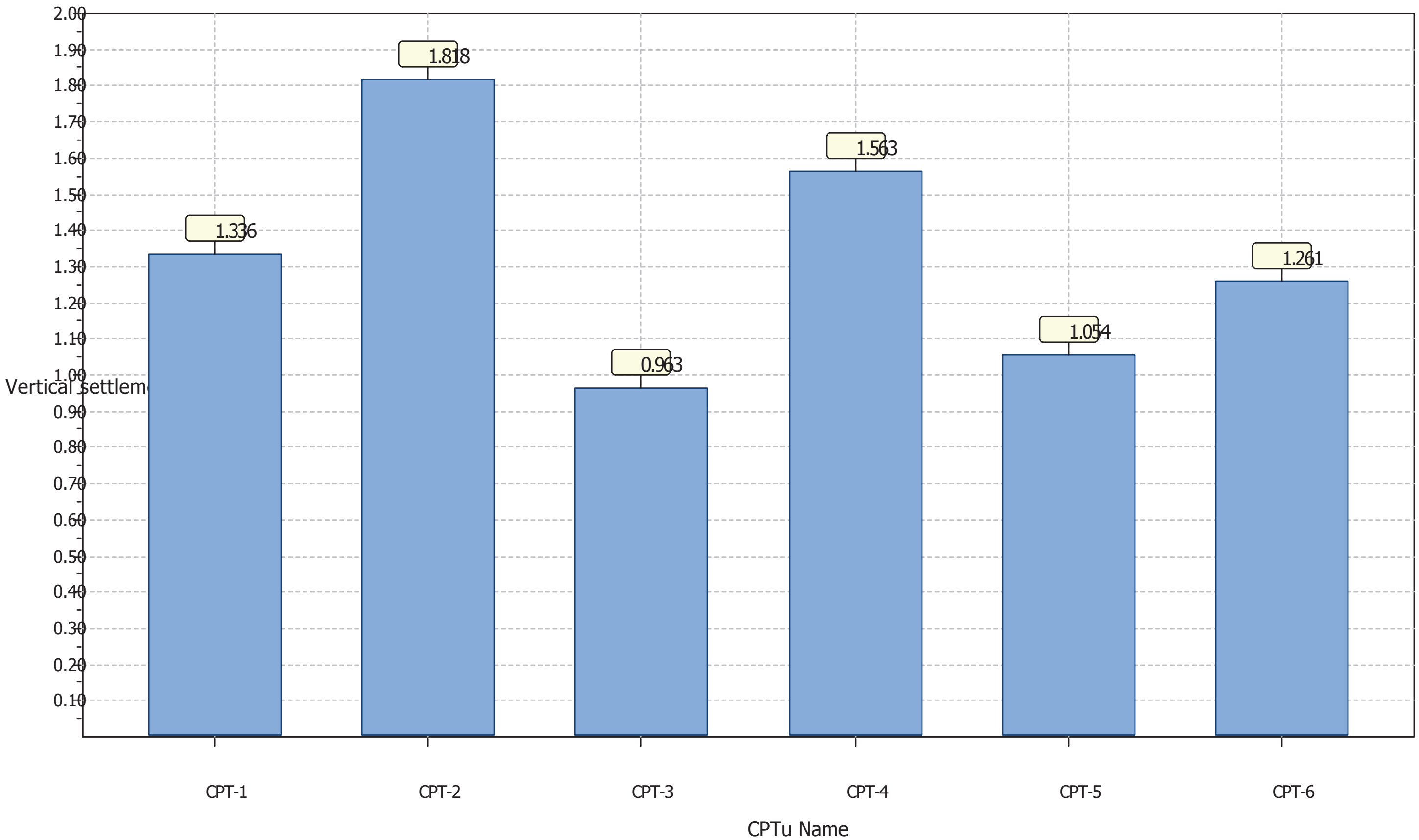
APPENDIX C

NMG Geotechnical, Inc.
17991 Fitch
Irvine, CA 92614

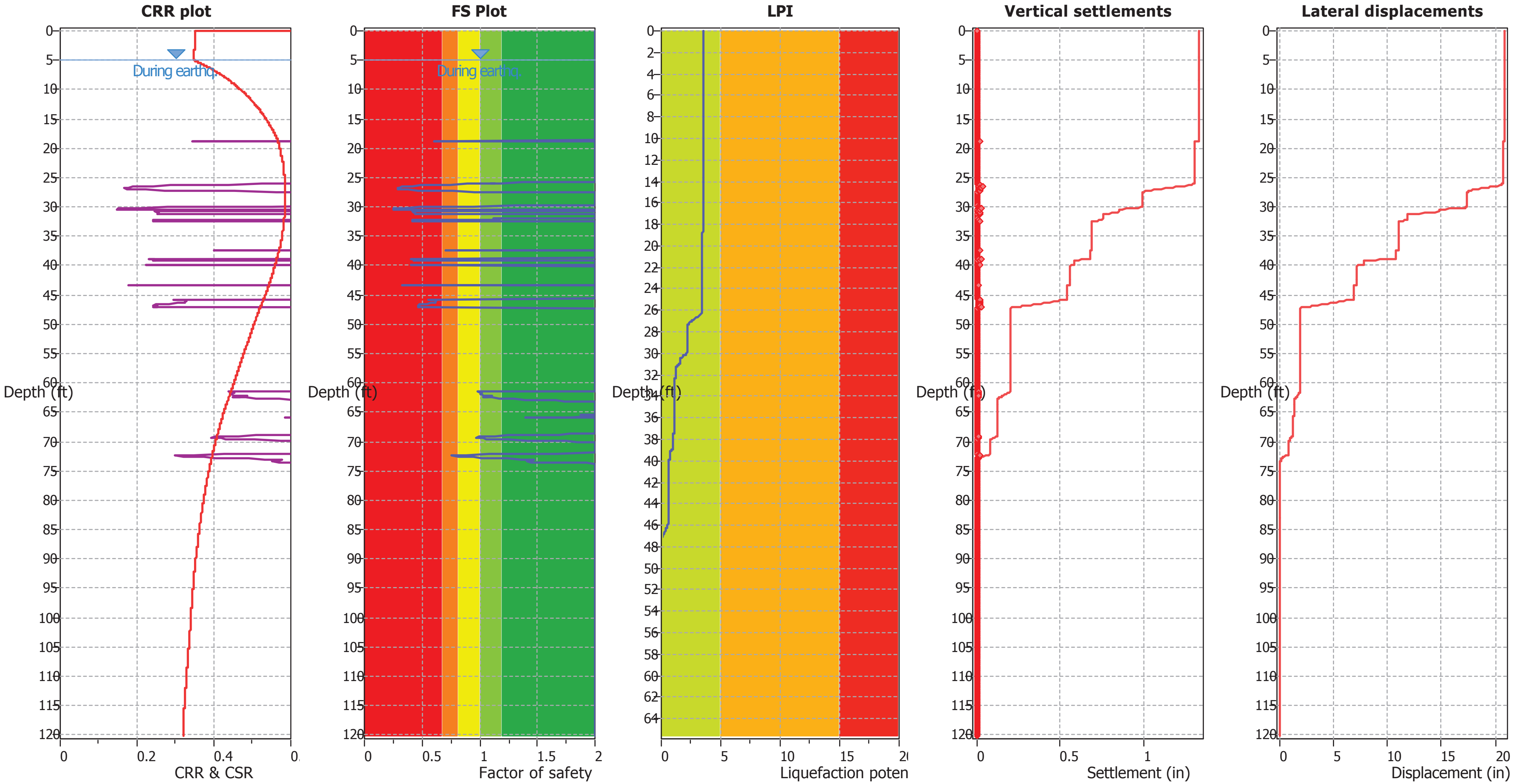
Project title : South Coast Plaza

Location :

Overall vertical settlements report



Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.15	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	75.00 ft

