Appendix 3.5-1

Preliminary Geotechnical Investigation

14 October 2022

Greg Gehlen
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1700 Owens Street
San Francisco, California 94158

Subject: Preliminary Geotechnical Investigation
Tanforan Mall Redevelopment
San Bruno, California
Project No. 750673801

Dear Greg:

This letter provides the results of our preliminary geotechnical investigation for the proposed Tanforan Mall Redevelopment in San Bruno, California. Our scope of services was outlined in our proposal dated 17 August 2021 and budget increase requests dated 2 June and 20 July 2022.

The project consists of the main project site and an adjacent parcel to the north as shown on Figures 1 and 2. The main site is on the east side of El Camino and the north side of interstate 380, and is bound by Sneath Lane to the north, Huntington Avenue and the San Bruno BART Station and associated garage and police station to the east, Interstate 380 to the south, and El Camino Real to the west, as shown on Figure 3. The main site is irregularly-shaped with north-south and east-west dimensions of approximately 1,900 and 1,200 feet, respectively. The ground surface at the main site ranges from approximately Elevation 36.5 feet[1] to 66 feet. The main site is occupied by several existing mall buildings, two above-grade parking structures, and surface parking.

The north parcel is bound by a one-story commercial building and associated parking to the north, a one-story structure to the east, and Huntington Avenue to the south and west, as shown on Figures 2 and 3. The ground surface at the north parcel ranges from approximately Elevation 38.5 to 44.5 feet and the parcel is occupied by a surface parking lot.

1.0 PLANNED DEVELOPMENT

We understand that you plan to develop the main site and north parcel as a mixed-use development with laboratory, office, retail, commercial, and residential space, as summarized below and presented on Figure 3:

- nine mid-rise office/laboratory buildings (designated Lab 1 through Lab 9) at grade or with a partial basement
- three residential buildings, one with a two-level basement (designated RESI Block A) and two with one-level basements (designated RESI Block B and RESI Block C)

[1] All elevations in this report reference the North American Vertical Datum of 1988 (NAVD88). Existing site elevations are taken from an existing conditions plan produced by the project civil engineer, BKF Engineers, dated 23 December 2021.

- Target store with a partial basement
- cinema at grade
- parking garage with a partial basement (designated Lab Garage)
- Central Utility Plant (designated CUP), at grade.

The ground surface at both the main site and north parcel generally slopes from west to east; however, there are also existing buildings and surface parking lots with variable topography. These elements will be demolished as part of construction.

Many of the structures are planned to be constructed at grade and will approximately match existing grades. Several of the proposed structures will have excavations for one or two basement levels. The bottommost level for the parking garage, Target, Lab 2, and Lab 3 will be cut into the existing slope on the west and will daylight on the east side of each respective building – we refer to this condition as a "partial basement".

Table 1 below summarizes our understanding of existing and proposed conditions at the proposed buildings, in addition to approximate anticipated excavation depths.

TABLE 1
Summary of Conditions at Proposed Buildings

Proposed Building	Description	Approximate Range of Ground Surface Elevation at Building (feet, NAVD88)	Proposed Finished Floor (feet, NAVD88)
RESI Block A	Seven levels above grade and two-level basement	46 to 50	25
RESI Block B	Seven levels above grade and one-level basement	42 to 44	35
RESI Block C	Five levels above grade and one-level basement	38 to 45	35
Cinema	Four levels at grade	42 to 44	45
Target	Two levels above grade with one-level partial basement	47 to 58	45
Lab 1	Four levels at grade	58 to 62	61
Lab 2	Four levels above grade and one-level partial basement at eastern end	61 to 64	45 and 61
Lab 3	Four levels above grade and one-level partial basement	61 to 66	45
Lab 4	Five levels at grade	(unknown)	45
Lab 5	Five levels at grade	(unknown)	45
Lab 6	Five levels at grade	48	45
Lab 7	Five levels at grade	45 to 48	45
Lab 8	Five levels at grade	39 to 48	45
Lab 9	Five levels at grade	48	45
CUP	Three levels at grade	63	61
Lab Garage	Seven levels above grade and one-level partial basement	40 to 63	38

Based on a preliminary loading exhibit provided by Tipping Structural Engineers[2], we understand the laboratory buildings, Target, Cinema, and CUP will have an average dead plus live load bearing pressure ranging from 600 to 1,200 pounds per square foot (psf), the residential buildings will have an average dead plus live bearing pressure ranging from 650 to 1,700 psf, and the lab garage will have an average dead plus live bearing pressure between 1,500 and 1,700 psf.

2.0 SCOPE OF SERVICES

The objectives of our preliminary investigation were to evaluate subsurface conditions at the site and develop preliminary geotechnical conclusions and recommendations regarding site development based on a limited site investigation and information from nearby projects.

Our scope included drilling eight borings and advancing twelve cone penetration tests (CPTs) and providing our preliminary conclusions and recommendations regarding geotechnical issues to be considered during planning and design of the project based on the results of our limited investigation and review of existing data, including:

- soil and groundwater conditions at the site
- seismic hazards, including ground rupture, liquefaction, and differential compaction
- probable foundation type(s) for the proposed structures
- temporary shoring type(s) for potential basement excavations
- below-grade wall considerations
- settlement behavior
- floor slab support
- seismic site class per 2019 California Building Code
- BART considerations
- construction considerations.

3.0 FIELD EXPLORATION

To investigate the subsurface conditions at the site, we drilled eight borings and performed twelve cone penetration tests in vacant areas of the site. The approximate locations of the borings and CPTs are also presented on Figure 2. Due to the presence of existing structures, exploration in the central and eastern areas of the main site was not possible during the time of our field exploration program. These areas should be further explored during a design-level investigation.

[2] "2022-08-26_Tanforan_Approximate Building Bearing Pressures" by Tipping Structural Engineers, dated 26 August 2022.

Prior to performing our field investigation, we notified the San Mateo County Environmental Health Services Division (SMC Health) and Underground Service Alert (USA), and checked the boring and CPT locations for utilities using an independent private utility locator.

Upon completion, the borings and CPTs were backfilled with grout consisting of cement and water in accordance with the requirements of SMC Health. The soil cuttings from the borings were collected in 55-gallon drums, which were stored temporarily off-site, tested, and eventually properly disposed.

3.1 Borings

Between 20 June 2022 and 25 June 2022, the borings (designated B-1 through B-8) were drilled using a truck-mounted drill rig equipped with hollow-stem augers operated by Exploration Geoservices, Inc. of San Jose, California. The borings were drilled to depths of approximately 50 to 110 feet beneath the existing ground surface (bgs). Logs of the borings are presented in Appendix A as Figures A-1 through A-8. The soil encountered in the borings was classified in accordance with the soil classification chart presented on Figure A-9.

Soil samples were obtained using one of two samplers:

- Sprague & Henwood (S&H) split-barrel sampler with a 3.0-inch outside diameter and 2.5-inch inside diameter, lined with steel or brass tubes with an inside diameter of 2.43 inches

- Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and 1.5-inch inside diameter, without liners.

The sampler types were chosen on the basis of soil type being sampled and desired sample quality for laboratory testing. In general, the S&H sampler was used to obtain samples in cohesive soil and the SPT sampler was used to evaluate the penetration resistance of sandy soil.

The SPT and S&H samplers were driven with a 140-pound, above-ground, automatic rope and cathead hammer falling 30 inches. The samplers were driven up to 18 inches and the hammer blows required to drive the samplers every six inches of penetration were recorded and are presented on the boring logs. The driving of samplers was discontinued if the observed (recorded) hammer blows was 50 for six inches or less of penetration. The blow counts required to drive the S&H and SPT samplers 12 inches (or less if 50 blows were achieved) were converted to approximate SPT N-values using factors of 0.6 and 0.1, respectively. The N-values are shown on the boring logs. The blow counts used for this conversion were: 1) the last two blow counts if the sampler was driven more than 12 inches, 2) the last one blow count if the sampler was driven more than six inches but less than 12 inches, and 3) the only blow count if the sampler was driven six inches or less. A summary of the borings performed is presented in Table 2.

TABLE 2
Summary of Borings

Boring	Approximate Ground Surface Elevation (feet, NAVD88)	Total Depth (feet)	Depth to Groundwater (feet)	Groundwater Elevation (feet, NAVD88)
B-1	38.4	50.0	13.3	25.1
B-2	41.6	108.8	12.0	29.6
B-3	46.6	50.0	15.3	31.3
B-4	48.5	51.5	19.0	29.5
B-5	60.7	110.0	29.0	31.7
B-6	64.6	50.0	33.0	31.6
B-7	63.5	56.5	39.0	24.5
B-8	48.4	99.0	30.0	18.4

3.2 Cone Penetration Tests

Between 22 June and 25 June 2022, twelve CPTs were advanced by ConeTec, Inc. of San Leandro, California to depths between approximately 19 and 101 feet bgs. Prior to pushing the CPTs, ConeTec cored through the asphalt. The CPTs were performed by hydraulically pushing a 1.7-inch-diameter, cone-tipped probe, with a projected area of 15 square centimeters, into the ground. The cone tip measures tip resistance, and the friction sleeve behind the cone tip measures frictional resistance. Electrical strain gauges or load cells within the cone continuously measured the cone tip resistance and frictional resistance during the entire depth of each probing. Accumulated data was then processed by computer to provide engineering information, such as the types and approximate strength characteristics of the soil encountered. Pore pressure dissipation tests (PPDTs) were performed at all CPTs. However, only the PPDTs performed at CPT-3, and CPT-5 through CPT-12 reached equilibrium pore pressures. The CPT logs, showing tip resistance and friction ratio by depth, as well as interpreted SPT N-values, friction angles, soil strength parameters, and interpreted soil classifications, are presented in Appendix B. The results of the PPDTs are also provided in Appendix B. A summary of the CPTs performed is presented in Table 3.

TABLE 3
Summary of CPTs

CPT	Approximate Ground Surface Elevation (feet, NAVD88)	Total Depth (feet)	Depth to Groundwater (feet)	Groundwater Elevation (feet, NAVD88)
CPT-1	43.4	100.9	N/A	N/A
CPT-2	41.8	41.8	N/A	N/A
CPT-3	46.7	87.3	24.1	22.6
CPT-4	56.7	19.4	N/A	N/A
CPT-5	62.6	100.6	32.4	30.2
CPT-6	61.4	71.4	30.1	31.3
CPT-7	62.2	73.8	30.2	32.0
CPT-8	58.8	50.7	25.5	33.3
CPT-9	44.5	33.4	15.4	29.1
CPT-10	47.9	50.9	22.8	25.1
CPT-11	64.8	79.0	36.4	28.4
CPT-12	48.4	89.7	25.8	22.6

Note: N/A = not available; equilibrium was not reached in the PPDT.

3.3 Laboratory Testing

The soil samples recovered from the borings were re-examined in the office for soil classifications, and representative samples were selected for laboratory testing. The laboratory testing program was designed to correlate and evaluate engineering properties of the soil at the sites. Samples were tested to measure moisture content, dry density, fines content, Atterberg limits, shear strength, and compressibility (consolidation characteristics). Results of the laboratory tests are included on the boring logs and in Appendix C.

3.4 Soil Corrosivity Testing

Additional laboratory testing was performed to evaluate the corrosivity of the near-surface soils. The results of the corrosivity analyses and a brief corrosivity evaluation by CERCO Analytical, Inc. are presented in Appendix D.

4.0 SITE CONDITIONS

The ground surface at the main site slopes from approximately Elevation 36.5 feet on the east side of the site to 66 feet on the west side. The main site is currently occupied by several existing mall buildings, two above-grade parking structures, and surface parking and is adjacent to a San Bruno BART parking garage, San Bruno police department, and San Bruno BART station at the north/ northeast site extents. We understand that the JCPenney building in the mall contains

a one-level basement, with a basement finished floor elevation of approximately 49.4 feet NAVD88[3].

We understand a below-grade BART tunnel runs approximately north–south along the eastern extent of the site; however, we do not know the depth and size of the tunnel, nor do we know its distance from the site. As-built BART drawings were not available at the time of writing but should be reviewed as part of a design-level geotechnical investigation.

The north parcel is an asphalt-paved parking lot that slopes gradually from about Elevation 45.5 feet on the west side to Elevation 38.5 feet on the east side.

5.0 SUBSURFACE CONDITIONS

The results of our investigation indicate the sites are underlain by moderately compressible medium stiff to hard clay and silt with variable amounts of sand and gravel, interbedded with layers of loose to very dense sands with variable amounts of gravel, clay, and silt, to the maximum explored depth of 110 feet bgs. At B-5, medium dense clayey sand fill was encountered, extending to a depth of 7 feet bgs. It is not known whether the fill was placed in a controlled (compacted) manner.

Atterberg limits tests performed on the near-surface soil indicate that the clay typically has low to moderate expansion potential[4]; however, one clay sample in B-2 at 9.5 feet bgs, which will be near the planned final grades, was found to be highly expansive, with a plasticity index of 24. Where tested, the clays are slightly overconsolidated[5] with overconsolidation ratios[6] (OCRs) from about 1.2 to 3.3 and undrained shear strengths of about 1,200 to 4,900 psf.

At the north parcel, at the location of the proposed RESI Block C, groundwater was encountered at 13.3 feet bgs (about Elevation 25.1 feet) in B-1. We reviewed data from monitoring wells[7] in the vicinity of the north parcel, which indicates high groundwater was encountered at depths between 8.0 and 8.3 feet bgs (corresponding to Elevations 24.7 to 25.4 feet).

At the main site, groundwater was encountered between about 12 and 39 feet bgs (Elevations 18.4 to 31.3 feet in the borings and 22.6 to 33.3 feet in the CPTs). We reviewed data from

3 "Site Demolition Plan, Sheet C-1.1" by Altoon and Porter Architects, dated 24 May 2006.

4 Highly expansive soil undergoes large volume changes with changes in moisture content.

5 An underconsolidated clay has not yet achieved equilibrium under the existing load; a normally consolidated clay has completed consolidation under the existing load; and an overconsolidated clay has experienced a pressure greater than its current load.

6 The overconsolidation ratio is the ratio of maximum past pressure a clay has experienced divided by the estimated in-situ effective stress the clay is currently under.

7 "First Semi-Annual 2010 Groundwater Monitoring & Investigation Report, Sears Automotive Center Facility (No. 1478), 1178 El Camino Real, San Bruno, California" by Burns & McDonnell Engineering Company, Inc." dated September 2010.

monitoring wells[8] in the vicinity of the main site, which indicates high groundwater was encountered between 5.5 and 24.1 feet bgs (Elevations 24.7 to 38.2 feet).

6.0 REGIONAL SEISMICITY AND FAULTING

The project site is in a seismically active region. Numerous earthquakes have been recorded in the region in the past, and moderate to large earthquakes should be anticipated during the service life of the proposed development. The major active faults in the area are the San Andreas, Pilarcitos, San Gregorio, Monte Vista-Shannon, and Hayward-Rodgers Creek faults. These and other faults of the region are shown on Figure 4. For each of the active faults within about 50 kilometers (km) of the site, the distance from the site and estimated mean characteristic Moment magnitude[9] [2014 Working Group on California Earthquake Probabilities (WGCEP) (2015) and Uniform California Earthquake Rupture Forecast Version 3 (UCERF3) as detailed in the United States Geological Survey Open File Report 2013-1165] are summarized in Table 4. The mean Moment magnitude presented on Table 4 was computed assuming full rupture of the segment using Hanks and Bakun (2008) relationship.

TABLE 4
Regional Faults and Seismicity

Fault Segment	Approx. Distance from fault (km)	Direction from Site	Mean Characteristic Moment Magnitude
San Andreas 1906 event	2.8	West	8.1
Pilarcitos	9	Southwest	6.7
Total San Gregorio	12	West	7.6
Monte Vista – Shannon	20	Southeast	7.0
Total Hayward-Rodgers Creek Healdsburg	27	East	7.6
Mission (connected)	33	East	6.1
Butano	37	South	6.7
Contra Costa (Lafayette)	37	Northeast	6.1
Total Calaveras	40	East	7.5
Franklin	40	Northeast	6.7
Contra Costa (Larkey)	40	Northeast	6.0
Contra Costa Shear Zone (connector)	41	Northeast	6.6
Mount Diablo Thrust	43	Northeast	6.6
Contra Costa (Dillon Point)	46	Northeast	6.1
Concord	48	Northeast	6.4

Note: The table above is a summary and does not include all the fault segmentation, alternate traces and low activity faults included in the UCERF3 model.

[8] "2021 Groundwater Monitoring Report, Sears Automotive Service Center (No. 1478), 1178 El Camino Real, San Bruno, CA" by AECOM, dated 11 February 2022 and "Groundwater Monitoring Report – First Quarter 2015, Shell-Branded Service Station, 1199 El Camino Real, San Bruno, California" by Conestoga-Rovers and Associates, dated 14 April 2015.

[9] Moment magnitude is an energy-based scale and provides a physically meaningful measure of the size of a faulting event. Moment magnitude is directly related to average slip and fault rupture area.

Figure 4 also shows the earthquake epicenters for events with magnitude greater than 5.0 from January 1800 through August 2014. Since 1800, four major earthquakes have been recorded on the San Andreas fault. In 1836 an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) scale (Figure 6) occurred east of Monterey Bay on the San Andreas fault (Toppozada and Borchardt 1998). The estimated Moment magnitude, $M_{w,}$ for this earthquake is about 6.25. In 1838, an earthquake occurred with an estimated intensity of about VIII-IX (MM), corresponding to an M_w of about 7.5. The San Francisco Earthquake of 1906 caused the most significant damage in the history of the Bay Area in terms of loss of lives and property damage. This earthquake created a surface rupture along the San Andreas fault from Shelter Cove to San Juan Bautista approximately 470 kilometers in length. It had a maximum intensity of XI (MM), an M_w of about 7.9, and was felt 560 kilometers away in Oregon, Nevada, and Los Angeles. The Loma Prieta Earthquake occurred on 17 October 1989 in the Santa Cruz Mountains with an M_w of 6.9, the epicenter of which is approximately 82 km from the site.

In 1868 an earthquake with an estimated maximum intensity of X on the MM scale occurred on the southern segment (between San Leandro and Fremont) of the Hayward fault. The estimated M_w for the earthquake is 7.0. In 1861, an earthquake of unknown magnitude (probably an M_w of about 6.5) was reported on the Calaveras fault. The most recent significant earthquake on this fault was the 1984 Morgan Hill earthquake (M_w = 6.2).

The most recent earthquake to affect the Bay Area occurred on 24 August 2014 and was located on the West Napa fault, approximately 66 km northeast of the site, with an M_W of 6.0.

The 2016 U.S. Geologic Survey (USGS) predicted a 72 percent chance of a magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area in 30 years (Aagaard et al. 2016). More specific estimates of the probabilities for different faults in the Bay Area are presented in Table 5.

TABLE 5
WGCEP (2015) Estimates of 30-Year Probability (2014 to 2043) of a Magnitude 6.7 or Greater Earthquake

Fault	Probability (percent)
Hayward-Rodgers Creek	33
Calaveras	26
N. San Andreas	22
San Gregorio	16
Mount Diablo Thrust	16

7.0 SEISMIC HAZARDS

During a major earthquake on a segment of one of the nearby faults, strong to very strong shaking is expected to occur at the project site. Strong shaking during an earthquake can result in ground

failure such as that associated with soil liquefaction[10], lateral spreading[11], and seismic densification[12].

7.1 Liquefaction

When a saturated soil with little to no cohesion liquefies during a major earthquake, it experiences a temporary loss of shear strength as a result of a transient rise in excess pore water pressure generated by strong ground motion. Flow failure, lateral spreading, differential settlement, loss of bearing, ground fissures, and sand boils are evidence of excess pore pressure generation and liquefaction. The California Geologic Survey (CGS) has prepared a map titled *State of California Seismic Hazard Zones, San Francisco South Quadrangle Official Map*, dated 23 September 2021. This map was prepared in accordance with the Seismic Hazards Mapping Act of 1990. This map indicates that both the main site and adjacent parcel are within a liquefaction hazard zone.

Thin, discontinuous layers of medium dense silty sand and clayey sand were encountered below the groundwater table. These layers vary in thickness from about ¼ to 1½ feet and were encountered at depths between approximately 10 and 42 feet bgs. Based on our analyses, we conclude several of these layers could potentially liquefy during a major earthquake and could experience liquefaction-induced settlement. We used design groundwater elevations ranging from Elevation 33 feet to Elevation 39 feet in our analysis, which is consistent with the preliminary design groundwater levels recommended herein. Using the Boulanger and Idriss (2014), Cetin et al. (2004), and Robertson (2016) liquefaction triggering analysis methods with a mapped peak ground acceleration (PGA_M) of 1.04g, we estimate up to approximately ½ inch of liquefaction-induced settlement could occur in the main site. In the north parcel, we estimate the soils below the water table are sufficiently dense or silty or clayey such that the potential for liquefaction is low. These conclusions should be confirmed as part of a design-level geotechnical investigation.

7.2 Lateral Spreading

Lateral spreading is a phenomenon in which a surficial soil displaces along a shear zone that has formed within a continuous underlying liquefied layer. The surficial blocks are transported downslope or in the direction of a free face, such as a channel, by earthquake and gravitational forces. Lateral spreading is generally the most pervasive and damaging type of liquefaction-induced ground failure generated by earthquakes.

According to Youd, Hansen, and Bartlett (1999), for significant lateral spreading displacements to occur, the soils should consist of saturated cohesionless sandy sediments with $(N_1)_{60}$ less than

[10] Liquefaction is a transformation of soil from a solid to a liquefied state during which saturated soil temporarily loses strength resulting from the buildup of excess pore water pressure, especially during earthquake-induced cyclic loading. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits.

[11] Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces.

[12] Seismic densification (also referred to as cyclic densification or differential compaction) is a phenomenon in which non-saturated, cohesionless soil is densified by earthquake vibrations, causing ground-surface settlement.

15, where liquefaction of the soils is likely to occur based on standard liquefaction analysis. While the main site has a significant downslope towards a free face at the eastern boundary of the site, the potentially liquefiable soils underlying the site are not continuous beneath the main site. The north parcel is relatively level without a significant downslope and the potential for liquefaction is low. Consequently, we conclude that the potential for lateral spreading at both the main site and the north parcel is low.

7.3 Seismic Densification

Seismic densification (also referred to as cyclic densification and differential compaction) can occur during strong ground shaking in loose, granular deposits above the water table, resulting in ground surface settlement. Loose to dense sand was encountered above the water table in the borings and CPTs; using the Pradel (1998) approach for seismic densification of dry sand and our engineering judgement, we estimate up to 3 inches of settlement due to seismic densification may occur across the sites. However, some of these layers are within the planned excavations for buildings; accounting for the excavations, we estimate the potential for seismic densification settlement within the building footprints is low, except for the at-grade lab structures, where we estimate up to 1 inch of seismic densification may occur within the building footprints. These conclusions should be confirmed as part of a design-level geotechnical investigation.

8.0 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

We conclude the planned development is feasible from a geotechnical standpoint. The primary geotechnical considerations for the project are: 1) the presence of the BART tunnel east of the main site; 2) the presence of moderately compressible native clay; 3) the presence of near-surface undocumented fill; and 4) selection of an appropriate foundation systems to support the buildings without excessive building settlement. Our preliminary conclusions and recommendations regarding these and other geotechnical issues are discussed in this section.

8.1 BART Considerations

At this time we do not know the depths and extents of the BART tunnel east of the main site. The presence of this tunnel will have a significant impact in determining appropriate foundation and dewatering systems for Labs 8 and 9, the lab garage, and RESI Blocks B and C. BART has developed guidelines for construction near their subway structures. These guidelines include the following:

1. The BART zone of influence (ZOI) is defined as the area above a line from the critical point of the substructure at a slope of 1½ horizontal to 1 vertical.

2. Soil redistribution caused by temporary shoring or permanent foundation systems shall be analyzed.

3. Shoring shall be required to maintain the soil's at-rest condition and the shoring should be checked for seismic loads; shoring structure shall be monitored for movement.

4. Minimum predrilled depth for driven piles shall be approximately 10 feet below the line of influence.

5. Vibration monitoring of piling operations closest to the tunnels will be required; piles to be installed in a sequence away from the subway structure.

6. Tunnels, where affected, shall be monitored for movement and deformation due to adjacent construction activities to ensure structural and operational safety.

7. Dewatering shall be monitored for changes in groundwater level; recharge program will be required if existing groundwater level is expected to drop more than two feet.

8. Where basements are excavated, the amount of loading (on subway) can be increased to the extent it is balanced by the weight of the removed material; however, the effect of soil rebound in such cases shall be fully analyzed.

9. All structures shall be designed so as not to impose any temporary or permanent adverse effects, including unbalanced loading and seismic loading, on the adjacent BART subways.

The BART guidelines will need to be considered during the design and construction of foundation systems, shoring, and below-grade walls for the planned buildings where within the zone of influence.

8.2 Foundations and Settlement

Factors influencing the selection of a safe, economical foundation system with adequate capacities for the proposed buildings are:

- the presence of the nearby BART tunnels and BART's guidelines and requirements for development adjacent to the tunnels
- the presence of undocumented fill encountered in B-5
- the presence of moderately compressible clay to significant depth
- total and differential settlement of the buildings and nearby improvements.

In general, the buildings should not be supported in undocumented fill, because the material is variable in its consistency and density and could be susceptible to erratic static settlement. In addition, some of the fill could be loose and susceptible to cyclic densification settlement during a major earthquake. Fill may be present in other portions of the site; a design-level geotechnical investigation should be performed to further evaluate the presence of fill. Where fill is encountered, foundations should extend below the fill or the fill should be improved. Improvement of the fill can be accomplished by overexcavating and recompacting it or by performing in-situ ground improvement.

Even where buildings extend below the fill, moderately compressible clay is present; buildings loads can cause long-term consolidation settlement of the clay. Where excessive total and/or differential is predicted, ground improvement can be performed to control settlement, allowing

for buildings to be supported on shallow foundations. Alternatively, these buildings can be supported on deep foundations. Where the predicted settlement is acceptable, buildings can be supported on shallow foundations consisting of footings or mat foundations.

8.2.1 Residential Buildings and Lab Garage with Basement(s)

We understand that RESI Block A will have a two-level basement with a finished floor at Elevation 25 feet , and RESI Blocks B and C will have one-level basements with finished floors at Elevation 35 feet. The proposed lab garage will have a one-level basement with a finished floor at Elevation 38 feet. Medium stiff to hard clay and medium dense to very dense sand are present at these elevations and have adequate bearing capacity to support the anticipated building loads. However, our analysis indicates that settlement under shallow foundation systems would be excessive. Therefore, we preliminarily conclude that shallow foundations are not feasible and the buildings will need to be supported on ground improvement or deep foundations to control consolidation settlement. Where the buildings are within the BART ZOI, deep foundation systems consisting of double-cased piles or drilled shafts extending through and gaining capacity below the BART ZOI will be needed.

8.2.2 Laboratory Buildings, Target, Cinema, and CUP

We understand that Lab 3 through Lab 9, Target, and the Cinema are all planned to have a finished floor elevation of 45 feet. As described, Lab 3 and Target are on sloping ground and will be cut into the slope and daylight at Elevation 45 feet. Cuts will be up to about 21 feet. The Cinema and Labs 4 through 9 will be at grade. Lab 2 will be stepped, and will be supported at grade, with finished floors at both Elevation 61 and 45 feet, and cut into the slope with a partial basement. Lab 1 and CUP will be supported at grade at Elevation 61 feet. At these given elevations, the buildings will bear in medium stiff to hard clay or medium dense to very dense sand. Based on our analysis, we estimate that static building settlement will be less than 1 inch, with differential settlement of less than ½ inch over 30 feet. Seismically induced settlement will be less than ½ inch at the Target, Cinema, and CUP and less than 1½ inches at the Lab buildings; we expect that all of the seismically induced settlement could be differential settlement over 30 feet. Therefore, we preliminarily conclude that the laboratory buildings, Target, Cinema and CUP can be supported on footings or a mat foundation gaining support in the medium stiff to hard clay or medium dense to very dense sand. Labs 8 and 9 may extend within the BART ZOI. Where these buildings are within the BART ZOI, deep foundation systems consisting of double-cased piles or drilled shafts extending through and gaining capacity below the BART ZOI will be needed.

Boring B-5, where undocumented fill was encountered, is within the planned Lab 2 footprint. Based on preliminary site and basement plans provided by Gensler[13], we understand that Lab 2 has a finished floor at Elevation 61 feet. At B-5, undocumented fill was encountered to Elevation 54 feet; Lab 2 foundations should bear below the bottom of the undocumented fill elevation or the fill should be improved.

[13] "220829_SitePlans" by Genlser, dated 29 August 2022.

8.2.3 Site Settlement at Areas with New Fill

We understand from the preliminary plans that planned grading throughout the site involves placing up to 6 feet of fill in between buildings. The results of consolidation testing indicate the native onsite clay is overconsolidated, but can still settle in recompression when new loads are applied. We used data from our investigation to estimate the amount of settlement that could occur from varying new fill thicknesses across the site; we estimate up to about 1 inch of consolidation settlement should be expected for up to about 6 feet of fill.

8.2.4 Ground Improvement

We judge feasible ground improvement techniques include rigid inclusions (RIs) or deep soil mixing (DSM). We also considered compacted aggregate columns (CAPs) and judge that they may not be suitable at this site due to the presence of clayey soils. A design-build contractor should design and install the ground improvement; the system should be designed to conform with the performance requirements of the structural engineer, including bearing capacity and total and differential settlement. In general, settlement of foundations supported on improved ground improved to competent soil should be expected to be less than 1 inch; differential settlement should be on the order of ½-inch between adjacent columns.

The purpose of ground improvement at the residential building and lab garage would be to control settlement. We preliminarily recommend that ground improvement elements should extend deep enough to limit static settlements to 1 inch or less. For estimating purposes, we anticipate ground improvement elements extending about 40 feet below the bottom of excavation should be sufficient to adequately control settlement. The design-level geotechnical report should be provided to the specialty ground improvement contractor for design and cost estimating purposes; we should review the final design.

DSM is in-place soil treatment with cement grout using mixing shafts consisting of auger cutting heads, discontinuous flight augers, or blades/paddles, creating soil-cement columns. DSM elements may be installed in a variety of patterns including cellular blocks, a grid pattern, or columns. Typical DSM columns have a minimum diameter of three feet. The soil-cement columns should be installed in a pattern that adequately resists the anticipated lateral forces and transfers building loads into the competent very dense sand and stiff clay layers. Resistance to lateral loads will be developed by friction along the contact area between the soil-cement column shafts and the bottom of the foundation. Use of soil-cement columns will require testing to confirm that adequate mixing and strength has been achieved. The soil replacement ratio of deep soil mixing can vary from 30 to 50 percent, depending on the building loads and subsurface soil.

RIs are constructed by using a non-displacement or a displacement tool to create a shaft that is filled with grout injected under pressure as the tool is withdrawn from the hole. Use of a displacement tool produces minimal soil cuttings because the soil is displaced during column installation; because the soil is displaced, some densification occurs in the soil between the individual columns. RIs typically vary from 18 to 36 inches in diameter; the selected diameter is based on building loads and spacing of columns. Use of RIs will require load testing to confirm estimated capacities.

Where rigid inclusions or non-overlapping DSM elements are installed, the foundations should not be in direct contact with the elements. If an LTP is not used, a seismic break should be provided between the element and the foundation to separate the foundation from the element such that the lateral loads are resisted solely by the foundation. A seismic break typically consists of a cushion of 12 to 18 inches of gravel, crushed rock, or aggregate base.

The ground improvement contractor should prepare a quality control plan to monitor the ground improvement element installation and submit it for our review and approval prior to construction. The planned layout of the ground improvement should take into account the column layout of the overlying building by centering ground improvement elements beneath building columns.

8.2.5 Shallow Foundations

While we understand the average loads across the building footprints range from 600 psf to 1,700 psf, we understand concentrated loads near columns could be higher; accordingly we preliminarily recommend footings or mat foundations bearing in medium stiff to stiff clay or medium dense to dense sand be designed for an allowable bearing capacity of 4,000 psf for dead-plus-live loads, which includes a factor of safety of about 2. For total loads, including wind and seismic loads, the allowable bearing capacity can be increased by one third, which results in a factor of safety of 1.5.

One near-surface clay sample in B-2 at 9.5 feet bgs, which is at approximate foundation subgrade level for RESI Block B, was found to be highly expansive, with a plasticity index of 24. During design-level investigations, additional Atterberg limits testing should be performed in order to evaluate the potential for expansive soil. Where expansive soil is present, deepened footings and/or a thickened floor slab may be needed, additional subgrade preparation will be needed under foundations and floor slabs, and moisture should be managed throughout construction.

Lateral loads can be resisted by a combination of passive resistance acting against the vertical faces of the mat or footings and friction along their base. To compute lateral passive resistance, we recommend using an equivalent fluid weight (triangular distribution) of 250 pounds per cubic foot (pcf) above the design groundwater level and 130 pcf below the design groundwater level. Frictional resistance should be computed using a base friction coefficient of 0.3, assuming the foundation bears directly on soil. If any type of membrane is placed under the foundations, the friction coefficient may be lower and will depend on the type of membrane – if concrete is placed over a vapor retarder, typical allowable friction coefficients are between 0.15 and 0.25. The passive pressure and frictional resistance values include a factor of safety of at least 1.5 and may be used in combination without reduction.

Where buildings on shallow foundations are placed, a new cycle of primary consolidation may begin and additional settlement may occur. We used the results of our preliminary studies to estimate the amount of settlement under buildings supported on shallow foundations; we anticipate up to 1 inch of settlement for mats with average bearing pressures of approximately 1,000 psf. At this preliminary level, we did not separately analyze footings with allowable bearing pressures of 4,000 psf.

8.2.6 Deep Foundations

Where deep foundations are required, we preliminarily conclude that the most viable deep foundation systems are non-displacement augured cast-in-place (ACIP) piles or drilled shafts gaining capacity in friction in the native soil. These foundation types are installed using equipment that does not create significant vibrations or excessive noise. In addition, the diameter and lengths of these foundation types can be adjusted to suit design requirements and specific site conditions.

For preliminary estimating purposes, we estimate an ultimate skin friction capacity of 950 psf can be used for ACIP piles and drilled shafts. End bearing should be neglected. ACIP piles or drilled shafts should be spaced at least three pile diameters center-to-center to prevent vertical capacity reductions due to pile interaction effects. For preliminary planning purposes, we anticipate ACIP piles or drilled shafts would settle less than 1 inch, with differential settlement of less than ½-inch over 30 feet.

Where deep foundations are within the BART ZOI, they will need to be double-cased or constructed with a permanent air void so that there is no vertical or lateral load transfer from the new buildings to the BART structures. Typically the permanent void is created in an annular space between the side of the pile and an outer casing.

The ability of an ACIP pile or drilled shaft to resist lateral loads is directly related to the stress-strain characteristics of the upper 10 to 20 feet of soil below the pile cap or double cased section of the pile. Because of the long free length of the double-cased section, no lateral load capacity will be provided by soil within the BART zone of influence. The faces of pile caps and retaining walls should have a compressible material provided to prevent application of lateral pressures within the BART ZOI. Outside the BART ZOI lateral load resistance can be obtained by passive resistance acting against the face of below-grade elements, such as piles, pile caps, grade beams, and interior key walls.

Drilled Shafts

Drilled shifts are installed by drilling and open hole to the required depth, placing reinforcement, and pouring concrete. If water is present, it should be removed prior to concrete placement, or the concrete should be placed by tremie method. Caving soil and groundwater may be encountered during drilling. Therefore, casing and/or drilling fluid may be needed to maintain an open hole. Concrete placement should start upon completion of the drilling and clean out; no holes should be left open overnight.

ACIP Piles

ACIP piles are installed by drilling to the required depth with a hollow-stem continuous-flight auger. When the auger reaches the required depth, cement grout or concrete is injected through the bottom port of the hollow stem auger. Grout or concrete is injected continuously as the augers, still rotating in a forward direction, are slowly withdrawn, replacing the soil removed by the drilling operation. While the grout is still fluid, a steel reinforcing cage is inserted into the shaft. ACIP piles can range in diameter; however, 16-, 18-, and 24-inch-diameter ACIP piles are

typical. Because their capacity depends on the method of installation, ACIP piles should be designed and installed by a design-build specialty contractor familiar with these types of piles.

ACIP piles are designed and constructed by a specialty foundation contractor. The pile specialty contractor should determine capacities, required lengths, and evaluate foundation settlements after a design-level geotechnical investigation is performed. Once designed, an indicator program should be established, and the piles load tested to confirm the design parameters used and estimated pile capacities. The load tests should be performed on indicator piles to confirm the axial compressive capacity. The number of load tests will depend on the proposed number of piles; we recommend planning for two compression and one tension piles load tests at each proposed building for each proposed production installation methodology (i.e. rig type, predrilling depth and diameter, pile length, etc.). Integrity testing, consisting of cross-hole sonic logging or thermal integrity profiling, should be performed on all test and indicator piles/shafts and on a representative number of production piles/shafts.

8.3 Groundwater

Groundwater measurements taken during our investigation were measured during a drought, and groundwater levels varied significantly around the site. We anticipate the groundwater level to vary seasonally. We reviewed the groundwater levels encountered during drilling and measured in pore pressure dissipation tests (PPDTs), as well as historic data available on the State of California Water Resources Control Board GeoTracker website, and judge the design groundwater elevations ranging from Elevation 33 to 39 feet as presented on Figure 3 are appropriate for preliminary design. These design groundwater elevations are preliminary and should be updated for each planned structure based on the design-level investigation(s). These design groundwater levels do not account for the effect of sea level rise, if any.

8.4 Floor Slabs

Where a mat is used for foundation support for a structure, the top of the mat can be used as the basement/ground floor, or a topping slab can be placed above the mat to provide a smooth wearing surface. Outside of the BART ZOI where footings are used for foundation support, floor slabs can be supported on grade. Where floor slabs lie within the BART ZOI, a permanent void should be provided below the slab so as not to load the soil within the BART ZOI and floor slabs should be designed to structurally span between pier/pile caps and grade beams.

We anticipate that the excavations for the mat or footings for the residential buildings and parking garage with one- and two-level basements will extend below the design groundwater elevations; therefore, they should be designed for hydrostatic pressure and waterproofed. The mat/slab for the Target, cinema, CUP, and laboratory buildings will be above the design groundwater elevations, and these mat foundations/slabs should be underlain by a capillary break and vapor retarder system where moisture is undesirable.

8.5 Permanent Below-Grade and Retaining Walls

Based on the planned structures and grading, below-grade walls will be needed for basements and at-grade structures cut into the slope. Retaining walls will be needed along the sloped pathways throughout the campus. For restrained walls, we preliminarily recommend designing

the walls for at-rest earth pressures corresponding to an equivalent fluid unit weight of 65 pounds per cubic foot (pcf) above the groundwater table where drainage is provided and 100 pcf below the groundwater table or where walls are undrained, plus a traffic increment where the wall is adjacent to streets. The traffic increment consists of a uniform lateral pressure of 100 pounds per square foot (psf) applied over the entire wall height. For unrestrained permanent walls, we preliminarily recommend designing the walls for active earth pressures corresponding to an equivalent fluid unit weight of 45 pounds per cubic foot (pcf) above the groundwater table where drainage is provided and 85 pcf below the groundwater table or where walls are undrained, plus a traffic increment where the wall is adjacent to streets. Walls within the BART ZOI will need to be designed as restrained walls.

Because the site is in a seismically active area, below-grade and retaining walls that retain six feet of soil or more should be designed to resist both static and seismic lateral earth pressures. For the seismic condition, the below-grade wall pressure consists of the combination of an active earth pressure and a seismic increment. For restrained walls, we recommend using an active earth pressure plus a seismic increment for the Design Earthquake (DE) using equivalent fluid weights of 100 pcf above the groundwater level where drainage is provided and 115 pcf below the design groundwater level or where walls are undrained. For unrestrained permanent walls, we recommend using an active earth pressure plus a seismic increment for the DE using equivalent fluid weights of 70 pcf above the groundwater level where drainage is provided and 100 pcf below the design groundwater level or where walls are undrained. The walls should be designed for the more critical of at-rest pressures or active plus seismic increment.

8.6 Excavation and Temporary Shoring Types

We anticipate that construction of the planned development will require cuts and excavations, approximately as follows:

- 6 to 13 feet for RESI Block C
- 24 to 28 feet for RESI Block A
- 10 to 12 feet for RESI Block B
- 5 to 16 feet for the Target
- up to 22 feet for the portion of Lab 2 with a finished floor of Elevation 45 feet
- up to 21 feet for Labs 3 and 4
- 13 to 28 feet for the parking garage.

We anticipate that excavation for the foundations of the other laboratory buildings, the CUP, and cinema will require up to approximately 6 feet of excavation.

The excavation for the basements for the residential buildings and the parking garage will extend below the design groundwater table elevations. Groundwater may be encountered during excavation. Where groundwater is encountered in excavations, dewatering will be required.

Temporary cut slopes may be made on a 1½:1 (horizontal:vertical) inclination provided groundwater is not present. Where there is insufficient space to slope the sides of the proposed excavation and where excavations extend below groundwater, temporary shoring will be required.

We judge a shoring system consisting of soldier beams and timber lagging would the most economical system; however, we conclude soldier pile and lagging shoring systems are not appropriate for the proposed basement excavations. Use of a soldier-pile-and-lagging shoring system requires that the area surrounding the project site be dewatered to a depth of at least three feet beneath the proposed excavation depth. Dewatering to significant depths below street grades would result in lowering groundwater beyond the excavation limits, which could result in settlement of the surrounding improvements, impose additional loads on the BART structures (where present), and trigger the need to recharge water levels adjacent to BART structures (where present). In addition, dewatering should not lower the groundwater more than 2 feet outside of the excavation within the BART ZOI. Therefore, a cutoff wall may be required for deeper excavations and for excavations in the BART ZOI. Cantilevered soldier beam and lagging shoring might be feasible for cuts outside the BART ZOI and less than about 10 feet. The groundwater elevation, depth of dewatering, and need for a cutoff wall should be evaluated further during the final geotechnical investigation.

There are several types of cutoff walls; we judge the most appropriate and likely cost-effective system for the project is a deep soil mix (DSM) wall. The depth of cutoff walls should be enough to effectively cut off the flow of groundwater into the planned excavation.

Based on the depths of the excavations, tiebacks or internal bracing will be required for certain buildings. Encroachment permits may be required for tiebacks that extend offsite. Based on our recent experience on other projects, BART has allowed tiebacks into their right of way and ZOI, but has required the tiebacks terminate at least 8 feet from the outside of any BART structure. We anticipate that the areas of the site that require excavation are further than 8 feet from the outside of any BART structure. Internal bracing may be needed if tiebacks are not feasible due to space constraints near BART.

Temporary shoring within the BART ZOI will need to be designed for at-rest pressures plus a seismic increment.

8.7 2019 California Building Code Site Class and Seismic Coefficients

Potentially liquefiable material was encountered in our investigation as previously discussed; however, because the layers that could potentially generate excess pore pressure and/or liquefy are relatively thin and discontinuous, the seismic ground response at the site should not be significantly affected, and the site should behave like a stiff soil site. Therefore, based on the results of our geotechnical investigation and shear wave velocity measurements at the site, we conclude the site can be classified as Site Class D, in accordance with the 2019 CBC and ASCE 7-16.

Accordingly, the following mapped seismic coefficients for design in accordance with the provisions of ASCE 7-16 can be used, provided the structural exceptions in Section 11.4.8 of ASCE 7-16 are met. If the structural exceptions from ASCE 7-16 Section 11.4.8 are not used by

the structural engineer, we should perform a site-specific seismic study to develop response spectra for the site.

- Risk-Targeted Maximum Considered Earthquake (MCE_R) S_S and S_1 of 2.199g and 0.916g, respectively
- Site Coefficients F_a and F_v of 1.0 and 1.7, respectively
- MCE_R spectral response acceleration parameters at short periods, S_{MS}, and at one-second period, S_{M1}, of 2.199g and 1.557g, respectively
- Design Earthquake (DE) spectral response acceleration parameters at short period, S_{DS}, and at one-second period, S_{D1}, of 1.466g and 1.038g, respectively.

8.8 Construction Considerations

During excavation, debris, existing foundations, and concrete rubble may be encountered and should be removed. Hoe-rams, jackhammers, and other similar equipment may be needed to remove some of the larger obstacles, if encountered.

If site grading is scheduled for the rainy season, the native soil may be too wet to achieve adequate compaction during fill placement and may deflect significantly under the weight of construction equipment. For these conditions, moisture conditioning and the use of lightweight and/or track-mounted equipment may be required to lower the moisture content of the soil to a level that will promote proper compaction. Methods of moisture conditioning include mixing and turning (aerating) the soil to naturally dry the soil and lower the moisture content to an acceptable level. Aeration typically requires at least a few days of warm, dry weather to effectively dry the material. Other soil stabilization alternatives include overexcavating the wet soil and replacing with drier material and/or lime/cement treatment.

9.0 DESIGN-LEVEL INVESTIGATION AND FUTURE SERVICES

Future services should include performing a design-level geotechnical investigation, providing consultation during final design, reviewing the geotechnical aspects of the plans, and providing geotechnical construction observation. Additional investigation, including drilling additional borings, piezometers, and CPTs, will be required to further evaluate subsurface conditions. We may need to develop site-specific response spectra during the design-level geotechnical investigation as part of the California Building Code seismic requirements. In addition, we may need to participate in the peer review process performed by BART, depending on the location of and depth to BART facilities. Consultation, response to peer review comments, and meetings will be required as part of this review process.

Recognizing that construction observation is the final stage of geotechnical design, quality assurance observation during construction by Langan will be necessary to confirm the design assumptions, to maintain our continuity of responsibility on this project, and allow us to make changes to our recommendations, as necessary.

10.0 LIMITATIONS

The conclusions and recommendations presented herein are preliminary. They may be used to estimate costs and for preliminary schematic drawings; these conclusions and recommendations should not be used to develop final plans or drawings. A design-level geotechnical investigation should be performed prior to development of final plans. Our scope of services relates solely to the geotechnical aspects of the proposed development and does not address environmental or other concerns.

Sincerely yours,
Lagan Engineering and Environmental Services, Inc.,

Taylor Gater
Senior Staff Engineer

Sarah Boudreau, PE, GE
Senior Project Manager

Lori A. Simpson PE, GE
Managing Principal/Executive Vice President

Attachments: Figure 1 – Site Location Map
Figure 2 – Site Plan
Figure 3 – Site Plan with Proposed Development and Design Groundwater Elevations
Figure 4 – Map of Major Faults and Earthquake Epicenters in the San Francisco Bay Area
Figure 5 – Modified Mercalli Intensity Scale
Appendix A – Logs of Borings
Appendix B – Cone Penetration Test Results
Appendix C – Laboratory Test Results
Appendix D – Corrosivity Results

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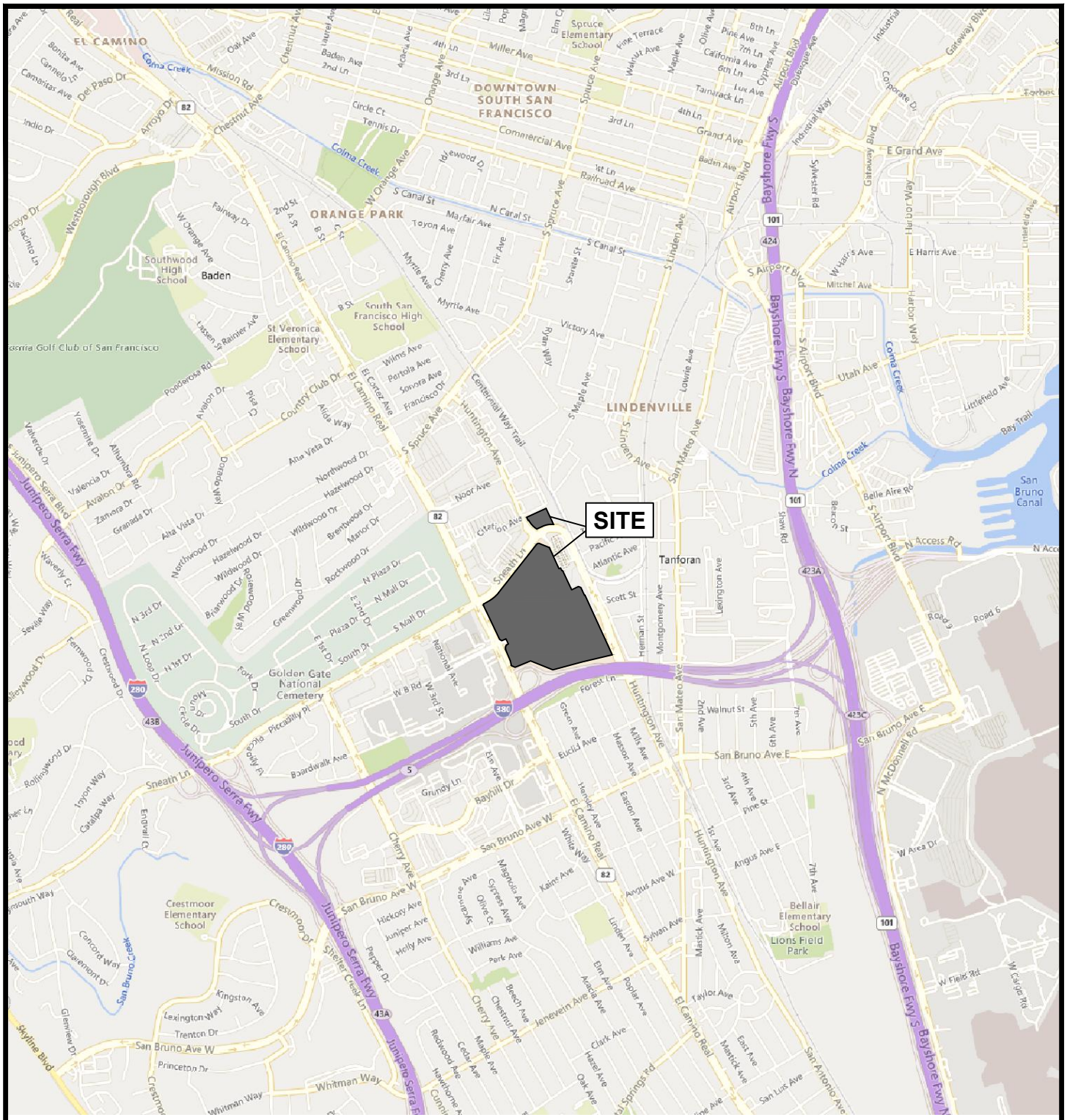
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FIGURES



Legend

Approximate site boundary

Notes:
1. Topographic base map is provided through Langan's Esri Arc GIS software licensing and Arc GIS online, National Geographic Society, i-cubed.