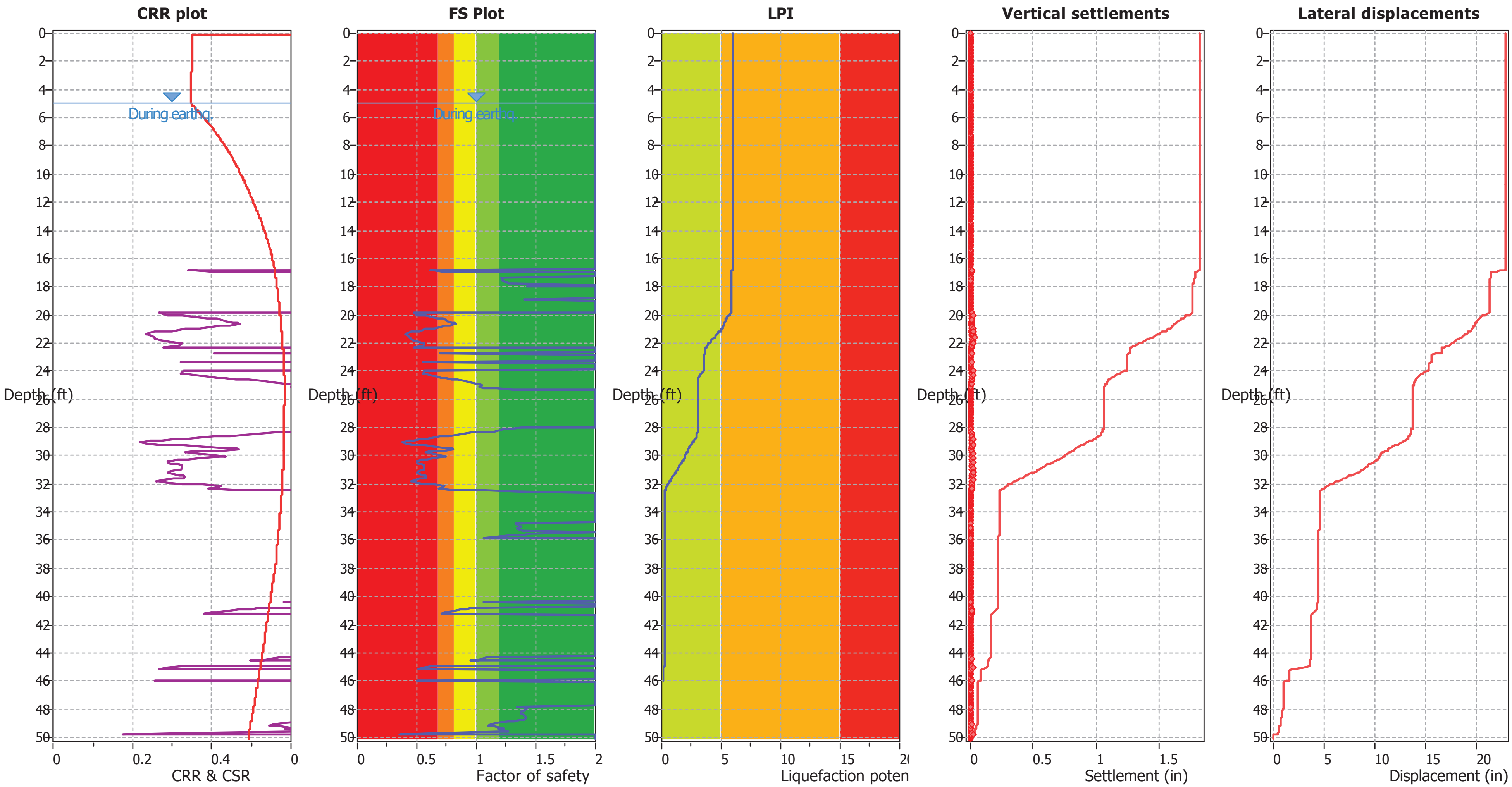
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.15	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

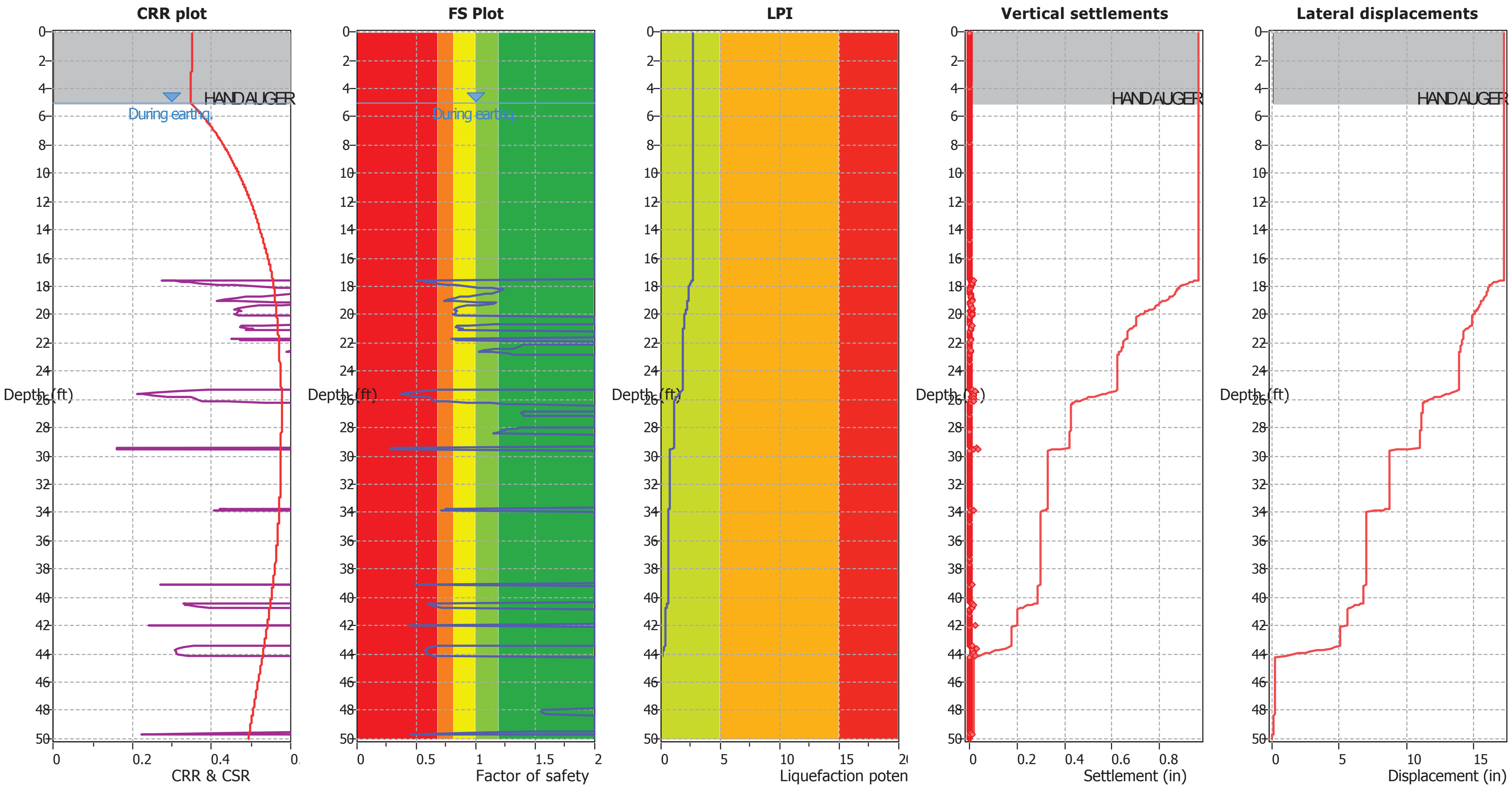
F.S. color scheme

- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.15	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