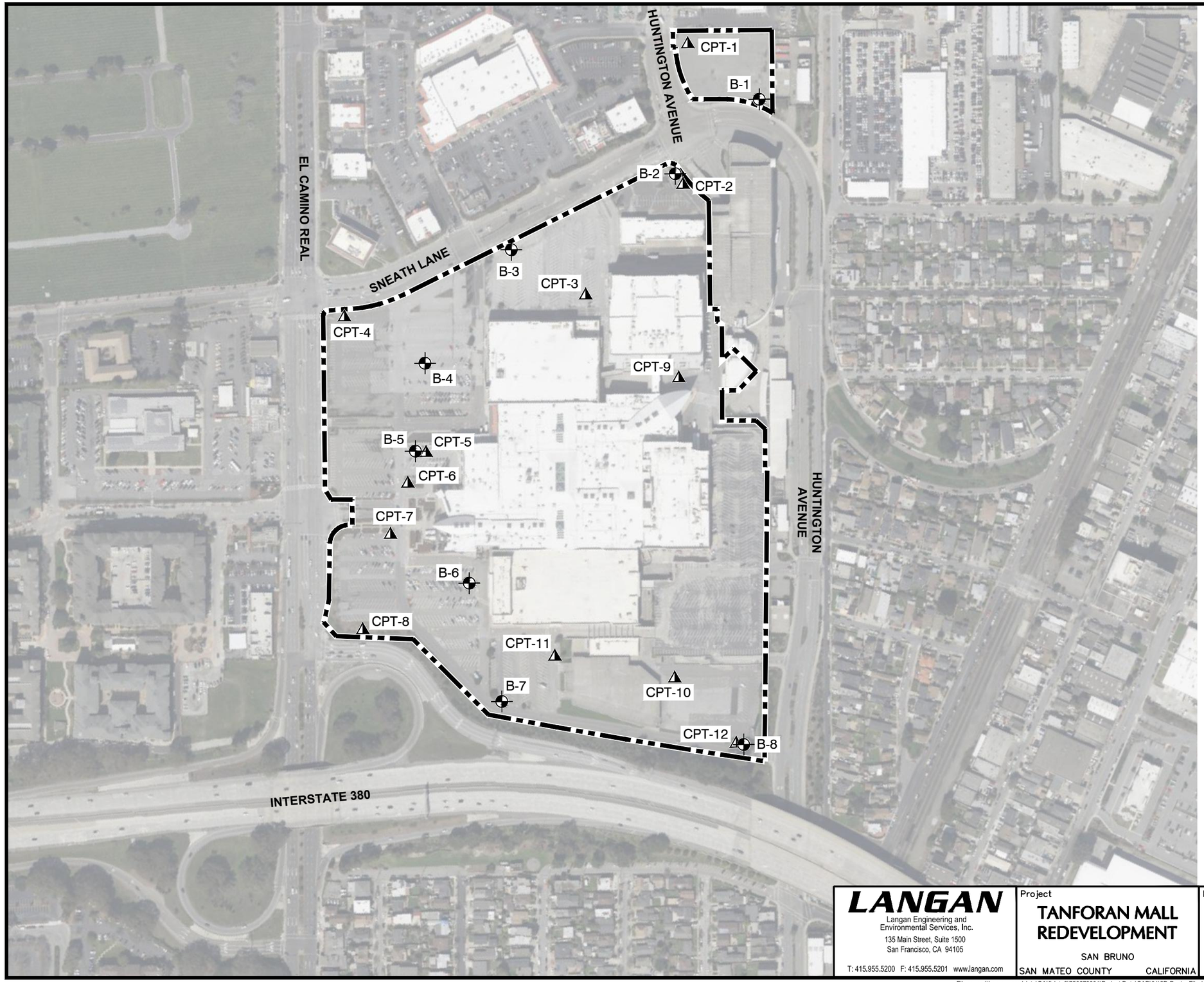
0 2,000 Feet

Approximate scale

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Project	Figure Title	Project No.	Figure
TANFORAN MALL REDEVELOPMENT SAN BRUNO SAN MATEO COUNTY CALIFORNIA	SITE LOCATION MAP	750673801 Date 07/25/2022 Drawn By JDF Checked By TG	1

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EXPLANATION

B-1 — Approximate location of boring by Langan, June 2022

CPT-1 — Approximate location of Cone Penetration Test by Langan, June 2022

Site boundary

Notes:

1. All dimensions and locations are approximate.
2. All elevations reference North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 23 December 2021.

0 300 Feet

Approximate scale

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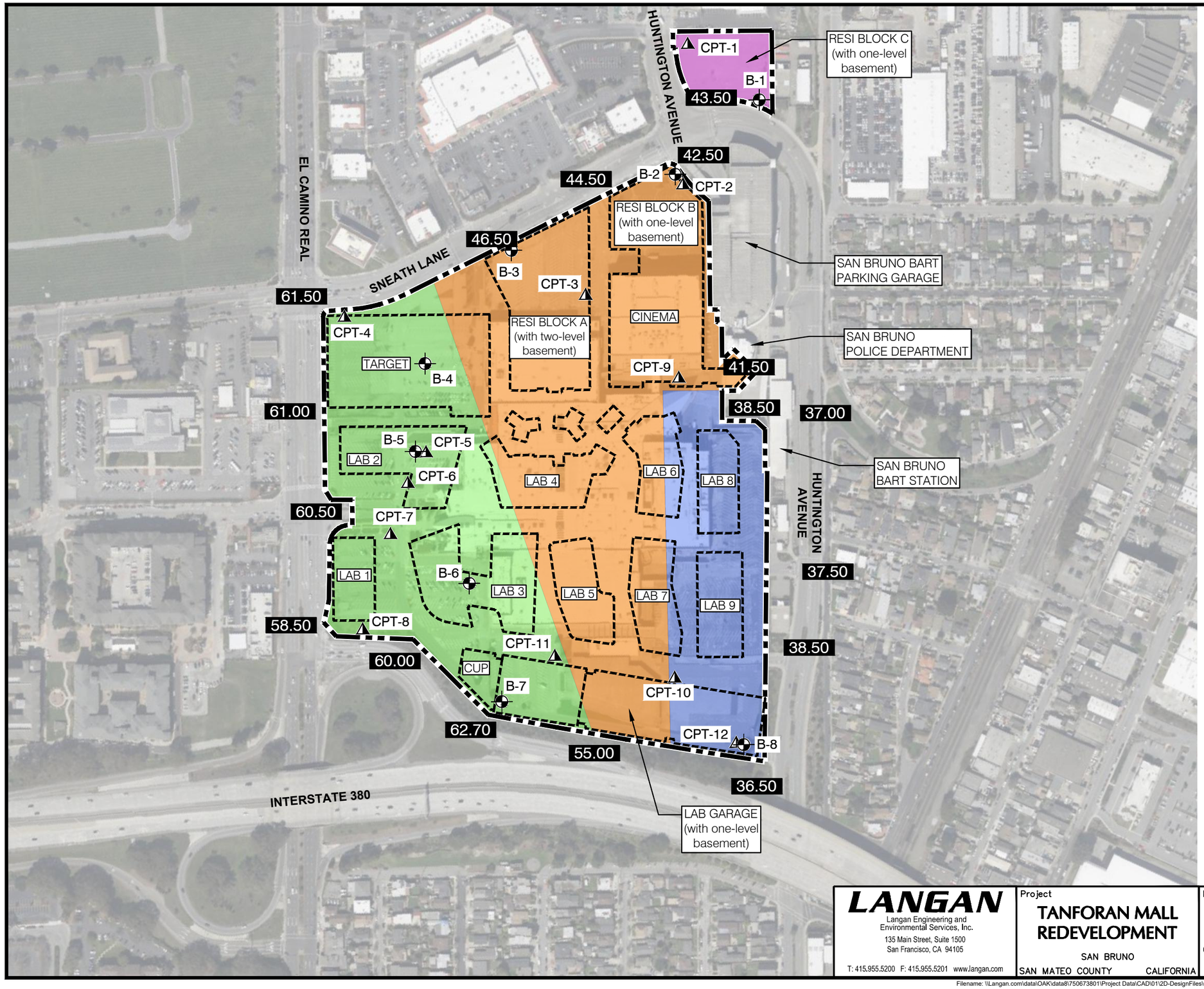
Project
TANFORAN MALL REDEVELOPMENT
SAN BRUNO
SAN MATEO COUNTY CALIFORNIA

Figure Title
SITE PLAN

Project No.	Figure
750673801	2
Date: 10/05/2022	
Drawn By: JDF	
Checked By: TG	

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EXPLANATION

- B-1 — Approximate location of boring by Langan, June 2022
- CPT-1 — Approximate location of Cone Penetration Test by Langan, June 2022
- Site boundary
- 46.50 — Existing grade

Design Groundwater Elevation (feet, NAVD88)

- 33
- 35
- 37
- 39

Notes:

1. Reference: Architectural base map "ARE Tanforan Pricing Package", by Alexandia and Gensler, 08/10/2022.
2. All dimensions and locations are approximate.
3. All elevations reference North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 23 December 2021.

N

0 300 Feet

Approximate scale

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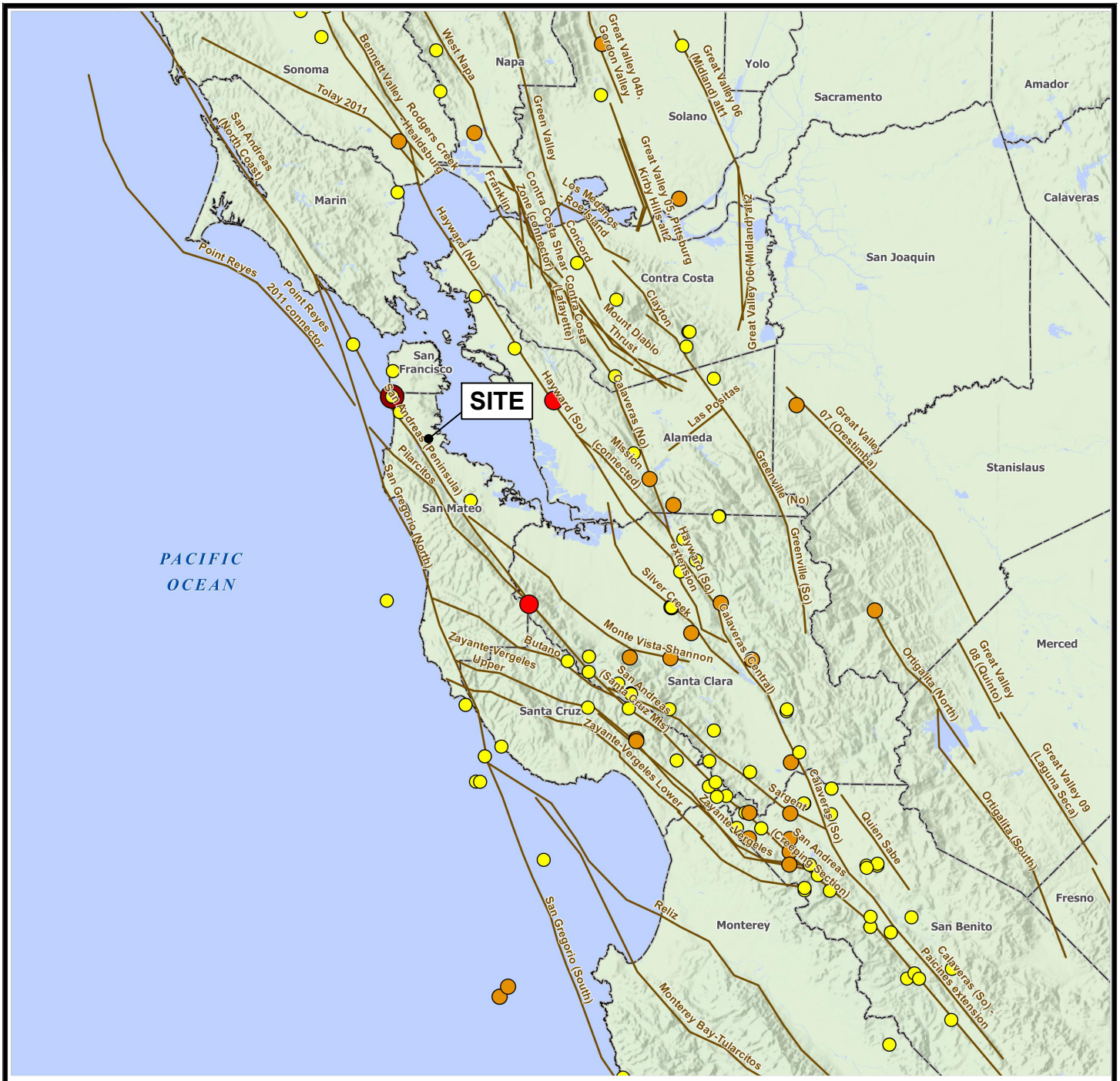
Project
TANFORAN MALL REDEVELOPMENT
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Figure Title
SITE PLAN WITH PROPOSED DEVELOPMENT AND DESIGN GROUNDWATER ELEVATIONS

Project No.	Figure
750673801	3
Date: 10/07/2022	
Drawn By: JDF	
Checked By: TG	

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Legend

County Boundary Earthquake Epicenter

Magnitude

- Magnitude 5 to 5.9
- Magnitude 6 to 6.9
- Magnitude 7 to 7.4
- Magnitude 7.5 to 8

Notes:

1. Quaternary fault data displayed are provided by the CGS Map Sheet 48: Fault-based seismic sources used in the Uniform California Earthquake Rupture Forecast, Version (UCERF3).
2. The Earthquake Epicenter (Magnitude) data is provided by the U.S Geological Survey (USGS) and is current through 2015.
3. Basemap hillshade and County boundaries provided by USGS and California Department of Transportation.
4. Map displayed in California State Coordinate System, California (Teale) Albers, North American Datum of 1983 (NAD83), Meters.

N W E S

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Miles

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Figure Title
MAP OF MAJOR FAULTS AND EARTHQUAKE EPICENTERS IN THE SAN FRANCISCO BAY AREA

Project No.	750673801
Date	08/26/2022
Drawn By	JDF
Checked By	TG

Figure 4

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Filename: \\Langan.com\data\OAK\data8\750673801\Project Data\CAD\01\2D-DesignFiles\Geotechnical\750673801-B-GI0101.dwg Date: 8/26/2022 Time: 11:24 User: jfrank Style Table: Langan.stb Layout: Fig 3 Fault Map

I Not felt by people, except under especially favorable circumstances. However, dizziness or nausea may be experienced.
Sometimes birds and animals are uneasy or disturbed. Trees, structures, liquids, bodies of water may sway gently, and doors may swing very slowly.

II Felt indoors by a few people, especially on upper floors of multi-story buildings, and by sensitive or nervous persons.
As in Grade I, birds and animals are disturbed, and trees, structures, liquids and bodies of water may sway. Hanging objects swing, especially if they are delicately suspended.

III Felt indoors by several people, usually as a rapid vibration that may not be recognized as an earthquake at first. Vibration is similar to that of a light, or lightly loaded trucks, or heavy trucks some distance away. Duration may be estimated in some cases.
Movements may be appreciable on upper levels of tall structures. Standing motor cars may rock slightly.

IV Felt indoors by many, outdoors by a few. Awakens a few individuals, particularly light sleepers, but frightens no one except those apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like a heavy body striking building, or the falling of heavy objects inside.
Dishes, windows and doors rattle; glassware and crockery clink and clash. Walls and house frames creak, especially if intensity is in the upper range of this grade. Hanging objects often swing. Liquids in open vessels are disturbed slightly. Stationary automobiles rock noticeably.

V Felt indoors by practically everyone, outdoors by most people. Direction can often be estimated by those outdoors. Awakens many, or most sleepers. Frightens a few people, with slight excitement; some persons run outdoors.
Buildings tremble throughout. Dishes and glassware break to some extent. Windows crack in some cases, but not generally. Vases and small or unstable objects overturn in many instances, and a few fall. Hanging objects and doors swing generally or considerably. Pictures knock against walls, or swing out of place. Doors and shutters open or close abruptly. Pendulum clocks stop, or run fast or slow. Small objects move, and furnishings may shift to a slight extent. Small amounts of liquids spill from well-filled open containers. Trees and bushes shake slightly.

VI Felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; general excitement, and some persons run outdoors.
Persons move unsteadily. Trees and bushes shake slightly to moderately. Liquids are set in strong motion. Small bells in churches and schools ring. Poorly built buildings may be damaged. Plaster falls in small amounts. Other plaster cracks somewhat. Many dishes and glasses, and a few windows break. Knickknacks, books and pictures fall. Furniture overturns in many instances. Heavy furnishings move.

VII Frightens everyone. General alarm, and everyone runs outdoors.
People find it difficult to stand. Persons driving cars notice shaking. Trees and bushes shake moderately to strongly. Waves form on ponds, lakes and streams. Water is muddied. Gravel or sand stream banks cave in. Large church bells ring. Suspended objects quiver. Damage is negligible in buildings of good design and construction; slight to moderate in well-built ordinary buildings; considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. Plaster and some stucco fall. Many windows and some furniture break. Loosened brickwork and tiles shake down. Weak chimneys break at the roofline. Cornices fall from towers and high buildings. Bricks and stones are dislodged. Heavy furniture overturns. Concrete irrigation ditches are considerably damaged.

VIII General fright, and alarm approaches panic.
Persons driving cars are disturbed. Trees shake strongly, and branches and trunks break off (especially palm trees). Sand and mud erupts in small amounts. Flow of springs and wells is temporarily and sometimes permanently changed. Dry wells renew flow. Temperatures of spring and well waters varies. Damage slight in brick structures built especially to withstand earthquakes; considerable in ordinary substantial buildings, with some partial collapse; heavy in some wooden houses, with some tumbling down. Panel walls break away in frame structures. Decayed pilings break off. Walls fall. Solid stone walls crack and break seriously. Wet grounds and steep slopes crack to some extent. Chimneys, columns, monuments and factory stacks and towers twist and fall. Very heavy furniture moves conspicuously or overturns.

IX Panic is general.
Ground cracks conspicuously. Damage is considerable in masonry structures built especially to withstand earthquakes; great in other masonry buildings - some collapse in large part. Some wood frame houses built especially to withstand earthquakes are thrown out of plumb, others are shifted wholly off foundations. Reservoirs are seriously damaged and underground pipes sometimes break.

X Panic is general.
Ground, especially when loose and wet, cracks up to widths of several inches; fissures up to a yard in width run parallel to canal and stream banks. Landsliding is considerable from river banks and steep coasts. Sand and mud shifts horizontally on beaches and flat land. Water level changes in wells. Water is thrown on banks of canals, lakes, rivers, etc. Dams, dikes, embankments are seriously damaged. Well-built wooden structures and bridges are severely damaged, and some collapse. Dangerous cracks develop in excellent brick walls. Most masonry and frame structures, and their foundations are destroyed. Railroad rails bend slightly. Pipe lines buried in earth tear apart or are crushed endwise. Open cracks and broad wavy folds open in cement pavements and asphalt road surfaces.

XI Panic is general.
Disturbances in ground are many and widespread, varying with the ground material. Broad fissures, earth slumps, and land slips develop in soft, wet ground. Water charged with sand and mud is ejected in large amounts. Sea waves of significant magnitude may develop. Damage is severe to wood frame structures, especially near shock centers, great to dams, dikes and embankments, even at long distances. Few if any masonry structures remain standing. Supporting piers or pillars of large, well-built bridges are wrecked. Wooden bridges that "give" are less affected. Railroad rails bend greatly and some thrust endwise. Pipe lines buried in earth are put completely out of service.

XII Panic is general.
Damage is total, and practically all works of construction are damaged greatly or destroyed. Disturbances in the ground are great and varied, and numerous shearing cracks develop. Landslides, rock falls, and slumps in river banks are numerous and extensive. Large rock masses are wrenched loose and torn off. Fault slips develop in firm rock, and horizontal and vertical offset displacements are notable. Water channels, both surface and underground, are disturbed and modified greatly. Lakes are dammed, new waterfalls are produced, rivers are deflected, etc. Surface waves are seen on ground surfaces. Lines of sight and level are distorted. Objects are thrown upward into the air.

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Project
TANFORAN MALL REDEVELOPMENT
SAN BRUNO
SAN MATEO COUNTY CALIFORNIA

Figure Title
MODIFIED MERCALLI INTENSITY SCALE

Project No.	750673801
Date	07/25/2022
Drawn By	JDF
Checked By	TG

Figure 5

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APPENDIX A

LOGS OF BORINGS

PROJECT:	**TANFORAN MALL REDEVELOPMENT** San Bruno, California	**Log of Boring B-1** PAGE 1 OF 2

Boring location:	See Site Plan, Figure 2	Logged by:	M. Moore
Date started:	06/25/22	Date finished: 06/25/22	Drilled By: Exploration Geoservices
Drilling method:	Hollow Stem Auger		
Hammer weight/drop:	140 lbs./30 inches	Hammer type: Rope and Cathead	
Samplers:	Sprague & Henwood (S&H), Standard Penetration Test (SPT)		

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION (Ground Surface Elevation: 38.4 feet[2])	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0					AB	1 inch asphalt concrete (AC) 6 inches aggregate base (AB)						
1–3					CL	CLAY with SAND (CL) brown to dark-brown, very stiff to hard, moist Corrosion Test, see Appendix D						
4–5	S&H		15 19 20	23		dark brown to gray-brown, fine to coarse sand, organics Triaxial Test, see Figure C-11	TxUU PP	480	4,870 4,500		10.9	127
6–8						SANDY CLAY (CL) gray-brown to yellow to yellow-brown, stiff to very stiff						
9–10	S&H		7 9 10	11		fine to medium sand	PP		3,750	68.2	22.2	
11–13						gray-brown to yellow-brown with yellow mottling, moist, very stiff, trace fine sand ▽ (6/25/22, 9:30am)						
14–15	S&H		8 10 16	16		LL = 29, PI = 10, see Figure C-1	PP		2,500		23.2	101
16–18					CL	olive-gray to gray-brown with yellow-brown mottling						
19–20	SPT		5 7 10	17								
21–23						gray						
24–25	SPT		8 11 14	25						22.7	20.6	
26–28					SC-SM	CLAYEY SILTY SAND (SC-SM) gray, medium dense, wet LL = 24, PI = 6, see Figure C-1						
29–30	S&H		20 20 22	25								

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Project No.:	Figure:
750673801	A-1a

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-1

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft[2]	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31					SC-SM	CLAYEY SILTY SAND (SC-SM) (continued)						
32						SANDY CLAY (CL) gray-brown to olive-gray, wet, stiff to very stiff LL = 27, PI = 11, see Figure C-1 Consolidation Test, see Figure C-6	PP		2,750		18.3	111
33												
34	S&H		10 10 10	12	CL							
35												
36												
37						CLAY with SAND (CL) gray-brown to olive-gray, wet, very stiff to hard LL = 31, PI = 14, see Figure C-1						
38												
39	S&H		10 20 22	25	CL	yellow-brown mottling	PP		4,500			
40												
41												
42						CLAYEY SILTY SAND (SC-SM) gray-brown with orange-brown mottling, wet, medium dense, fine- to medium-grained, trace fine to coarse subangular gravel LL = 24, PI = 6, see Figure C-1						
43					SC-SM							
44	S&H		10 10 16	16								
45										35.3	22.5	
46	SPT		16 18 24	42		CLAY with SAND (CL) gray-brown to yellow-brown, hard, wet, fine to medium sand, trace fine subangular gravel						
47					CL							
48												
49	SPT		25 32 50/ 6"	82/ 12"								
50					SP-SC	GRAVELLY SAND with CLAY (SP-SC) red-brown to yellow-brown, very dense, wet, fine- to coarse-grained, fine to coarse subangular to subrounded gravel						
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 50 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 13.3 feet bgs (6/25/22, 9:30am) at time of drilling.
PP = Pocket penetrometer

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.6 and 1.0, respectively, to account for sampler type and hammer energy.
[2] Elevations based on North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 12/23/2021.

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Project No.: 750673801
Figure: A-1b

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT:	**TANFORAN MALL REDEVELOPMENT** San Bruno, California	**Log of Boring B-2**

Boring location: See Site Plan, Figure 2

Date started: 06/21/22 Date finished: 06/21/22

Drilling method: Hollow Stem Auger

Hammer weight/drop: 140 lbs./30 inches Hammer type: Rope and Cathead

Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Logged by: M. Moore
Drilled By: Exploration Geoservices

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						Ground Surface Elevation: 41.6 feet[2]						
0						3.5 inches asphalt concrete (AC)						
1						8.5 inches aggregate base (AB)						
2					SM	SILTY SAND with GRAVEL (SM) dark brown, moist, fine- to coarse-grained, fine subangular gravel R-Value, see Figure C-18						
3												
4	S&H		3 4 5	5	SC-SM	CLAYEY SILTY SAND (SC-SM) dark brown, loose, moist, fine- to medium- grained LL = 23, PI = 7, see Figure C-1					20.6	101
5												
6												
7												
8					CL	CLAY (CL) yellow-brown with yellow and dark brown mottling, medium stiff to stiff, trace fine sand, trace organics						
9	S&H		4 5 7	7		Triaxial Test, see Figure C-12 LL = 40, PI = 29, see Figure C-1	PP TxUU	 1,140	2,500 1,400		22.9	104
10												
11					ML	SILT with SAND (ML) yellow-brown with yellow and dark brown mottling, medium stiff, fine sand						
12						▽ (6/21/2022, 9:30am)	PP		1,500			
13						CLAY with SAND (CL) gray brown to olive-brown, stiff, moist, fine to coarse sand, trace subangular to subrounded gravel, trace organics LL = 30, PI = 15, see Figure C-1						
14	S&H		5 6 10	10			PP		1,000			
15												
16												
17					CL							
18												
19	S&H		9 9 8	10		stiff to very stiff Consolidation Test, see Figure C-7	PP		3,500		21.4	106
20												
21												
22						CLAYEY SAND with GRAVEL (SC) yellow-brown, very dense, wet, fine- to coarse-grained, fine subangular to subrounded gravel, trace shells						
23												
24	SPT		14 44 50	94						16.4	12.3	
25												
26					SC							
27												
28												
29	SPT		40 50/4"	50/4"								
30												

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Project No.: 750673801 Figure: A-2a

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-2

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31					SC	CLAYEY SAND with GRAVEL (SC) (continued)						
32						CLAY with SAND (CL) gray, hard, wet, fine to medium sand, trace fine subangular to subrounded gravel						
33												
34	S&H		24 24 38	42		LL = 25, PI = 10, see Figure C-2	PP		4,500			
35												
36												
37					CL							
38												
39	S&H		15 23 30	32			PP		4,500		21.1	107
40						gray-brown with yellow mottling, fine to coarse sand						
41												
42						CLAYEY SAND (SC) yellow-brown, very dense, wet, fine- to coarse-grained, trace fine to coarse subrounded gravel						
43												
44	S&H		20 40 50/6"	54/12"						12.7	17.2	
45												
46												
47												
48					SC							
49	SPT		13 23 40	38		dense					17.7	109
50												
51												
52												
53						very dense						
54	SPT		20 30 40	70		CLAY with SAND (CL) gray-brown to olive-brown, hard, wet, fine sand LL = 34, PI = 16, see Figure C-2						
55												
56												
57					CL							
58												
59	S&H		18 24 36	36						43.3	21.2	
60												

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Project No.: 750673801 | Figure: A-2b

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-2

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
61					SC-SM	CLAYEY SILTY SAND (SC-SM) yellow-brown, dense, wet, fine to medium-grained LL = 23, PI = 7, see Figure C-2						
62												
63						SAND with CLAY (SP-SC) gray, dense, wet, fine- to coarse-grained, trace fine subangular gravel, trace silt						
64	S&H	■	26 36 43	47								
65					SP-SC					10.2	16.6	
66												
67												
68												
69	SPT	◪	15 15 30	45		SANDY SILTY CLAY (CL-ML) gray, hard, wet, fine to medium sand						
70												
71												
72												
73												
74	S&H	■	18 33 40	44			PP		2,000	58.7	29.8	
75					CL-ML	LL = 23, PI = 7, see Figure C-2						
76												
77												
78												
79	S&H	■	28 33 40	44			PP		3,750			
80												
81												
82												
83						CLAY with SAND (CL) blue-gray, very stiff, wet, fine to medium sand						
84	S&H	■	14 19 24	26			PP		3,750		24.4	102
85												
86					CL							
87												
88												
89	SPT	◪	15 20 40	60								
90						hard						

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Project No.: 750673801 | Figure: A-2c

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-2

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft[2]	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
91					CL	CLAY with SAND (CL) (continued)						
92						CLAYEY SAND (SC) yellow-brown to gray-brown, very dense, wet, fine- to coarse-grained, trace silt						
93												
94	SPT		35 50/6"	50/6"	SC					39.1	25.0	
95												
96												
97						CLAY with SAND (CL) gray with red-brown mottling, hard, wet, fine to medium sand LL = 40, PI = 20, see Figure C-2						
98												
99	SPT		30 50/4"	50/4"								
100												
101					CL							
102												
103												
104												
105						SILTY SAND (SM) gray-brown to yellow-brown, very dense, wet, fine-grained						
106												
107					SM							
108												
109	S&H		50/4"	50/4"								
110												
111												
112												
113												
114												
115												
116												
117												
118												
119												
120												

Boring terminated at a depth of 108.8 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 12.0 feet bgs (6/21/22, 9:30am) at time of drilling.
PP = Pocket penetrometer

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.6 and 1.0, respectively, to account for sampler type and hammer energy.
[2] Elevations based on North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 12/23/2021.

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Project No.: 750673801
Figure: A-2d

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT:	**TANFORAN MALL REDEVELOPMENT** San Bruno, California	**Log of Boring B-3** PAGE 1 OF 2

Boring location: See Site Plan, Figure 2 | Logged by: M. Moore
Date started: 06/20/22 | Date finished: 06/20/22 | Drilled By: Exploration Geoservices
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches | Hammer type: Rope and Cathead
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION (Ground Surface Elevation: 46.6 feet[2])	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
1					AB	3 inches asphalt concrete (AC) 8 inches aggregate base (AB)						
2					CL	CLAY with SAND (CL) yellow-brown to brown, moist, fine sand, trace fine subangular gravel						
3						R-Value, see Figure C-19						
4	S&H	■	3 5 6	7		gray-brown, medium stiff LL = 33, PI = 19, see Figure C-2	PP		1,250			
5												
6												
7												
8												
9	S&H	■	5 8 10	11		stiff						
10						Triaxial Test, see Figure C-13	TxUU PP	1,140	1,220 1,500		22.5	105
11												
12						SANDY CLAY (CL) gray brown, very stiff, moist, fine sand						
13					CL							
14	S&H	■	7 14 18	19			PP		3,500		16.9	109
15						▽ CLAYEY SAND with GRAVEL (SC) gray, medium dense, wet, fine- to coarse-grained, fine subangular to subrounded gravel, trace shell fragments (6/20/2022, 9:27am)						
16					SC							
17												
18												
19	SPT	◪	14 18 22	40		CLAYEY SILTY SAND with GRAVEL (SC-SM) gray-brown, dense, wet, fine- to coarse-grained, fine to coarse subangular to subrounded gravel LL = 21, PI = 5, see Figure C-2				22.8	14.0	
20												
21												
22												
23					SC-SM							
24	SPT	◪	20 24 27	51		yellow-brown to gray-brown, very dense LL = 23, PI = 6, see Figure C-2				25.0	11.9	
25												
26												
27												
28						SANDY CLAY (CL) gray-brown with red-brown mottling, very stiff, wet, fine to coarse sand, trace fine subangular gravel Consolidation Test, see Figure C-8						
29	S&H	■	8 12 14	16	CL		PP		3,750		18.6	112
30												

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Project No.: 750673801 | Figure: A-3a

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-3

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft[2]	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31					CL	SANDY CLAY (CL) (continued)						
32						CLAY with SAND (CL) gray-brown, very stiff, wet, fine sand						
33												
34	S&H	■	8 10 18	17								
35			10		CL	LL = 34, PI = 18, see Figure C-3	PP		4,500		16.2	116
36	SPT	◪	14 22	36		brown to red-brown, hard						
37												
38						SILT (ML) yellow-brown with brown mottling, hard, wet, trace organics						
39	S&H	■	18 24 32	34								
40					ML							
41												
42						CLAYEY SILTY SAND (SC-SM) gray-brown with red-brown mottling, medium dense, wet, fine- to medium-grained LL = 23, PI = 5, see Figure C-3						
43												
44	S&H	■	20 20 25	27								
45			18		SC-SM					38.5	22.1	
46	SPT	◪	32 45	77		very dense						
47												
48						SAND with GRAVEL (SP) yellow-brown, very dense, wet, fine- to coarse-grained, trace fine subangular gravel, trace silt						
49	SPT	◪	21 45	96	SP							
50		□	50									
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 50.0 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 15.3 feet bgs (6/20/22, 9:27am) at time of drilling.
PP = Pocket penetrometer

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.6 and 1.0, respectively, to account for sampler type and hammer energy.
[2] Elevations based on North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 12/23/2021.

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Project No.: 750673801
Figure: A-3b

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-4

Boring location: See Site Plan, Figure 2
Logged by: M. Moore
Date started: 06/20/22 Date finished: 06/20/22
Drilled By: Exploration Geoservices
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Safety
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION (Ground Surface Elevation: 48.5 feet[2])	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0					AB	2.5 inches asphalt concrete (AC) 8 inches aggregate base (AB)						
1–3					CL	SANDY CLAY (CL) gray-brown, moist, fine sand and rounded medium to coarse gravel Corrosion Test, see Appendix D						
4–5	S&H		10 10 12	13	CL	CLAY with SAND (CL) dark gray, stiff to very stiff, moist, fine sand Triaxial Test, see Figure C-14	TxUU PP	540	2,150 3,250		21.8	107
5–6	S&H		10 16 23	23								
6–10					SC	CLAYEY SAND (SC) gray-brown to yellow-brown with dark brown mottling, medium dense, fine- to coarse-grained LL = 27, PI = 12 see Figure C-3				45.8	15.2	120
10–12	S&H		22 28 36	38		olive-gray to gray-brown, dense, fine to coarse subangular gravel	PP		1,250			
12–15					SM	SILTY SAND (SM) gray-brown with red-yellow mottling, very dense, moist, fine- to medium-grained, trace fine to coarse subrounded gravel						
15–16	SPT		22 26 30	56		Non-plastic, see Figure C-3				33.0	17.3	
16–19						▽ (6/20/2022, 4:09pm)						
19–21	SPT		25 33 38	71	SC-SM	CLAYEY SILTY SAND with GRAVEL (SC-SM) yellow-brown to gray-brown, very dense, wet, fine- to coarse-grained, fine to coarse angular to subangular gravel LL = 22, PI = 7, see Figure C-3				20.8	10.4	
21–25					SM	SILTY SAND with GRAVEL (SM) yellow-brown to gray-brown, very dense, wet, fine- to coarse-grained, fine to coarse angular to subangular gravel, trace shells						
25–26	SPT		25 32 39	71							11.1	
26–30												

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Project No.: 750673801 Figure: A-4a

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-4

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft[2]	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						SILTY SAND with GRAVEL (SM) (continued)						
31	SPT		21 25 25	50	SM	gray-brown to yellow-brown, dense to very dense, wet, fine- to coarse-grained, fine to coarse subangular gravel						
32												
33												
34						SANDY CLAY (CL) yellow-brown to brown, very stiff, wet, fine to medium sand, trace subangular to subrounded gravel						
35												
36	S&H		10 19 28	28								
37												
38	S&H		15 32 48	48	CL	hard LL = 34, PI = 18, see Figure C-3	PP		4,500	53.5	15.0	
39												
40												
41	S&H		22 24 40	44			PP		4,000			
42						SILTY SAND (SM) yellow-brown, very dense, wet, fine- to coarse-grained, trace fine subangular gravel						
43												
44												
45												
46	SPT		15 28 33	61	SM						20.6	
47												
48												
49												
50												
51	SPT		22 28 36	64								
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 51.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 19.0 feet bgs (6/20/22, 4:09pm) at time of drilling.
PP = Pocket penetrometer

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.6 and 1.0, respectively, to account for sampler type and hammer energy.
[2] Elevations based on North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 12/23/2021.

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Project No.: 750673801
Figure: A-4b

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT:	**TANFORAN MALL REDEVELOPMENT** San Bruno, California	**Log of Boring B-5** PAGE 1 OF 4

Boring location:	See Site Plan, Figure 2	Logged by:	M. Moore
Date started:	06/22/22	Date finished: 06/22/22	Drilled By: Exploration Geoservices
Drilling method:	Hollow Stem Auger		
Hammer weight/drop:	140 lbs./30 inches	Hammer type: Rope and Cathead	
Samplers:	Sprague & Henwood (S&H), Standard Penetration Test (SPT)		

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION (Ground Surface Elevation: 60.7 feet[2])	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0						4 inches asphalt concrete (AC)						
0.3					AB	8 inches aggregate base (AB)						
0.7					CL	CLAY with SAND and GRAVEL (CL) [FILL] gray, moist, fine to coarse sand, fine to coarse subangular to subrounded gravel Corrosion Test, see Appendix D						
4	S&H		12 14 30	26	SC	CLAYEY SAND (SC) [FILL] yellow-brown to gray-brown with red-brown mottling, medium dense, moist, fine- to coarse-grained, trace fine to coarse subangular to subrounded gravel LL = 28, PI = 12, see Figure C-3 trace asphalt decreasing gravel content				36.1	12.1	
8	S&H		8 10 11	13	SC-SM	CLAYEY SILTY SAND (SC-SM) gray-brown to olive-gray with yellow-brown mottling, medium dense, moist, fine- to coarse-grained, trace fine subangular to subrounded gravel LL = 24, PI = 7, see Figure C-3				40.6	18.4	
14	S&H		10 13 50	40	CL	CLAY (CL) blue-gray to gray-brown with gray and yellow mottling, hard, moist LL = 29, PI = 15, see Figure C-4	PP		4,500			
16					SC-SM	CLAYEY SILTY SAND (SC-SM) gray, moist, dense, fine-grained LL = 18, PI = 4, see Figure C-4						
19	SPT		9 8 12	20		CLAY with SAND (CL) gray-brown with gray and yellow-brown mottling, very stiff, moist, fine sand, trace organics						
22					CL							
24	S&H		7 11 19	18		blue-gray to gray-brown with yellow-brown mottling LL = 32, PI = 15, see Figure C-4	PP		3,750			
28												
29	S&H		12 20 20	24	CL-ML	SILTY CLAY with SAND (CL-ML) gray-brown to yellow-brown, very stiff, wet, fine sand LL = 27, PI = 7, see Figure C-4 (6/22/2022, 9:52am)						
30												

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Project No.:	Figure:
750673801	A-5a

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-5

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31					CL-ML	SILTY CLAY with SAND (CL-ML) (continued)						
32												
33						SILTY SAND (SM) yellow-brown to gray-brown, dense, wet, fine- to medium-grained, trace coarse sand, trace fine subangular to subrounded gravel Non-plastic, see Figure C-4						
34	SPT		9 18 18	36						26.4	17.6	
35												
36					SM							
37												
38												
39	SPT		12 14 24	38								
40						SANDY CLAY (CL) gray-brown with yellow-brown mottling, hard, wet, fine to medium sand, trace coarse sand, trace fine subangular to subrounded gravel				56.1	17.6	
41												
42												
43					CL							
44	S&H		10 14 20	21		very stiff to hard Consolidation Test, see Figure C-9	PP		4,500			
45												
46												
47												
48						SAND with CLAY and GRAVEL (SP-SC) yellow-brown, very dense, wet, fine- to coarse-grained, fine to coarse subangular to subrounded gravel, trace silt						
49	SPT		17 24 34	58						9.2	12.4	
50					SP-SC							
51												
52						CLAYEY SAND with GRAVEL (SC) yellow-brown, very dense, wet, fine- to coarse-grained, fine to coarse subangular to subrounded gravel, trace organics						
53					SC							
54	S&H		21 40 50/ 6"	50/ 6"								
55						CLAYEY SAND (SC) mottled orange-brown and gray-brown, very dense, wet, fine- to coarse-grained				42.1	23.6	
56												
57					SC							
58												
59	S&H		17 24 30	32		gray-brown, dense, fine- to medium-grained LL = 27, PI = 12, see Figure C-4				31.5	17.1	
60												

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Project No.: 750673801 | Figure: A-5b

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-5

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
61					SC	CLAYEY SAND (SC) (continued)						
62												
63						SILT (ML) gray-brown, hard, wet, trace fine sand						
64	SPT		14 16 26	42	ML							
65												
66												
67						SILTY SAND (SM) gray-brown with red-brown mottling, very dense, wet, fine-grained, trace clay, trace fine subangular to subrounded gravel						
68												
69	S&H		40 75/ 6"	69		Non-plastic, see Figure C-4				35.5	19.0	
70												
71												
72												
73												
74	S&H		20 20 30	30								
75					SM	medium dense to dense						
76												
77												
78												
79	S&H		18 18 28	28								
80						medium dense						
81												
82												
83						CLAYEY SAND (SC) yellow-brown with red-brown mottling, very dense, wet, fine-grained						
84	S&H		28 40 50/ 6"	54						38.3	20.0	
85					SC							
86												
87						SILTY SAND with GRAVEL (SM) yellow-brown, very dense, wet, fine- to coarse-grained, fine to coarse subangular gravel						
88												
89	SPT		14 24 34	58	SM							
90												

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Project No.: 750673801

Figure: A-5c

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-5

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft[2]	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
91					SM	SILTY SAND with GRAVEL (SM) (continued)						
92												
93												
94	SPT		32 50/ 3"	50/ 3"		SANDY SILT (ML) yellow to yellow-brown, hard, wet, fine-grained sand						
95												
96												
97												
98												
99	SPT		20 30 50/ 6"	80/ 12"								
100												
101												
102					ML							
103												
104												
105												
106												
107												
108												
109	SPT		20 30 50/ 6"	80/ 12"								
110												
111												
112												
113												
114												
115												
116												
117												
118												
119												
120												

Boring terminated at a depth of 110.0 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 29.0 feet bgs (6/22/22, 9:52am) at time of drilling.
PP = Pocket penetrometer

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.6 and 1.0, respectively, to account for sampler type and hammer energy.
[2] Elevations based on North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 12/23/2021.

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Project No.: 750673801
Figure: A-5d

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT:	**TANFORAN MALL REDEVELOPMENT** San Bruno, California	**Log of Boring B-6** PAGE 1 OF 2

Boring location: See Site Plan, Figure 2 | Logged by: M. Moore
Date started: 06/23/22 | Date finished: 06/23/22 | Drilled By: Exploration Geoservices
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches | Hammer type: Rope and Cathead
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION (Ground Surface Elevation: 64.6 feet[2])	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0					AB	1 inch asphalt concrete (AC)						
						6 inches aggregate base (AB)						
1						SILTY SAND (SM) yellow-brown, medium dense, moist, fine- to medium-grained, trace fine subangular to subrounded gravel, trace clay R-Value, see Figure C-20						
2												
3												
4	S&H		10 16 26	25	SM	Non-plastic, see Figure C-4				29.7	14.8	
5												
6												
7						SANDY CLAY (CL) dark-gray to blue-gray, stiff, moist, fine to medium sand						
8												
9	S&H		4 7 8	9			PP		1,750			
10					CL							
11												
12												
13												
14	S&H		8 12 20	19		very stiff	PP PP		3,750 2,750		14.6	115
15					CL	CLAY with SAND (CL) yellow-brown to gray-brown, very stiff, moist, fine to medium sand, trace fine subangular gravel						
16												
17						CLAYEY SAND (SC) yellow-brown, medium dense, moist, fine- to medium-grained, trace fine subangular gravel						
18					SC							
19	S&H		12 12 13	15	CL	CLAY with GRAVEL (CL) dark-gray, stiff to very stiff, moist, fine to coarse subangular to subrounded gravel Triaxial Test, see Figure C-15	TxUU PP	2,220	2,280 4,000		13.3	121
20												
21						SANDY CLAY (CL) gray with dark brown mottling, stiff to very stiff, moist, fine to medium sand, trace rootlets						
22												
23												
24	SPT		6 7 7	14						60.9	17.8	
25					CL	yellow-brown to gray-brown, stiff, fine to coarse sand, trace fine subangular to subrounded gravel, trace organics						
26												
27												
28												
29	S&H		11 13 15	17			PP		2,250		16.6	111
30						very stiff						

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Project No.: 750673801 | Figure: A-6a

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-6

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft[2]	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31						SANDY CLAY (CL) (continued)						
32												
33						▽ (6/23/2022, 9:29am)						
34	S&H		7 7 8	15	CL	stiff to very stiff, wet, trace fine subangular to subrounded gravel	PP		1,750			
35												
36												
37						SAND with SILT and GRAVEL (SP-SM) yellow-brown to red-brown, very dense, wet, fine- to coarse-grained, fine to coarse subangular to subrounded gravel, trace clay						
38												
39	SPT		21 40 50/ 3"	90/ 9"	SP-SM					9.9	13.9	
40												
41												
42						SANDY SILT (ML) gray, hard, wet, fine sand						
43												
44	SPT		5 12 20	32	ML							
45												
46												
47						SILTY SAND with GRAVEL (SM) gray-brown, medium dense, wet, fine- to medium-grained, fine to coarse subangular to subrounded gravel						
48					SM							
49	S&H		12 16 18	20						20.9	22.9	
50					CL	SANDY CLAY (CL) gray-brown to yellow-brown, very stiff, wet, fine to medium sand, trace organics LL = 37, PI = 18, see Figure C-4	PP		3,500			
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 50.0 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 33.0 feet bgs (6/23/22, 9:29am) at time of drilling.
PP = Pocket penetrometer

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.6 and 1.0, respectively, to account for sampler type and hammer energy.
[2] Elevations based on North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 12/23/2021.

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Project No.: 750673801
Figure: A-6b

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT:	**TANFORAN MALL REDEVELOPMENT** San Bruno, California	**Log of Boring B-7** PAGE 1 OF 2

Boring location:	See Site Plan, Figure 2	Logged by:	M. Moore
Date started:	06/23/22	Date finished: 06/23/22	Drilled By: Exploration Geoservices
Drilling method:	Hollow Stem Auger		
Hammer weight/drop:	140 lbs./30 inches	Hammer type: Rope and Cathead	
Samplers:	Sprague & Henwood (S&H), Standard Penetration Test (SPT)		

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						Ground Surface Elevation: 63.5 feet[2]						
0					AB	1 inch asphalt concrete (AC)						
1						6 inches aggregate base (AB)						
2					CL	SANDY CLAY (CL) yellow-brown, moist, fine to coarse sand						
3						Corrosion Test, see Appendix D						
4						CLAY with SAND (CL) dark-gray with gray mottling, stiff to very stiff, moist, fine to medium sand, trace organics						
5	S&H		3 5 4	10			PP		2,500			
6												
7												
8												
9												
10	S&H		9 16 27	26			PP		1,500			
11												
12												
13					CL							
14												
15	S&H		8 16 26	25		LL = 27, PI = 12, see Figure C-5	PP		3,250			
16												
17												
18												
19												
20	S&H		6 12 21	20			PP		4,250		16.9	114
21												
22												
23												
24						SANDY CLAY (CL) gray-brown to gray with yellow-brown mottling, hard, fine to medium sand, trace fine subangular to subrounded gravel						
25	SPT		9 11 21	32								
26					CL							
27												
28												
29					CL	CLAY (CL)						
30												

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Project No.:	Figure:
750673801	A-7a

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-7

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft[2]	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
							SAMPLES			LABORATORY TEST DATA		
31	S&H		8 10 16	16	CL	CLAY (CL) (continued) yellow to yellow-brown with gray-brown and dark brown mottling, stiff to very stiff, moist, trace fine to medium sand LL = 33, PI = 17, see Figure C-5	PP		1,750			
32												
33												
34						CLAY with SAND (CL) gray-brown, stiff, moist, fine to medium sand						
35	S&H		11 11 11	13			PP		2,250		18.8	107
36												
37												
38					CL							
39						▽ (6/23/2022, 1:40pm)						
40	S&H		6 12 24	22		yellow-brown to gray-brown, medium stiff to very stiff, organics	TxUU PP	4,800	1,860 2,250		21.7	108
41						Triaxial Test, see Figure C-16						
42												
43												
44					SC-SM	CLAYEY SILTY SAND (SC-SM) yellow-brown, medium dense, wet, fine to medium-grained LL = 26, PI = 7, see Figure C-5				49.4	22.6	
45	SPT		6 12 15	27								
46					CL	CLAY (CL) gray-brown to gray, very stiff, wet, trace shells						
47												
48												
49					SC	CLAYEY SAND (SC) gray-brown with yellow-brown mottling, dense, wet, fine-grained, trace fine to coarse subangular to subrounded gravel						
50	S&H		22 22 32	32								
51												
52												
53												
54					SC-SM	CLAYEY SILTY SAND with GRAVEL (SC-SM) yellow-brown to red-brown, very dense, wet, fine- to coarse-grained, fine to coarse rounded to angular gravel, trace cobbles LL = 25, PI = 6, see Figure C-5				18.3	18.1	
55	S&H		35 50/5"	50/5"								
56												
57												
58												
59												
60												

Boring terminated at a depth of 56.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 39.0 feet bgs (6/23/22, 1:40pm) at time of drilling.
PP = Pocket penetrometer

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.6 and 1.0, respectively, to account for sampler type and hammer energy.
[2] Elevations based on North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 12/23/2021.