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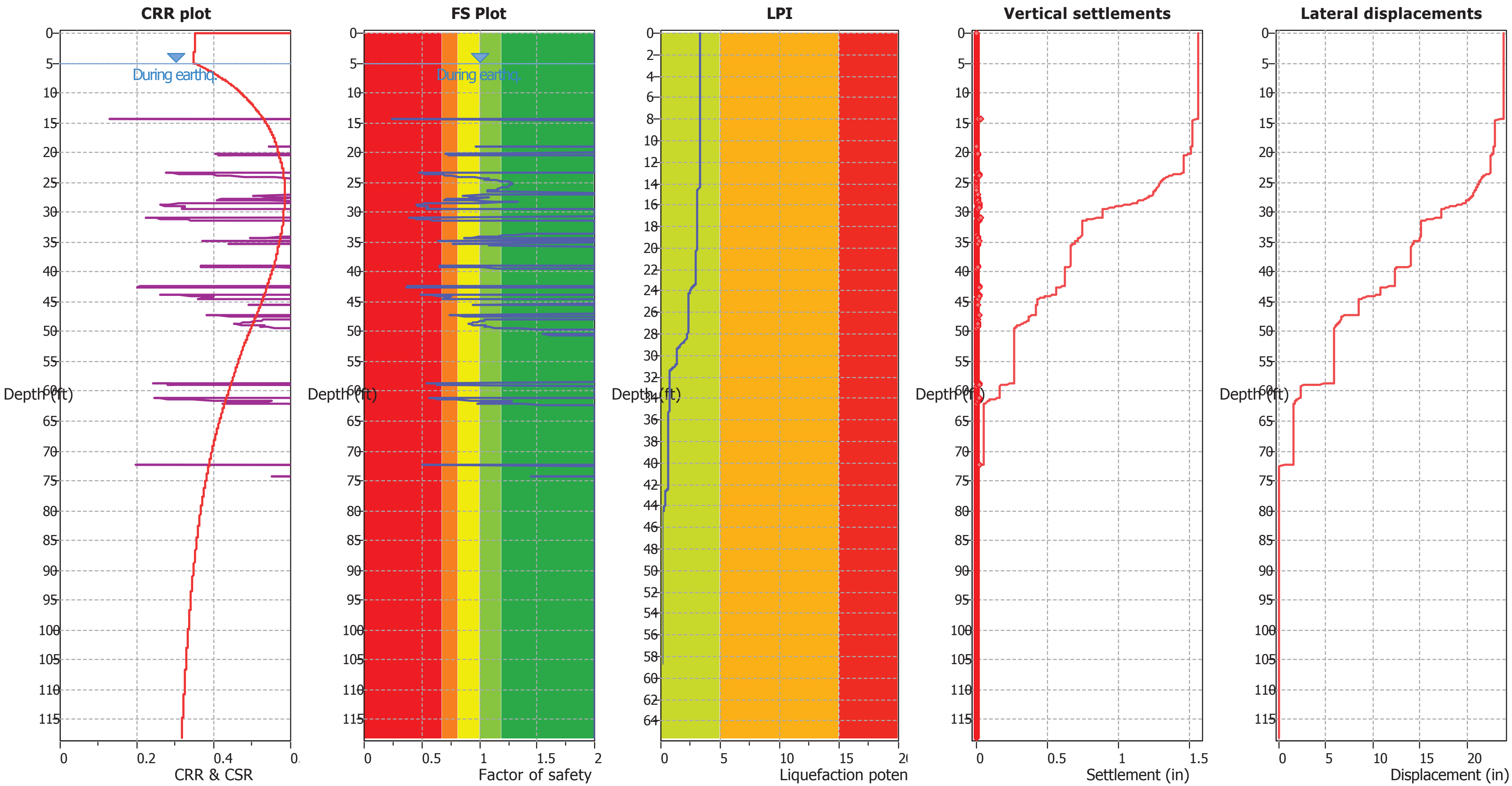
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.15	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	75.00 ft

F.S. color scheme

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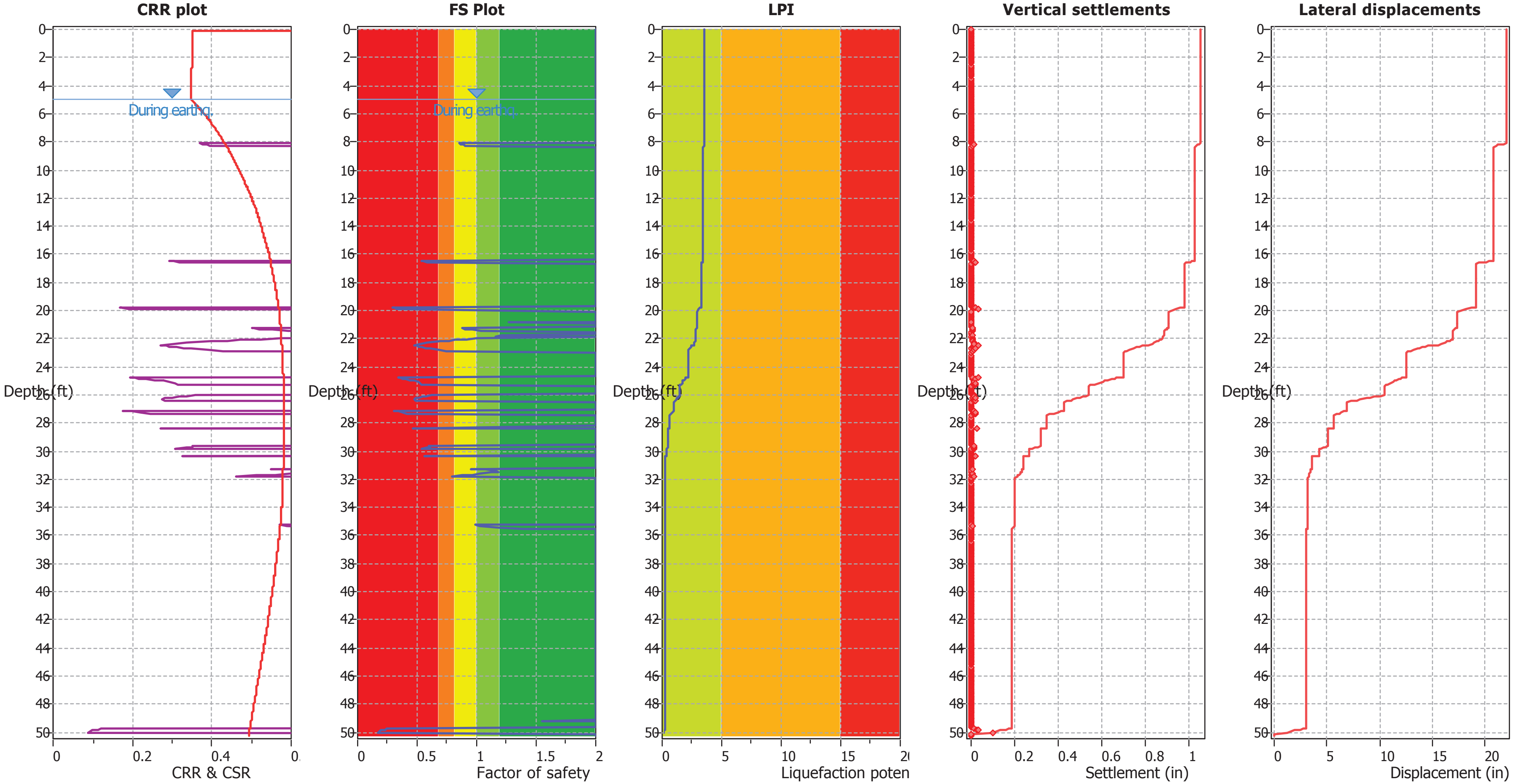
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.15	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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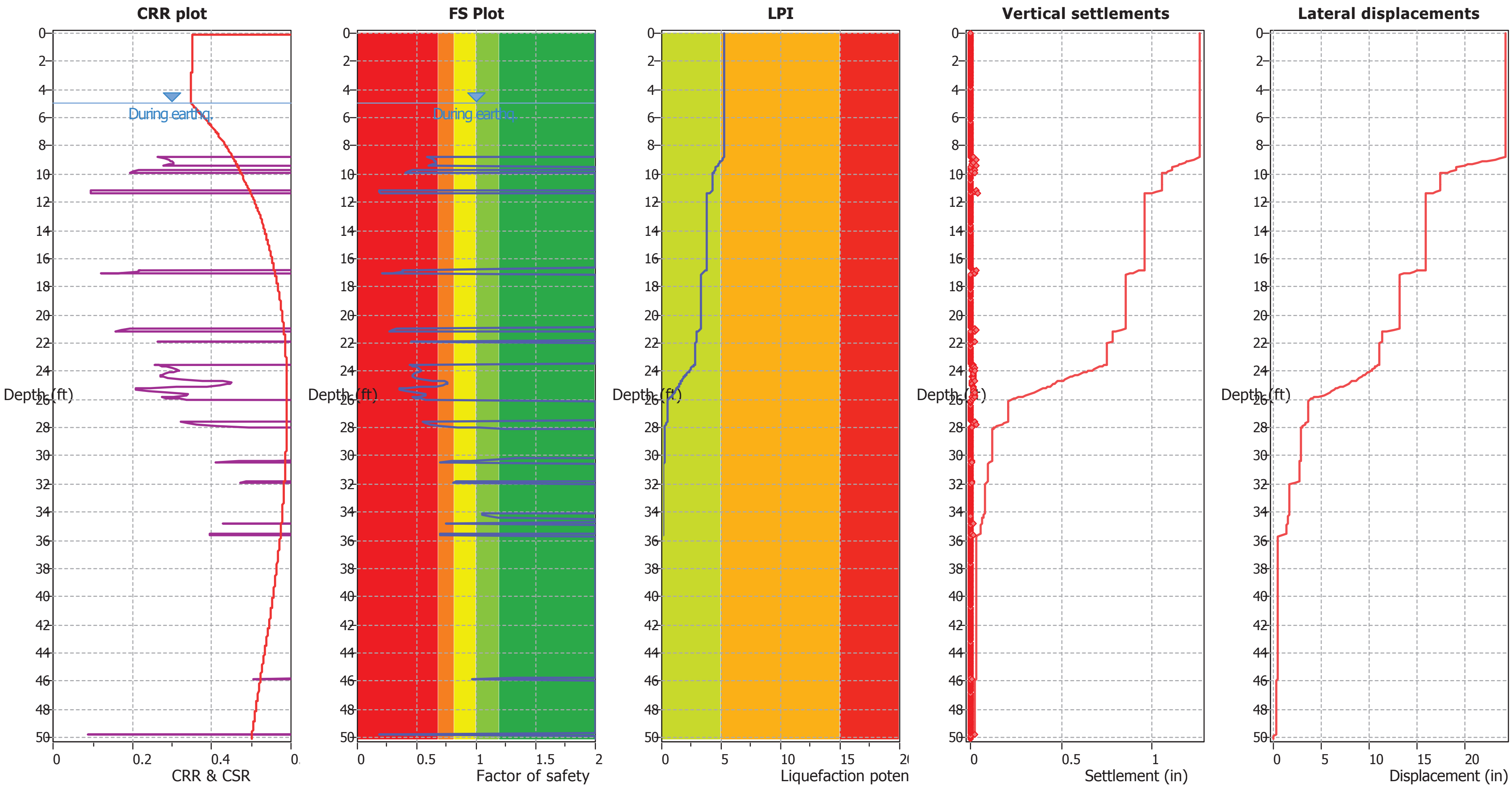
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.15	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.61	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 ft	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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APPENDIX D