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Project No.: 750673801
Figure: A-7b

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT:	**TANFORAN MALL REDEVELOPMENT** San Bruno, California	**Log of Boring B-8** PAGE 1 OF 4

Boring location: See Site Plan, Figure 2 | Logged by: M. Moore
Date started: 06/23/22 | Date finished: 06/23/22 | Drilled By: Exploration Geoservices
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches | Hammer type: Rope and Cathead
Samplers: Sprague & Henwood (S&H), Standard Penetration Test (SPT)

Ground Surface Elevation: 48.4 feet[2]

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						LABORATORY TEST DATA						
1					AB	3.5 inch asphalt concrete (AC)						
						4 inches aggregate base (AB)						
2						SILTY SAND (SM) yellow-brown, moist, fine- to coarse-grained R-Value, see Figure C-21						
3					SM							
4	S&H		8 8	11		yellow to yellow-brown, medium dense, moist, fine-grained, trace rounded gravel				12.9	7.4	
5			10				PP		3,500			
6						CLAY with SAND (CL) dark gray to dark brown, stiff to very stiff, moist, fine to medium sand, trace fine subangular to subrounded gravel LL = 24, PI = 9, see Figure C-5						
7												
8					CL							
9	S&H		7 14	21		very stiff to hard						
10			21			Triaxial Test, see Figure C-17	TxUU	1,140	4,160		14.5	121
							PP		4,500			
11												
12						SANDY CLAY (CL) dark gray to dark brown, very stiff to hard, moist, fine to medium sand						
13												
14	S&H		12 14	20								
15			20				PP		4,500		14.0	110
16					CL							
17												
18												
19	S&H		16 40	43			PP		2,250			
20			32			CLAYEY SAND (SC) gray to blue gray with yellow-brown mottling, dense, moist, fine- to coarse-grained, trace fine subangular gravel					13.2	121
21					SC							
22						SANDY CLAY (CL) yellow-brown to gray-brown with red-yellow mottling, very stiff, moist, fine to medium sand						
23												
24	SPT		7 7	17		LL = 25, PI = 8, see Figure C-5						
25			16									
26					CL							
27												
28						stiff						
29	S&H		7 9	11			PP		2,250		20.7	107
30			10			▽ (6/24/2022, 9:30am)						

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Project No.: 750673801 | Figure: A-8a

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-8

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
31					CL	SANDY CLAY (CL) (continued)						
32												
33						SILTY SAND (SM) yellow to yellow-brown, medium dense, wet, fine- to medium-grained, trace organics						
34	S&H		14 30 24	26	SM	Non-plastic, see Figure C-5						
35										22.9	19.5	
36												
37												
38						CLAYEY SAND with GRAVEL (SC) yellow to yellow-brown, very dense, wet, fine- to coarse-grained sand, fine to coarse subangular to angular gravel						
39	SPT		18 36 26	62	SC							
40												
41												
42						CLAYEY SAND (SC) gray to blue-gray, dense, wet, fine- to coarse-grained, trace shells						
43												
44	SPT		8 16 30	46								
45										27.1	21.8	
46												
47					SC							
48												
49	SPT		25 25 23	43								
50												
51												
52						SANDY CLAY (CL) gray to blue-gray, stiff to very stiff, wet, fine sand, trace organics						
53												
54	S&H		13 20 28	29		Consolidation Test, see Figure C-10	PP		1,250			
55												
56					CL							
57												
58												
59	S&H		14 21 28	29		LL = 28, PI = 11, see Figure C-5	PP		3,500			
60												

LANGAN

Project No.: 750673801

Figure: A-8b

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-8

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
61					CL	SANDY CLAY (CL) (continued)						
62						CLAY (CL) gray to blue-gray, wet, stiff to very stiff						
63												
64	S&H		13 18 30	29		LL = 36, PI = 18, see Figure C-5	PP		1,250			
65						dark gray, trace fine to coarse sand, trace organics	PP		3,000			
66												
67					CL							
68												
69	SPT		8 19 16	30		gray, very stiff to hard, trace fine to medium sand						
70												
71												
72						CLAY with SAND (CL) gray to blue-gray, stiff to very stiff, wet, fine to medium sand						
73												
74	S&H		10 14 16	18			PP		2,500		18.4	111
75												
76												
77												
78					CL	hard						
79	S&H		15 30 40	42								
80							PP		4,500			
81												
82												
83												
84	S&H		9 18 30	29		stiff to very stiff	PP		3,250			
85						CLAYEY SAND (SC) yellow-brown to gray-brown, medium dense, wet, fine- to coarse-grained						
86												
87												
88					SC							
89	SPT		16 28 28	31		red-brown to yellow-brown, dense				16.3	18.7	
90												

LANGAN

Project No.: 750673801

Figure: A-8c

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

PROJECT: **TANFORAN MALL REDEVELOPMENT**
San Bruno, California

Log of Boring B-8

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
91					CL	CLAY with SAND (CL) gray-brown, hard, wet, fine to medium sand						
92												
93						CLAYEY SAND (SC) red-brown to yellow-brown, very dense, wet, fine- to coarse-grained						
94	SPT		50/6"	50/6"								
95					SC							
96												
97												
98												
99	SPT		50/6"	50/6"	CL	CLAY with SAND (CL) gray-brown with red-yellow mottling, hard, wet, fine to medium sand, trace fine subangular to subrounded gravel, trace organics						
100												
101												
102												
103												
104												
105												
106												
107												
108												
109												
110												
111												
112												
113												
114												
115												
116												
117												
118												
119												
120												

Boring terminated at a depth of 99.0 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at 30.0 feet bgs (6/24/22, 9:30am) at time of drilling.
PP = Pocket penetrometer

[1] S&H and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.6 and 1.0, respectively, to account for sampler type and hammer energy.
[2] Elevations based on North American Vertical Datum of 1988 (NAVD88), per "Topographic Survey, Tanforan Mall" by BKF, dated 12/23/2021.

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Project No.: 750673801
Figure: A-8d

TEST GEOTECH LOG 750673801 BORING LOGS.GPJ TEMPLATE_CA-MODIFIED.GDT 10/07/22

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size)	**Gravels** (More than half of coarse fraction > no. 4 sieve size)	**GW**	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	**SW**	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine -Grained Soils (more than half of soil < no. 200 sieve size)	**Silts and Clays** LL = < 50	**ML**	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	**MH**	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		**PT**	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	Grain Size in Millimeters
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 4.76
coarse	3" to 3/4"	76.2 to 19.1
fine	3/4" to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.075
coarse	No. 4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

Unstabilized groundwater level

Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered

Classification sample taken with Standard Penetration Test sampler

Undisturbed sample taken with thin-walled tube

Disturbed sample, hand auger

Sampling attempted with no recovery

Core sample

Analytical laboratory sample, grab groundwater

Sample taken with Direct Push sampler

Sonic

SAMPLER TYPE

C Core barrel

CA California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter

D&M Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube

O Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube

PT Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube

S&H Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter

SPT Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter

ST Shelby Tube (3.0-inch outside diameter, thin-walled tube)

LANGAN
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Project: TANFORAN MALL REDEVELOPMENT
SAN BRUNO
SAN MATEO COUNTY CALIFORNIA

Figure Title: SOIL CLASSIFICATION CHART

Project No. 750673801
Date 10/14/2022
Drawn By JDF
Checked By TG

Figure A-9

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Filename: \\Langan.com\data\OAK\data8\750673801\Project Data\CAD\01\2D-DesignFiles\Geotechnical\750673801-B-GI0101.dwg Date: 10/14/2022 Time: 12:33 User: jfrank Style Table: Langan.stb Layout: Fig C-21 R-value (2)

APPENDIX B

CONE PENETRATION TEST RESULTS

PRESENTATION OF SITE INVESTIGATION RESULTS

Tanforan Mall Redevelopment

Prepared for:

Langan Engineering

ConeTec Job No: 22-56-24357

Project Start Date: 2022-Jun-22
Project End Date: 2022-Jun-24
Report Date: 2022-Jun-29

Prepared by:

ConeTec Inc.

820 Aladdin Avenue, San Leandro, CA 95477

Tel: (510) 357-3677

ConeTecCA@conetec.com

www.conetec.com
www.conetecdataservices.com



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ABOUT THIS REPORT

The enclosed report presents the results of the site investigation program conducted by ConeTec, Inc. The program consisted of Seismic Piezocone Penetration Testing and Pore Pressure Dissipation Testing. Please note that this report, which also includes all accompanying data, are subject to the 3rd Party Disclaimer and Client Disclaimer that follow in the 'Limitations' section of this report.

Project Information	
Client	Langan Engineering
Project	Tanforan Mall Redevelopment
ConeTec Project Number	22-56-24357
Rig Description	30-ton Truck CPT Rig (C-17)

Coordinates	
Collection Method	Consumer Grade GPS
EPSG Number	32610 (WGS 84 / UTM 10S)

Cone Penetration Test (CPTu)	
Depth Reference	Existing ground surface at the time of the investigation
Sleeve data offset	0.1 Meters

Calculated Geotechnical Parameters Tables	
Additional Information	The Normalized Soil Behaviour Type Chart based on Q_{tn} (SBT Q_{tn}) (Robertson, 2009) was used to classify the soil for this project. A detailed set of calculated CPTu parameters have been generated and are provided in Excel format files in the release folder. The CPTu parameter calculations are based on values of corrected tip resistance (q_t) sleeve friction (f_s) and pore pressure (u_2). Effective stresses are calculated based on unit weights that have been assigned to the individual soil behaviour type zones and the assumed equilibrium pore pressure profile. Soils were classified as either drained or undrained based on the Q_{tn} Normalized Soil Behaviour Type Chart (Robertson, 2009). Calculations for both drained and undrained parameters were included for materials that classified as silt mixtures (zone 4).

Please refer to the list of attached documents following the text of this report. A test summary, location map, and plots are included. Thank you for the opportunity to work on this project.

CONETEC

LIMITATIONS

3rd Party Disclaimer

- The “Report” refers to this report titled Tanforan Mall Redevelopment
- The Report was prepared by ConeTec for Langan Engineering

The Report is confidential and may not be distributed to or relied upon by any third parties without the express written consent of ConeTec. Any third parties gaining access to the Report do not acquire any rights as a result of such access. Any use which a third party makes of the Report, or any reliance on or decisions made based on it, are the responsibility of such third parties. ConeTec accepts no responsibility for loss, damage and/or expense, if any, suffered by any third parties as a result of decisions made, or actions taken or not taken, which are in any way based on, or related to, the Report or any portion(s) thereof.

Client Disclaimer

- ConeTec was retained by Langan Engineering
- The “Report” refers to this report titled Tanforan Mall Redevelopment
- ConeTec was retained to collect and provide the raw data (“Data”) which is included in the Report.

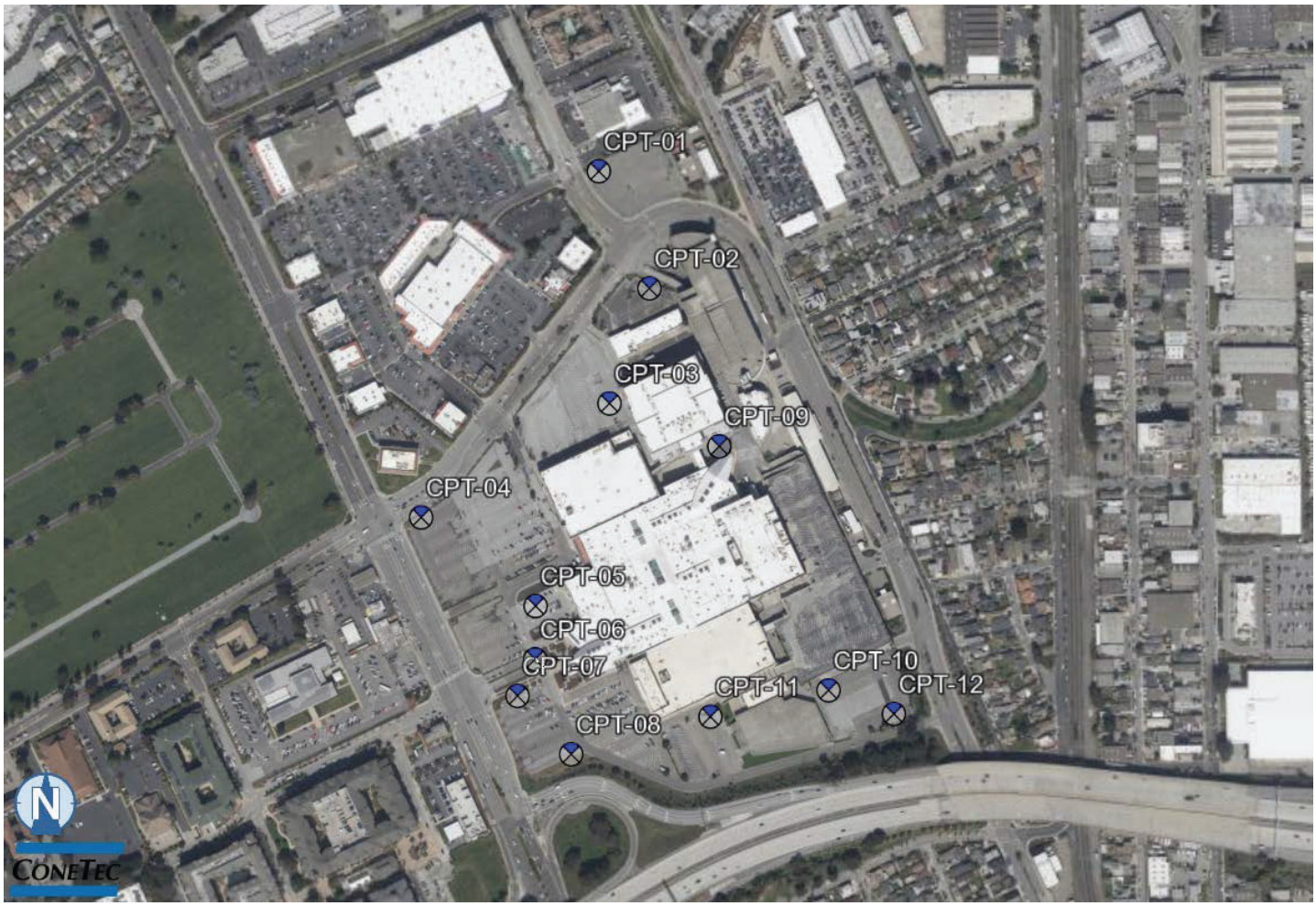
ConeTec has collected and reported the Data in accordance with current industry standards. No other warranty, express or implied, with respect to the Data is made by ConeTec. In order to properly understand the Data included in the Report, reference must be made to the documents accompanying and other sources referenced in the Report in their entirety. Other than the Data, the contents of the Report (including any Interpretations) should not be relied upon in any fashion without independent verification and ConeTec is in no way responsible for any loss, damage or expense resulting from the use of, and/or reliance on, such material by any party.

CONTENTS

The following listed below are included in the report:

- **Site Map**
- **Piezocone Penetration Test (CPTu) Sounding Summary**
- **CPTu Standard Plots, Advanced Plots, and Normalized Plots**
- **SBT Zone Scatter Plots**
- **Pore Pressure Dissipation (PPD) Test Summary**
- **PPD Test Plots**
- **Seismic CPTu Results, Plots, and Traces**
- **Methodology Statements**
- **Data File Formats**
- **Description of Methods for Calculated CPT Geotechnical Parameters**

SITE MAP



ConeTec Job Number: 22-56-24357

Client: Langan Engineering

Project: Tanforan Mall Redevelopment

Report Date: 2022-Jun-29

Sounding Location

All sounding locations are approximate

CONETEC

Cone Penetration Test Summary and Standard Cone Penetration Test Plots

CONETEC

Job No: 22-56-24357
Client: Langan Engineering
Project: Tanforan Mall Redevelopment
Start Date: 22-Jun-2022
End Date: 24-Jun-2022

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Cone Area (cm^2)	Assumed Phreatic Surface[1] (ft)	Final Depth (ft)	Northing[2]	Easting[2]	Elevation[3] (ft)	Refer to Notation Number
CPT-01	22-56-24357_SP01	24-Jun-2022	EC813:T1500F15U35	15	22.0	100.89	4166051	551281	44	4
CPT-02	22-56-24357_SP02	23-Jun-2022	EC813:T1500F15U35	15	20.0	41.83	4165928	551335	42	4
CPT-03	22-56-24357_SP03	22-Jun-2022	EC813:T1500F15U35	15	24.1	87.27	4165807	551294	47	
CPT-04	22-56-24357_SP04	22-Jun-2022	EC813:T1500F15U35	15	>19.5	19.44	4165687	551099	57	4
CPT-05	22-56-24357_SP05	22-Jun-2022	EC813:T1500F15U35	15	32.4	100.56	4165596	551219	61	
CPT-06	22-56-24357_CP06	22-Jun-2022	EC813:T1500F15U35	15	30.1	71.36	4165541	551219	63	
CPT-07	22-56-24357_CP07	23-Jun-2022	EC813:T1500F15U35	15	30.2	73.82	4165503	551201	62	
CPT-08	22-56-24357_SP08	23-Jun-2022	EC813:T1500F15U35	15	25.5	50.69	4165443	551257	59	
CPT-09	22-56-24357_SP09	24-Jun-2022	EC813:T1500F15U35	15	15.4	33.38	4165763	551409	45	
CPT-10	22-56-24357_SP10	24-Jun-2022	EC815:T1500F15U35	15	22.8	50.85	4165510	551524	48	
CPT-11	22-56-24357_CP11	23-Jun-2022	EC813:T1500F15U35	15	36.4	78.98	4165483	551401	64	
CPT-12	22-56-24357_SP12	24-Jun-2022	EC815:T1500F15U35	15	25.8	89.73	4165486	551592	48	

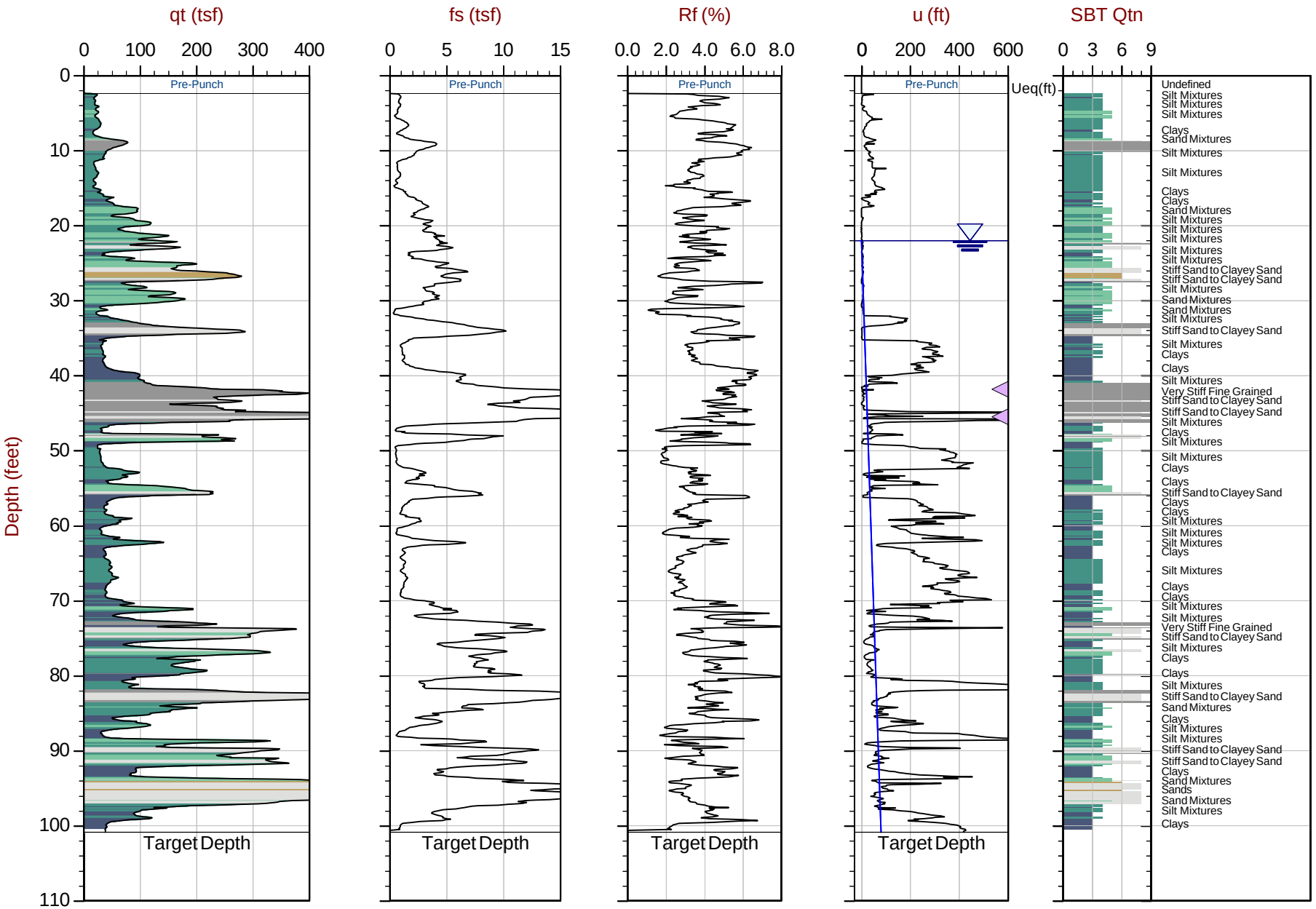
1. The assumed phreatic surface was based off the shallowest pore pressure dissipation tests performed within or nearest the sounding. Hydrostatic conditions were assumed for the calculated parameters.
2. The coordinates were collected using consumer grade GPS equipment. EPSG number: 32610 (WGS84 / UTM Zone 10S).
3. Elevations are referenced to the ground surface and were acquired from the Google Earth Elevation for the recorded coordinates.
4. The assumed phreatic is based on the pore pressure dissipation tests at nearby soundings.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 09:18
Site: Tanforan Mall Redevelopment

Sounding: CPT-01
Cone: 813:T1500F15U35



Max Depth: 30.750 m / 100.88 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP01.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4166051m E: 551281m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

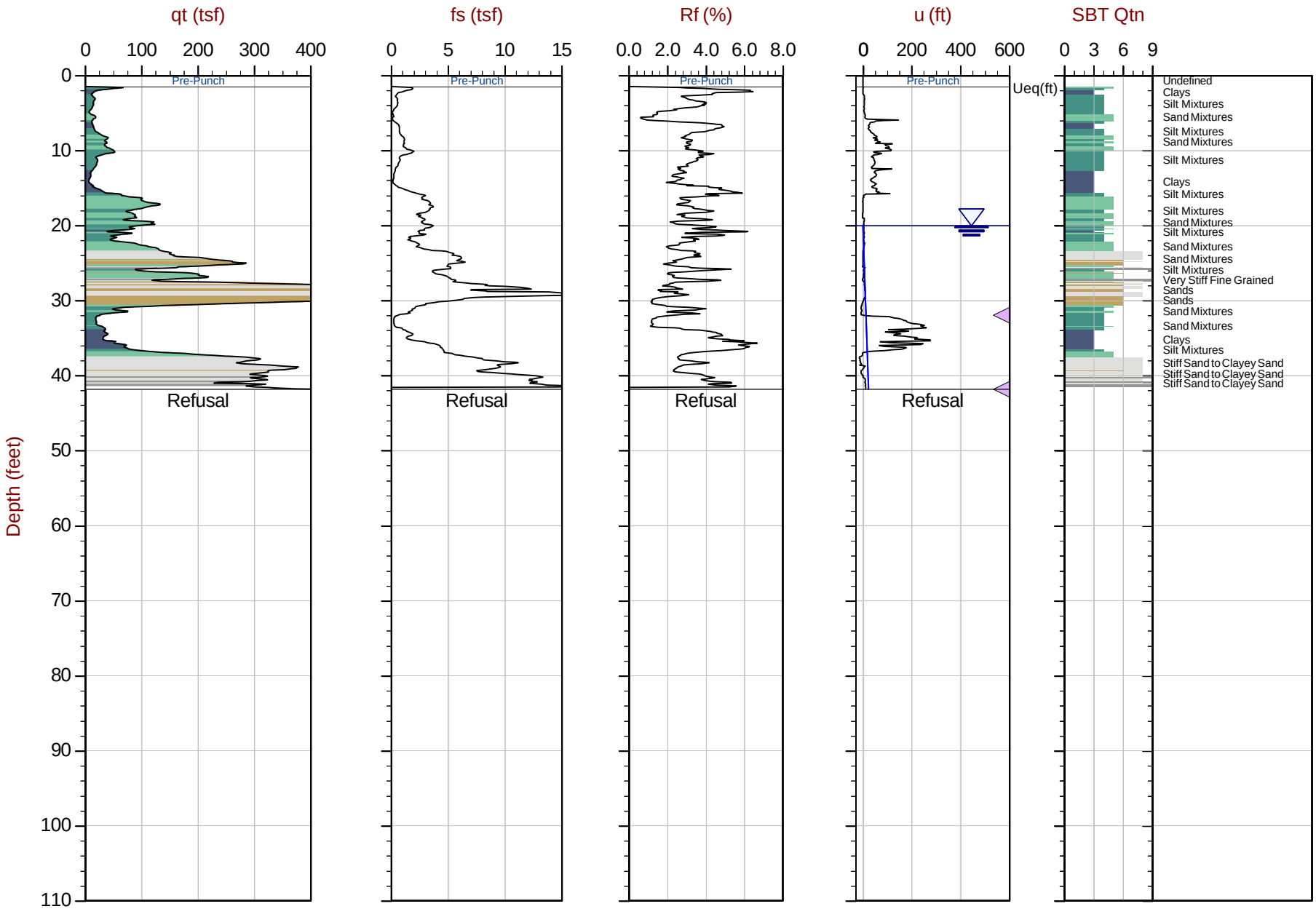
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 12:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-02
Cone: 813:T1500F15U35



Max Depth: 12.750 m / 41.83 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP02.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165928m E: 551335m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

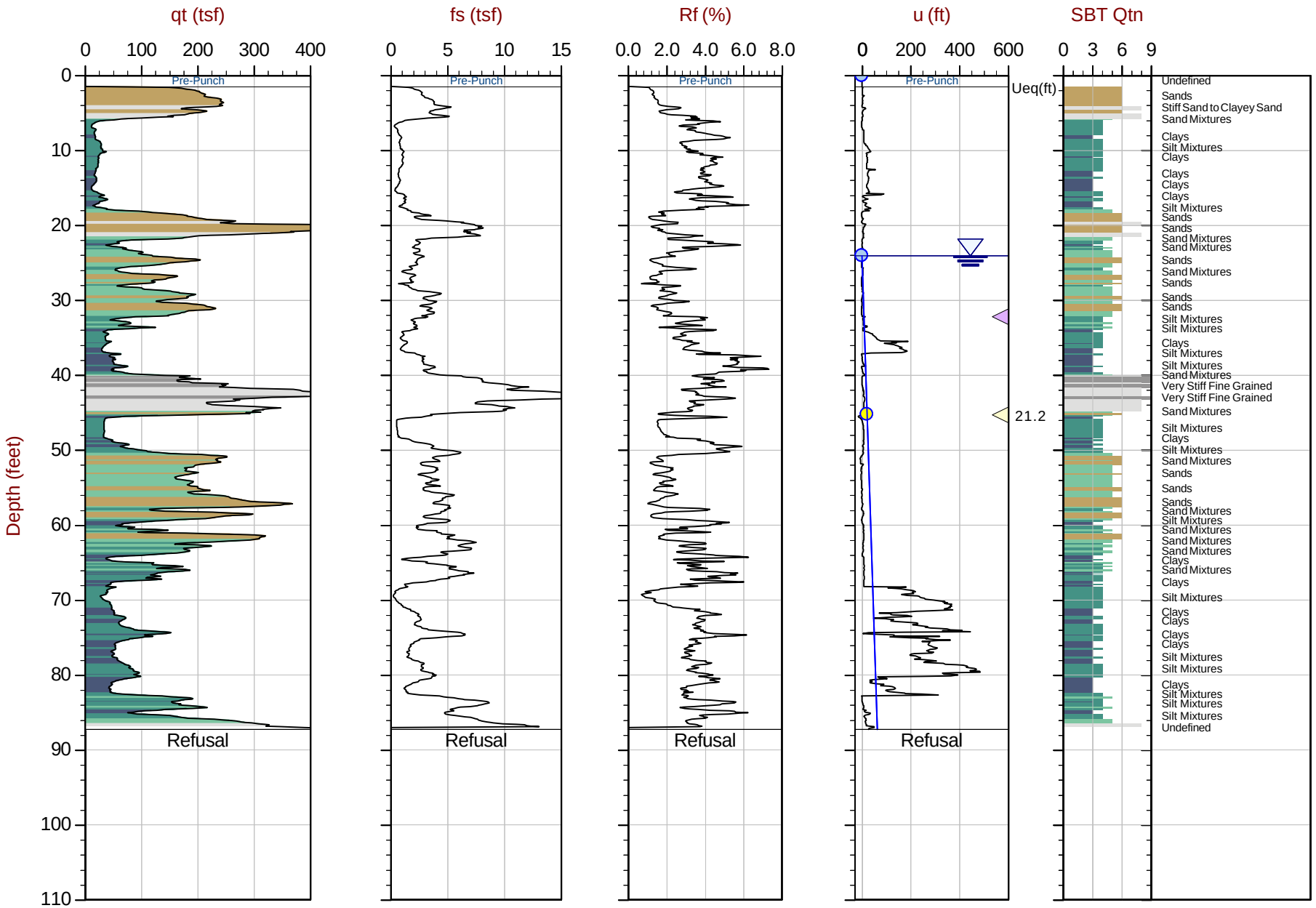
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 11:59
Site: Tanforan Mall Redevelopment

Sounding: CPT-03
Cone: 813:T1500F15U35



Max Depth: 26.600 m / 87.27 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165807m E: 551294m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

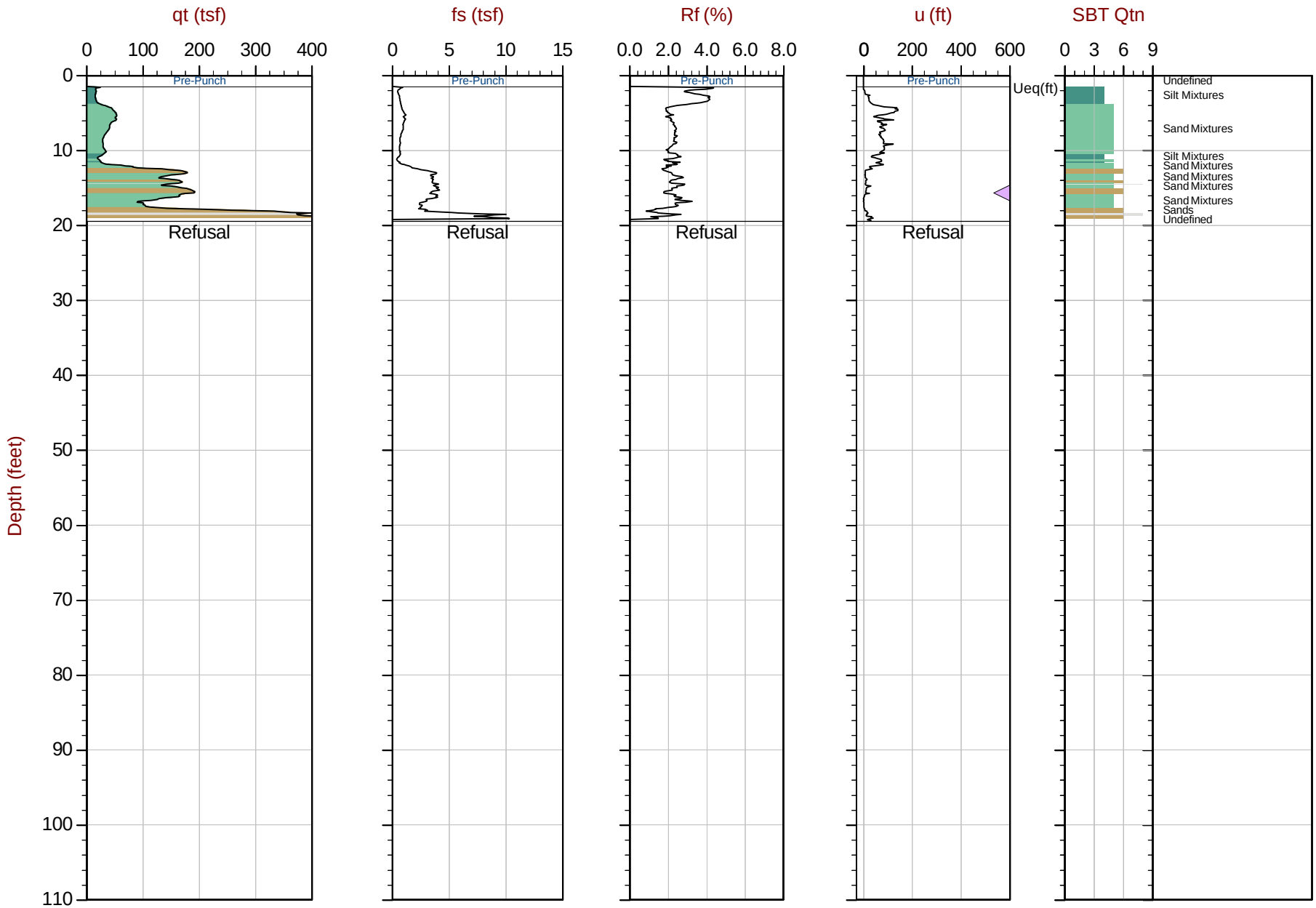
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 07:57
Site: Tanforan Mall Redevelopment

Sounding: CPT-04
Cone: 813:T1500F15U35



Max Depth: 5.925 m / 19.44 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165687m E: 551099m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

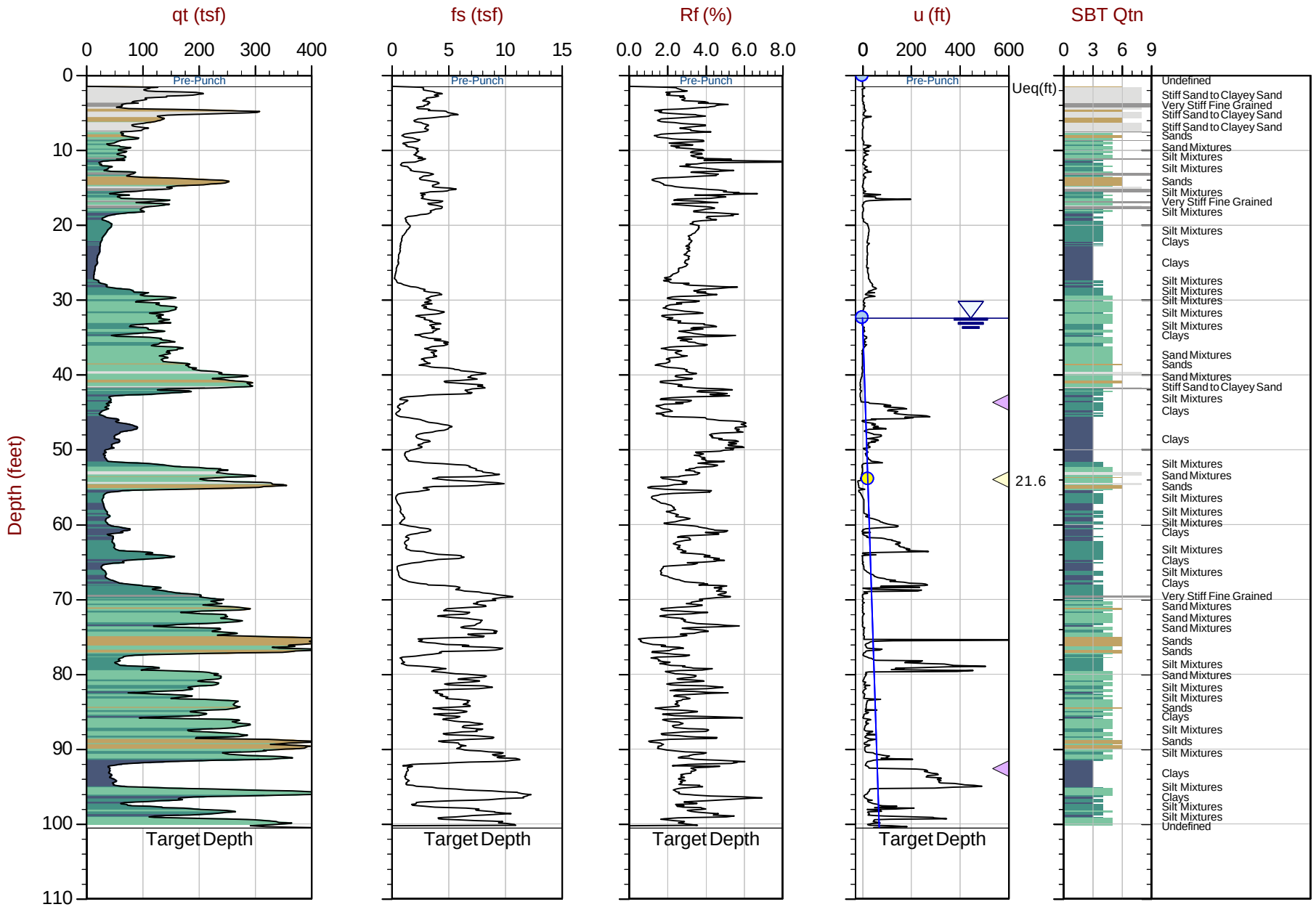
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 09:34
Site: Tanforan Mall Redevelopment

Sounding: CPT-05
Cone: 813:T1500F15U35



Max Depth: 30.650 m / 100.56 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165596m E: 551219m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

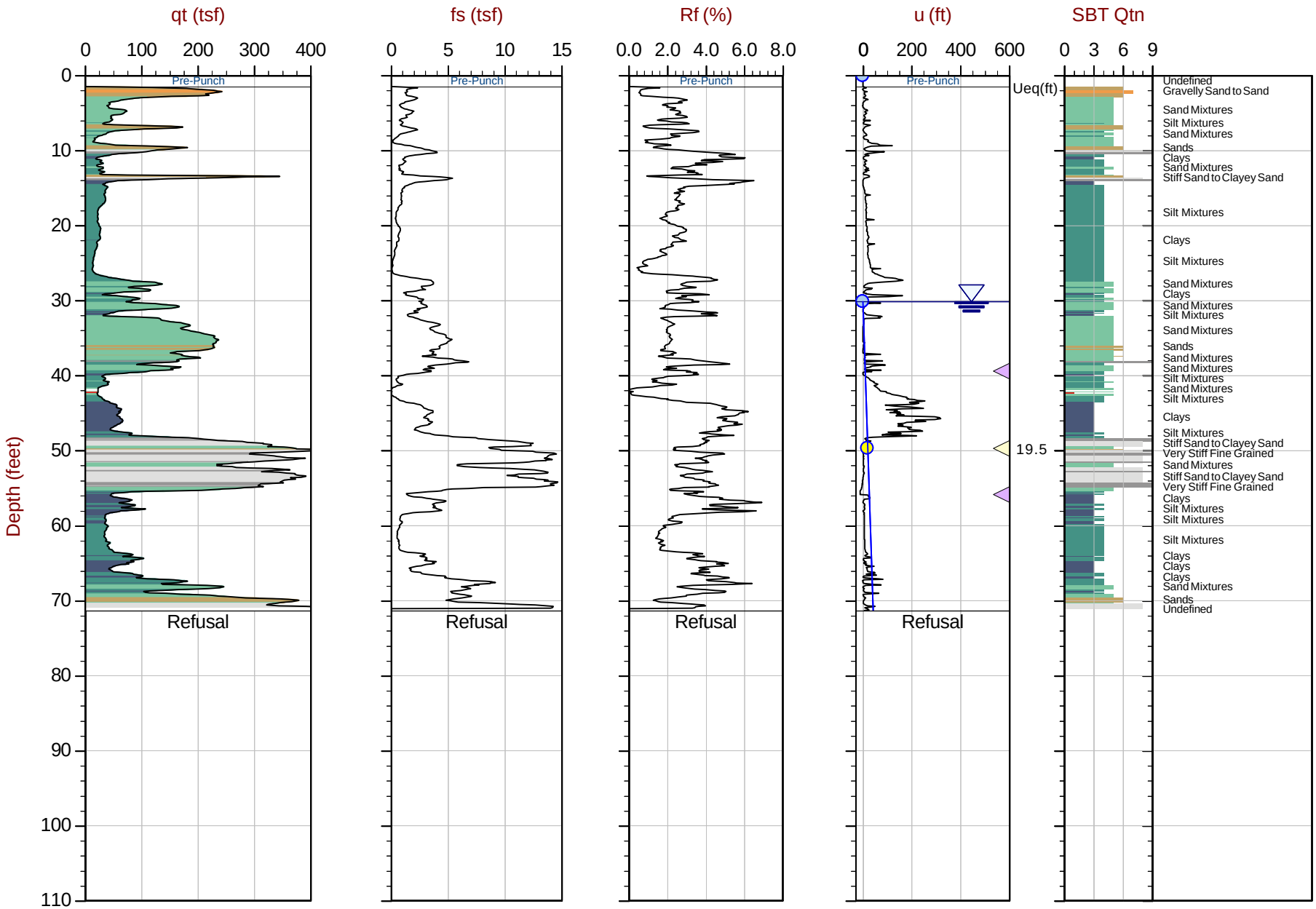
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 14:15
Site: Tanforan Mall Redevelopment

Sounding: CPT-06
Cone: 813:T1500F15U35



Max Depth: 21.750 m / 71.36 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_CP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165541m E: 551219m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

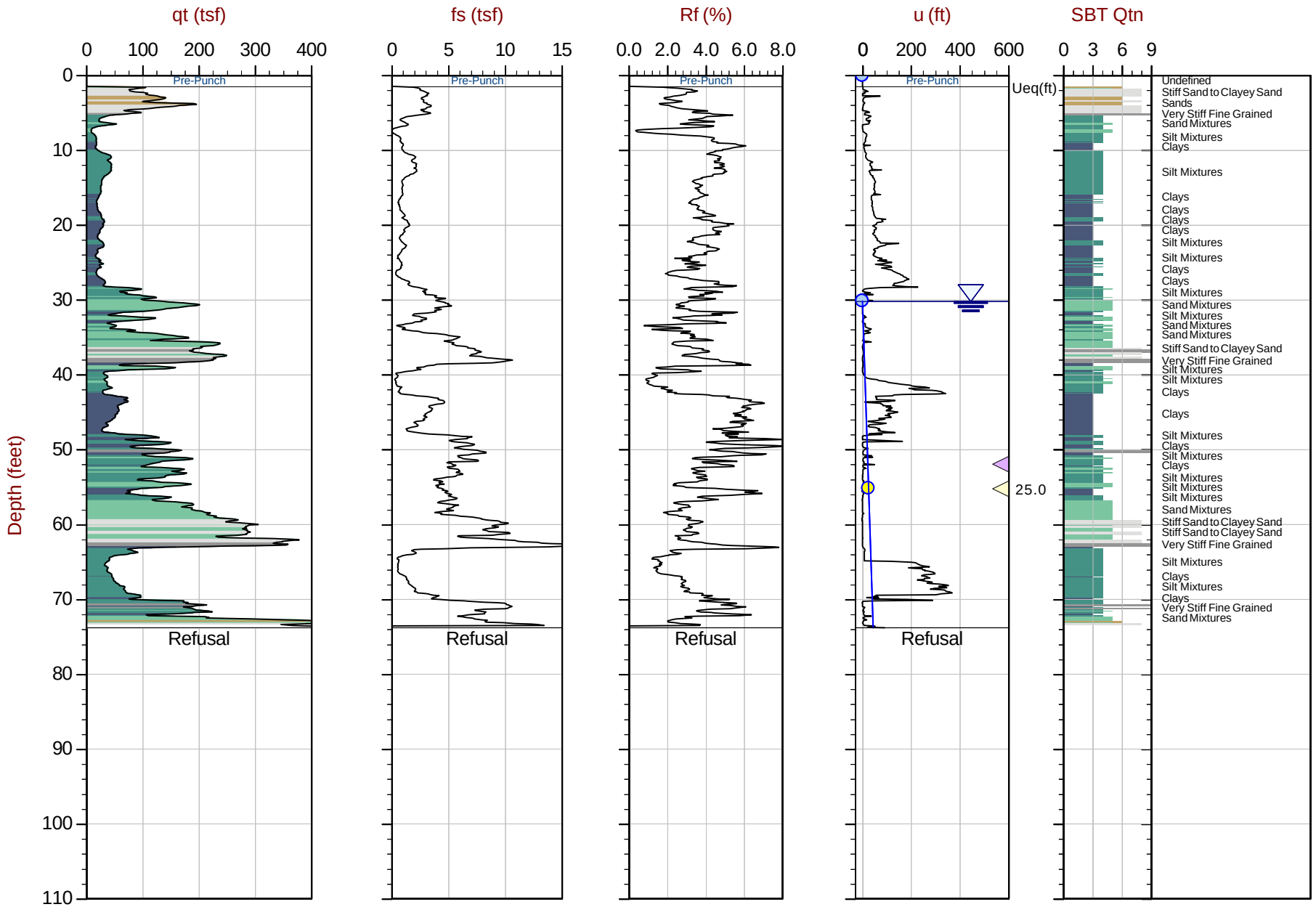
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 10:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-07
Cone: 813:T1500F15U35



Max Depth: 22.500 m / 73.82 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_CP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165503m E: 551201m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

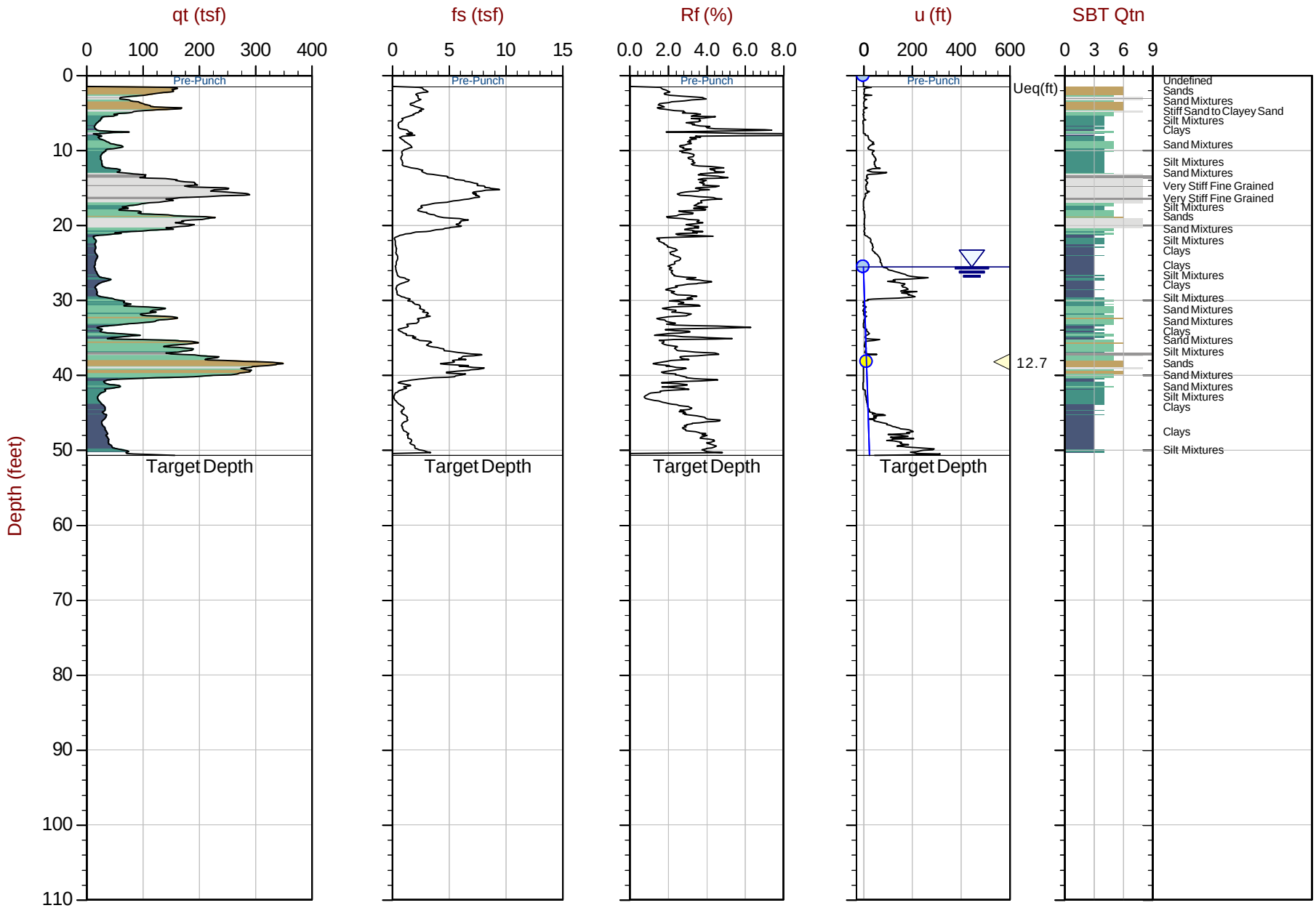
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 07:22
Site: Tanforan Mall Redevelopment