OSHPD

Latitude, Longitude: 33.6956, -117.8908

Date	4/21/2021, 2:18:40 PM
Design Code Reference Document	ASCE7-16
Risk Category	III
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.29	MCE_R ground motion. (for 0.2 second period)
S_1	0.463	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.29	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.86	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.552	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.608	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.29	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.397	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.011	Factored deterministic acceleration value. (0.2 second)
S1RT	0.463	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.5	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.693	Factored deterministic acceleration value. (1.0 second)
PGAd	0.826	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.923	Mapped value of the risk coefficient at short periods
C_{R1}	0.925	Mapped value of the risk coefficient at a period of 1 s

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U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u...

Latitude

Decimal degrees

33.6956

Longitude

Decimal degrees, negative values for western longitudes

-117.8908

Site Class

259 m/s (Site class D)

Spectral Period

Peak Ground Acceleration

Time Horizon

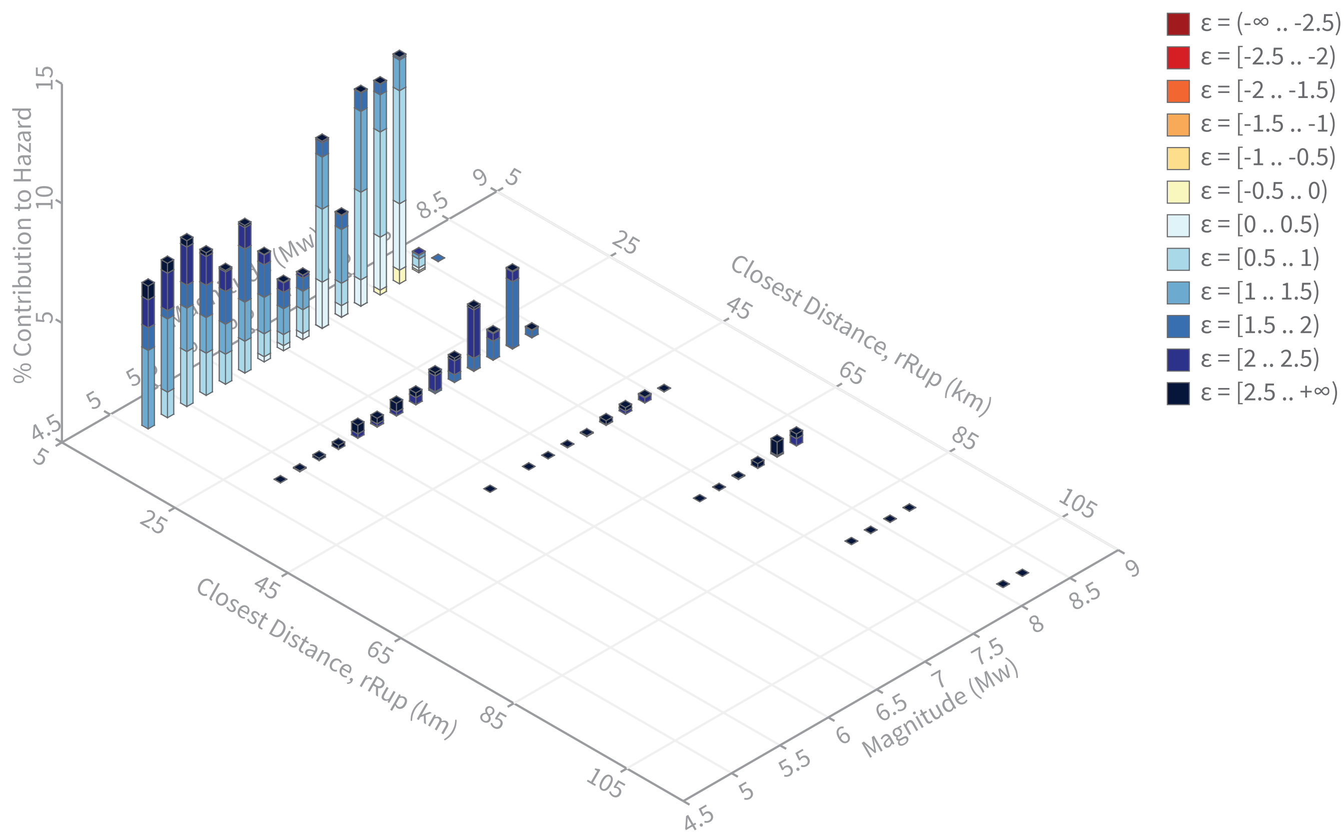
Return period in years

2475

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.65239994 g

Recovered targets

Return period: 2950.9624 yrs
Exceedance rate: 0.00033887249 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.06 %

Mean (over all sources)

m: 6.62
r: 11.6 km
ε_0: 1.3 σ

Mode (largest m-r bin)

m: 7.69
r: 7.43 km
ε_0: 0.62 σ
Contribution: 9.47 %

Mode (largest m-r-ε_0 bin)

m: 7.68
r: 8.26 km
ε_0: 0.72 σ
Contribution: 4.73 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM32	System							29.05