Sounding: CPT-08
Cone: 813:T1500F15U35



Max Depth: 15.450 m / 50.69 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165443m E: 551257m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

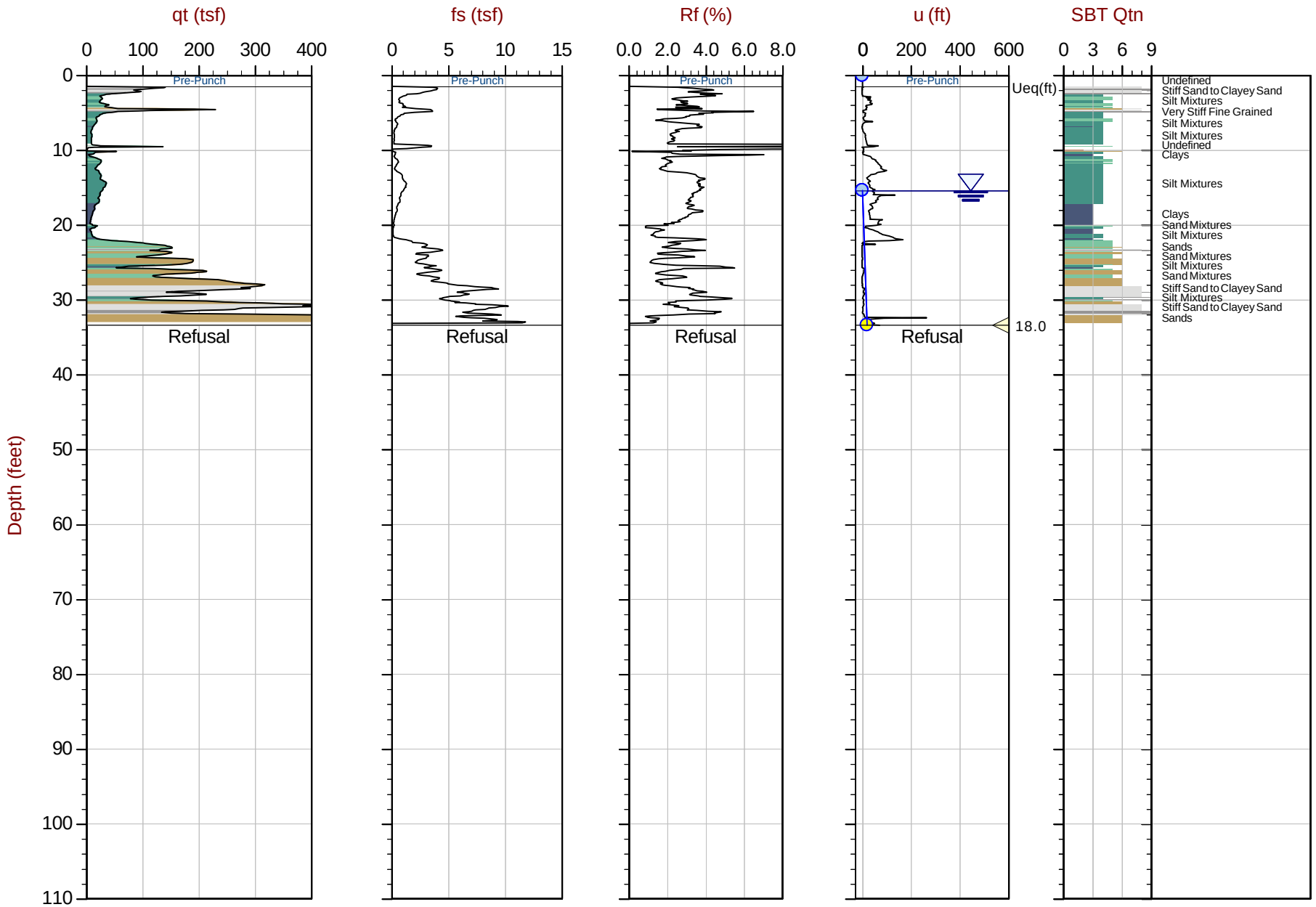
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 07:39
Site: Tanforan Mall Redevelopment

Sounding: CPT-09
Cone: 813:T1500F15U35



Max Depth: 10.175 m / 33.38 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP09.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165763m E: 551409m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

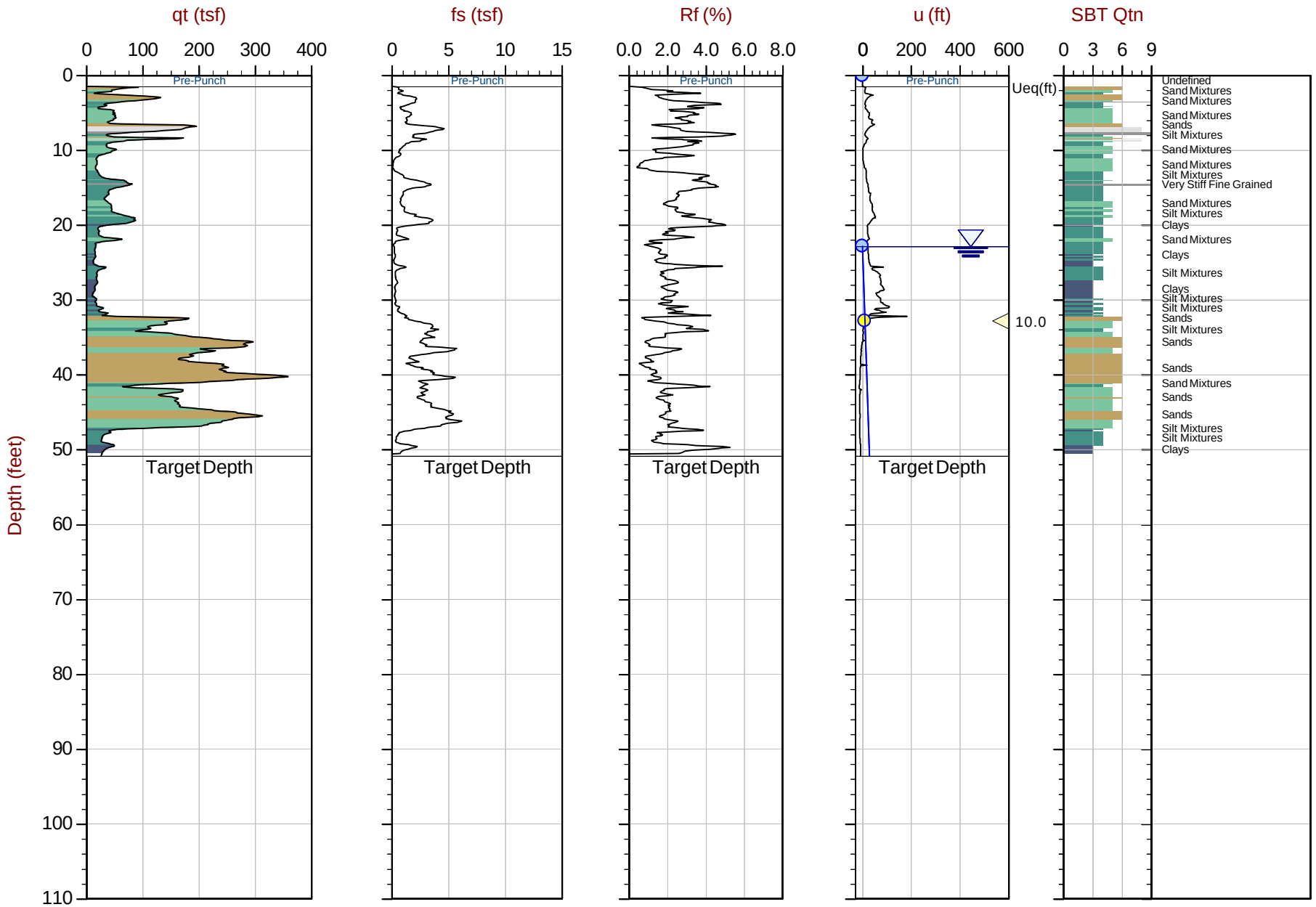
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 12:05
Site: Tanforan Mall Redevelopment

Sounding: CPT-10
Cone: 815:T1500F15U35



Max Depth: 15.500 m / 50.85 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP10.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165510m E: 551524m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

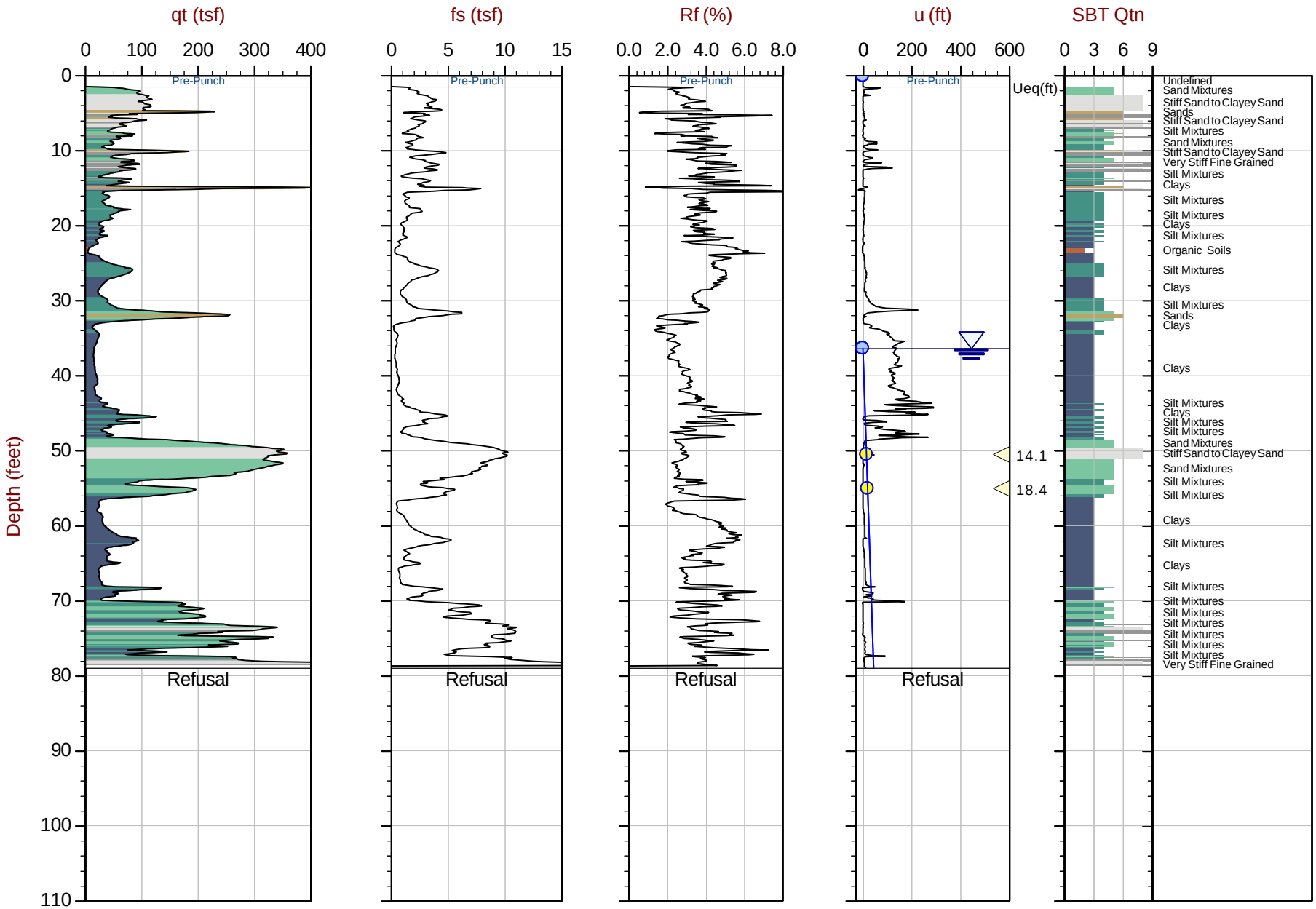
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 08:55
Site: Tanforan Mall Redevelopment

Sounding: CPT-11
Cone: 813:T1500F15U35



Max Depth: 24.075 m / 78.99 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_CP11.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165483m E: 551401m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

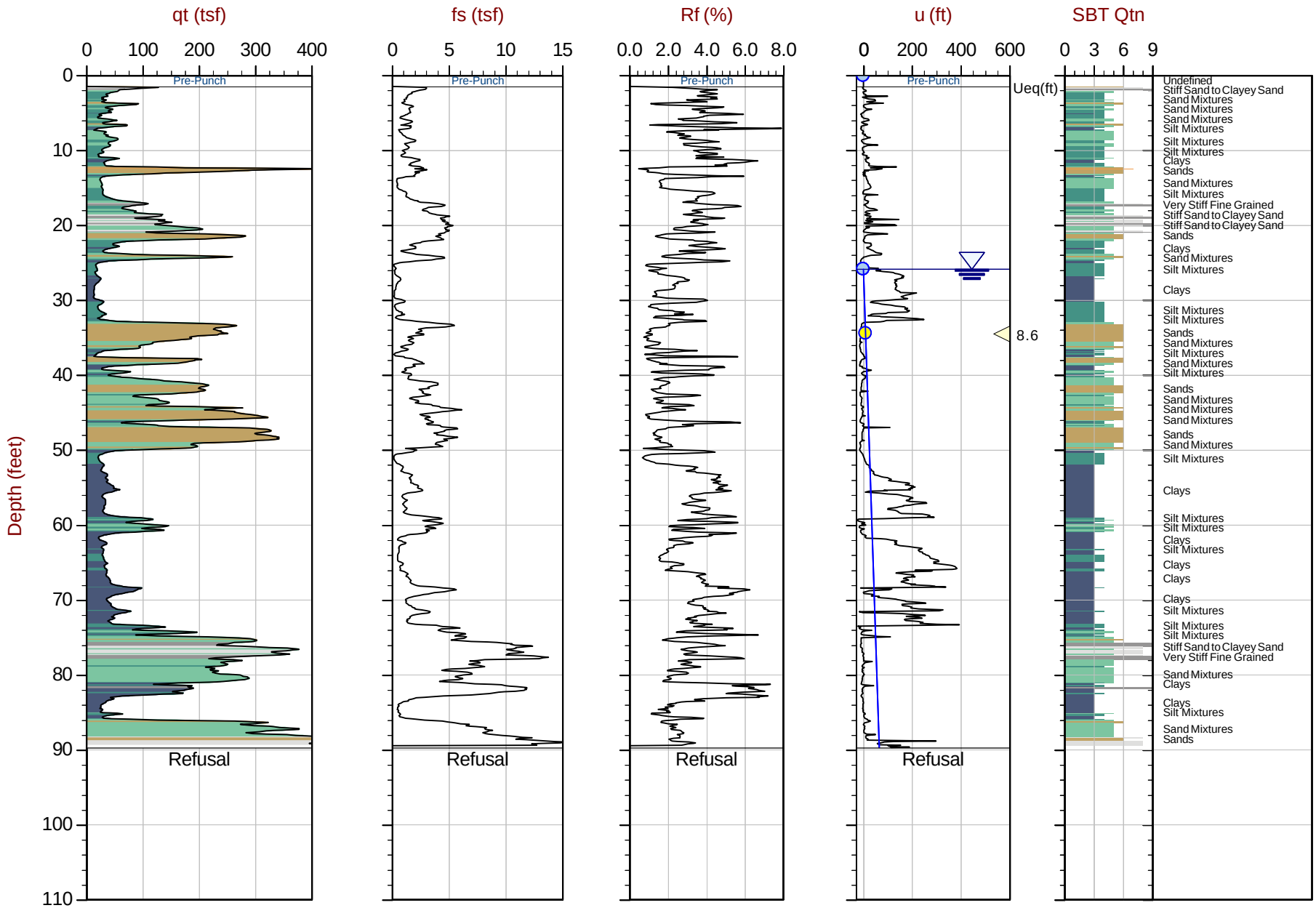
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 13:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-12
Cone: 815:T1500F15U35



Max Depth: 27.350 m / 89.73 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP12.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165486m E: 551592m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Advanced Cone Penetration Test Plots

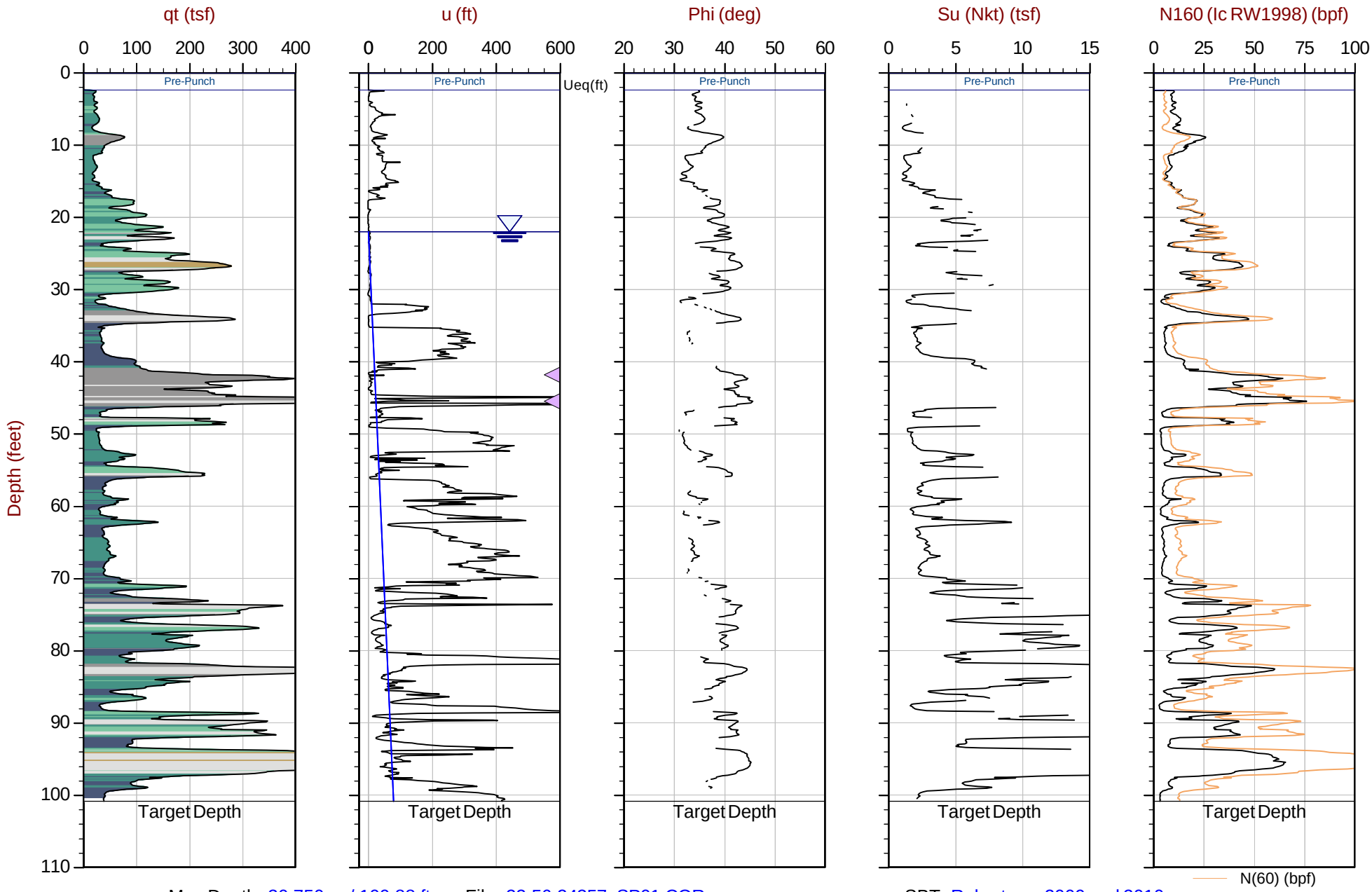


CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 09:18
Site: Tanforan Mall Redevelopment

Sounding: CPT-01
Cone: 813:T1500F15U35



Max Depth: 30.750 m / 100.88 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP01.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4166051m E: 551281m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

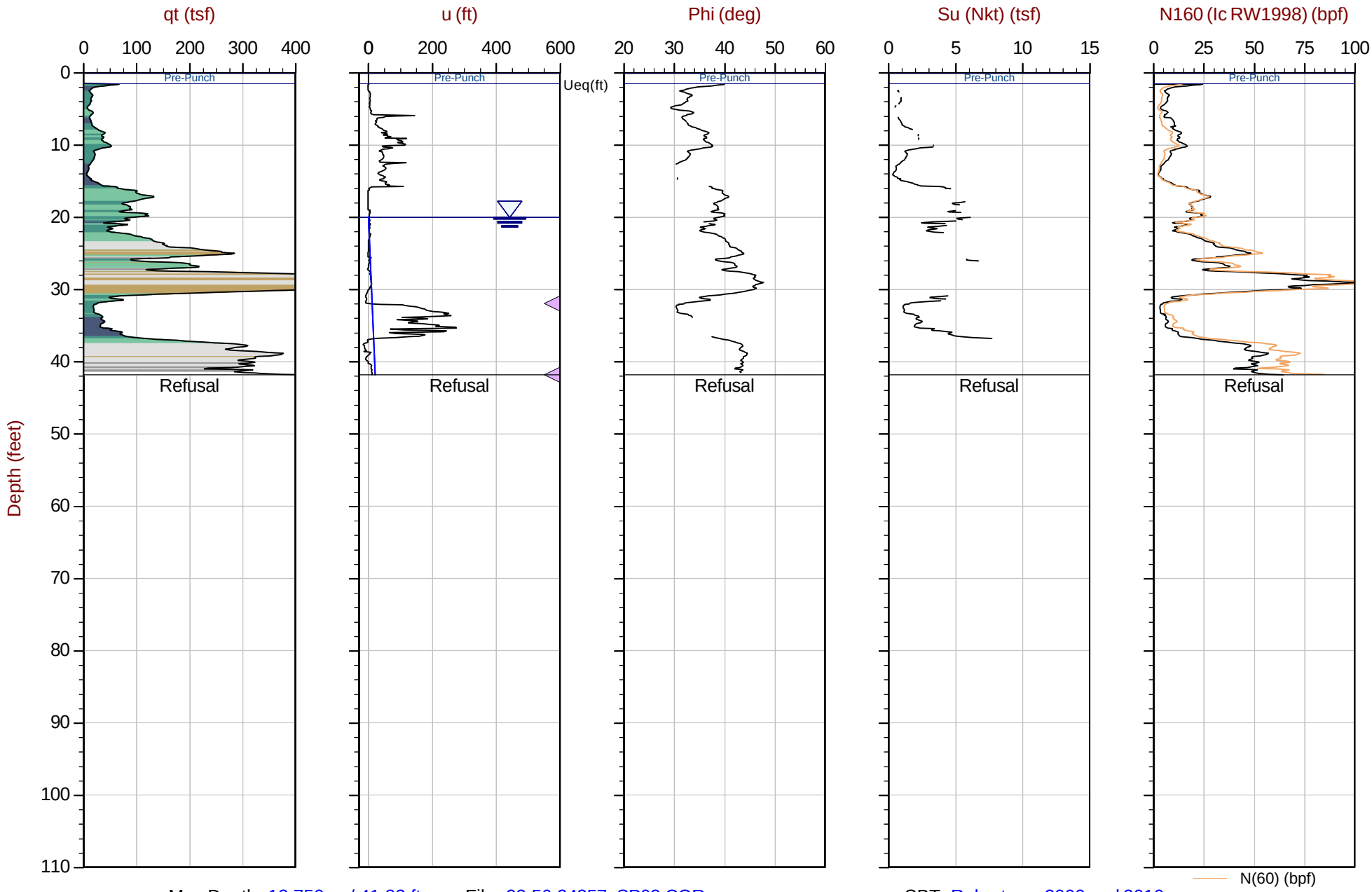
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 12:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-02
Cone: 813:T1500F15U35



Max Depth: 12.750 m / 41.83 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP02.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165928m E: 551335m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

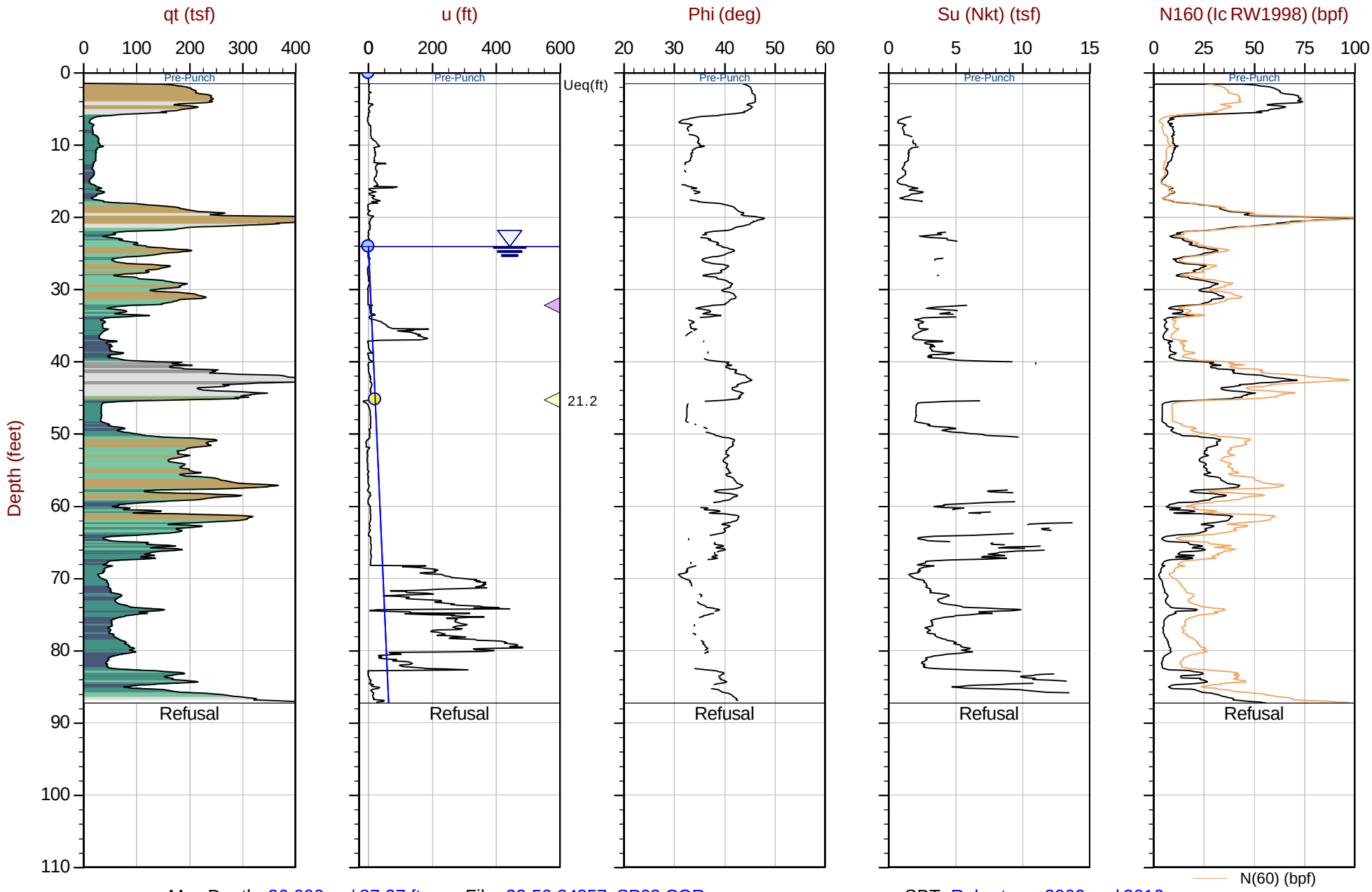
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 11:59
Site: Tanforan Mall Redevelopment

Sounding: CPT-03
Cone: 813:T1500F15U35



Max Depth: 26.600 m / 87.27 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP03.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165807m E: 551294m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

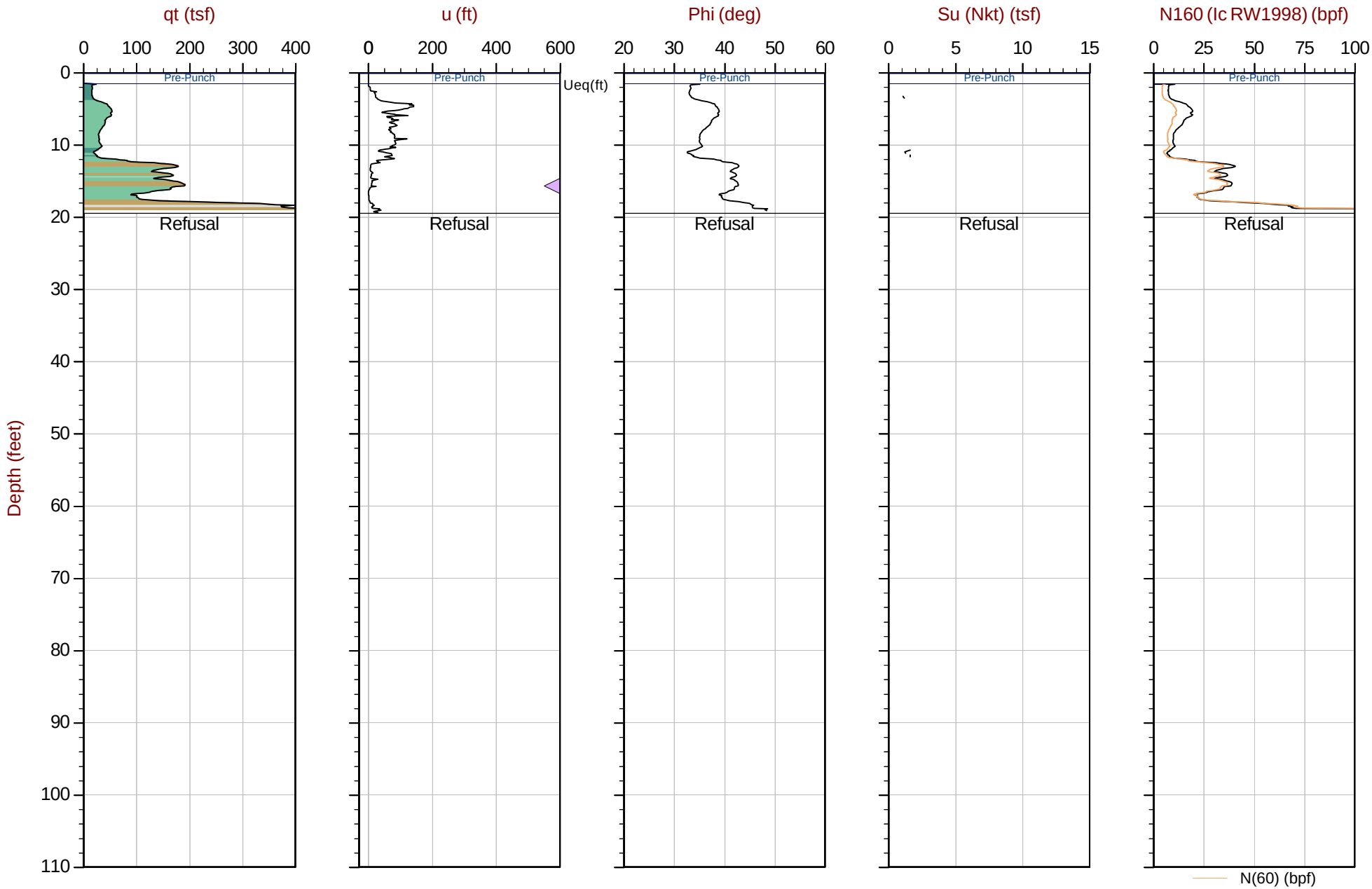
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 07:57
Site: Tanforan Mall Redevelopment

Sounding: CPT-04
Cone: 813:T1500F15U35



Max Depth: 5.925 m / 19.44 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP04.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165687m E: 551099m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

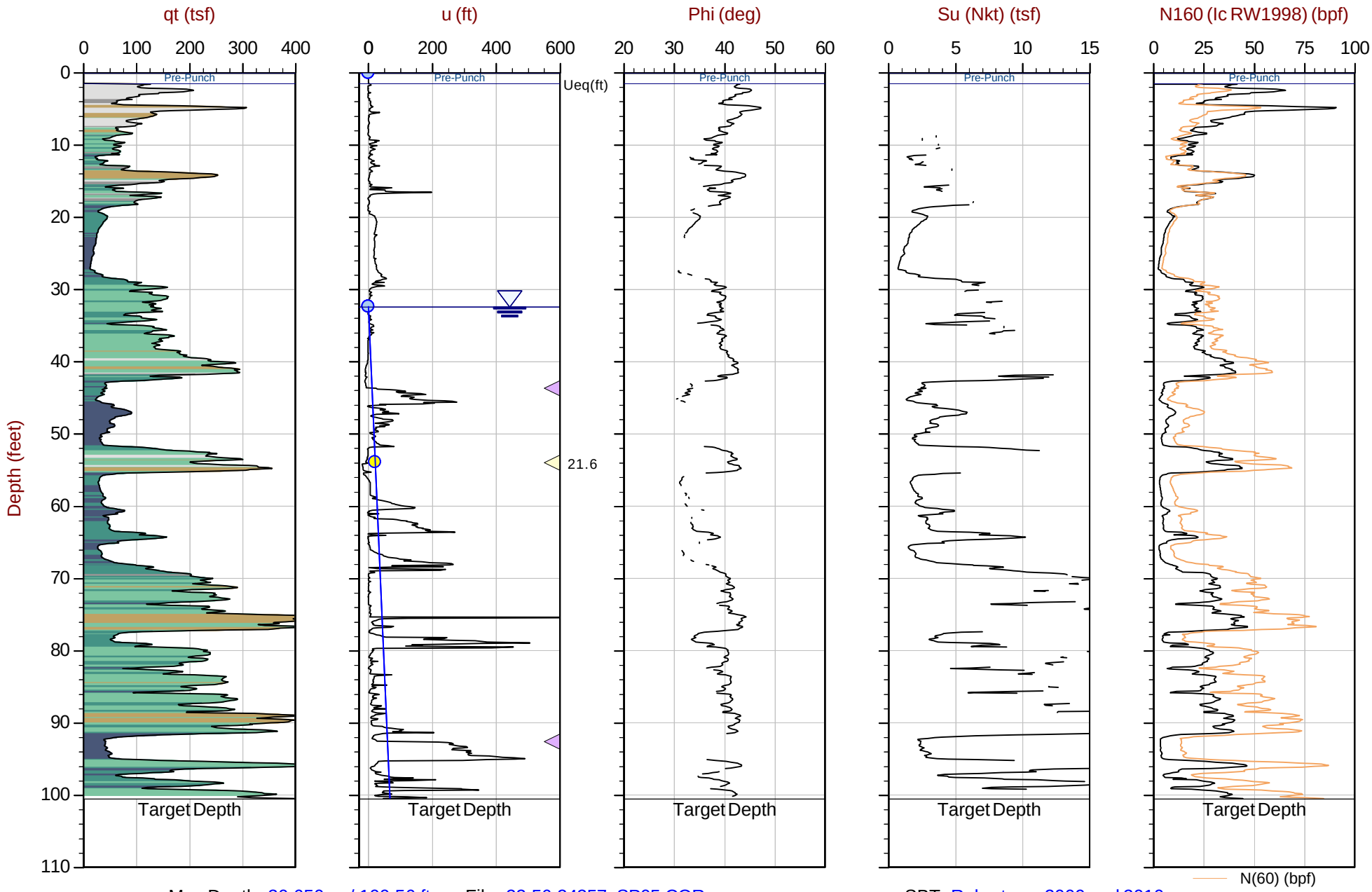
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 09:34
Site: Tanforan Mall Redevelopment

Sounding: CPT-05
Cone: 813:T1500F15U35



Max Depth: 30.650 m / 100.56 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP05.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165596m E: 551219m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

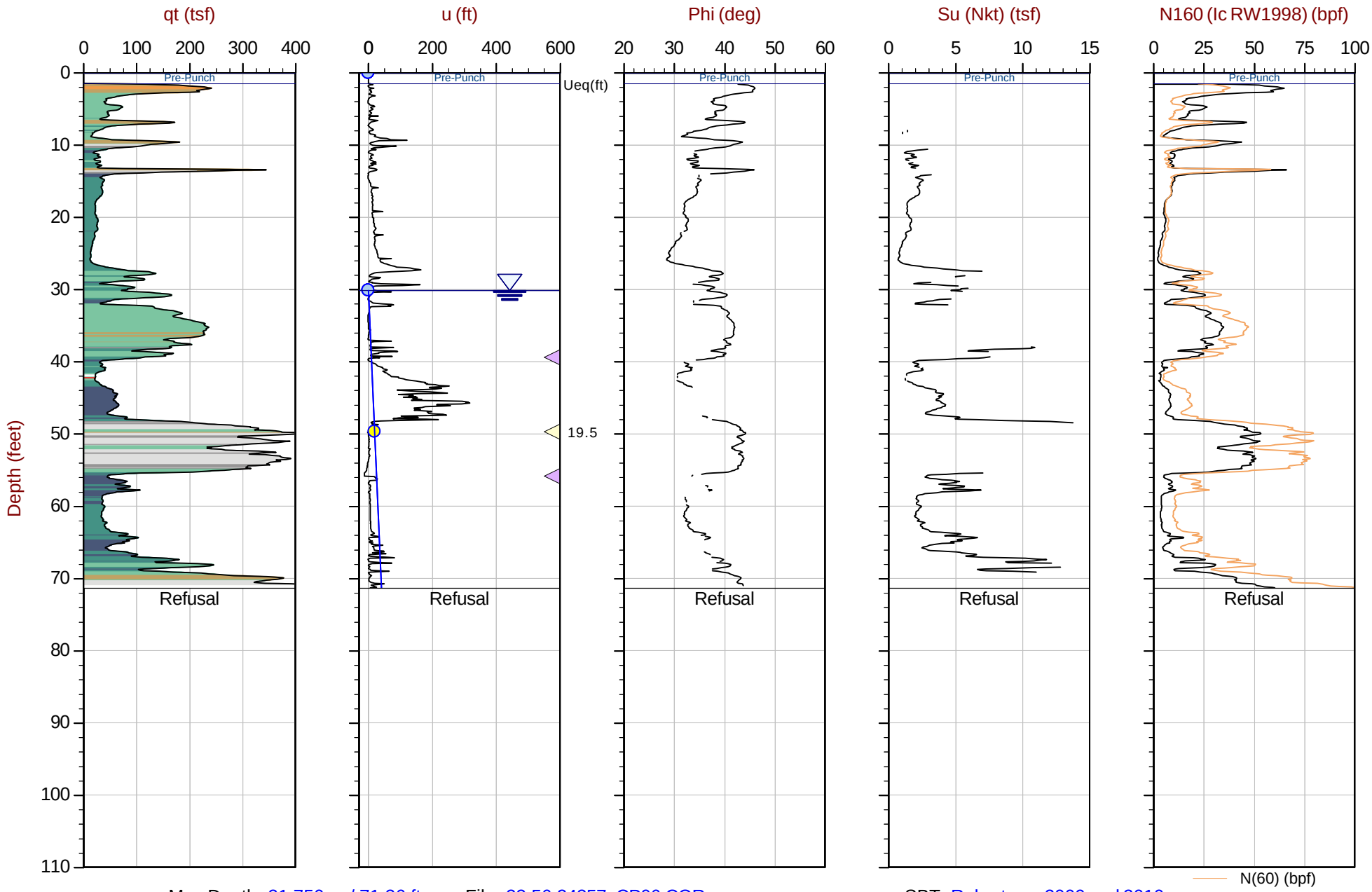
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 14:15
Site: Tanforan Mall Redevelopment

Sounding: CPT-06
Cone: 813:T1500F15U35



Max Depth: 21.750 m / 71.36 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_CP06.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165541m E: 551219m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

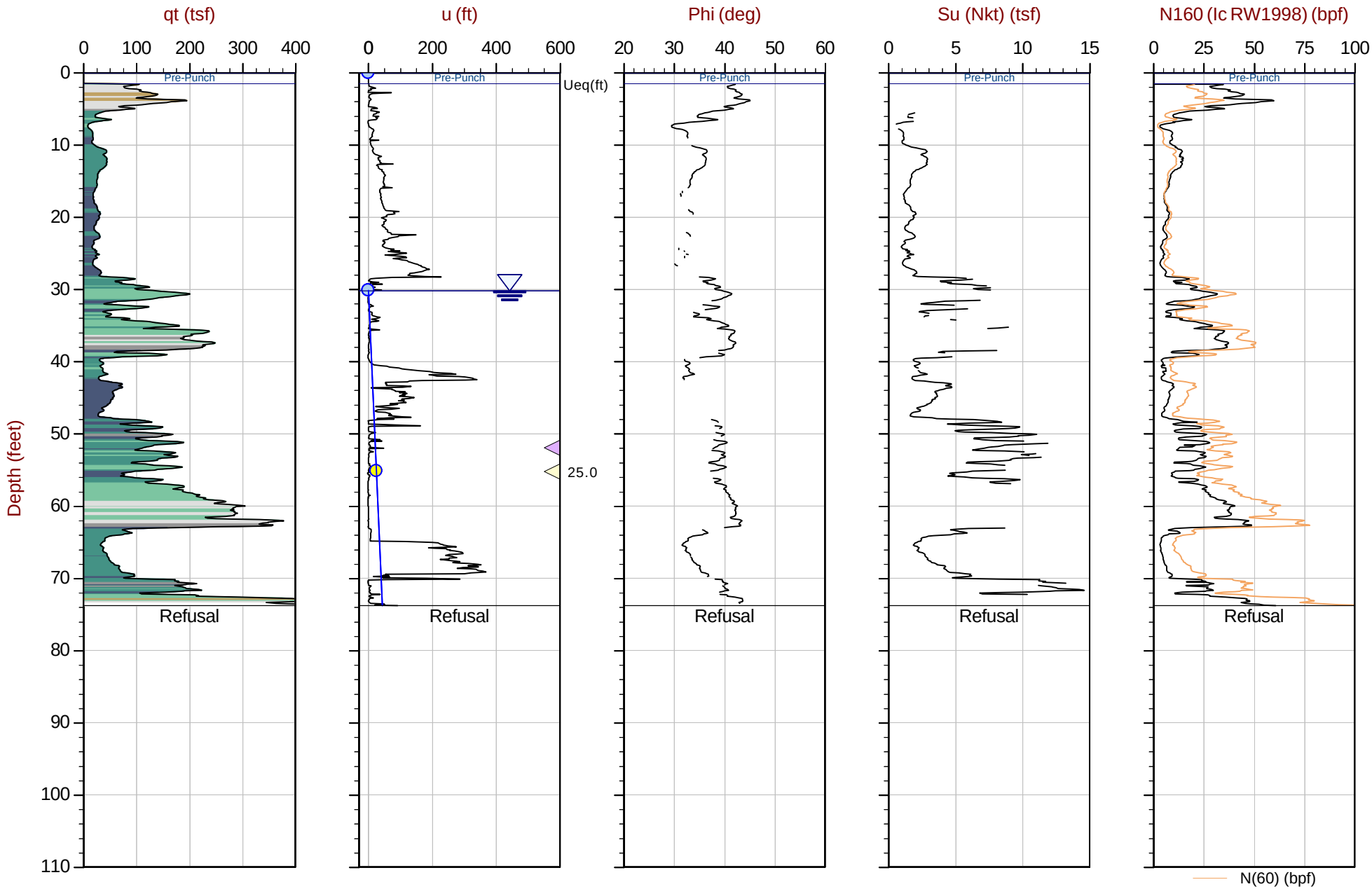
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 10:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-07
Cone: 813:T1500F15U35



Max Depth: 22.500 m / 73.82 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_CP07.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165503m E: 551201m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

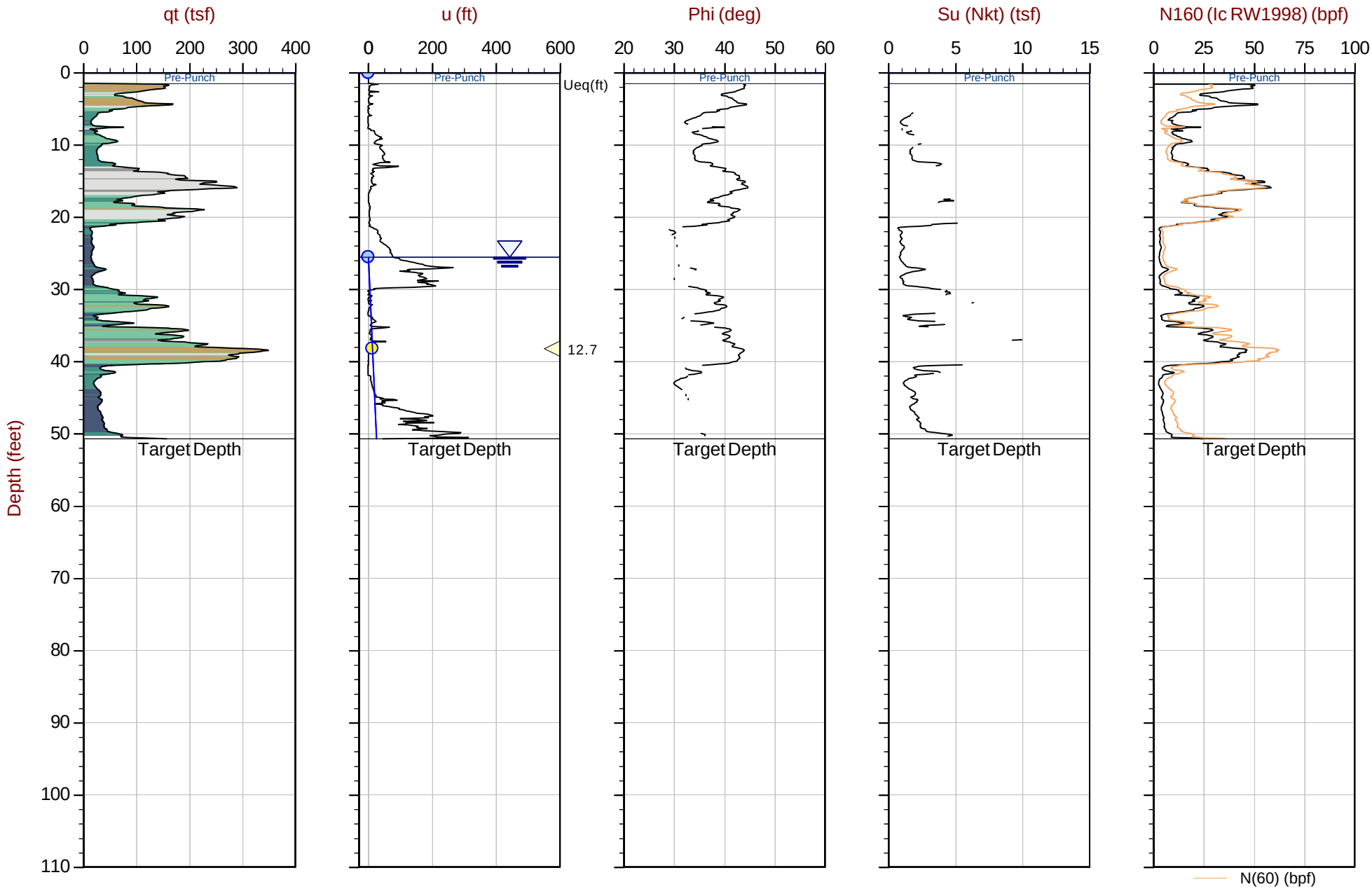
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 07:22
Site: Tanforan Mall Redevelopment

Sounding: CPT-08
Cone: 813:T1500F15U35



Max Depth: 15.450 m / 50.69 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP08.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165443m E: 551257m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