San Joaquin Hills [0]		4.05	7.15	0.54	117.895°W	33.672°N	187.60	9.60
Newport-Inglewood alt 2 [0]		8.85	7.49	0.93	117.962°W	33.644°N	229.09	5.03
Compton [0]		14.68	7.34	1.07	118.043°W	33.702°N	273.14	3.83
Palos Verdes [6]		26.72	7.46	2.04	118.139°W	33.574°N	239.61	1.58
Whittier alt 2 [2]		25.46	7.64	1.85	117.755°W	33.895°N	29.47	1.19
Anaheim [0]		11.61	6.91	1.30	117.943°W	33.780°N	332.98	1.17
UC33brAvg_FM31	System							25.84
San Joaquin Hills [0]		4.05	7.53	0.44	117.895°W	33.672°N	187.60	6.82
Newport-Inglewood alt 1 [0]		8.94	7.46	0.93	117.964°W	33.645°N	230.34	5.56
Compton [0]		14.68	7.27	1.11	118.043°W	33.702°N	273.14	3.66
Whittier alt 1 [2]		25.52	7.58	1.88	117.758°W	33.897°N	28.65	1.56
Palos Verdes [6]		26.72	7.29	2.14	118.139°W	33.574°N	239.61	1.45
Anaheim [0]		11.61	6.86	1.32	117.943°W	33.780°N	332.98	1.17
UC33brAvg_FM31 (opt)	Grid							22.74
PointSourceFinite: -117.891, 33.700		4.99	5.59	1.07	117.891°W	33.700°N	0.00	5.75
PointSourceFinite: -117.891, 33.700		4.99	5.59	1.07	117.891°W	33.700°N	0.00	5.75
PointSourceFinite: -117.891, 33.772		8.95	5.94	1.54	117.891°W	33.772°N	0.00	1.54
PointSourceFinite: -117.891, 33.772		8.95	5.94	1.54	117.891°W	33.772°N	0.00	1.54
PointSourceFinite: -117.891, 33.790		11.00	5.77	1.87	117.891°W	33.790°N	0.00	1.40
PointSourceFinite: -117.891, 33.790		11.00	5.77	1.87	117.891°W	33.790°N	0.00	1.40
UC33brAvg_FM32 (opt)	Grid							22.38
PointSourceFinite: -117.891, 33.700		5.00	5.58	1.08	117.891°W	33.700°N	0.00	5.56
PointSourceFinite: -117.891, 33.700		5.00	5.58	1.08	117.891°W	33.700°N	0.00	5.56
PointSourceFinite: -117.891, 33.772		8.96	5.93	1.55	117.891°W	33.772°N	0.00	1.55
PointSourceFinite: -117.891, 33.772		8.96	5.93	1.55	117.891°W	33.772°N	0.00	1.55
PointSourceFinite: -117.891, 33.790		11.02	5.76	1.87	117.891°W	33.790°N	0.00	1.41
PointSourceFinite: -117.891, 33.790		11.02	5.76	1.87	117.891°W	33.790°N	0.00	1.41