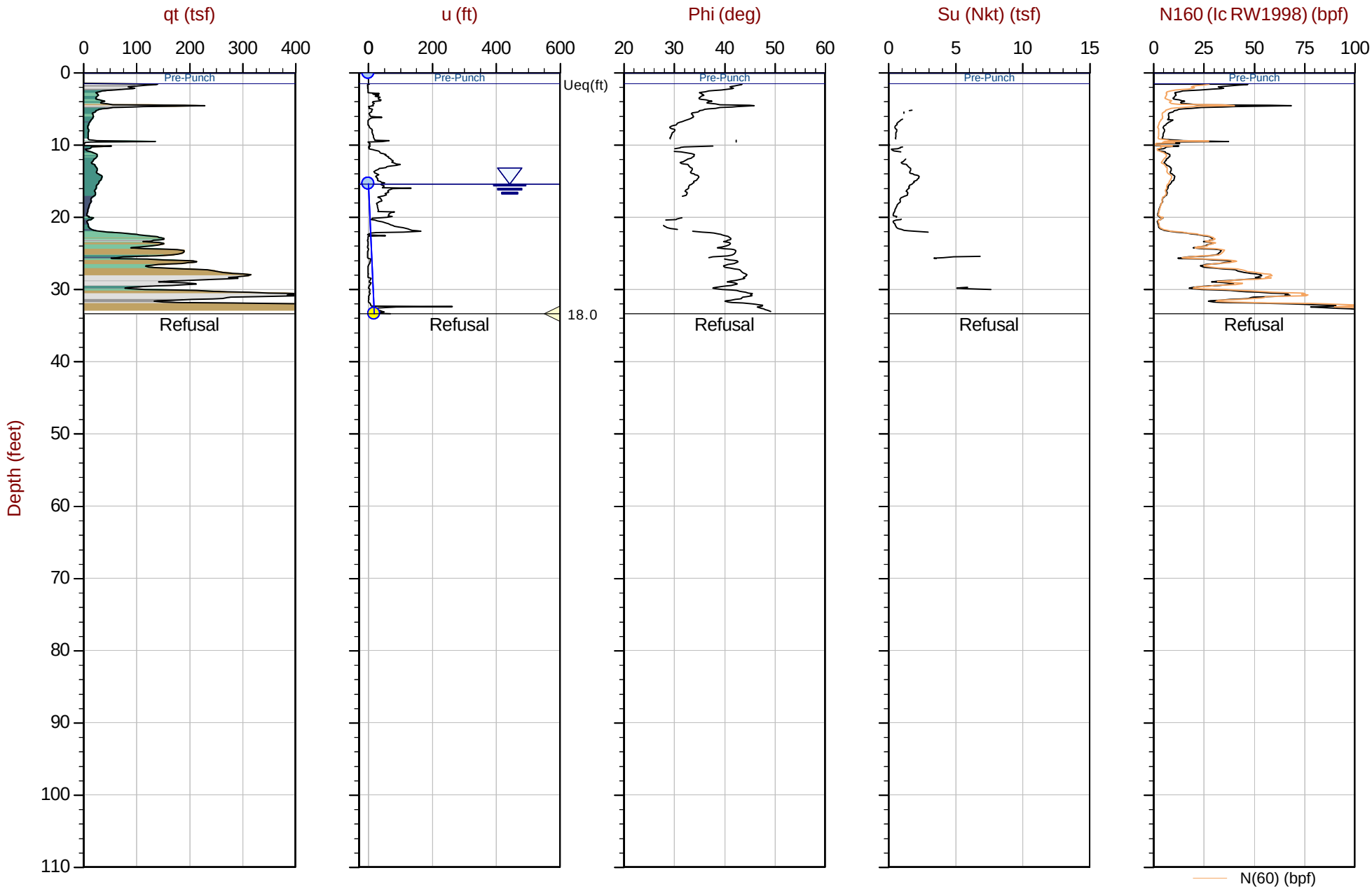
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 07:39
Site: Tanforan Mall Redevelopment

Sounding: CPT-09
Cone: 813:T1500F15U35



Max Depth: 10.175 m / 33.38 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP09.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165763m E: 551409m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

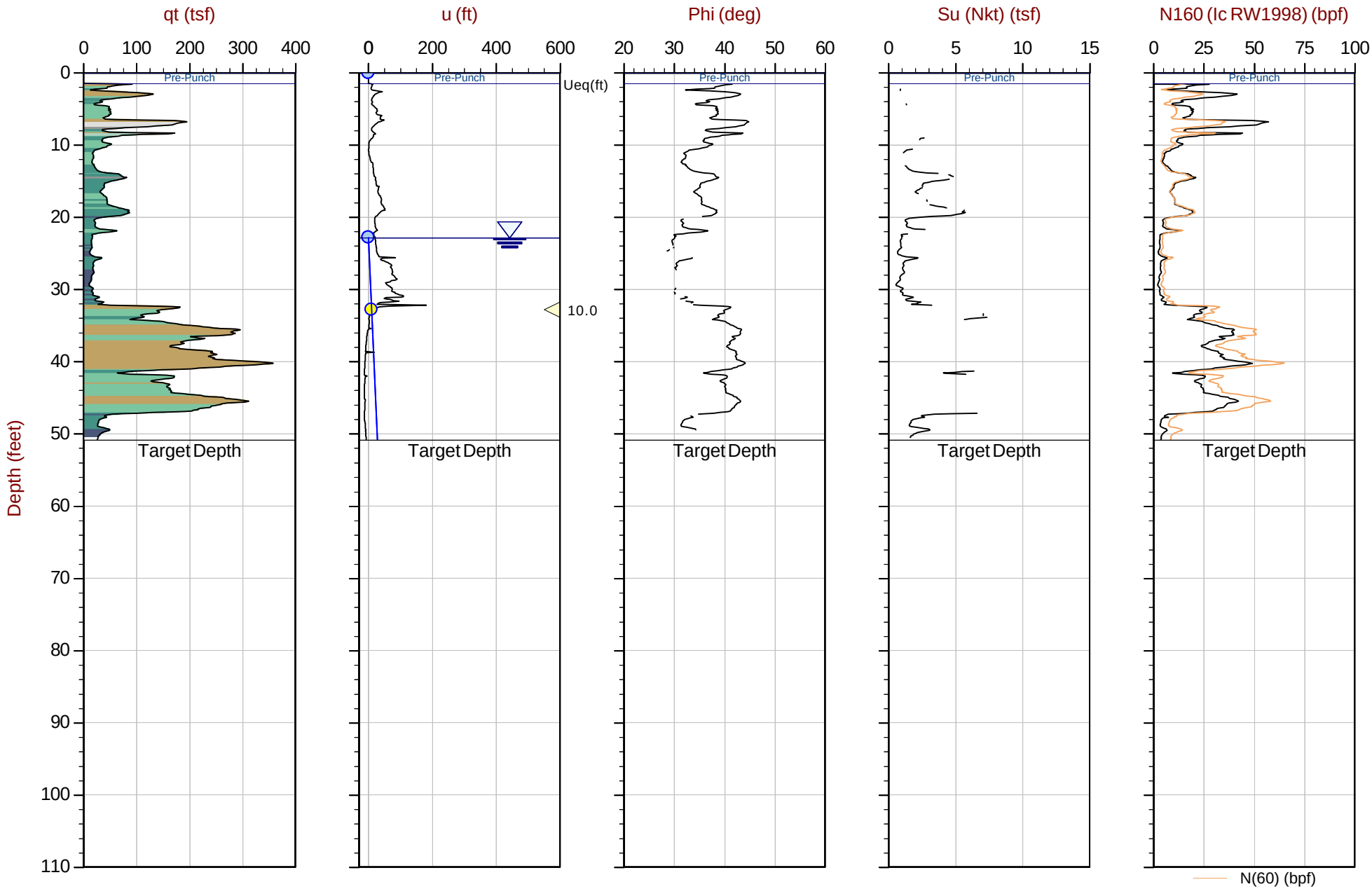
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 12:05
Site: Tanforan Mall Redevelopment

Sounding: CPT-10
Cone: 815:T1500F15U35



Max Depth: 15.500 m / 50.85 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP10.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165510m E: 551524m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

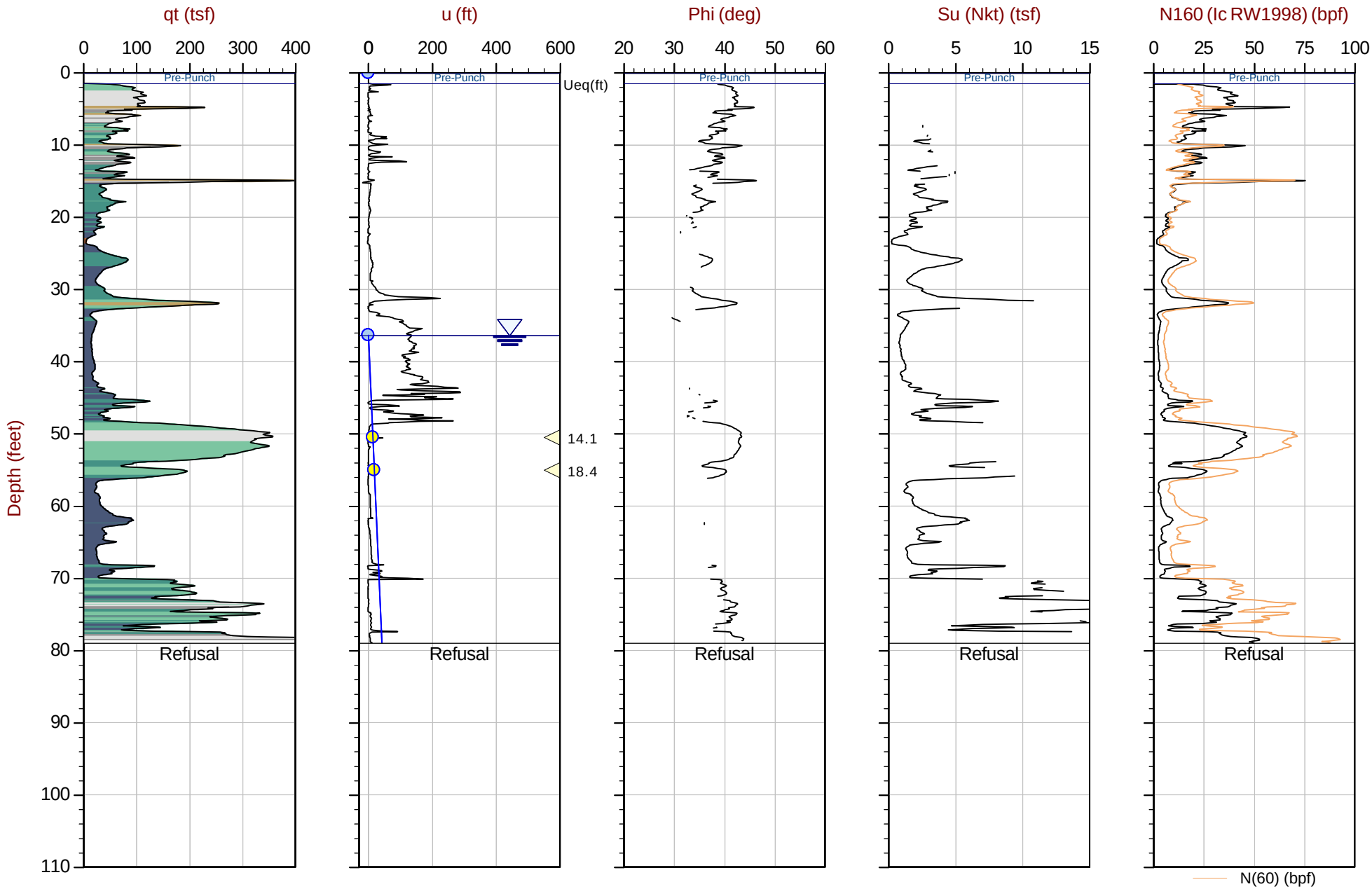
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 08:55
Site: Tanforan Mall Redevelopment

Sounding: CPT-11
Cone: 813:T1500F15U35



Max Depth: 24.075 m / 78.99 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_CP11.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165483m E: 551401m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

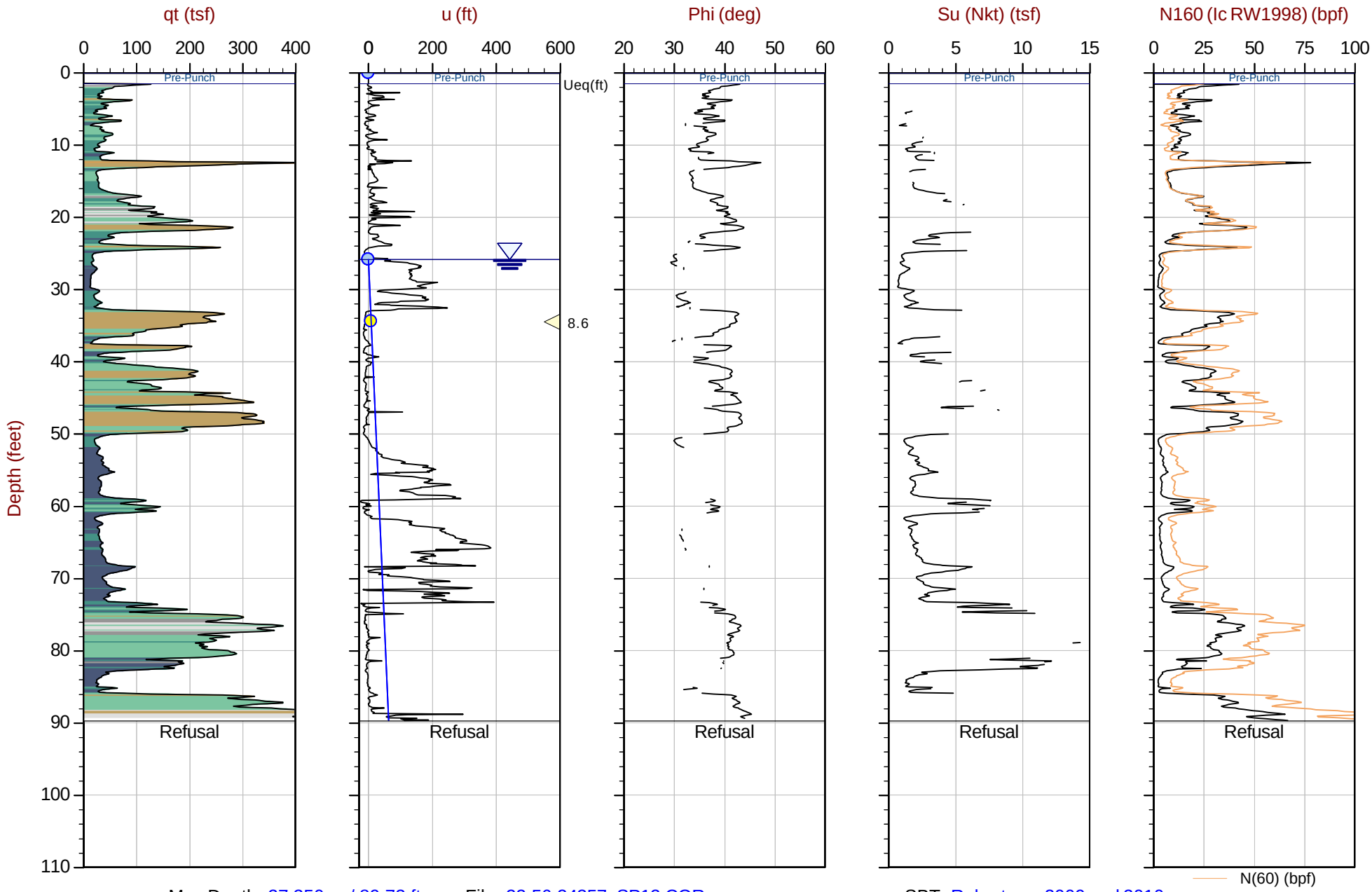
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 13:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-12
Cone: 815:T1500F15U35



Max Depth: 27.350 m / 89.73 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP12.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165486m E: 551592m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

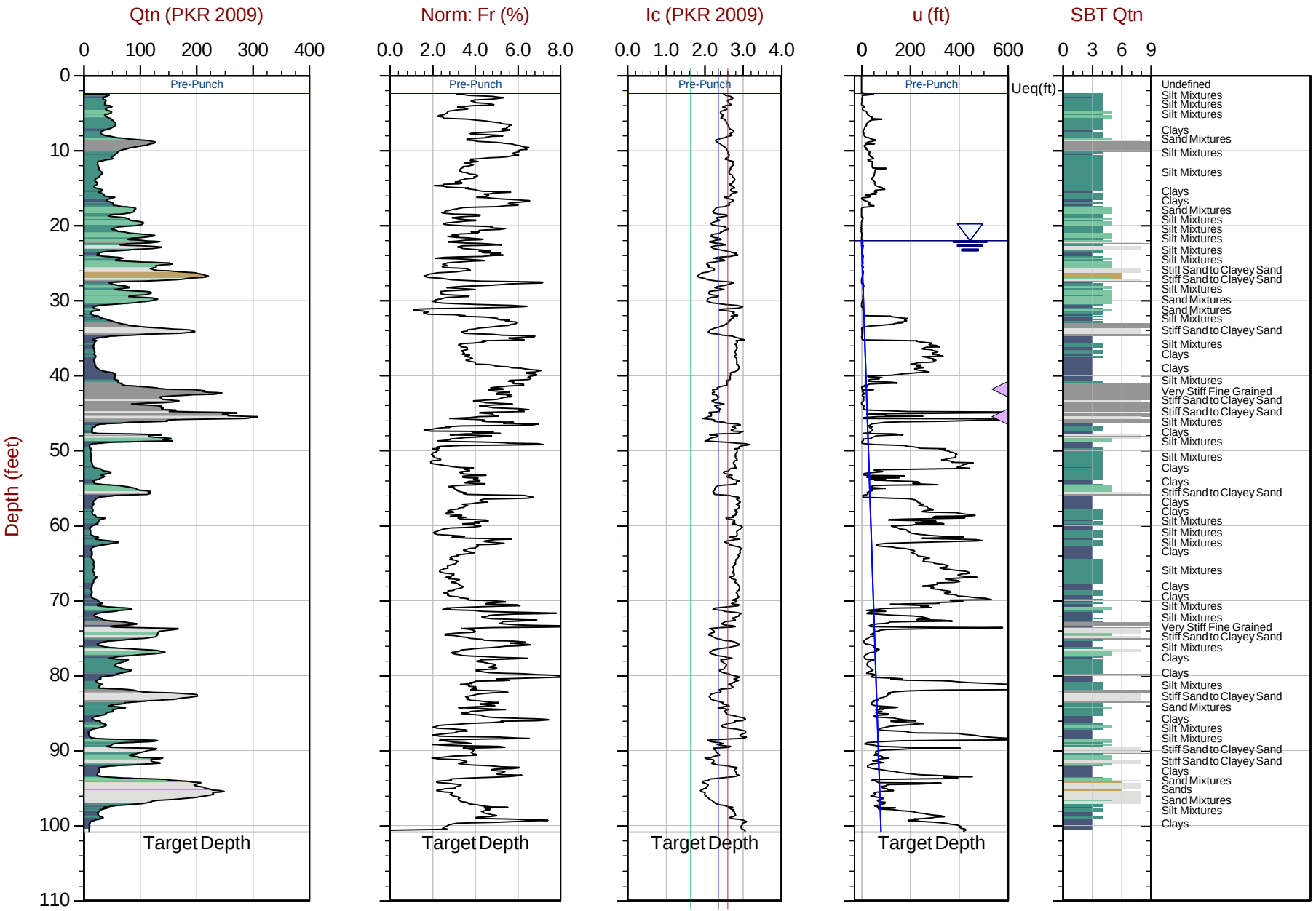
Normalized Cone Penetration Test Plots

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 09:18
Site: Tanforan Mall Redevelopment

Sounding: CPT-01
Cone: 813:T1500F15U35



Max Depth: 30.750 m / 100.88 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP01.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4166051m E: 551281m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

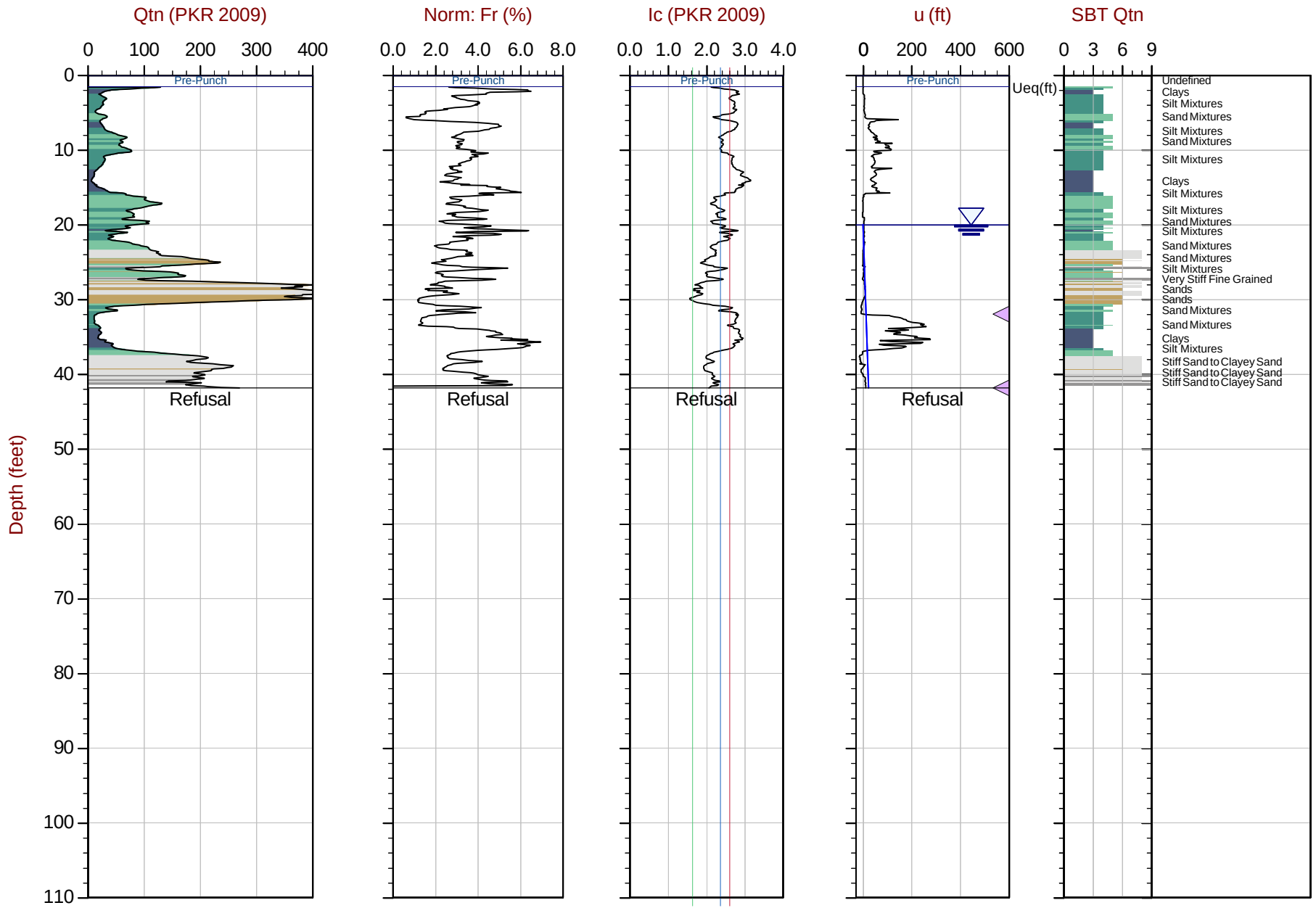
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 12:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-02
Cone: 813:T1500F15U35



Max Depth: 12.750 m / 41.83 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP02.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165928m E: 551335m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

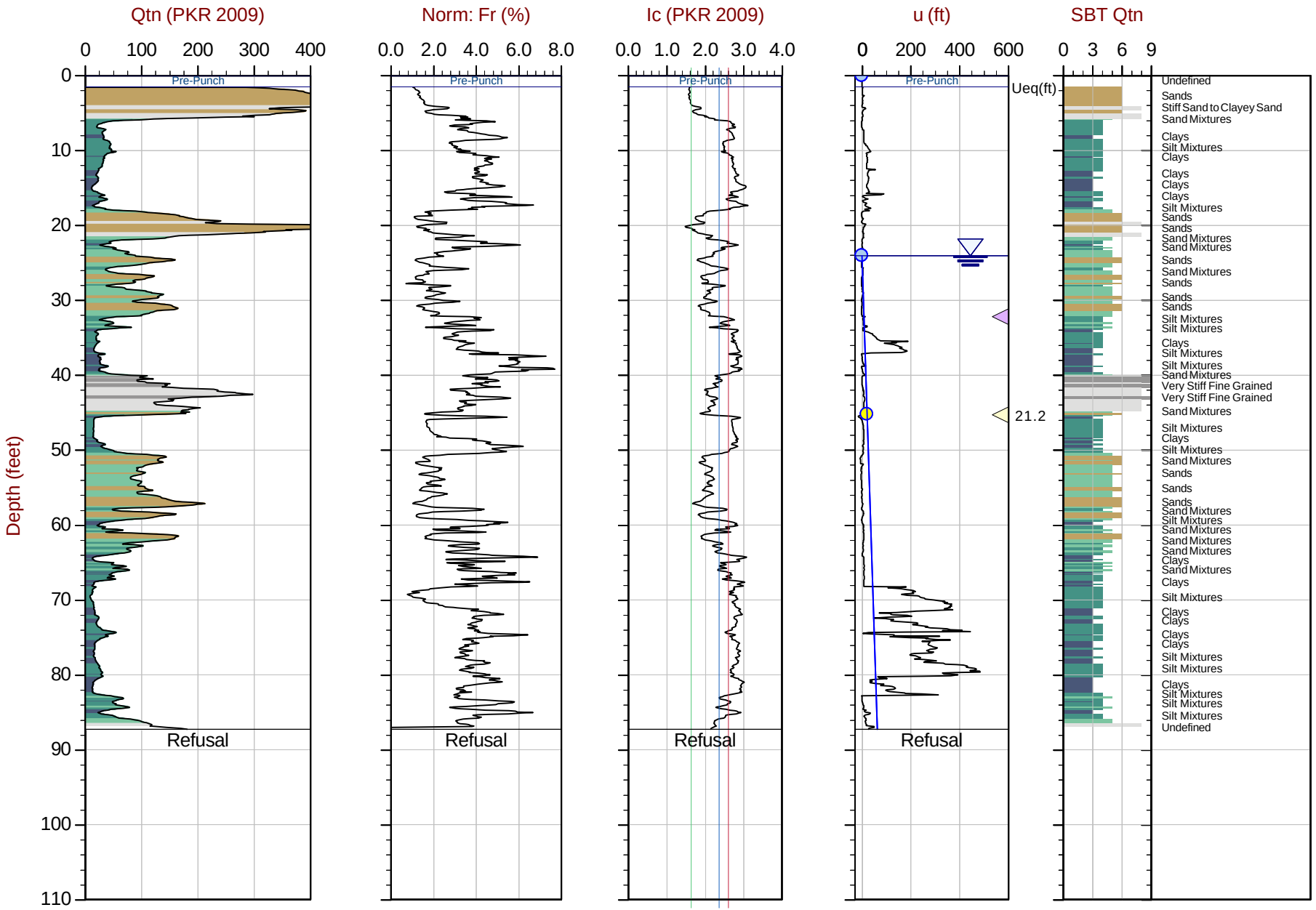
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 11:59
Site: Tanforan Mall Redevelopment

Sounding: CPT-03
Cone: 813:T1500F15U35



Max Depth: 26.600 m / 87.27 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165807m E: 551294m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

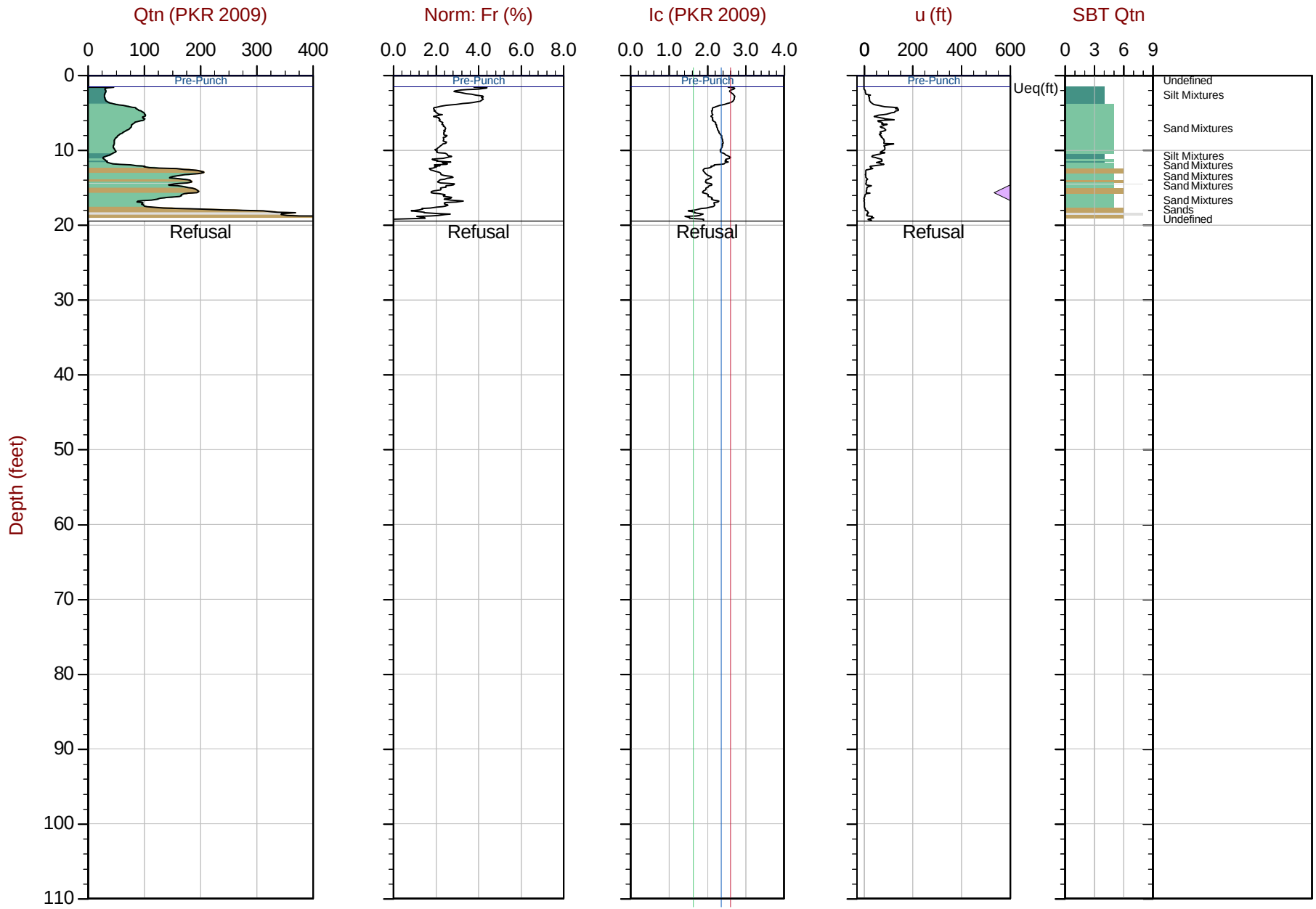
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 07:57
Site: Tanforan Mall Redevelopment

Sounding: CPT-04
Cone: 813:T1500F15U35



Max Depth: 5.925 m / 19.44 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165687m E: 551099m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

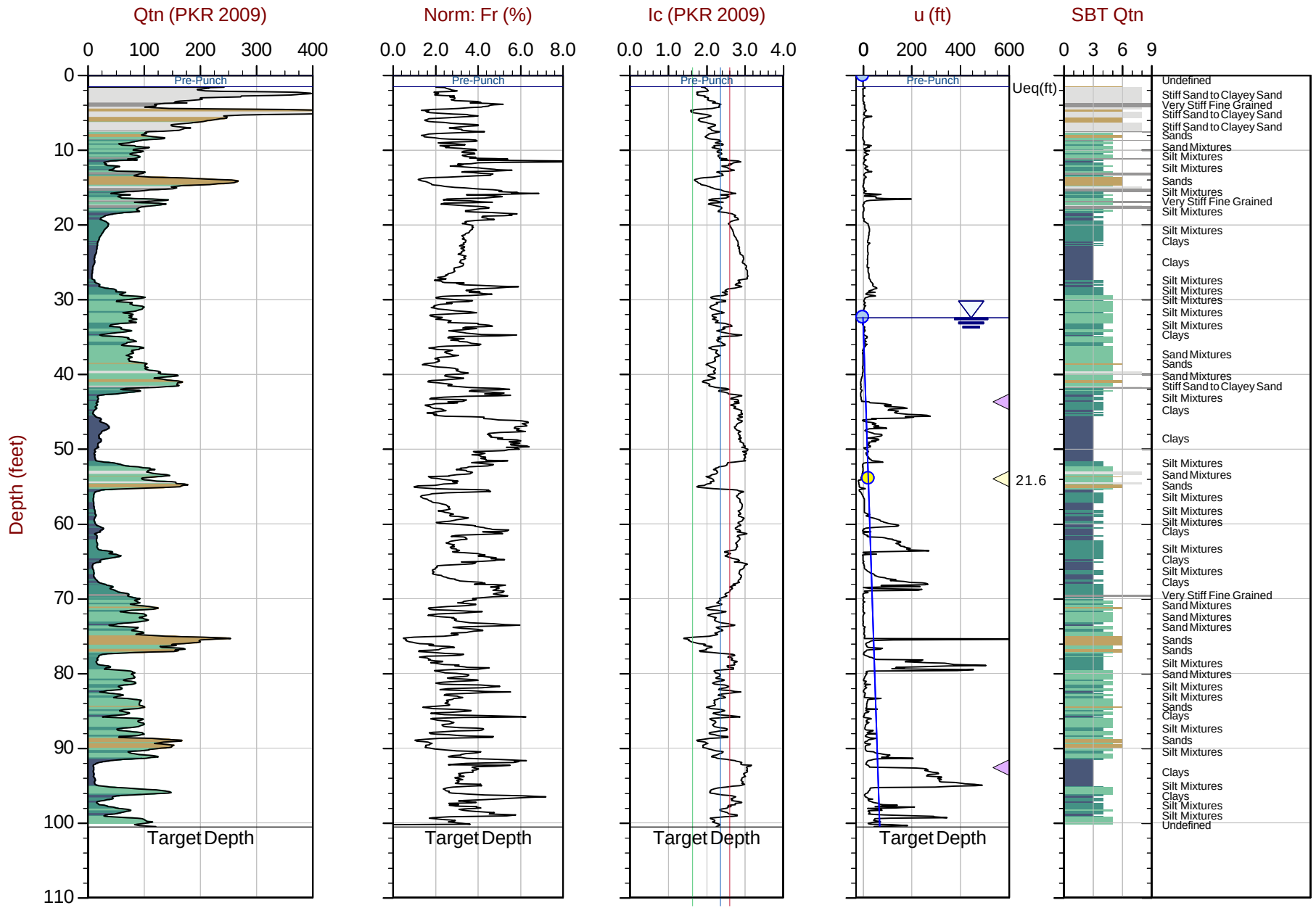
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 09:34
Site: Tanforan Mall Redevelopment

Sounding: CPT-05
Cone: 813:T1500F15U35



Max Depth: 30.650 m / 100.56 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165596m E: 551219m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

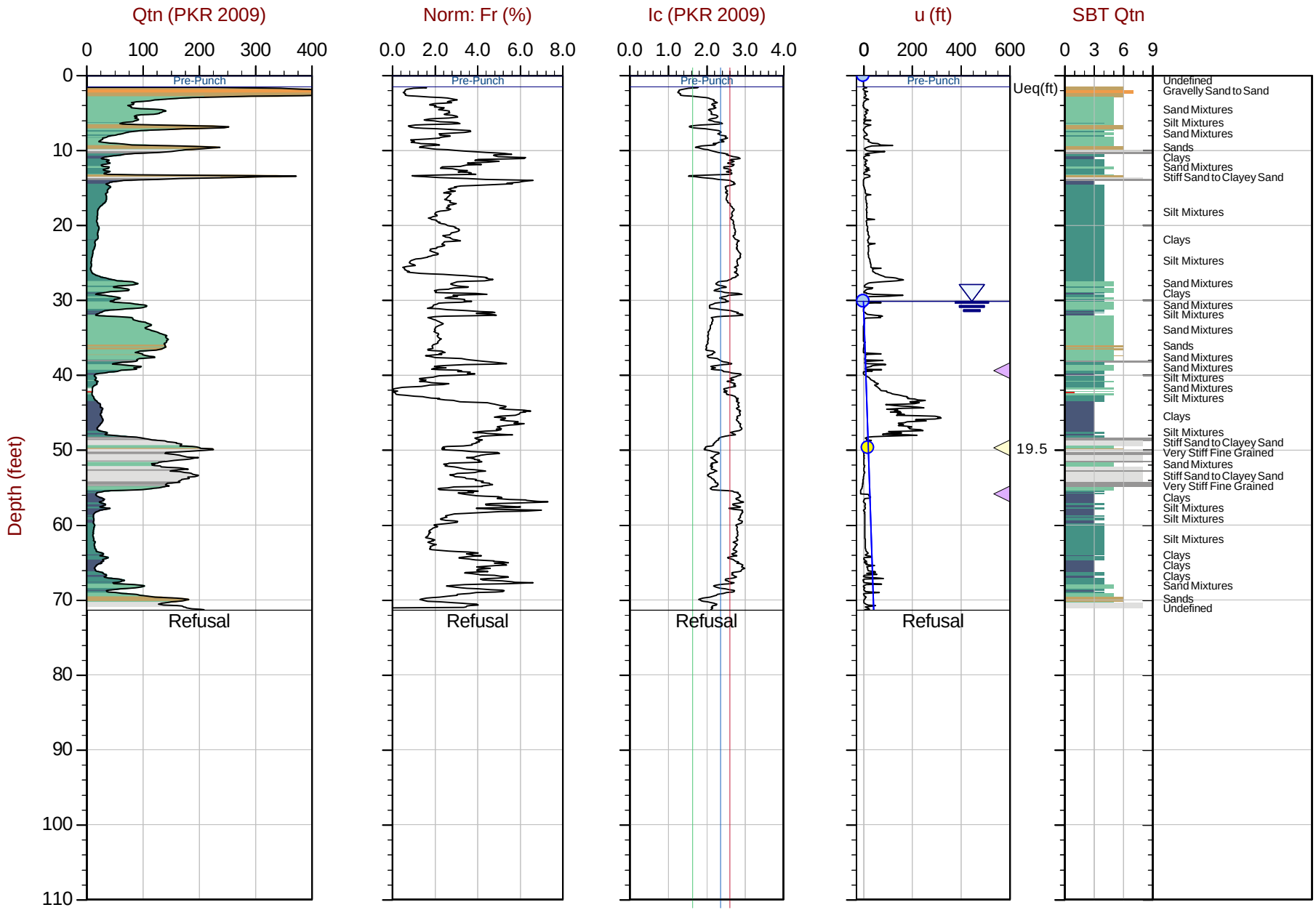
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 14:15
Site: Tanforan Mall Redevelopment

Sounding: CPT-06
Cone: 813:T1500F15U35



Max Depth: 21.750 m / 71.36 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_CP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165541m E: 551219m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

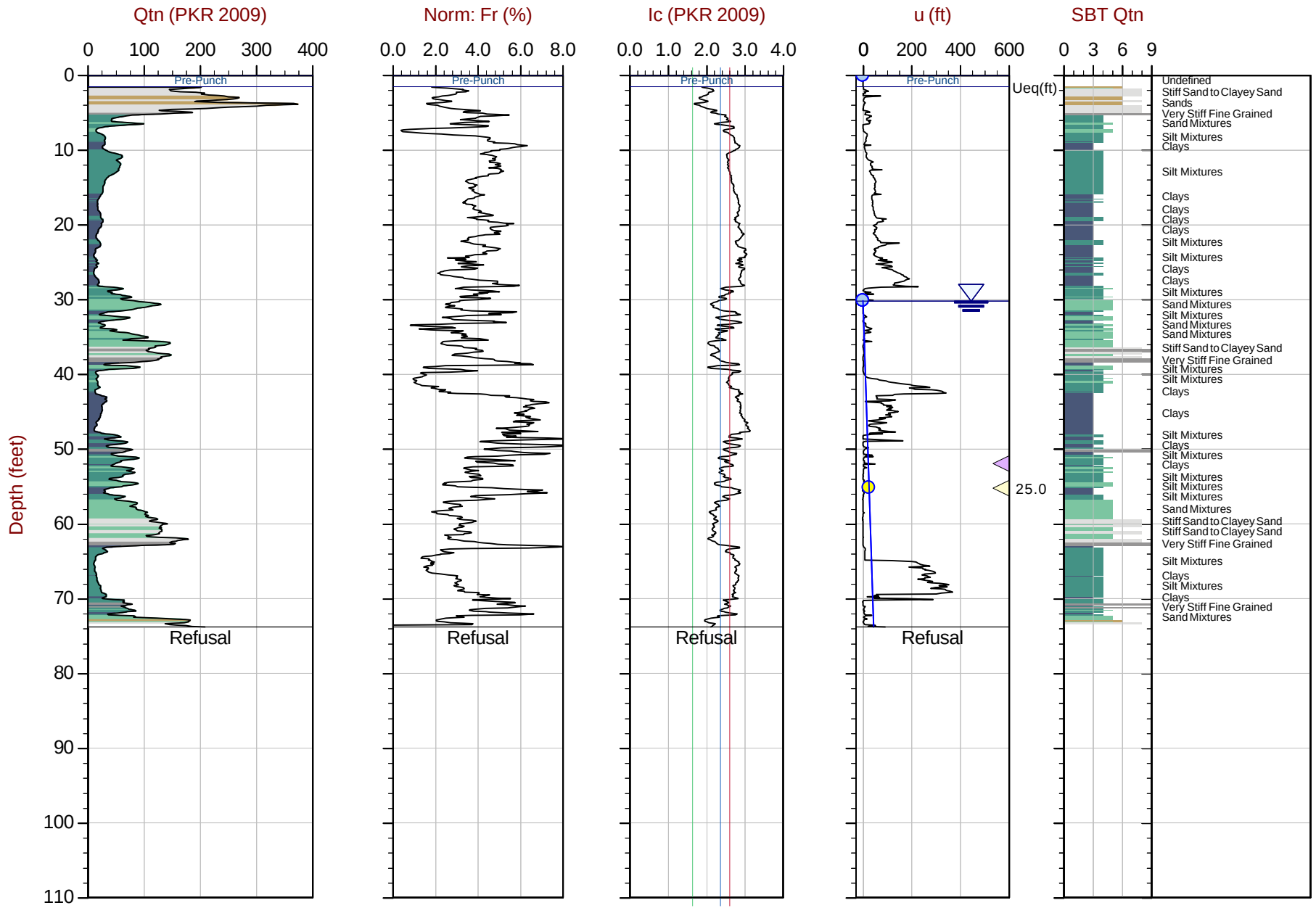
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 10:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-07
Cone: 813:T1500F15U35



Max Depth: 22.500 m / 73.82 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_CP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165503m E: 551201m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

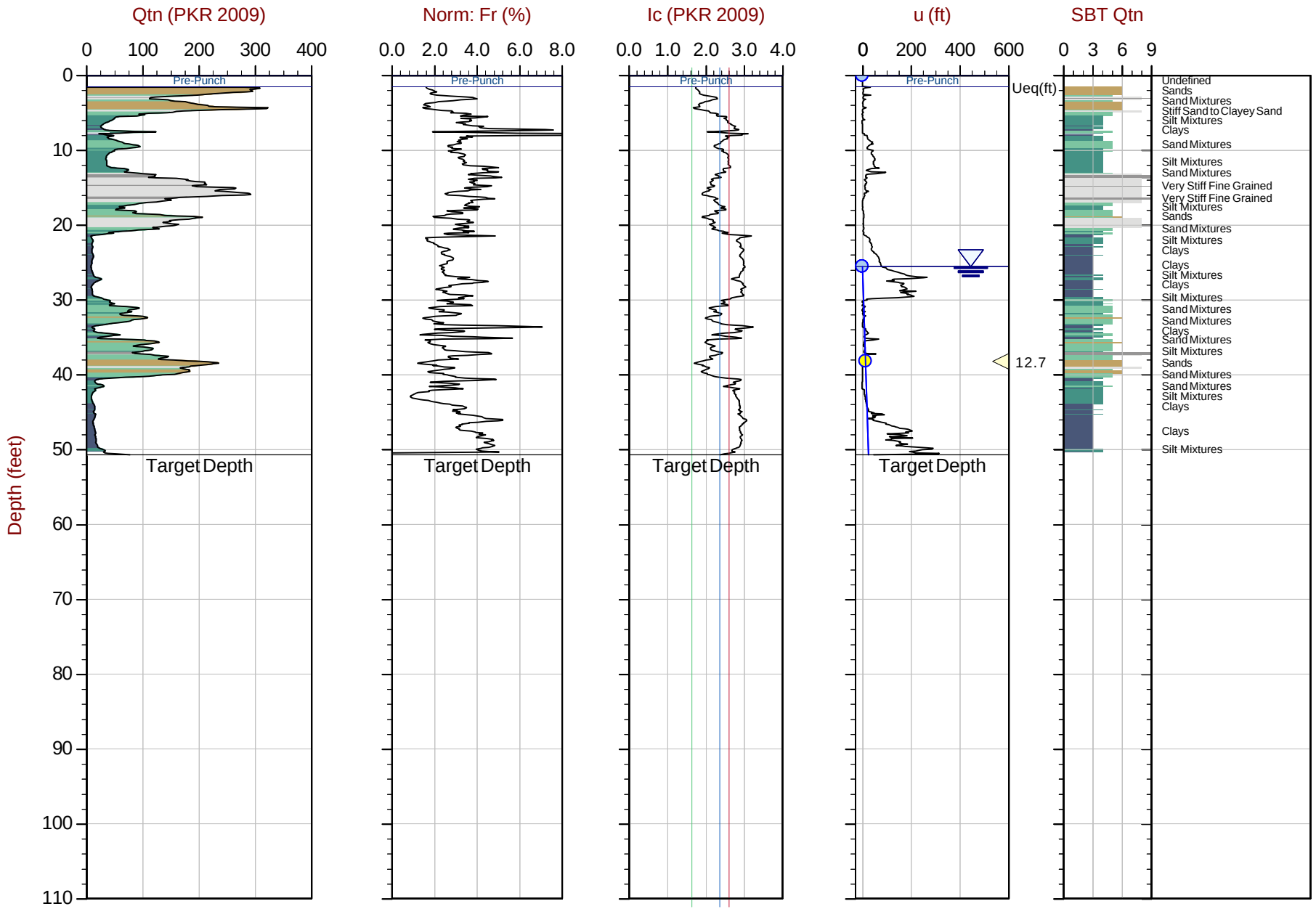
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 07:22
Site: Tanforan Mall Redevelopment

Sounding: CPT-08
Cone: 813:T1500F15U35



Max Depth: 15.450 m / 50.69 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165443m E: 551257m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

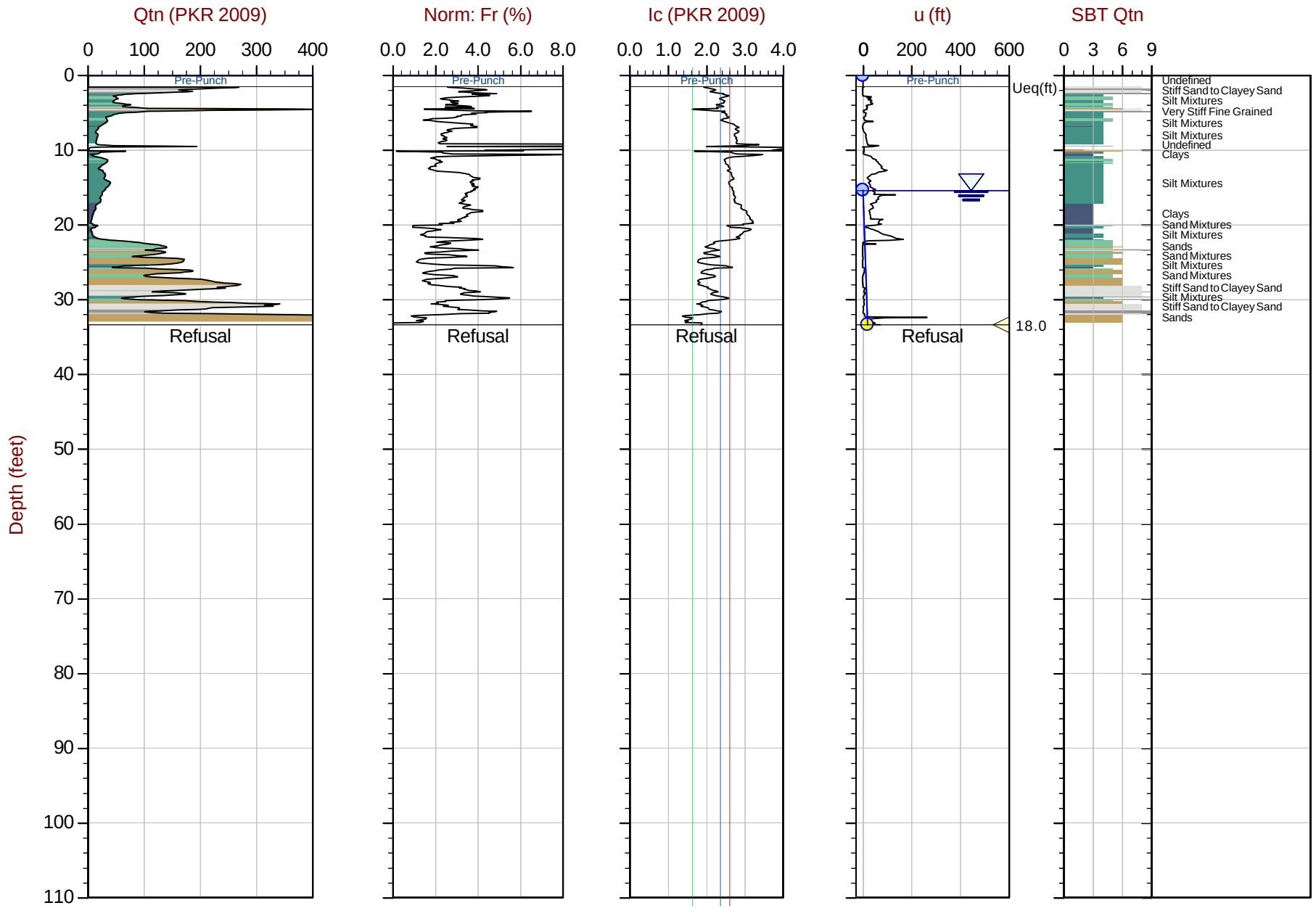
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 07:39
Site: Tanforan Mall Redevelopment

Sounding: CPT-09
Cone: 813:T1500F15U35



Max Depth: 10.175 m / 33.38 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP09.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165763m E: 551409m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

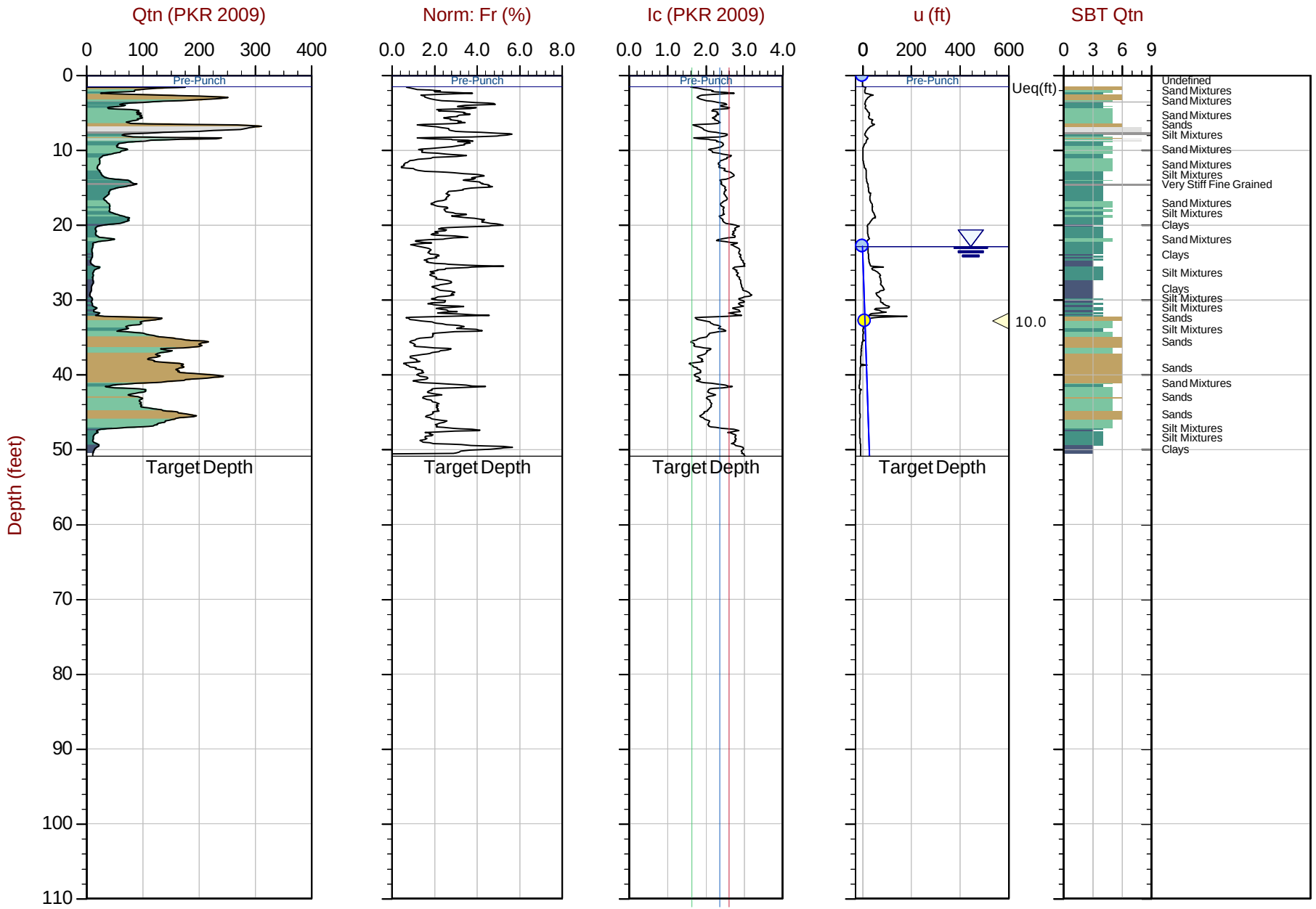
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 12:05
Site: Tanforan Mall Redevelopment

Sounding: CPT-10
Cone: 815:T1500F15U35



Max Depth: 15.500 m / 50.85 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP10.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165510m E: 551524m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

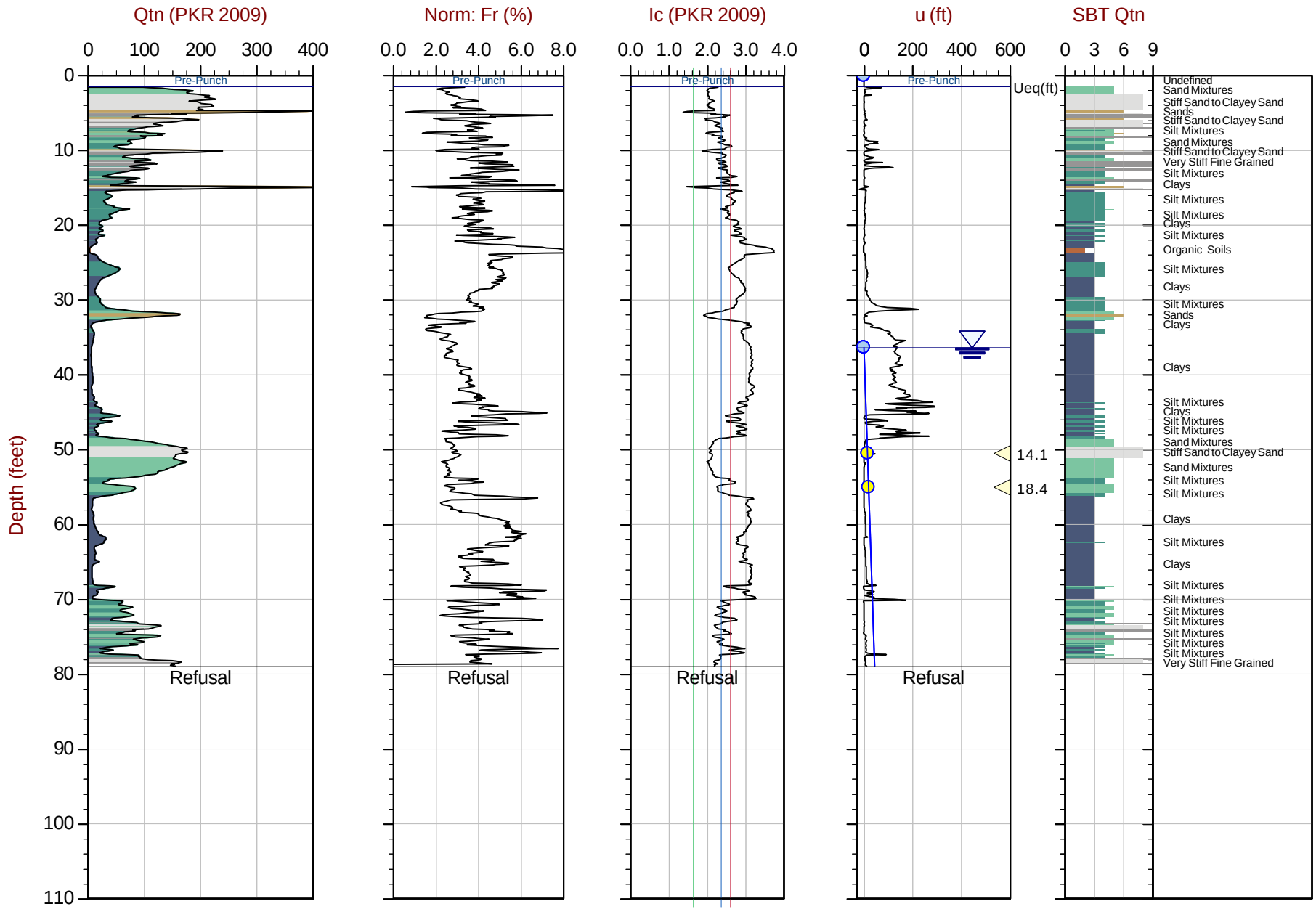
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 08:55
Site: Tanforan Mall Redevelopment

Sounding: CPT-11
Cone: 813:T1500F15U35



Max Depth: 24.075 m / 78.99 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_CP11.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165483m E: 551401m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

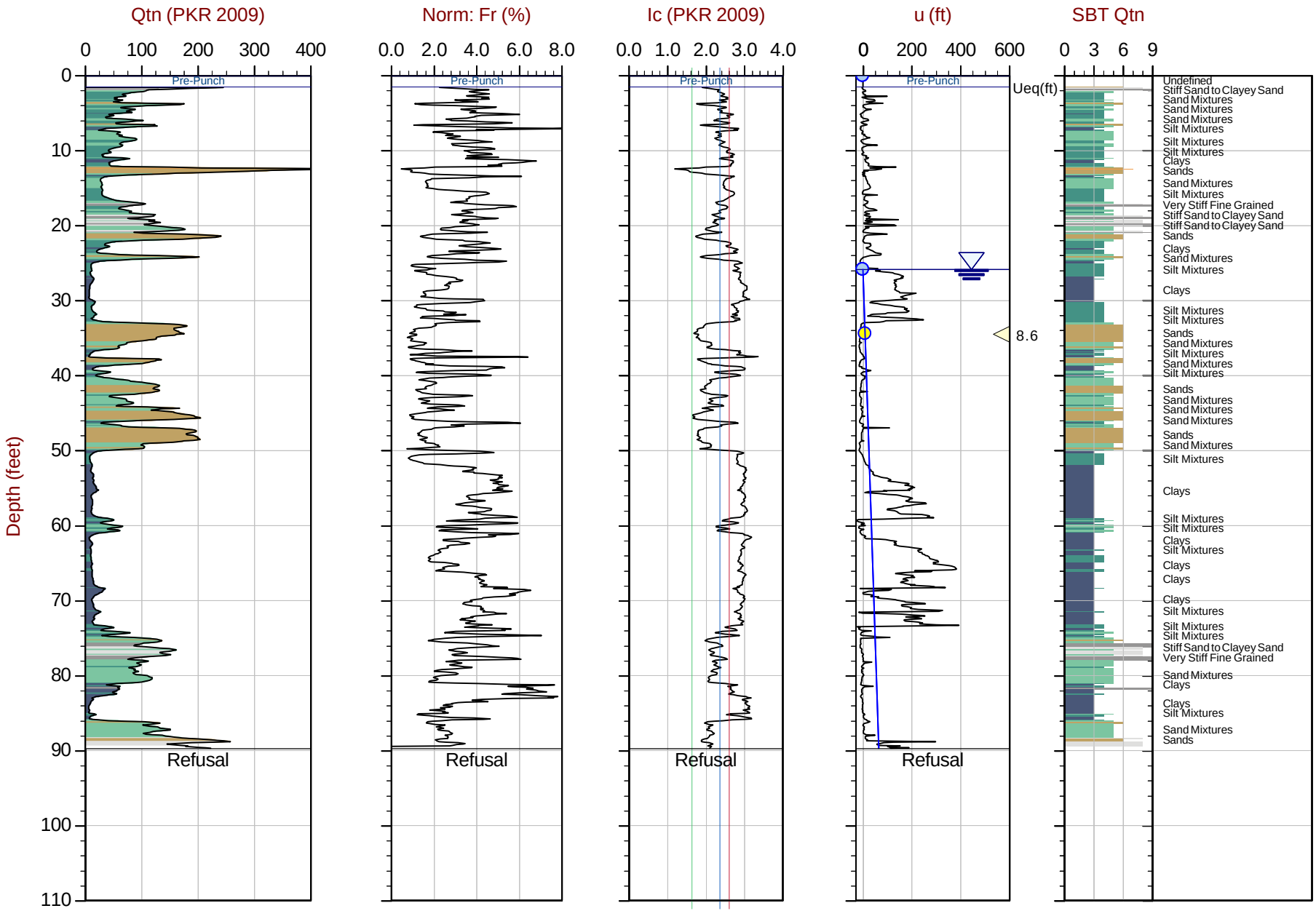
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 13:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-12
Cone: 815:T1500F15U35



Max Depth: 27.350 m / 89.73 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP12.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165486m E: 551592m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Soil Behavior Type (SBT) Scatter Plots

CONETEC

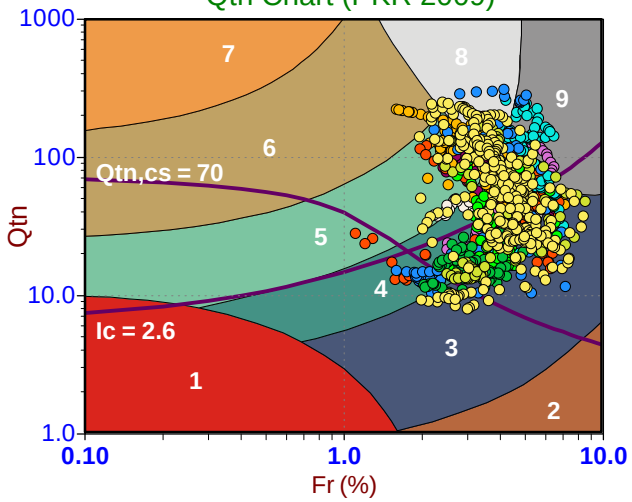
CONETEC

Langan Engineering

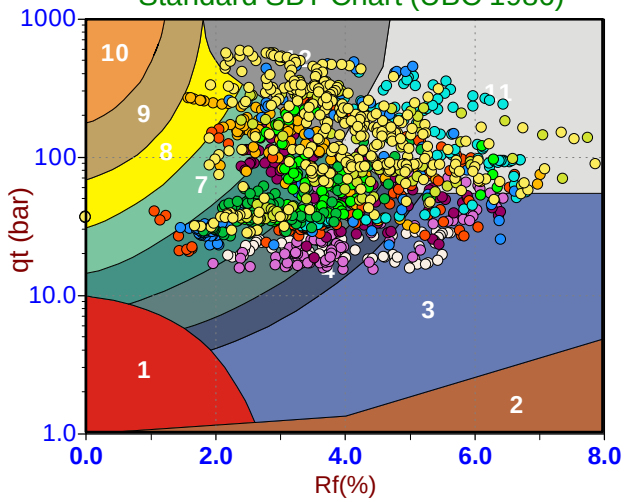
Job No: 22-56-24357
Date: 2022-06-24 09:18
Site: Tanforan Mall Redevelopment

Sounding: CPT-01
Cone: 813:T1500F15U35

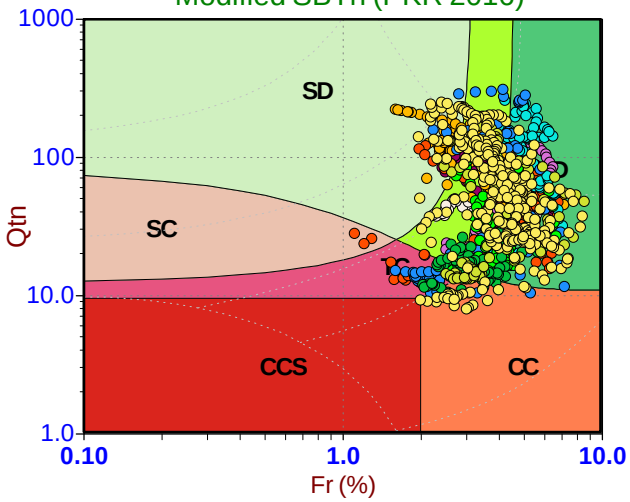
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

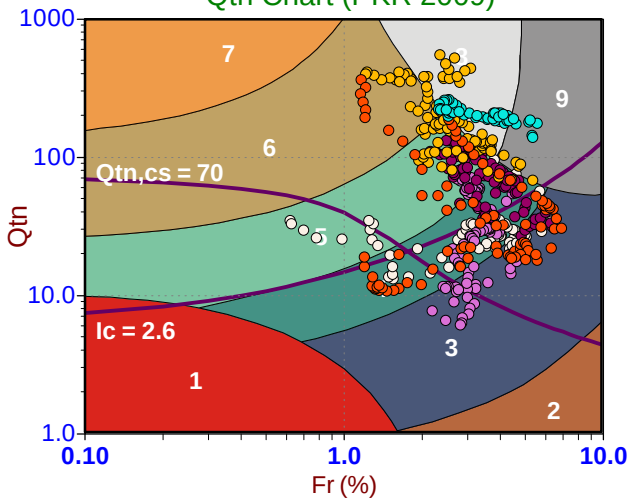
CONETEC

Langan Engineering

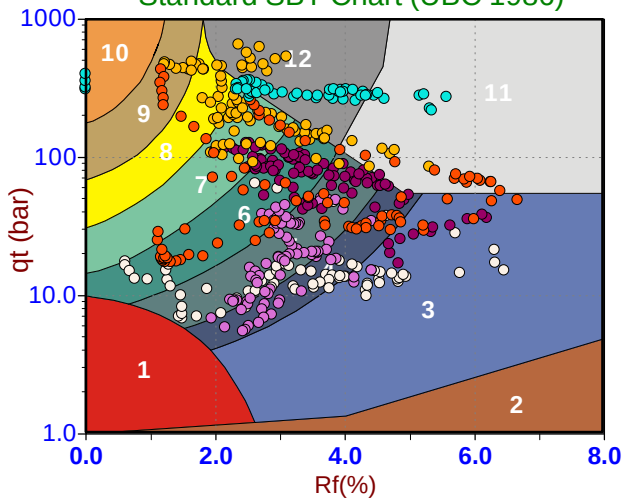
Job No: 22-56-24357
Date: 2022-06-23 12:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-02
Cone: 813:T1500F15U35

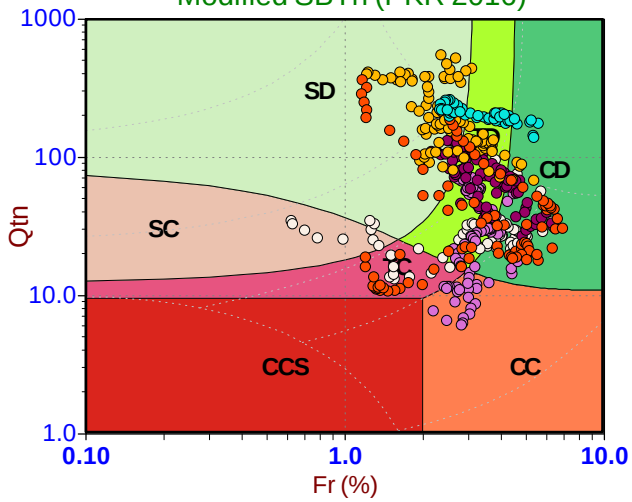
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

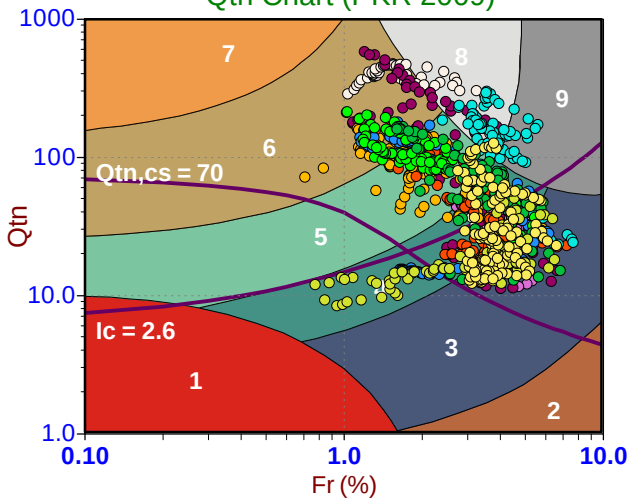
CONETEC

Langan Engineering

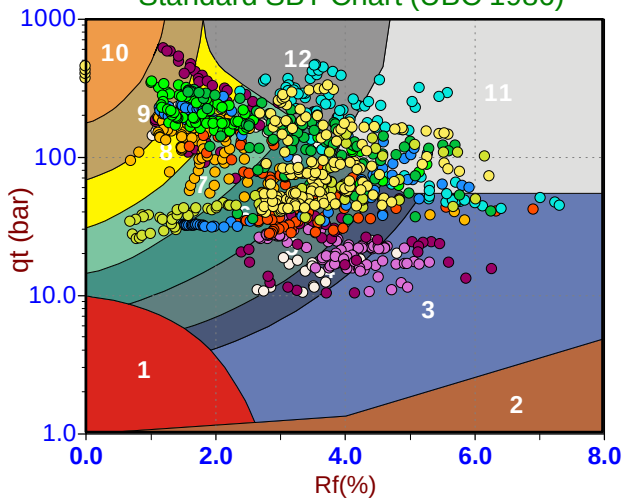
Job No: 22-56-24357
Date: 2022-06-22 11:59
Site: Tanforan Mall Redevelopment

Sounding: CPT-03
Cone: 813:T1500F15U35

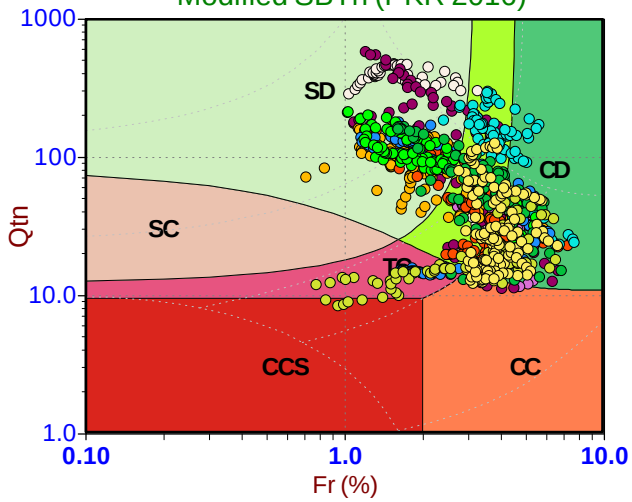
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

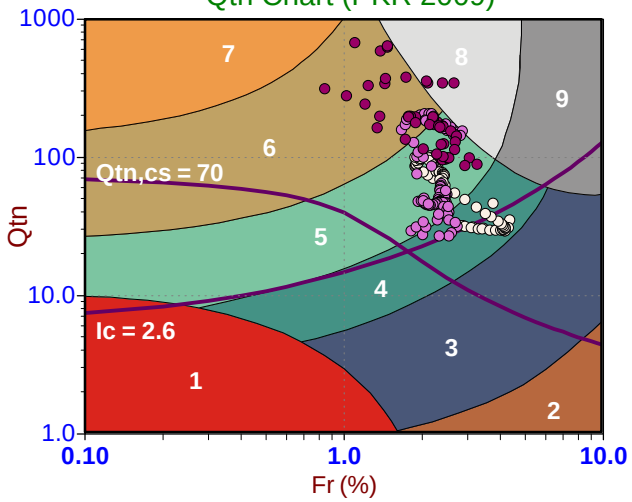
CONETEC

Langan Engineering

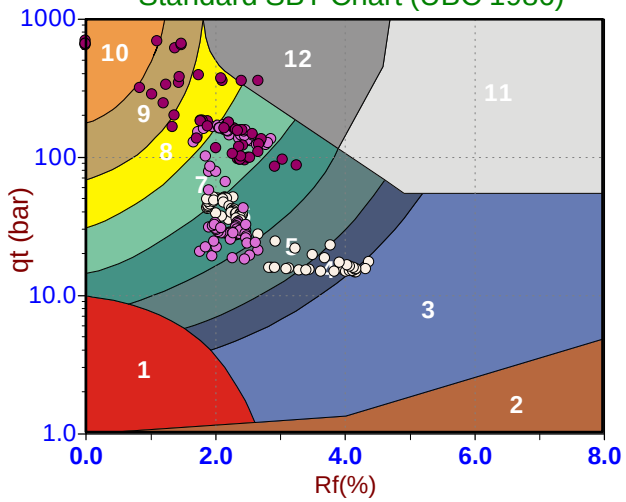
Job No: 22-56-24357
Date: 2022-06-22 07:57
Site: Tanforan Mall Redevelopment

Sounding: CPT-04
Cone: 813:T1500F15U35

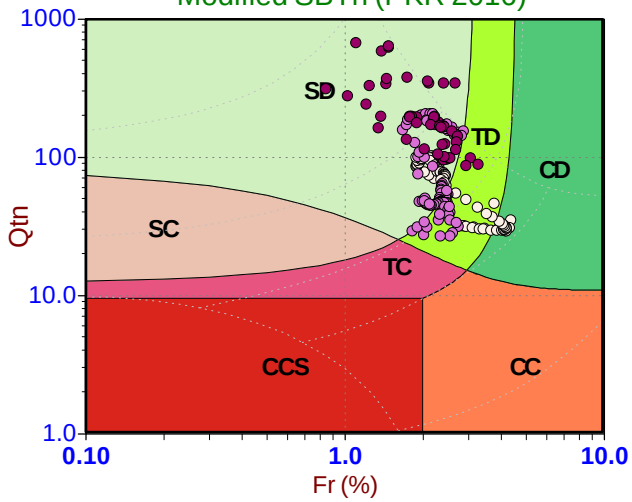
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

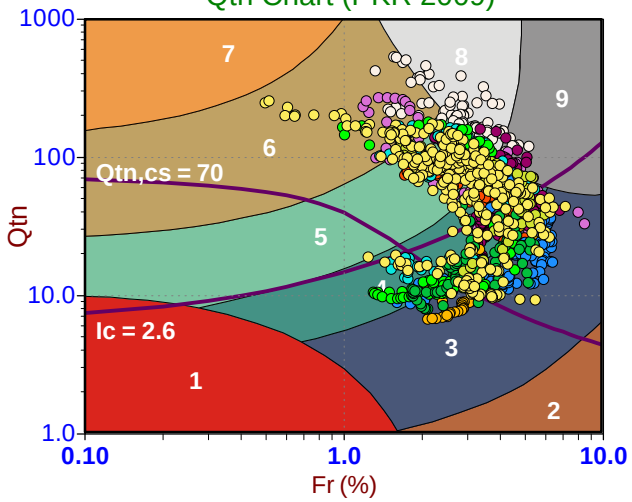
CONETEC

Langan Engineering

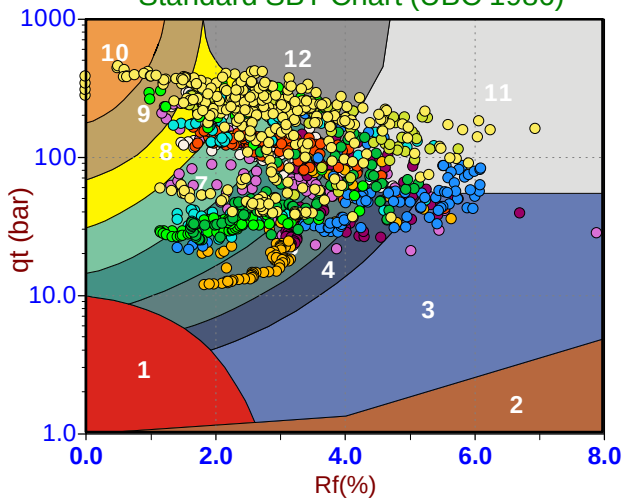
Job No: 22-56-24357
Date: 2022-06-22 09:34
Site: Tanforan Mall Redevelopment

Sounding: CPT-05
Cone: 813:T1500F15U35

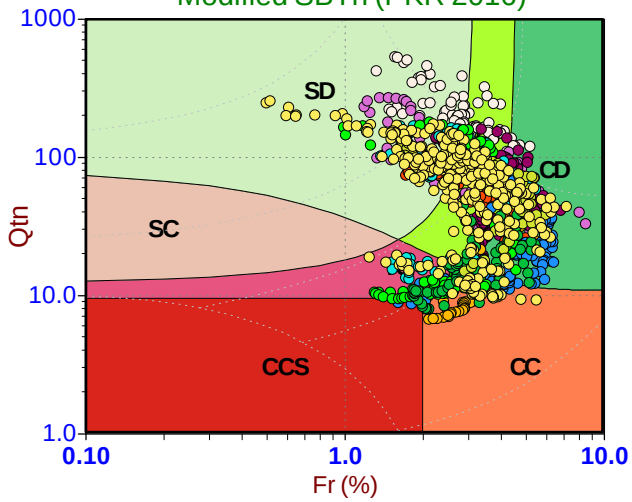
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

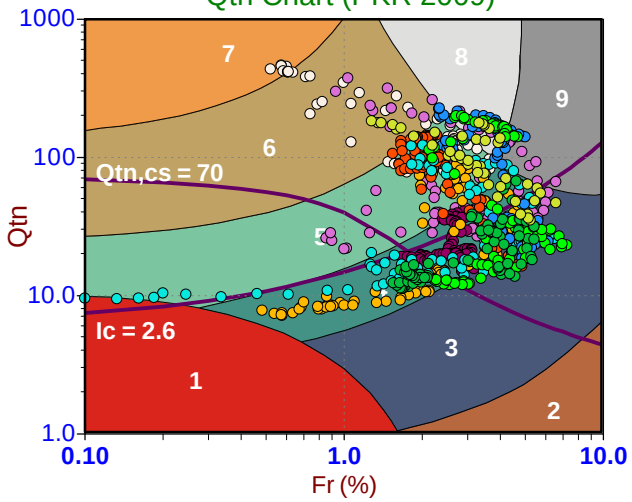
CONETEC

Langan Engineering

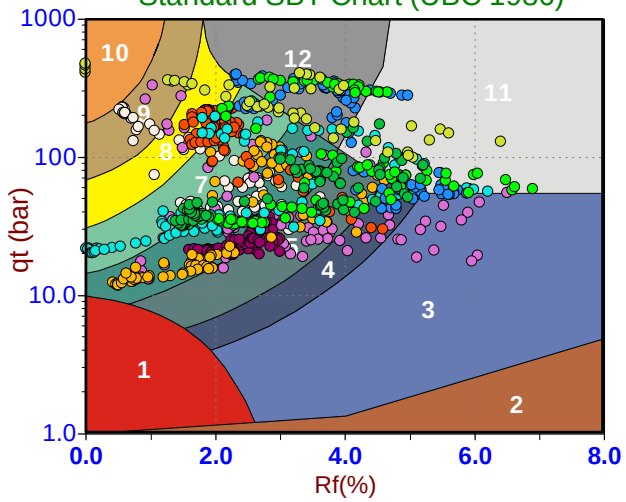
Job No: 22-56-24357
Date: 2022-06-22 14:15
Site: Tanforan Mall Redevelopment

Sounding: CPT-06
Cone: 813:T1500F15U35

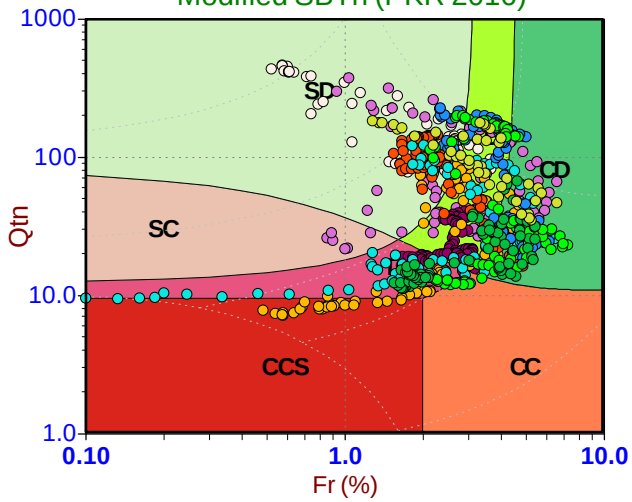
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

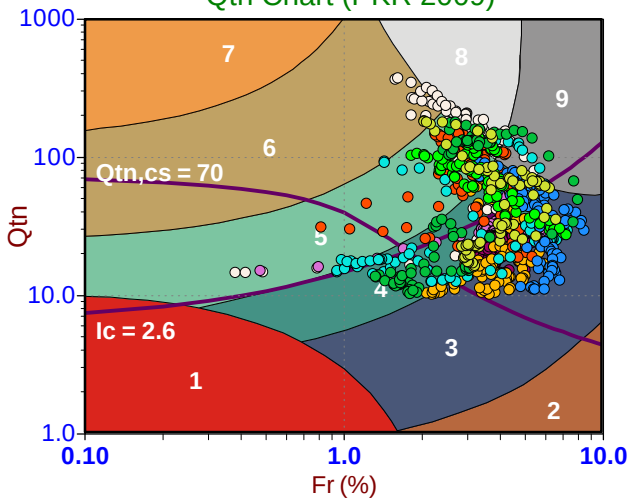
CONETEC

Langan Engineering

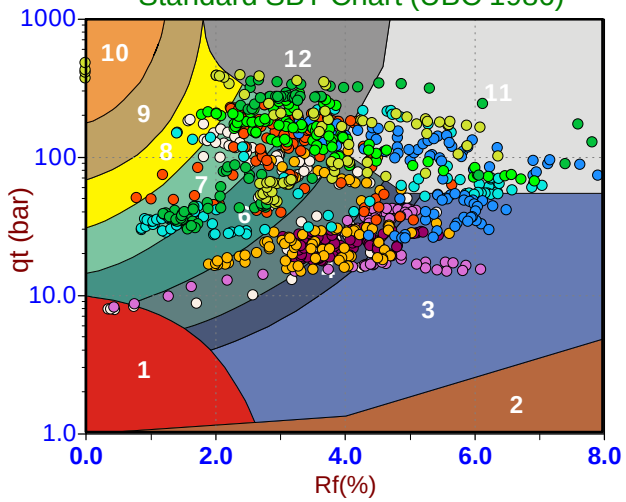
Job No: 22-56-24357
Date: 2022-06-23 10:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-07
Cone: 813:T1500F15U35

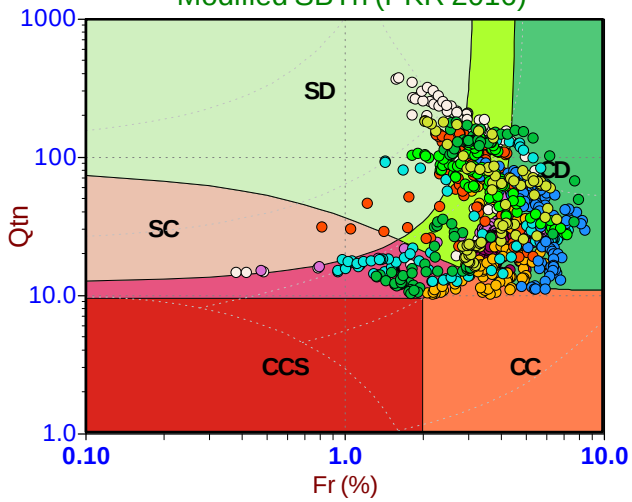
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

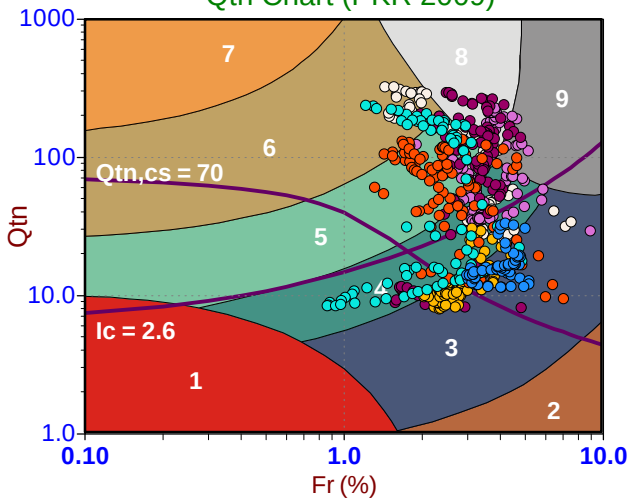
CONETEC

Langan Engineering

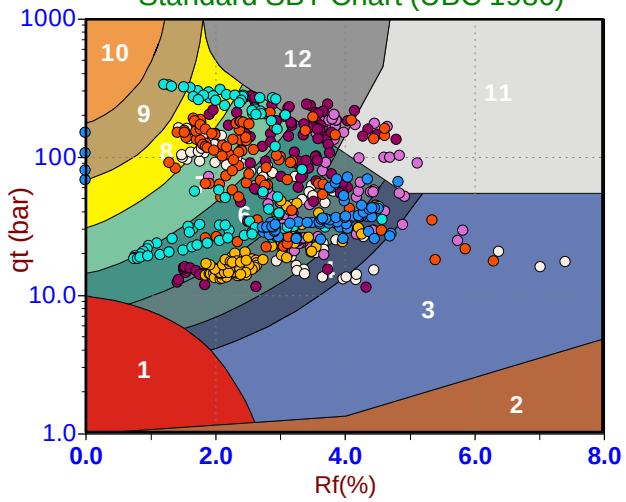
Job No: 22-56-24357
Date: 2022-06-23 07:22
Site: Tanforan Mall Redevelopment

Sounding: CPT-08
Cone: 813:T1500F15U35

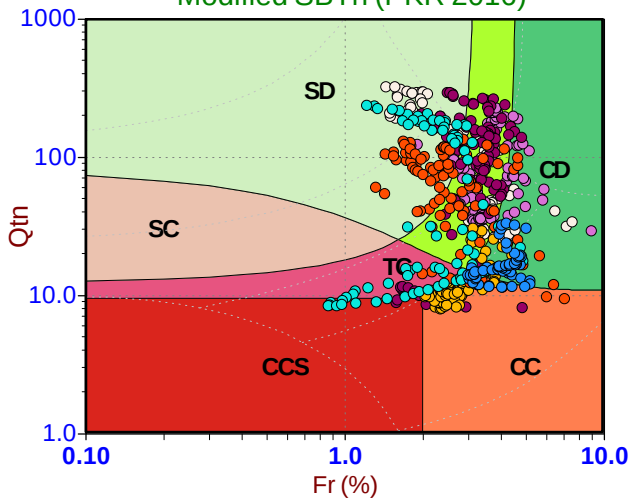
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

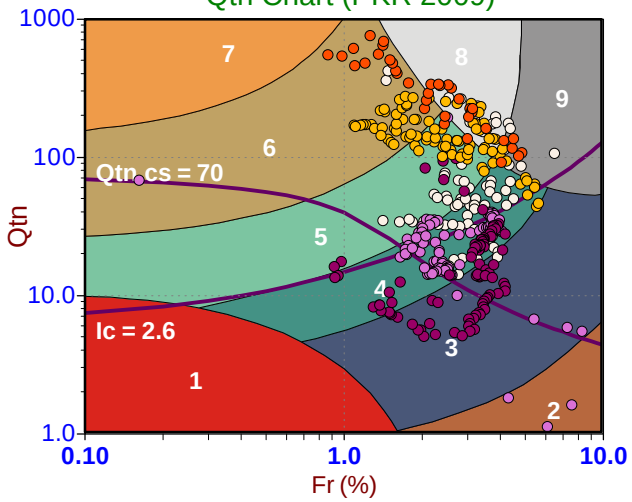
CONETEC

Langan Engineering

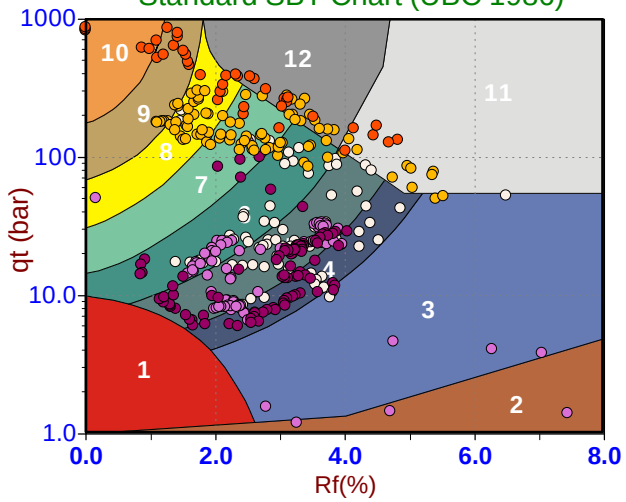
Job No: 22-56-24357
Date: 2022-06-24 07:39
Site: Tanforan Mall Redevelopment

Sounding: CPT-09
Cone: 813:T1500F15U35

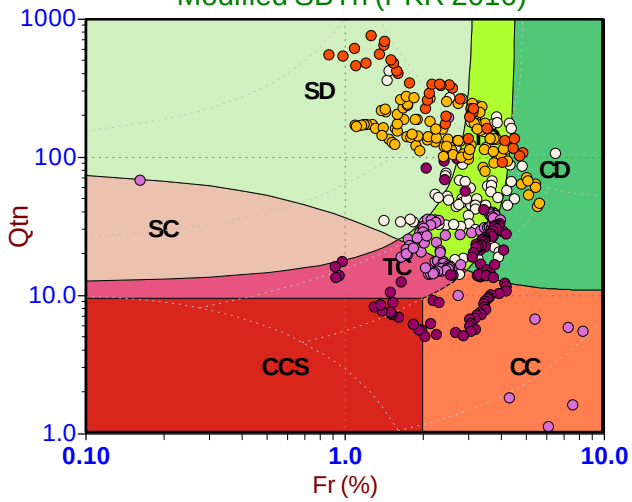
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

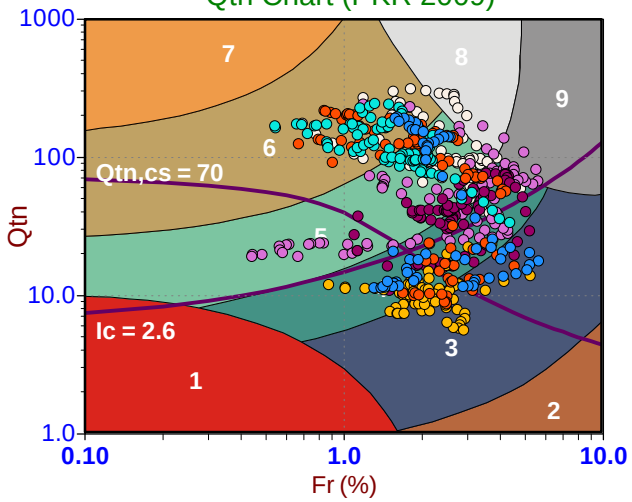
CONETEC

Langan Engineering

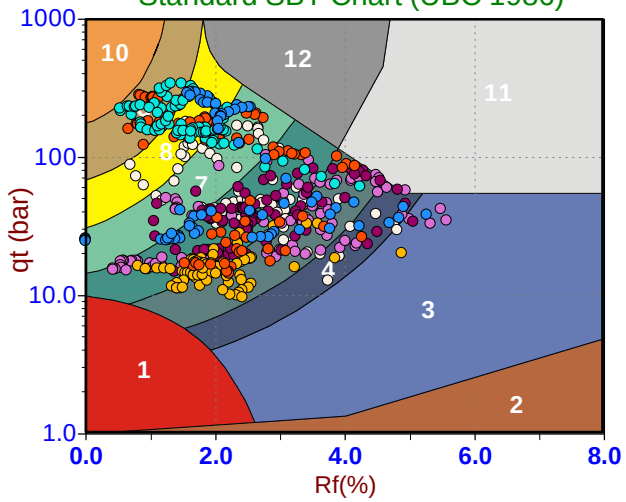
Job No: 22-56-24357
Date: 2022-06-24 12:05
Site: Tanforan Mall Redevelopment

Sounding: CPT-10
Cone: 815:T1500F15U35

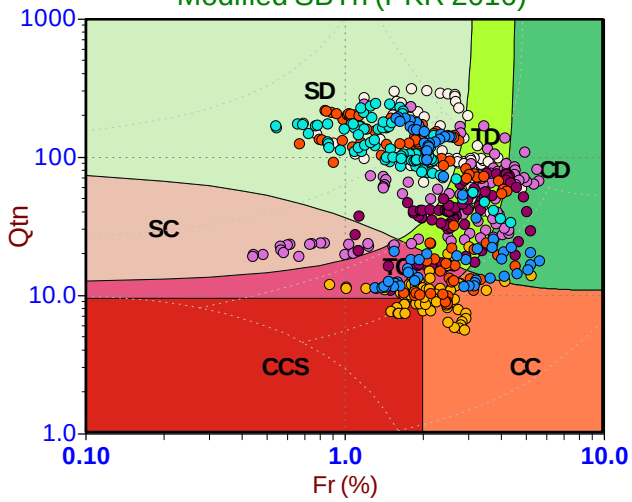
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

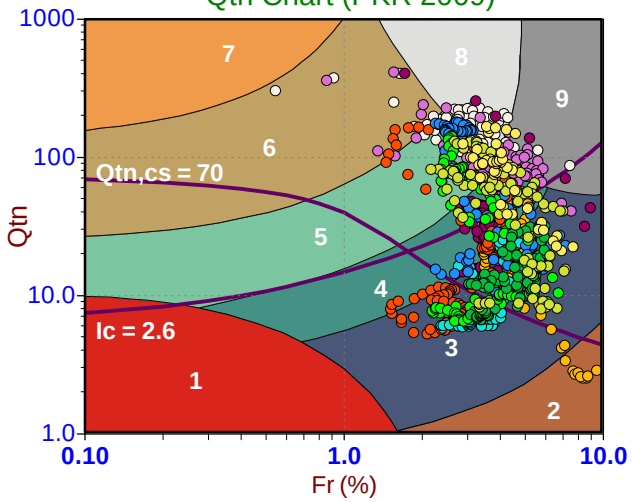
CONETEC

Langan Engineering

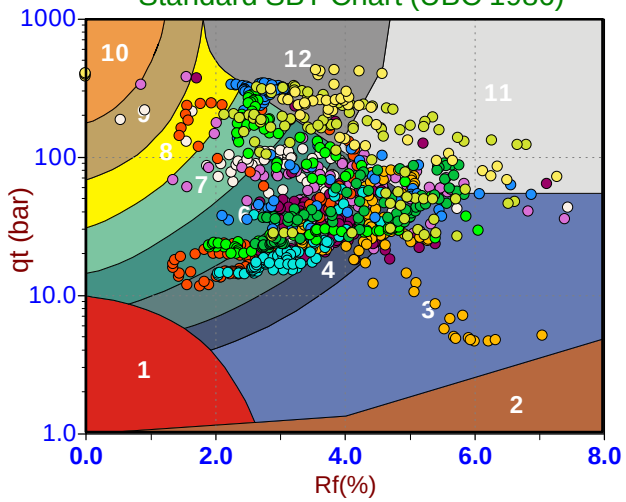
Job No: 22-56-24357
Date: 2022-06-23 08:55
Site: Tanforan Mall Redevelopment

Sounding: CPT-11
Cone: 813:T1500F15U35

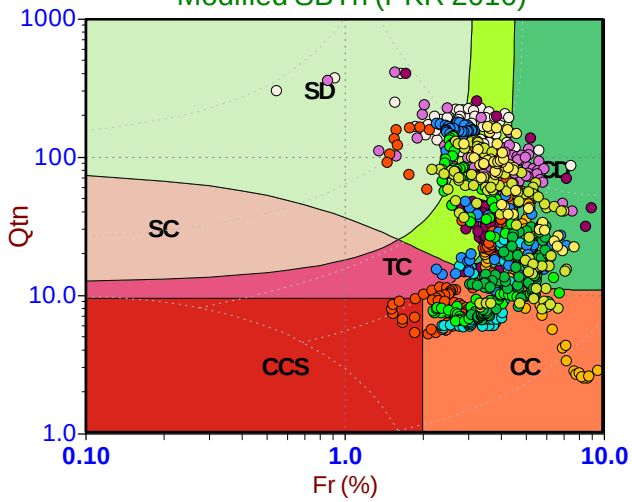
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

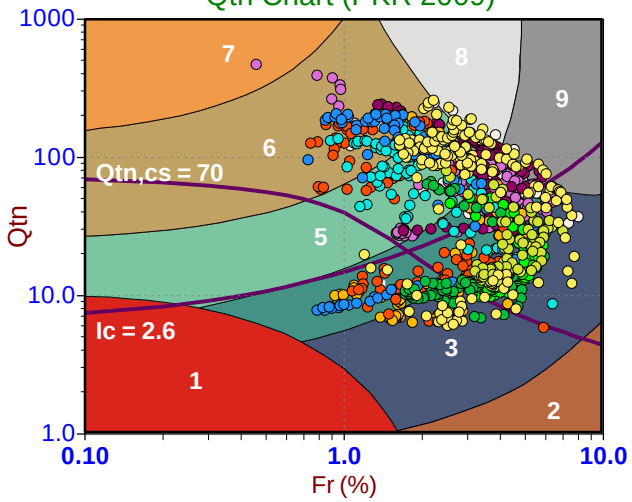
CONETEC

Langan Engineering

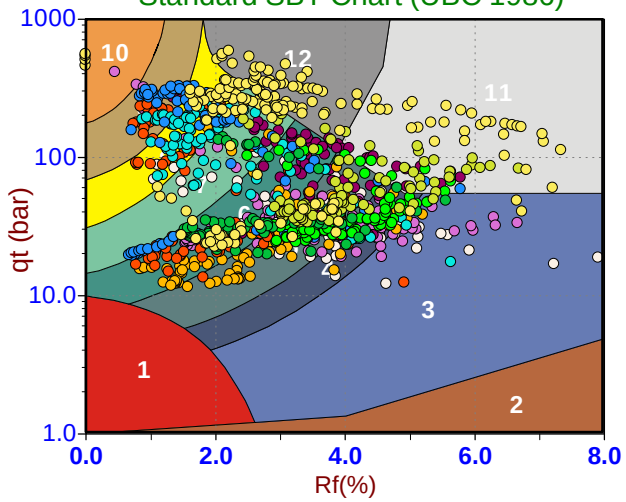
Job No: 22-56-24357
Date: 2022-06-24 13:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-12
Cone: 815:T1500F15U35

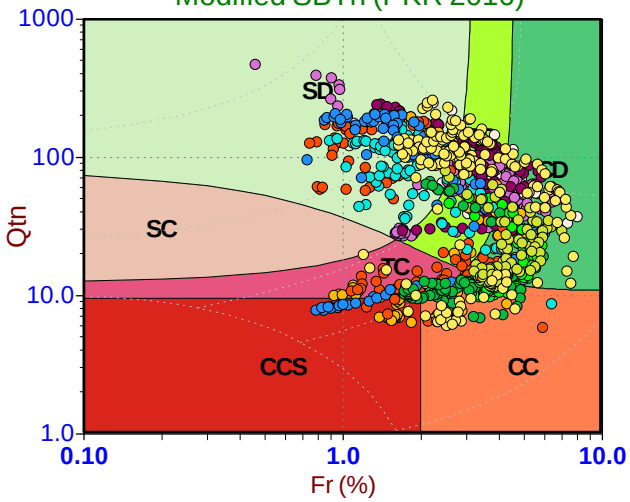
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 7.5 ft
- >7.5 to 15.0 ft
- >15.0 to 22.5 ft
- >22.5 to 30.0 ft
- >30.0 to 37.5 ft
- >37.5 to 45.0 ft
- >45.0 to 52.5 ft
- >52.5 to 60.0 ft
- >60.0 to 67.5 ft
- >67.5 to 75.0 ft
- >75.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Job No: 22-56-24357
Client: Langan Engineering
Project: Tanforan Mall Redevelopment
Start Date: 22-Jun-2022
End Date: 24-Jun-2022

CPTu PORE PRESSURE DISSIPATION SUMMARY

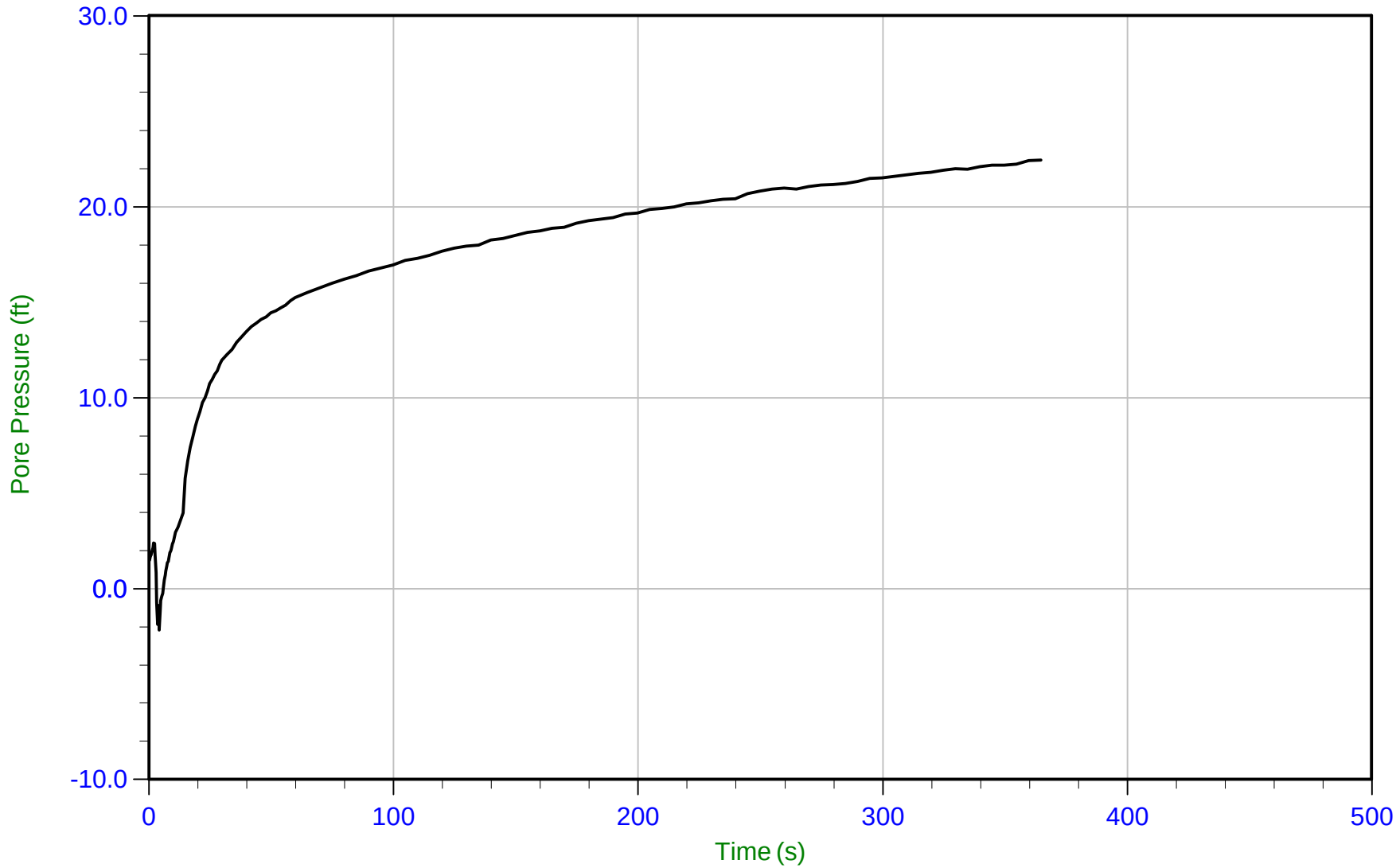
Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft)	Estimated Equilibrium Pore Pressure U_{eq} (ft.)	Calculated Phreatic Surface (ft.)
CPT-01	22-56-24357_SP01	15	365	41.83	Not Achieved	
CPT-01	22-56-24357_SP01	15	525	45.44	Not Achieved	
CPT-02	22-56-24357_SP02	15	515	31.91	Not Achieved	
CPT-02	22-56-24357_SP02	15	1800	41.83	Not Achieved	
CPT-03	22-56-24357_SP03	15	320	32.15	Not Achieved	
CPT-03	22-56-24357_SP03	15	390	45.28	21.2	24.1
CPT-04	22-56-24357_SP04	15	610	15.67	Not Achieved	
CPT-05	22-56-24357_SP05	15	380	43.63	Not Achieved	
CPT-05	22-56-24357_SP05	15	440	53.97	21.6	32.4
CPT-05	22-56-24357_SP05	15	380	92.60	Not Achieved	
CPT-06	22-56-24357_CP06	15	600	39.37	Not Achieved	
CPT-06	22-56-24357_CP06	15	810	49.70	19.6	30.1
CPT-06	22-56-24357_CP06	15	495	55.86	Not Achieved	
CPT-07	22-56-24357_CP07	15	770	51.92	Not Achieved	
CPT-07	22-56-24357_CP07	15	1340	55.20	25.0	30.2
CPT-08	22-56-24357_SP08	15	365	38.22	12.7	25.5
CPT-09	22-56-24357_SP09	15	950	33.38	18.0	15.4
CPT-10	22-56-24357_SP10	15	525	32.81	10.0	22.8
CPT-11	22-56-24357_CP11	15	640	50.52	14.1	36.4
CPT-11	22-56-24357_CP11	15	350	55.04	18.4	36.6
CPT-12	22-56-24357_SP12	15	520	34.45	8.6	25.8

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/24/2022 09:18
Site: Tanforan Mall Redevelopment

Sounding: CPT-01
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP01.PPD2
Depth: 12.750 m / 41.830 ft
Duration: 365.0 s

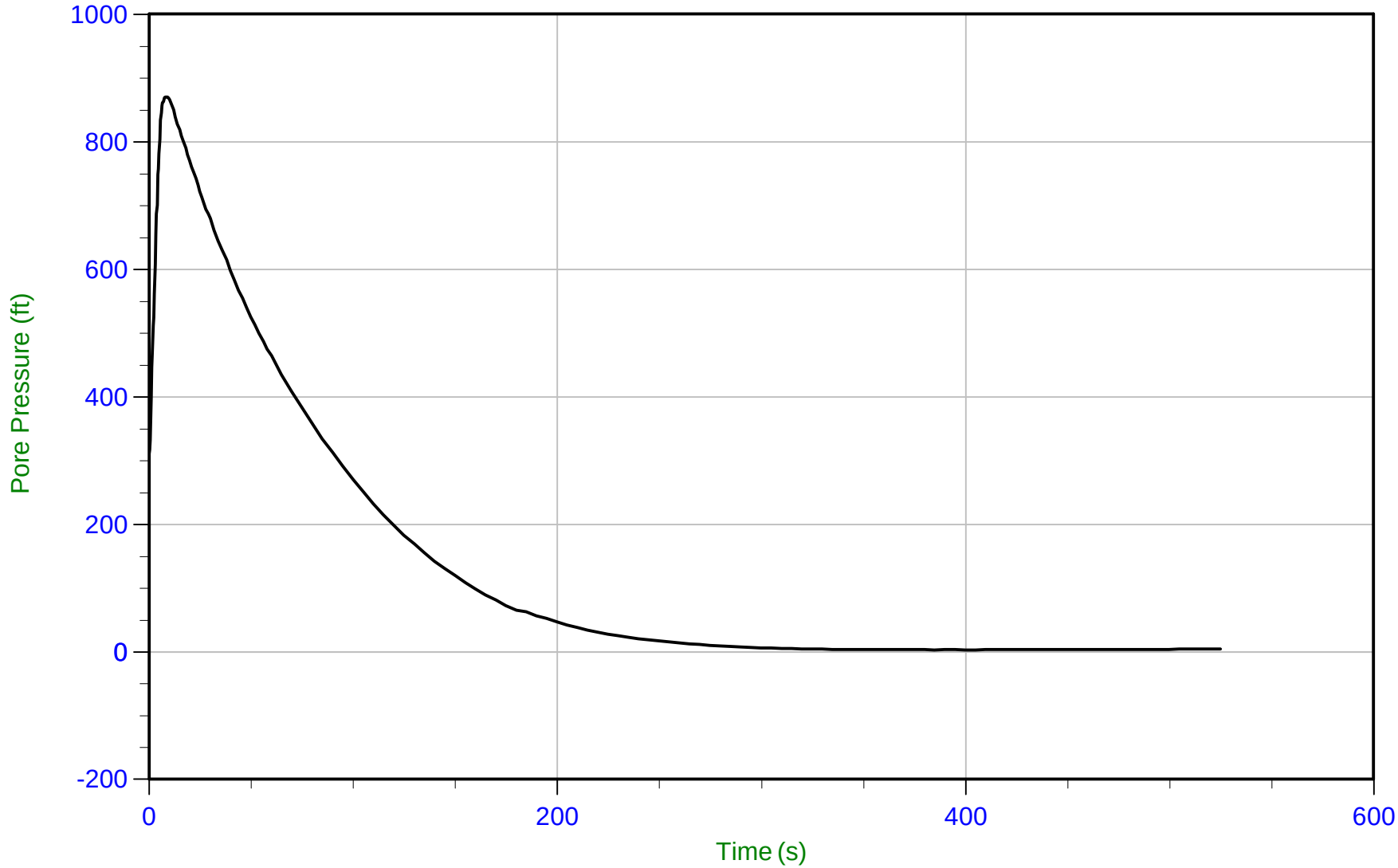
u Min: -2.2 ft
u Max: 22.5 ft
u Final: 22.5 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/24/2022 09:18
Site: Tanforan Mall Redevelopment

Sounding: CPT-01
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP01.PPD2
Depth: 13.850 m / 45.439 ft
Duration: 525.0 s

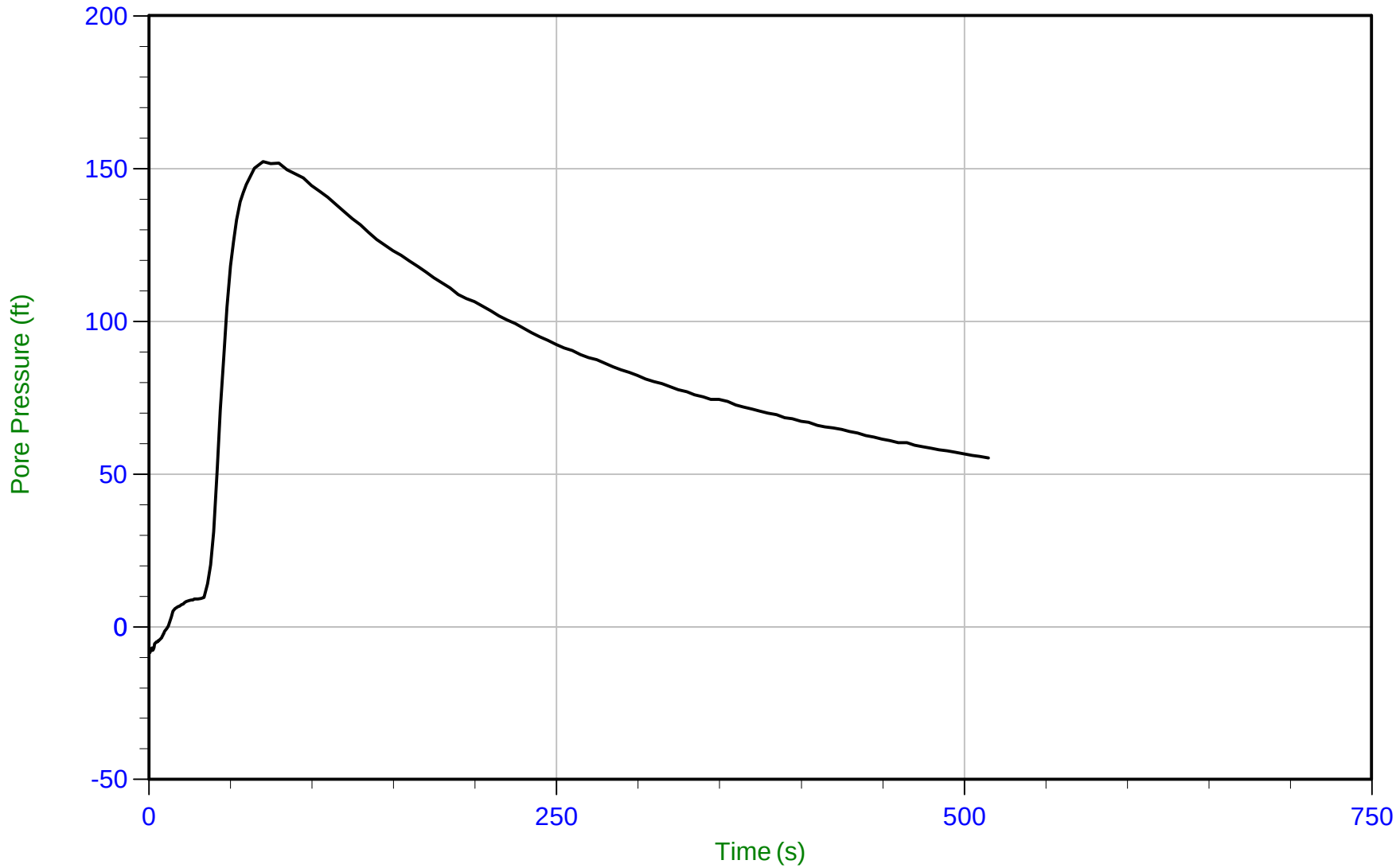
u Min: 3.2 ft
u Max: 870.3 ft
u Final: 4.2 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/23/2022 12:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-02
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP02.PPD2
Depth: 9.725 m / 31.906 ft
Duration: 515.0 s

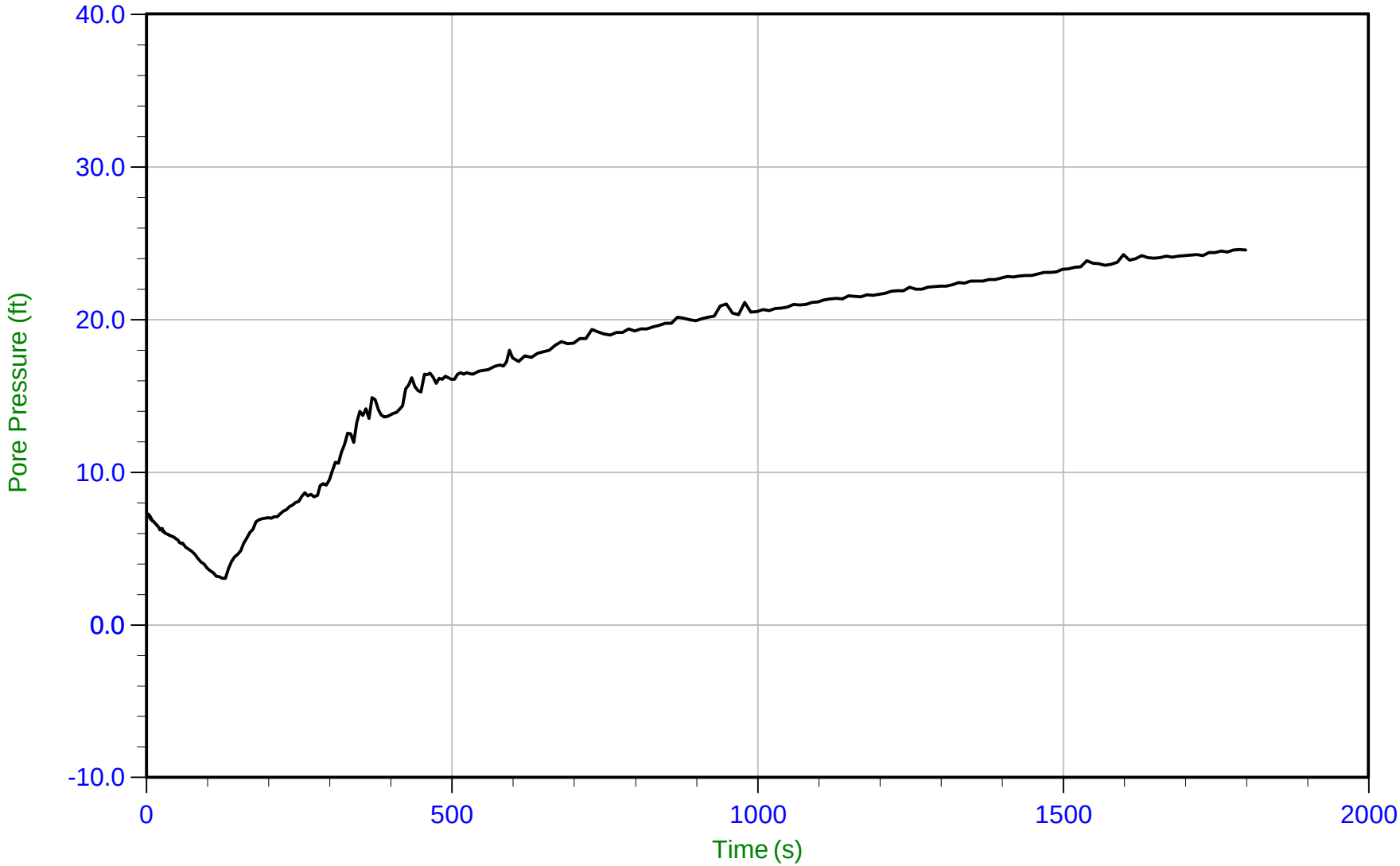
u Min: -8.7 ft
u Max: 152.2 ft
u Final: 55.3 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/23/2022 12:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-02
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP02.PPD2
Depth: 12.750 m / 41.830 ft
Duration: 1800.0 s

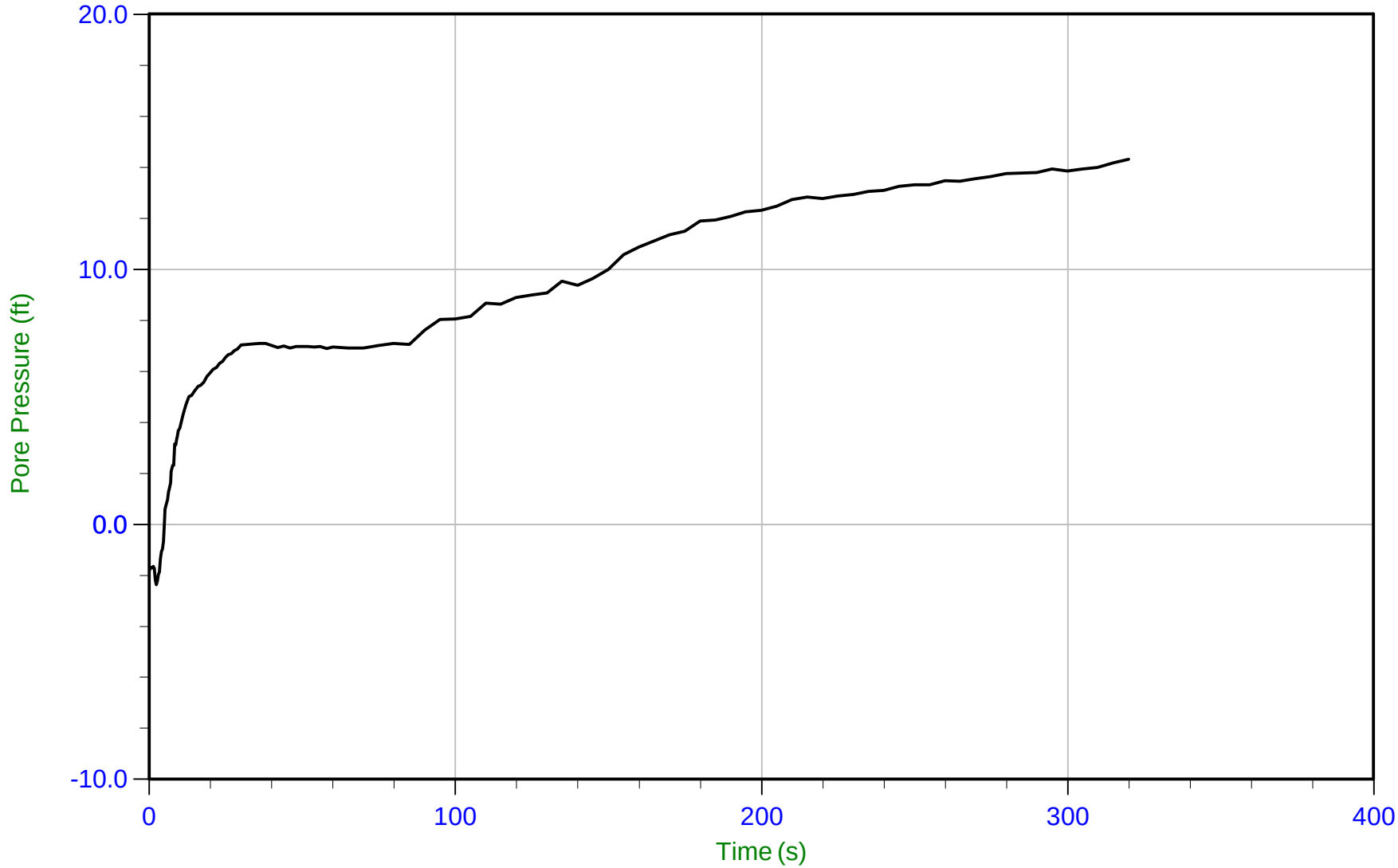
u Min: 3.0 ft
u Max: 24.6 ft
u Final: 24.5 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/22/2022 11:59
Site: Tanforan Mall Redevelopment

Sounding: CPT-03
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP03.PPD2
Depth: 9.800 m / 32.152 ft
Duration: 320.0 s

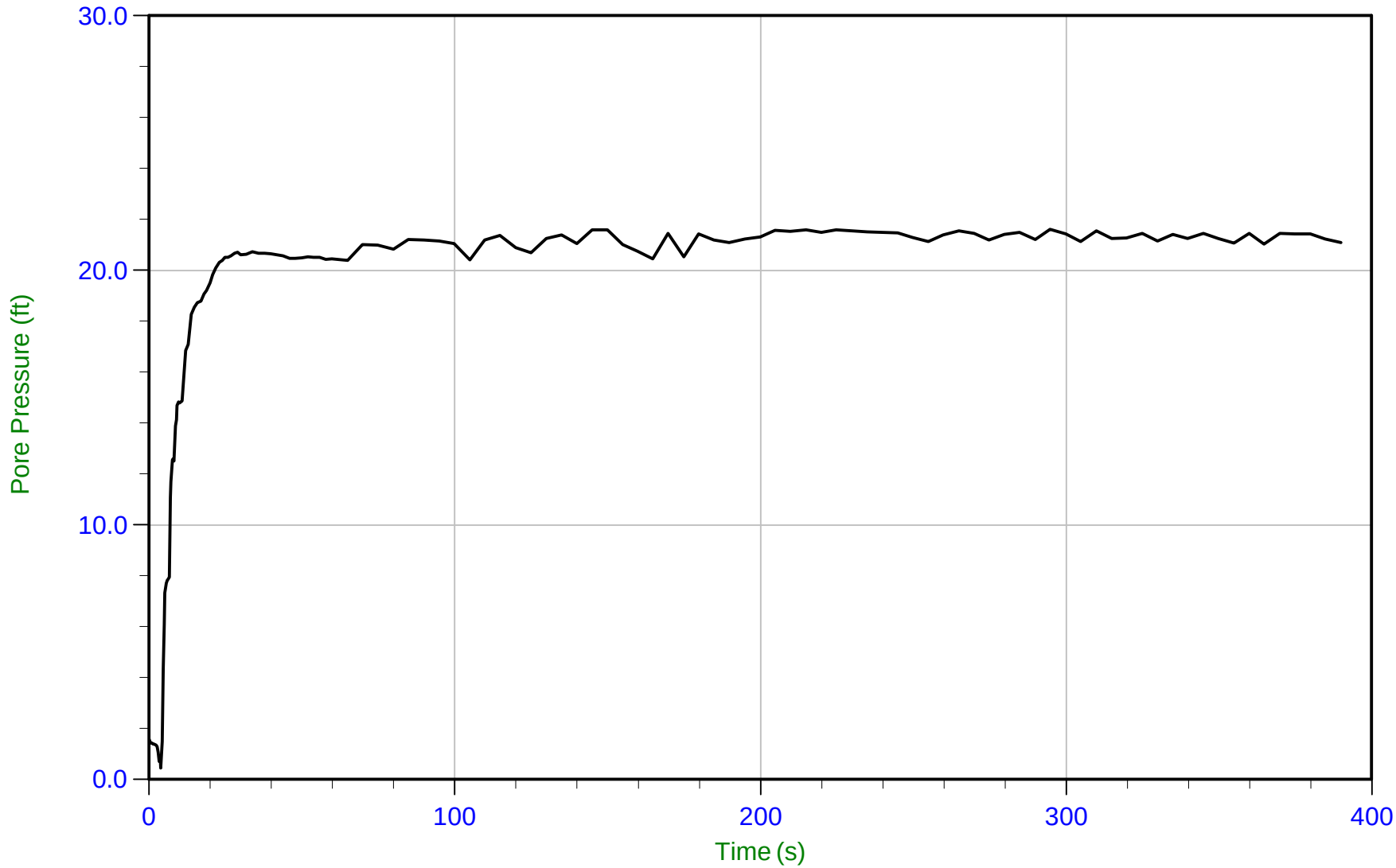
u Min: -2.4 ft
u Max: 14.3 ft
u Final: 14.3 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/22/2022 11:59
Site: Tanforan Mall Redevelopment

Sounding: CPT-03
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP03.PPD2
Depth: 13.800 m / 45.275 ft
Duration: 390.0 s

u Min: 0.4 ft
u Max: 21.6 ft
u Final: 21.1 ft

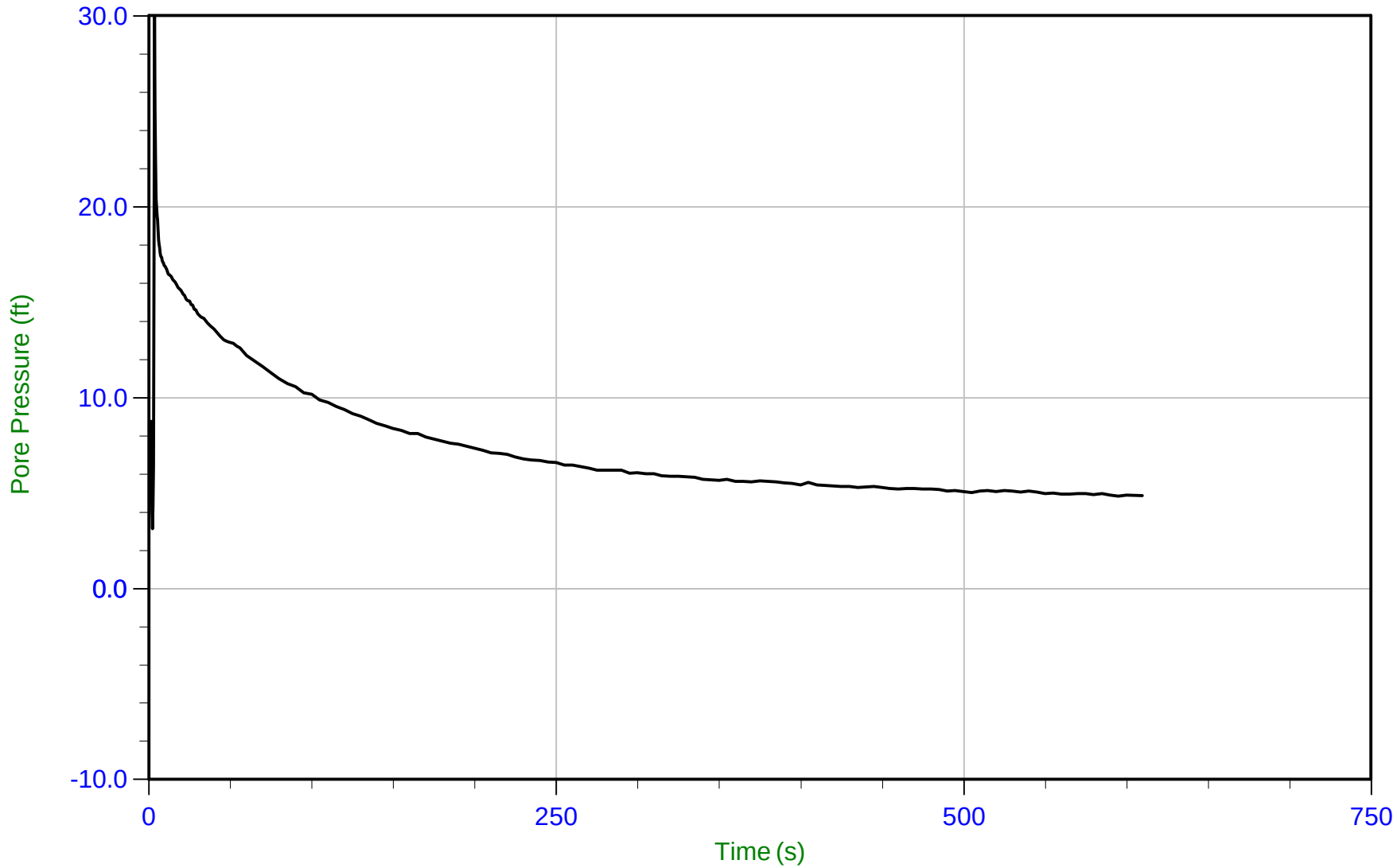
WT: 7.334 m / 24.060 ft
Ueq: 21.2 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/22/2022 07:57
Site: Tanforan Mall Redevelopment

Sounding: CPT-04
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP04.PPD2
Depth: 4.775 m / 15.666 ft
Duration: 610.0 s

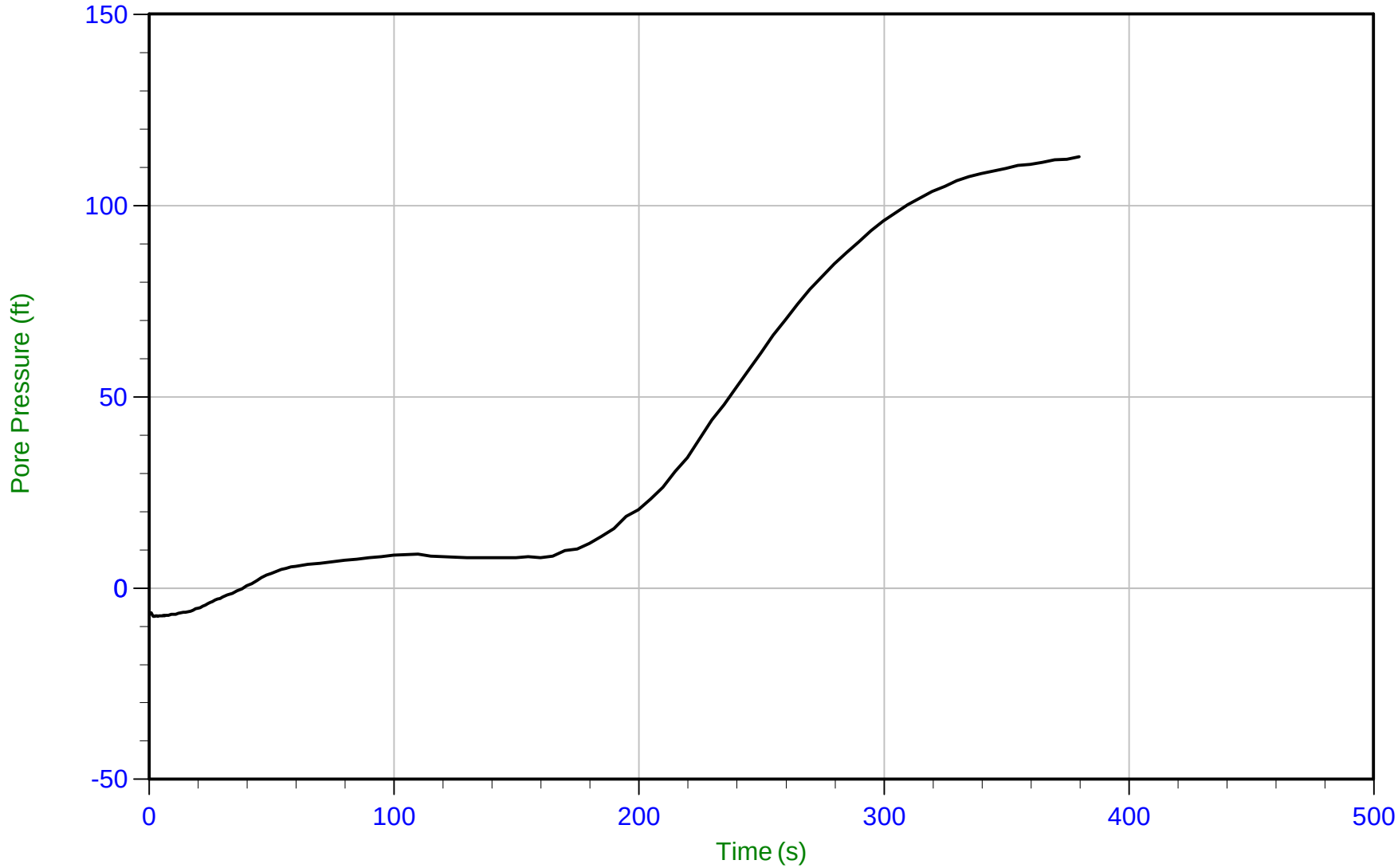
u Min: 3.1 ft
u Max: 30.0 ft
u Final: 4.9 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/22/2022 09:34
Site: Tanforan Mall Redevelopment

Sounding: CPT-05
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP05.PPD2
Depth: 13.300 m / 43.635 ft
Duration: 380.0 s

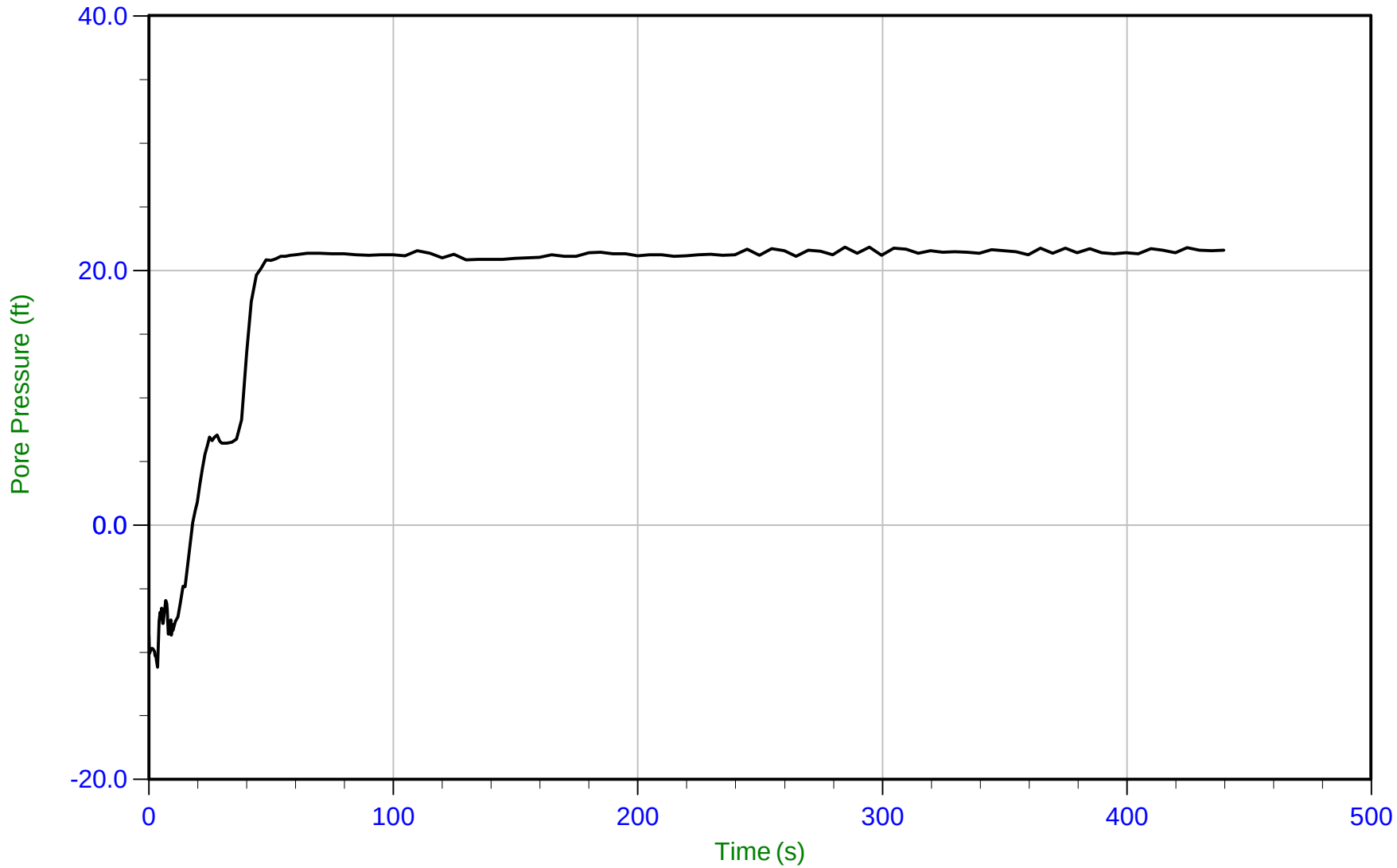
u Min: -7.4 ft
u Max: 112.7 ft
u Final: 112.7 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/22/2022 09:34
Site: Tanforan Mall Redevelopment

Sounding: CPT-05
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP05.PPD2
Depth: 16.450 m / 53.969 ft
Duration: 440.0 s

u Min: -11.2 ft
u Max: 21.8 ft
u Final: 21.6 ft

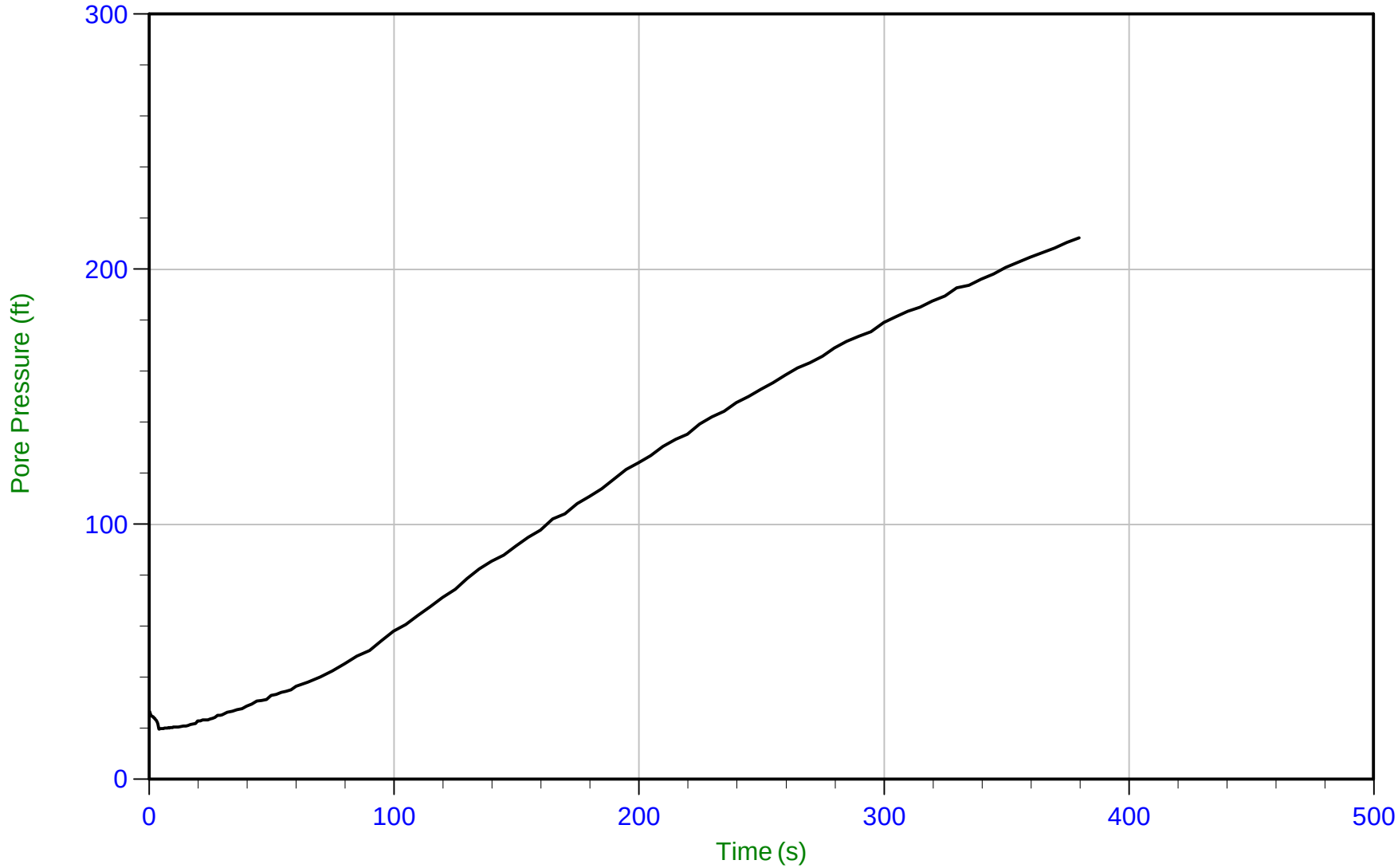
WT: 9.876 m / 32.403 ft
Ueq: 21.6 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/22/2022 09:34
Site: Tanforan Mall Redevelopment

Sounding: CPT-05
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP05.PPD2
Depth: 28.225 m / 92.601 ft
Duration: 380.0 s

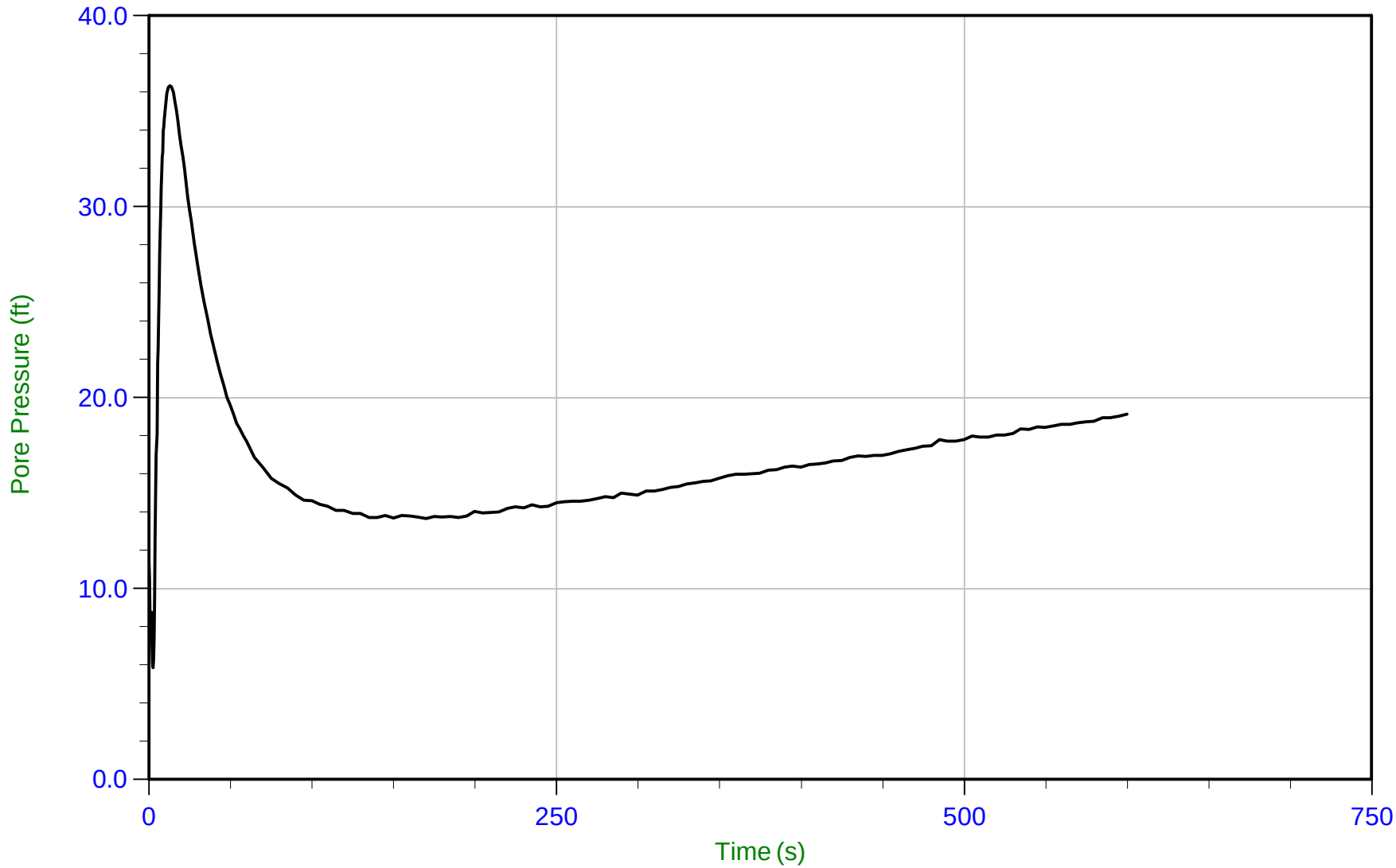
u Min: 19.6 ft
u Max: 212.2 ft
u Final: 212.2 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/22/2022 14:15
Site: Tanforan Mall Redevelopment

Sounding: CPT-06
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_CP06.PPD2
Depth: 12.000 m / 39.370 ft
Duration: 600.0 s

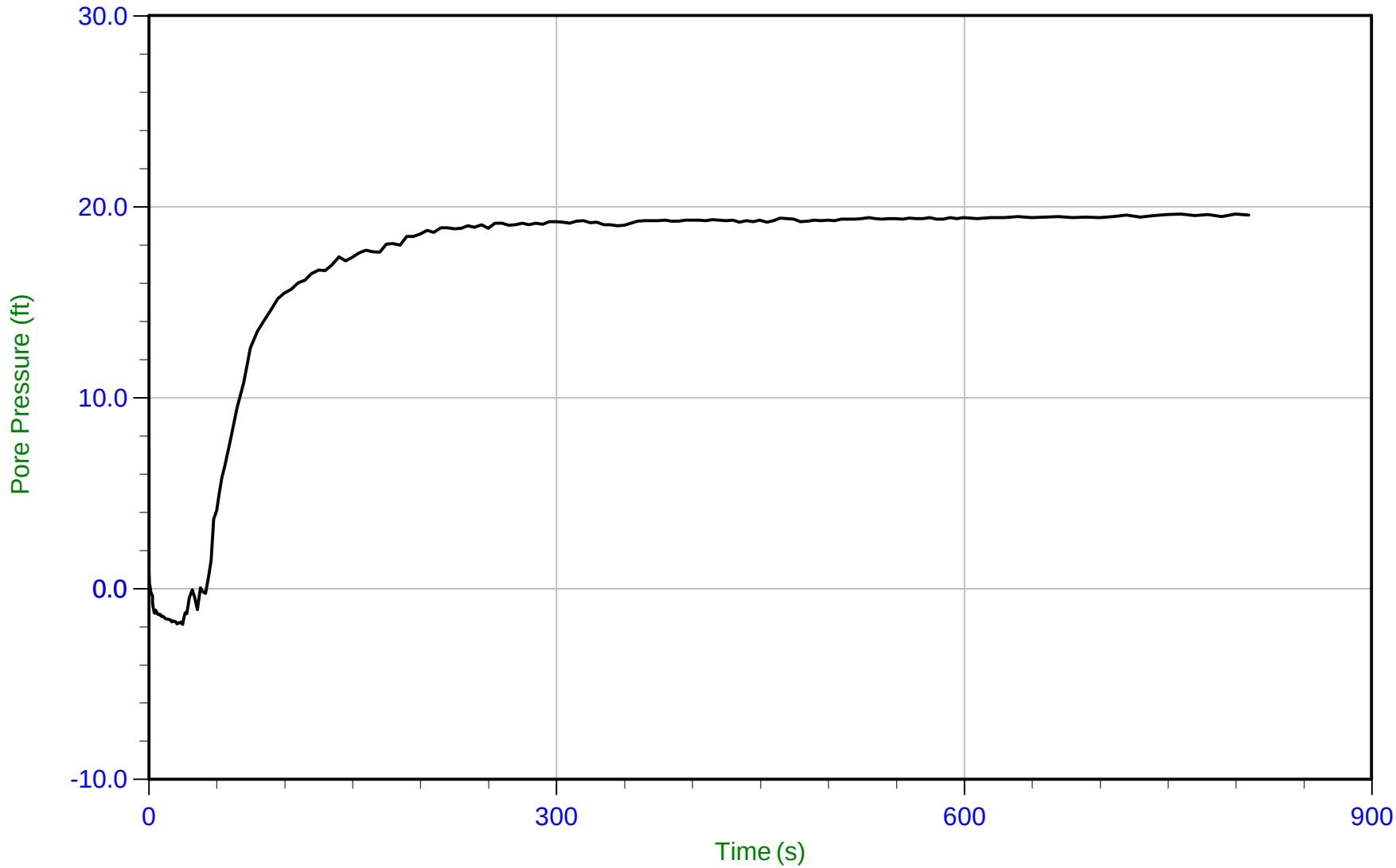
u Min: 5.8 ft
u Max: 36.3 ft
u Final: 19.1 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/22/2022 14:15
Site: Tanforan Mall Redevelopment

Sounding: CPT-06
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_CP06.PPD2
Depth: 15.150 m / 49.704 ft
Duration: 810.0 s

u Min: -1.9 ft
u Max: 19.6 ft
u Final: 19.5 ft

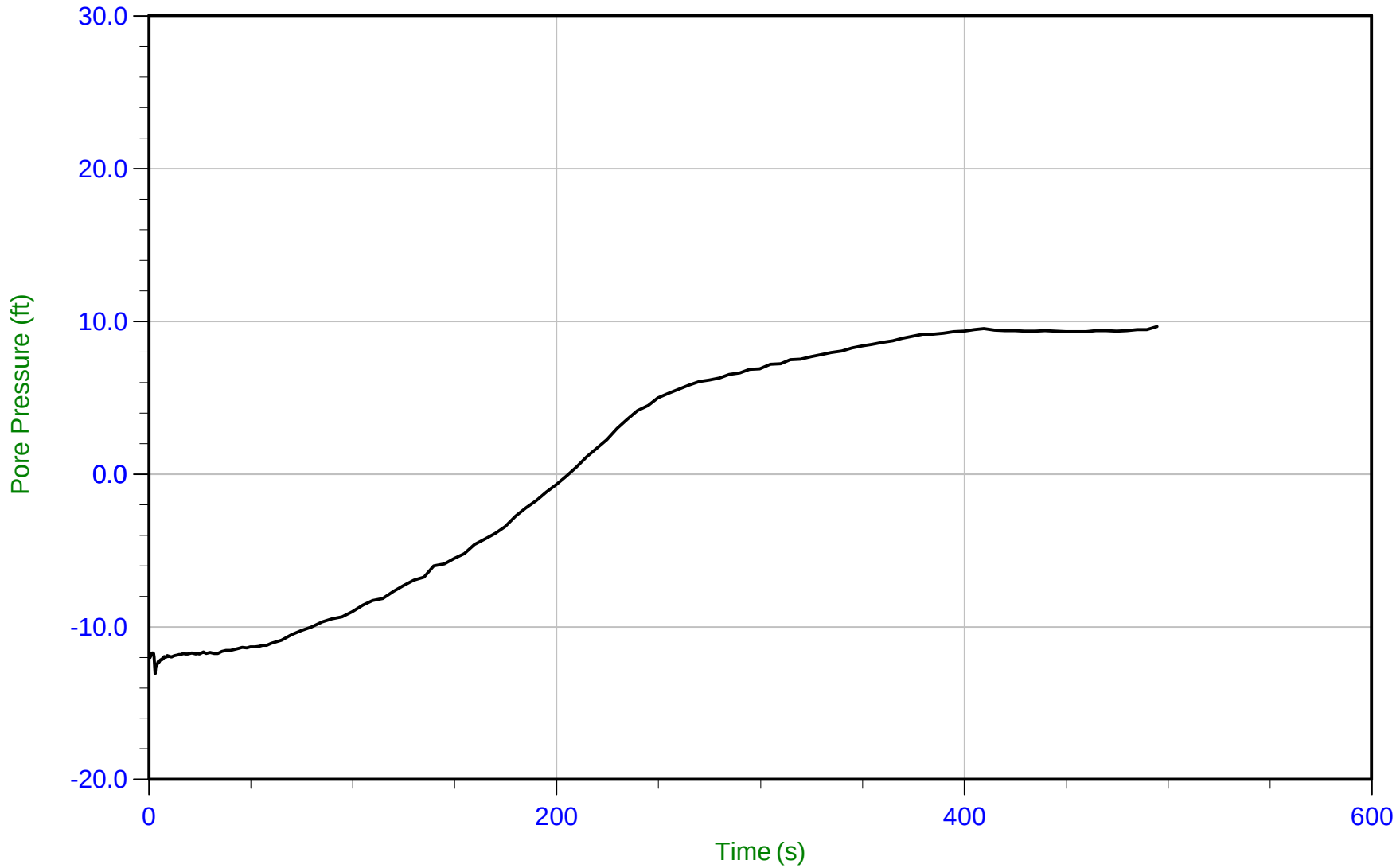
WT: 9.188 m / 30.144 ft
Ueq: 19.6 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/22/2022 14:15
Site: Tanforan Mall Redevelopment

Sounding: CPT-06
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_CP06.PPD2
Depth: 17.025 m / 55.856 ft
Duration: 495.0 s

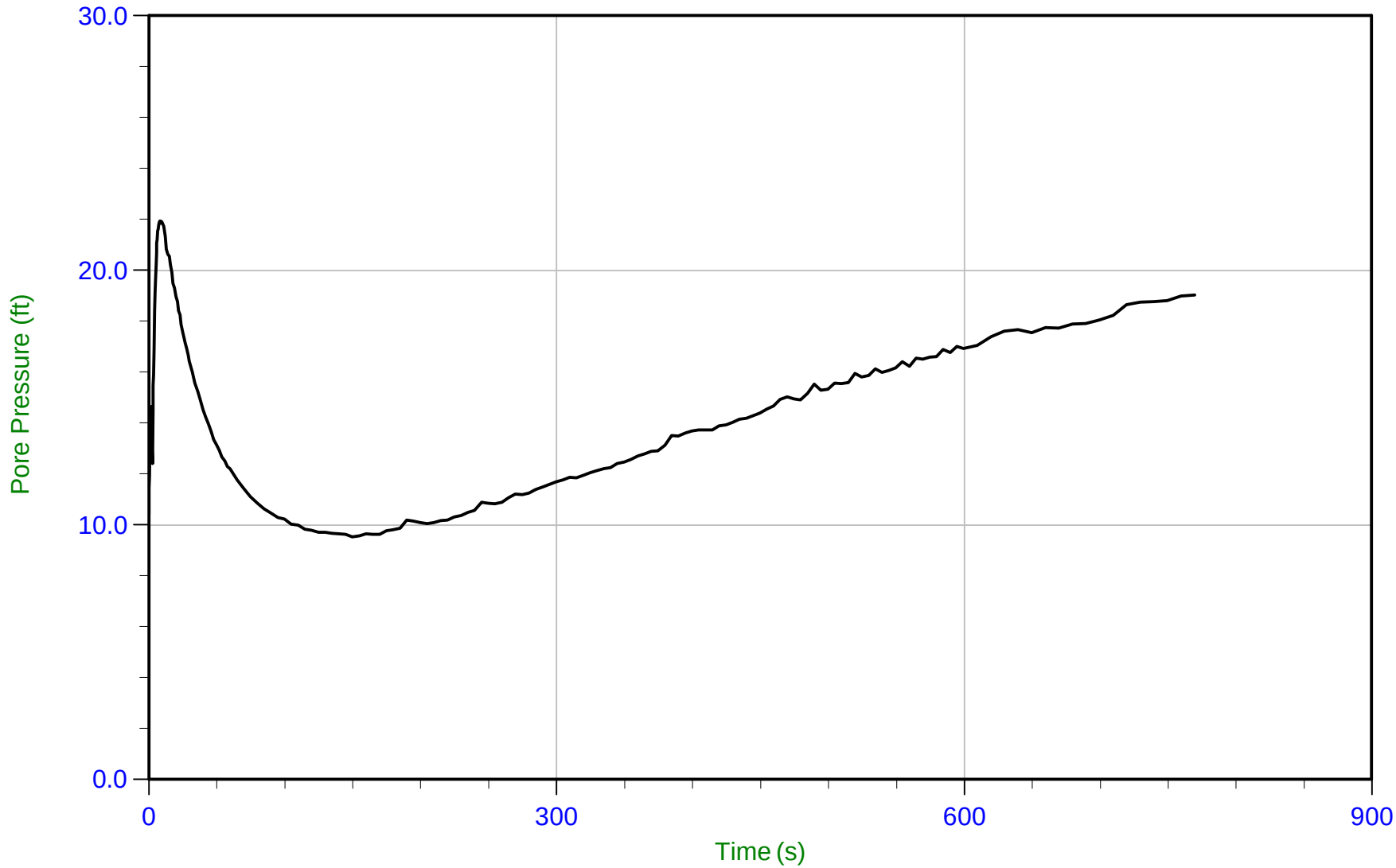
u Min: -13.1 ft
u Max: 9.7 ft
u Final: 9.7 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/23/2022 10:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-07
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_CP07.PPD2
Depth: 15.825 m / 51.919 ft
Duration: 770.0 s

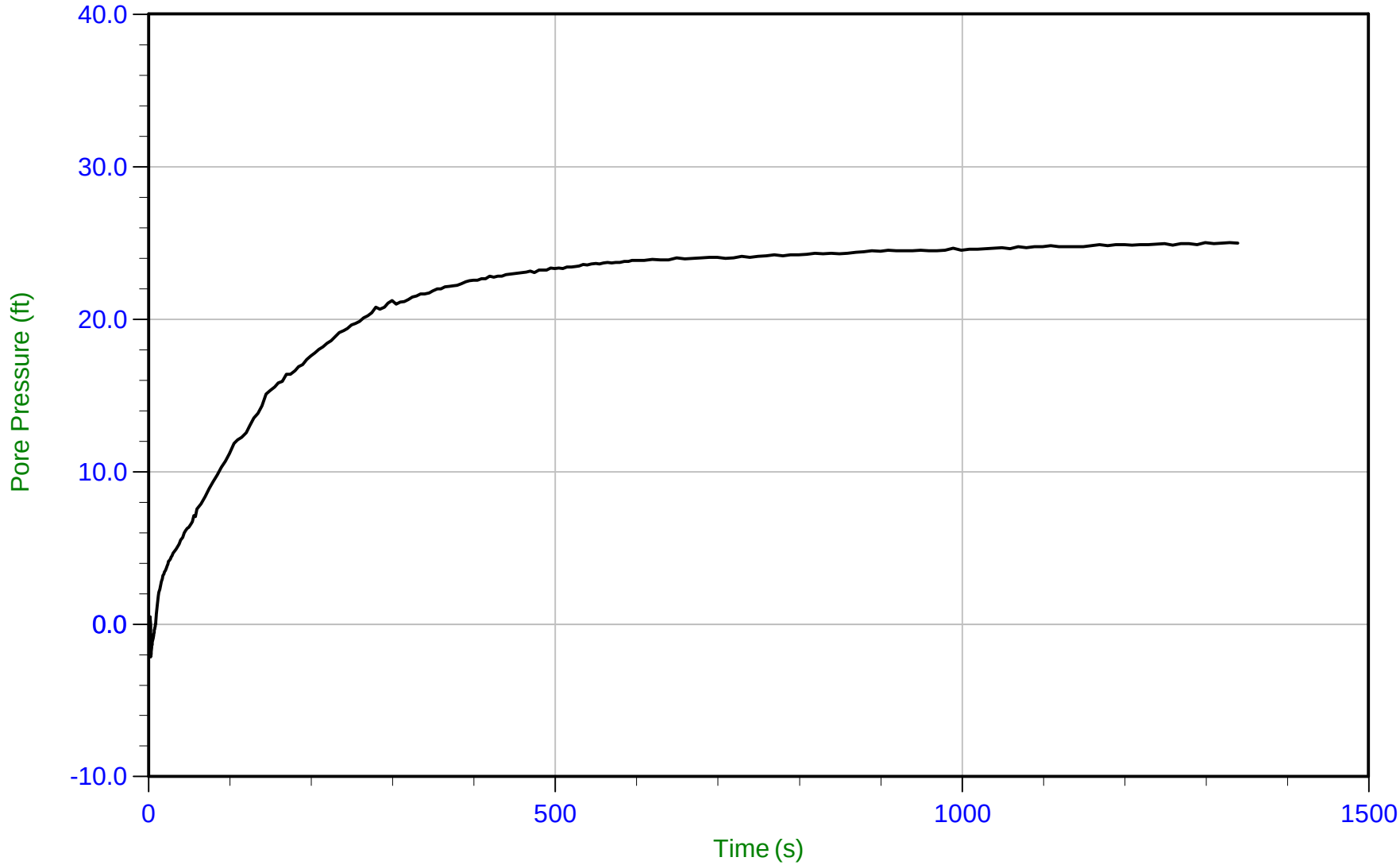
u Min: 9.5 ft
u Max: 21.9 ft
u Final: 19.0 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/23/2022 10:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-07
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_CP07.PPD2
Depth: 16.825 m / 55.199 ft
Duration: 1340.0 s

u Min: -2.1 ft
u Max: 25.0 ft
u Final: 25.0 ft

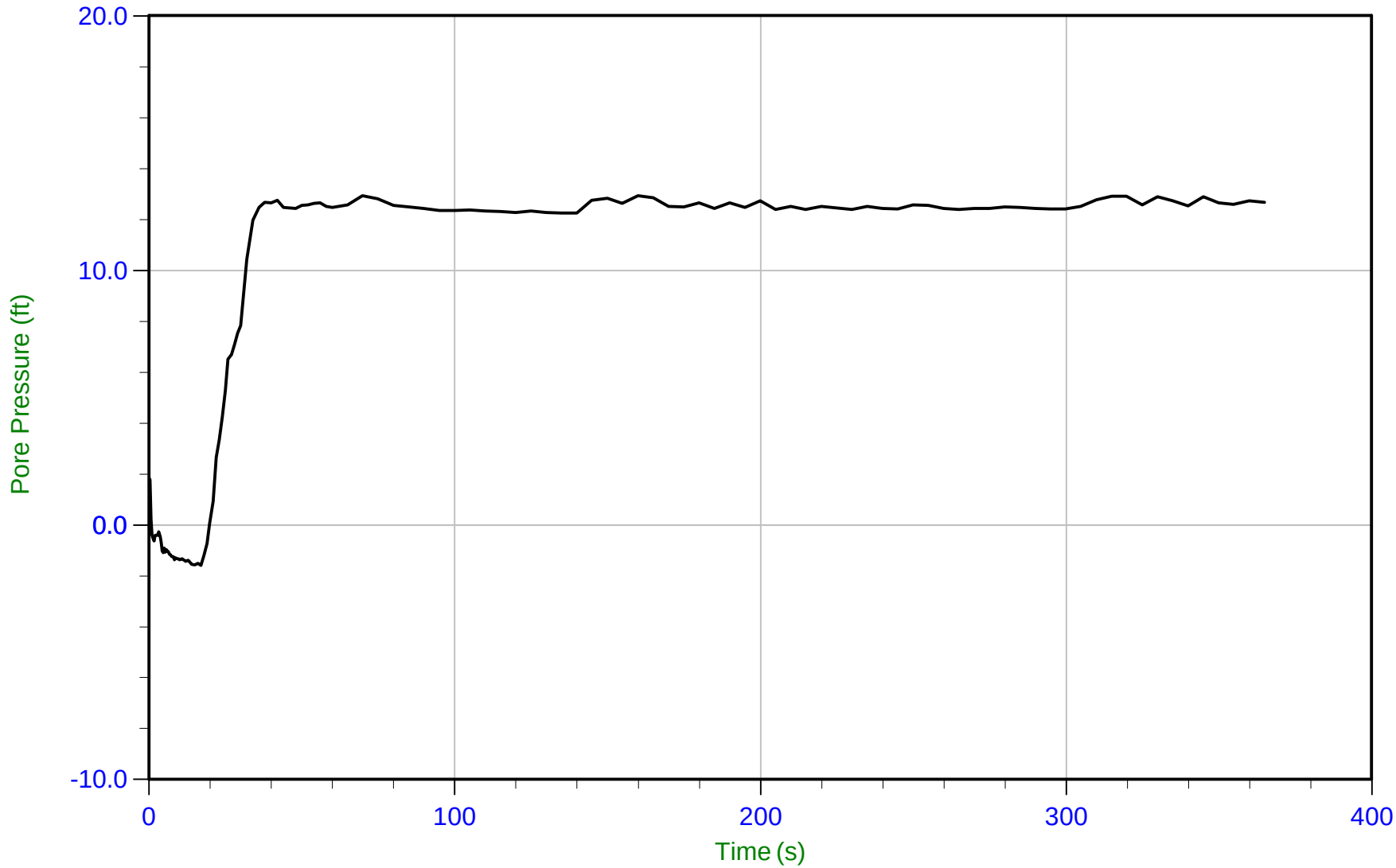
WT: 9.196 m / 30.170 ft
Ueq: 25.0 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/23/2022 07:22
Site: Tanforan Mall Redevelopment

Sounding: CPT-08
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP08.PPD2
Depth: 11.650 m / 38.221 ft
Duration: 365.0 s

u Min: -1.6 ft
u Max: 12.9 ft
u Final: 12.7 ft

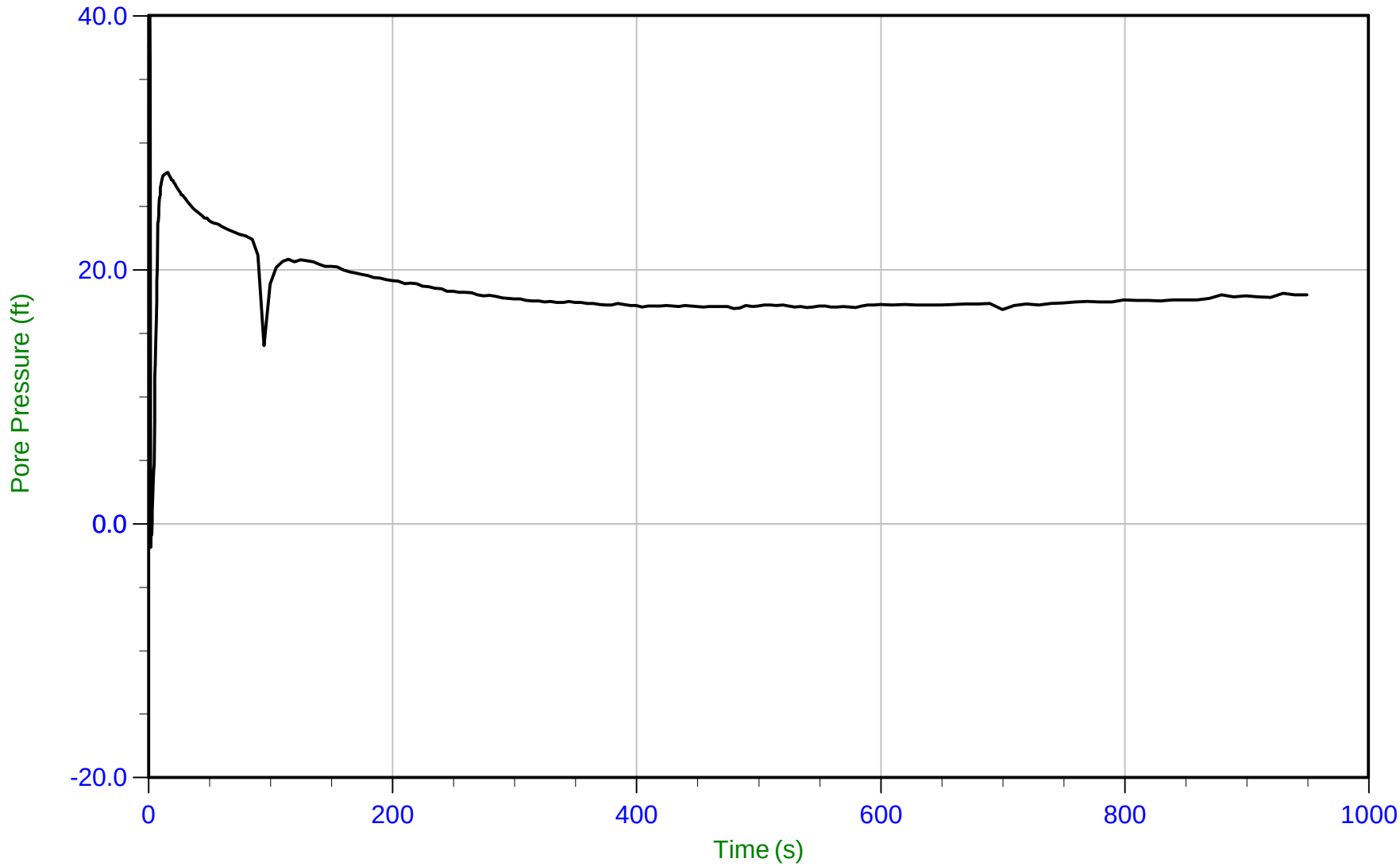
WT: 7.785 m / 25.542 ft
Ueq: 12.7 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/24/2022 07:39
Site: Tanforan Mall Redevelopment

Sounding: CPT-09
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP09.PPD2
Depth: 10.175 m / 33.382 ft
Duration: 950.0 s

u Min: -1.9 ft
u Max: 60.2 ft
u Final: 18.0 ft

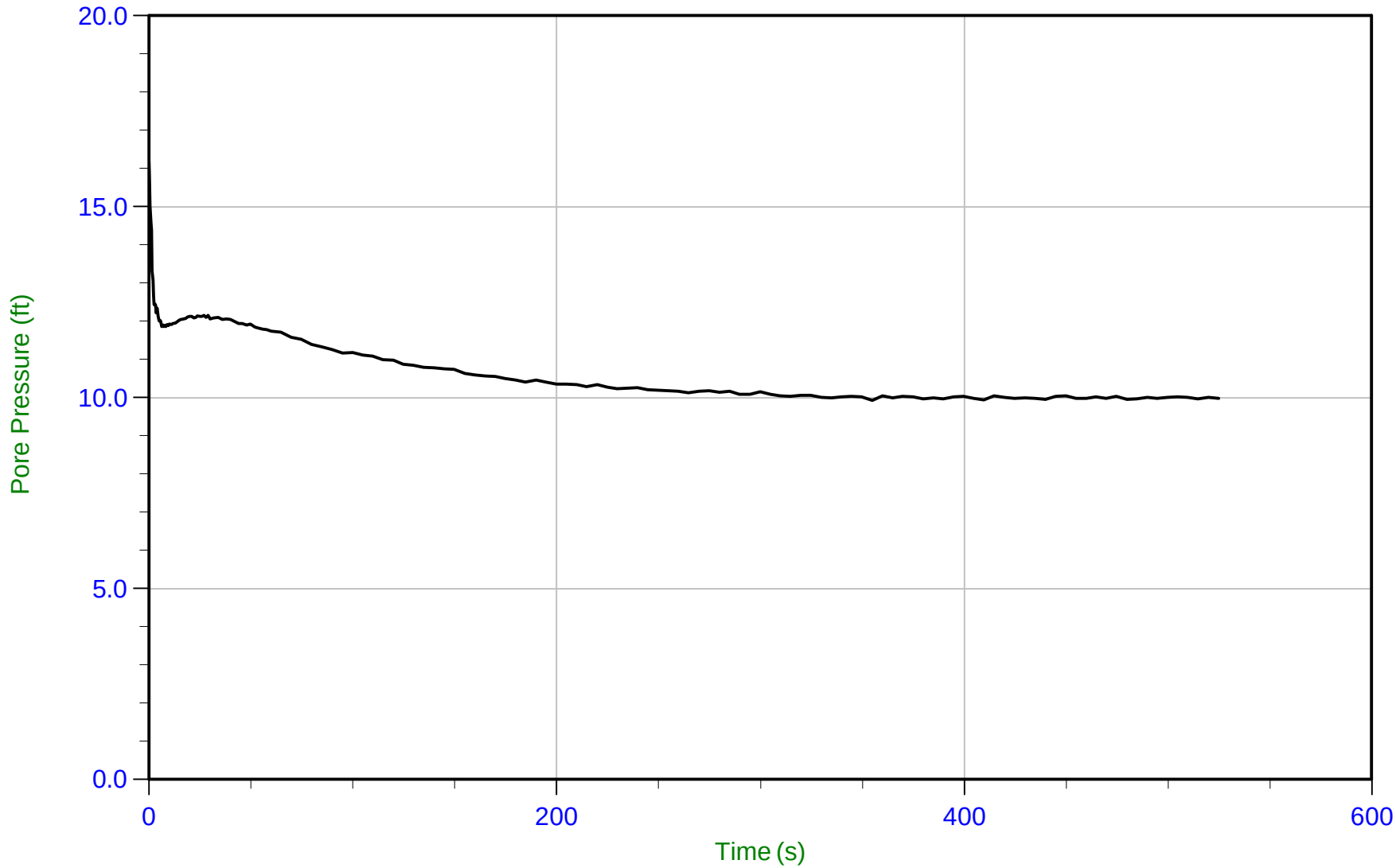
WT: 4.687 m / 15.378 ft
Ueq: 18.0 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/24/2022 12:05
Site: Tanforan Mall Redevelopment

Sounding: CPT-10
Cone: 815:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP10.PPD2
Depth: 10.000 m / 32.808 ft
Duration: 525.0 s

u Min: 9.9 ft
u Max: 16.2 ft
u Final: 10.0 ft

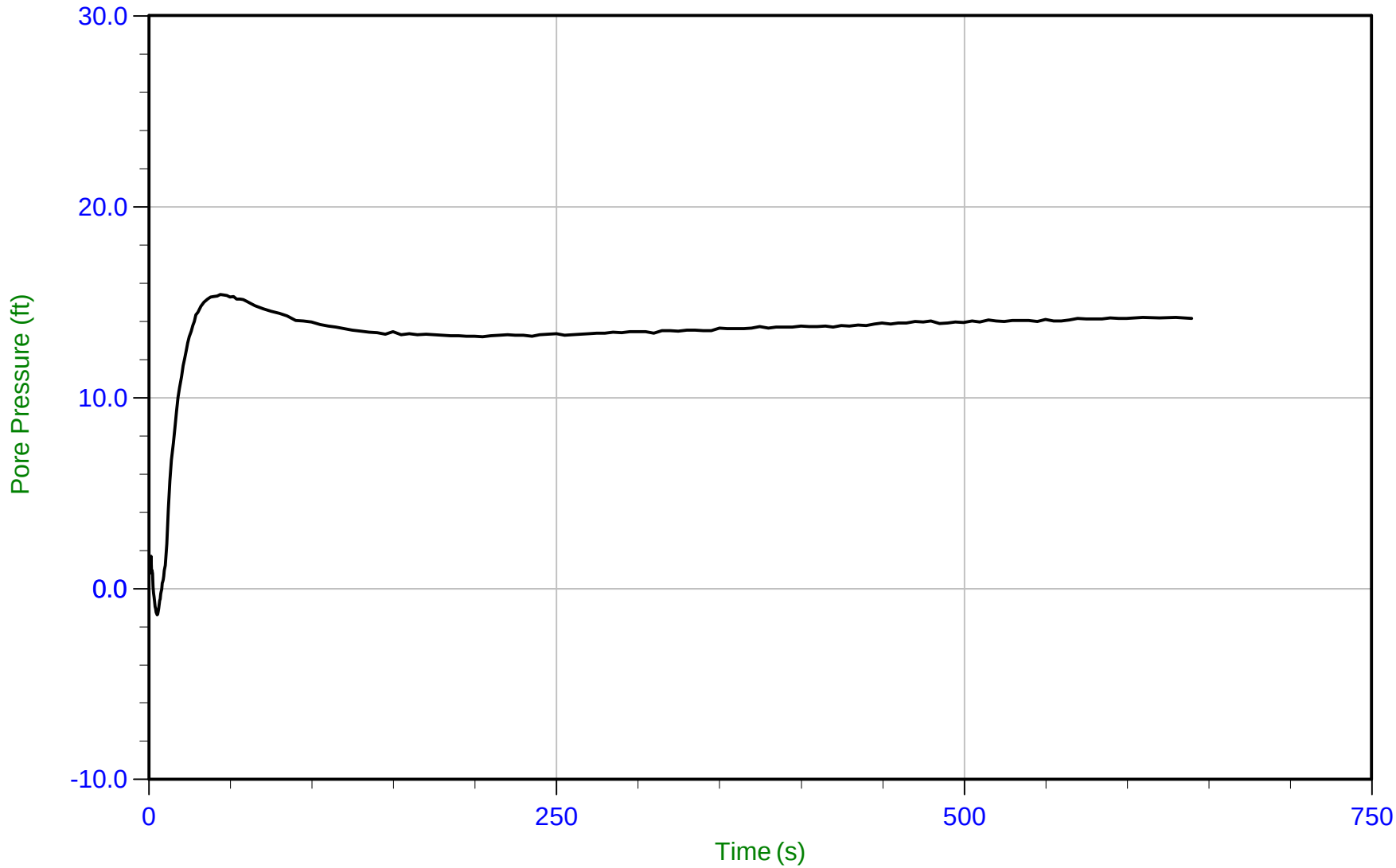
WT: 6.958 m / 22.829 ft
Ueq: 10.0 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/23/2022 08:55
Site: Tanforan Mall Redevelopment

Sounding: CPT-11
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_CP11.PPD2
Depth: 15.400 m / 50.524 ft
Duration: 640.0 s

u Min: -1.4 ft
u Max: 15.4 ft
u Final: 14.1 ft

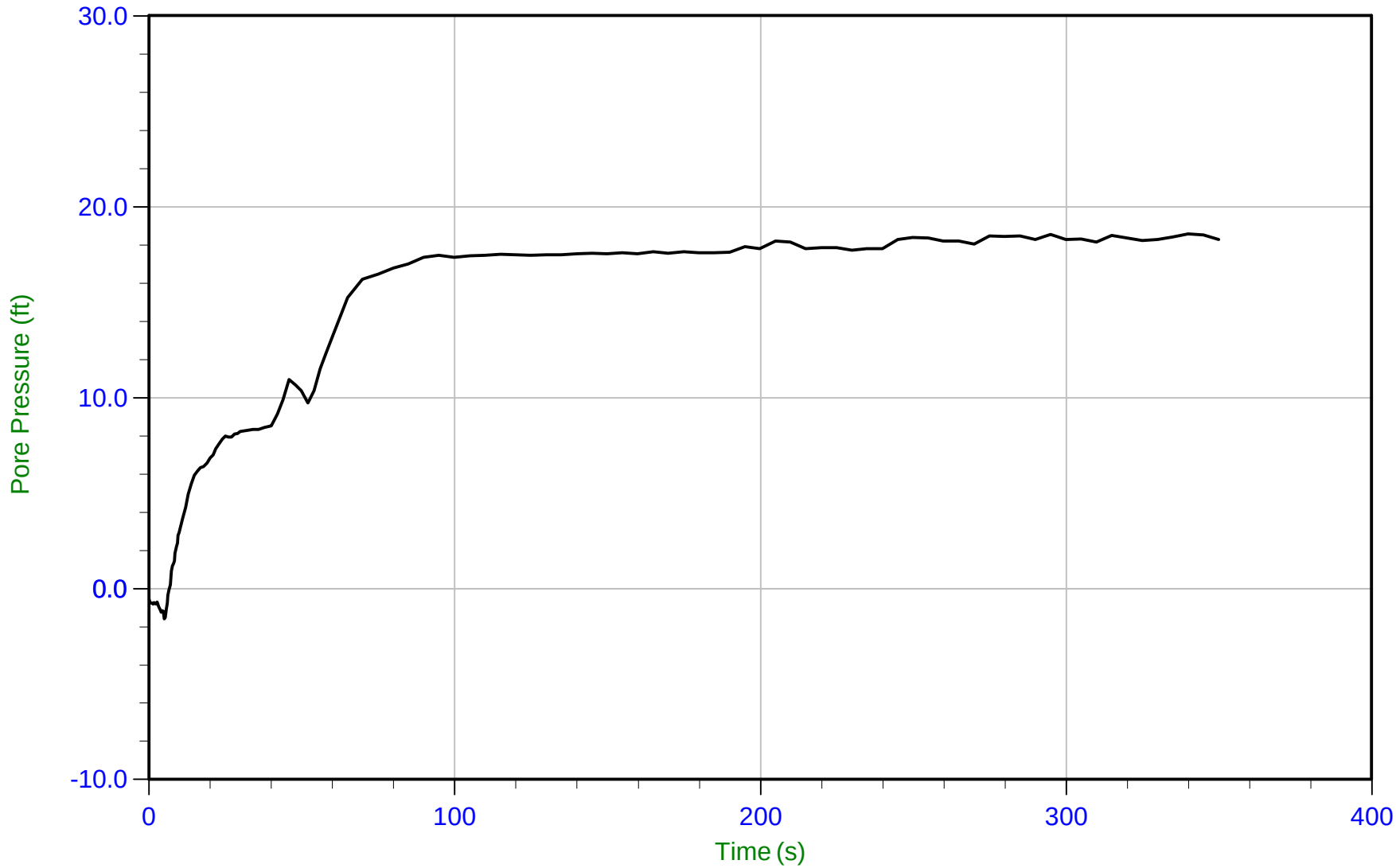
WT: 11.089 m / 36.381 ft
Ueq: 14.1 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/23/2022 08:55
Site: Tanforan Mall Redevelopment

Sounding: CPT-11
Cone: 813:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_CP11.PPD2
Depth: 16.775 m / 55.035 ft
Duration: 350.0 s

u Min: -1.6 ft
u Max: 18.6 ft
u Final: 18.3 ft

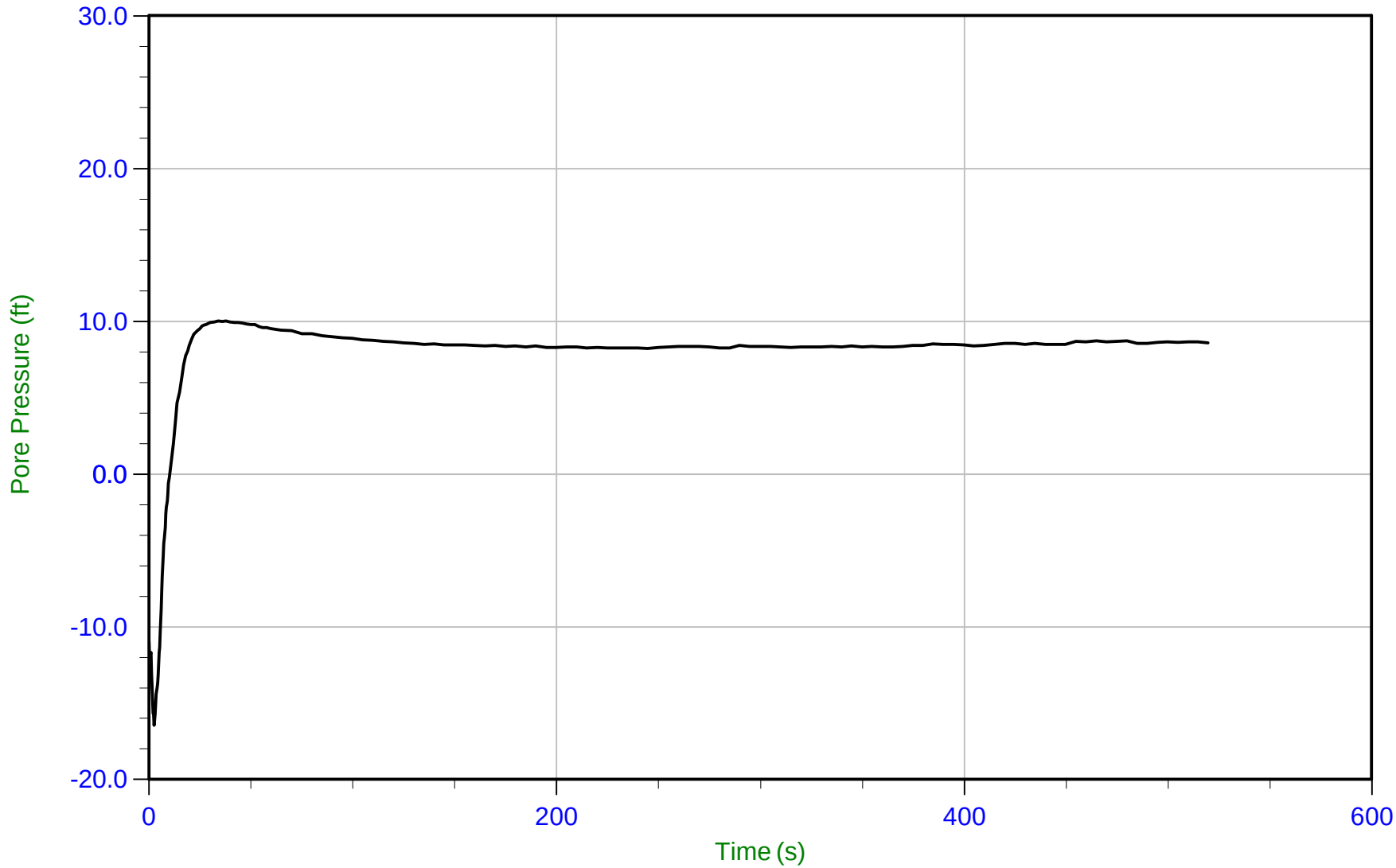
WT: 11.170 m / 36.646 ft
Ueq: 18.4 ft

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 06/24/2022 13:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-12
Cone: 815:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 22-56-24357_SP12.PPD2
Depth: 10.500 m / 34.448 ft
Duration: 520.0 s

u Min: -16.5 ft
u Max: 10.0 ft
u Final: 8.6 ft

WT: 7.876 m / 25.839 ft
Ueq: 8.6 ft

Seismic Cone Penetration Test Tabular Results

CONETEC

Job No:	22-56-24357
Client:	Langan Engineering
Project:	Tanforan Mall Redevelopment
Sounding ID:	CPT-01
Date:	06:24:22 09:18
Seismic Source:	Beam
Seismic Offset (ft):	2.10
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
5.74	4.93	5.36			
9.02	8.21	8.47	3.12	4.50	692
12.30	11.49	11.68	3.21	3.55	903
15.58	14.77	14.92	3.24	4.41	736
18.87	18.05	18.18	3.25	4.02	810
22.15	21.33	21.44	3.26	3.93	830
25.43	24.62	24.70	3.27	3.22	1014
28.71	27.90	27.97	3.27	3.71	883
31.99	31.18	31.25	3.27	3.49	938
35.27	34.46	34.52	3.27	3.76	871
38.55	37.74	37.80	3.28	3.33	984
41.83	41.02	41.07	3.28	3.17	1034
45.11	44.30	44.35	3.28	2.57	1273
48.39	47.58	47.63	3.28	2.52	1299
51.61	50.80	50.84	3.21	2.47	1298
54.95	54.14	54.18	3.35	3.55	944
58.24	57.42	57.46	3.28	2.69	1221
61.52	60.70	60.74	3.28	3.38	969
64.80	63.99	64.02	3.28	2.74	1197
68.08	67.27	67.30	3.28	2.85	1152
71.36	70.55	70.58	3.28	2.80	1173
74.54	73.73	73.76	3.18	2.52	1262
77.82	77.01	77.04	3.28	2.36	1388
81.10	80.29	80.32	3.28	2.52	1299
84.38	83.57	83.60	3.28	2.15	1527
87.66	86.85	86.88	3.28	2.74	1198
90.95	90.13	90.16	3.28	2.71	1212
94.32	93.51	93.54	3.38	3.00	1128
97.61	96.79	96.82	3.28	2.47	1328
100.89	100.07	100.10	3.28	2.99	1096

Job No:	22-56-24292
Client:	Langan Engineering
Project:	Tanforan Mall Redevelopment
Sounding ID:	CPT-02
Date:	06:23:22 12:32
Seismic Source:	Beam
Seismic Offset (ft):	2.10
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
6.00	5.19	5.60			
9.02	8.21	8.47	2.87	3.88	741
12.40	11.59	11.78	3.30	3.73	885
15.68	14.87	15.02	3.24	4.53	716
18.96	18.15	18.27	3.25	4.53	719
22.24	21.43	21.54	3.26	3.48	937
25.53	24.71	24.80	3.27	4.58	714
28.81	27.99	28.07	3.27	4.38	747
32.09	31.27	31.34	3.27	2.39	1371
35.37	34.56	34.62	3.28	4.18	784
38.65	37.84	37.89	3.28	3.18	1029

Job No:	22-56-24292
Client:	Langan Engineering
Project:	Tanforan Mall Redevelopment
Sounding ID:	CPT-03
Date:	06:22:22 11:36
Seismic Source:	Beam
Seismic Offset (ft):	2.10
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
5.91	5.09	5.51			
9.12	8.31	8.57	3.06	4.18	732
12.47	11.66	11.84	3.27	3.78	865
15.75	14.94	15.08	3.24	5.37	604
19.03	18.22	18.34	3.26	3.67	887
22.31	21.50	21.60	3.26	2.86	1142
25.59	24.78	24.87	3.27	4.03	811
28.87	28.06	28.14	3.27	4.00	817
32.15	31.34	31.41	3.27	3.58	915
35.43	34.62	34.69	3.28	3.34	981
38.71	37.90	37.96	3.28	2.68	1221
42.00	41.18	41.24	3.28	2.36	1388
45.28	44.46	44.51	3.28	1.49	2195
48.56	47.74	47.79	3.28	2.92	1123
51.84	51.03	51.07	3.28	3.28	1000
55.12	54.31	54.35	3.28	2.98	1100
58.40	57.59	57.63	3.28	2.92	1122
61.68	60.87	60.90	3.28	2.97	1104
64.96	64.15	64.18	3.28	2.75	1192
68.24	67.43	67.46	3.28	2.80	1170
71.52	70.71	70.74	3.28	3.25	1009
74.80	73.99	74.02	3.28	3.00	1095
78.08	77.27	77.30	3.28	2.45	1341
81.37	80.55	80.58	3.28	2.74	1196
84.65	83.83	83.86	3.28	2.85	1150

Job No:	22-56-24292
Client:	Langan Engineering
Project:	Tanforan Mall Redevelopment
Sounding ID:	CPT-04
Date:	06:22:22 07:42
Seismic Source:	Beam
Seismic Offset (ft):	2.10
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
5.84	5.03	5.45			
9.12	8.31	8.57	3.12	4.09	762
12.40	11.59	11.78	3.21	4.64	691
15.68	14.87	15.02	3.24	3.85	842
18.87	18.05	18.18	3.16	3.88	814

Job No:	22-56-24292
Client:	Langan Engineering
Project:	Tanforan Mall Redevelopment
Sounding ID:	CPT-05
Date:	06:22:22 09:24
Seismic Source:	Beam
Seismic Offset (ft):	2.10
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
6.00	5.19	5.60			
9.25	8.44	8.70	3.10	3.11	995
12.53	11.72	11.91	3.21	3.33	964
15.81	15.00	15.15	3.24	3.48	930
19.09	18.28	18.40	3.25	4.04	806
22.38	21.56	21.67	3.26	4.17	782
25.66	24.84	24.93	3.27	4.49	727
28.97	28.16	28.24	3.30	4.71	701
32.25	31.44	31.51	3.27	3.92	835
35.50	34.69	34.75	3.24	3.48	931
38.78	37.97	38.03	3.28	3.45	950
42.06	41.25	41.30	3.28	2.78	1180
45.28	44.46	44.51	3.21	3.03	1061
48.56	47.74	47.79	3.28	3.33	984
51.90	51.09	51.13	3.34	2.76	1211
55.18	54.37	54.41	3.28	2.78	1181
58.46	57.65	57.69	3.28	2.66	1234
61.75	60.93	60.97	3.28	3.40	965
65.06	64.25	64.28	3.31	3.16	1047
68.34	67.53	67.56	3.28	3.40	964
71.62	70.81	70.84	3.28	3.02	1086
74.90	74.09	74.12	3.28	3.16	1040
78.18	77.37	77.40	3.28	2.67	1229
81.46	80.65	80.68	3.28	3.24	1013
84.74	83.93	83.96	3.28	3.02	1086
88.03	87.21	87.24	3.28	3.06	1074
91.31	90.49	90.52	3.28	2.99	1098
94.59	93.77	93.80	3.28	2.72	1206
97.87	97.06	97.08	3.28	3.07	1068
100.56	99.75	99.77	2.69	1.90	1419

Job No:	22-56-24292
Client:	Langan Engineering
Project:	Tanforan Mall Redevelopment
Sounding ID:	CPT-08
Date:	06:23:22 07:14
Seismic Source:	Beam
Seismic Offset (ft):	2.10
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.56	1.75	2.73			
5.84	5.03	5.45	2.72	4.55	598
9.12	8.31	8.57	3.12	5.03	621
12.40	11.59	11.78	3.21	4.97	645
15.58	14.77	14.92	3.14	3.19	985
18.96	18.15	18.27	3.35	2.54	1319
22.24	21.43	21.54	3.26	3.57	914
25.53	24.71	24.80	3.27	4.92	664
28.81	27.99	28.07	3.27	4.05	807
32.09	31.27	31.34	3.27	4.54	721
35.37	34.56	34.62	3.28	3.84	853
38.65	37.84	37.89	3.28	3.62	905
41.93	41.12	41.17	3.28	2.65	1235
45.21	44.40	44.45	3.28	4.16	787
48.39	47.58	47.63	3.18	3.73	852
50.69	49.88	49.92	2.30	2.22	1035

Job No:	22-56-24357
Client:	Langan Engineering
Project:	Tanforan Mall Redevelopment
Sounding ID:	CPT-09
Date:	06:24:22 07:39
Seismic Source:	Beam
Seismic Offset (ft):	2.10
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.79	1.98	2.88			
6.07	5.26	5.66	2.78	5.28	526
9.35	8.54	8.79	3.13	5.83	537
12.63	11.82	12.00	3.21	4.48	717
15.91	15.10	15.25	3.24	4.36	744
19.19	18.38	18.50	3.26	5.46	597
22.47	21.66	21.76	3.26	5.77	566
25.75	24.94	25.03	3.27	3.87	845
29.04	28.22	28.30	3.27	3.87	846
32.32	31.50	31.57	3.27	3.67	892
33.37	32.55	32.62	1.05	1.14	920

Job No:	22-56-24357
Client:	Langan Engineering
Project:	Tanforan Mall Redevelopment
Sounding ID:	CPT-10
Date:	06:24:22 12:05
Seismic Source:	Beam
Seismic Offset (ft):	2.10
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.56	1.75	2.73			
5.84	5.03	5.45	2.72	4.18	649
9.12	8.31	8.57	3.12	6.68	467
12.40	11.59	11.78	3.21	4.38	732
15.68	14.87	15.02	3.24	4.54	714
18.96	18.15	18.27	3.25	4.01	811
25.53	24.71	24.80	6.53	8.43	775
28.81	27.99	28.07	3.27	5.33	614
32.09	31.27	31.34	3.27	4.73	691
35.37	34.56	34.62	3.28	3.44	951
38.65	37.84	37.89	3.28	3.39	967
41.93	41.12	41.17	3.28	2.48	1324
45.21	44.40	44.45	3.28	3.98	823
48.49	47.68	47.72	3.28	3.39	967
50.85	50.04	50.09	2.36	3.28	719

Job No:	22-56-24357
Client:	Langan Engineering
Project:	Tanforan Mall Redevelopment
Sounding ID:	CPT-12
Date:	06:24:22 13:38
Seismic Source:	Beam
Seismic Offset (ft):	2.10
Source Depth (ft):	0.00
Geophone Offset (ft):	0.81

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
2.69	1.88	2.82			
6.00	5.19	5.60	2.78	6.92	402
9.19	8.37	8.63	3.03	4.70	645
12.47	11.66	11.84	3.21	3.60	892
15.81	15.00	15.15	3.31	3.72	890
19.09	18.28	18.40	3.25	3.73	872
22.31	21.50	21.60	3.20	3.33	961
25.66	24.84	24.93	3.33	3.67	908
28.97	28.16	28.24	3.30	4.91	673
32.25	31.44	31.51	3.27	4.91	667
38.78	37.97	38.03	6.52	8.24	791
42.06	41.25	41.30	3.28	4.00	819
45.34	44.53	44.58	3.28	3.48	942
48.62	47.81	47.86	3.28	3.38	970
51.90	51.09	51.13	3.28	3.51	933
55.18	54.37	54.41	3.28	3.73	879
58.46	57.65	57.69	3.28	3.46	948
61.75	60.93	60.97	3.28	3.54	926
65.06	64.25	64.28	3.31	3.80	872
68.34	67.53	67.56	3.28	3.59	915
71.62	70.81	70.84	3.28	3.16	1038
74.90	74.09	74.12	3.28	2.87	1144
78.18	77.37	77.40	3.28	3.02	1085
81.37	80.55	80.58	3.18	2.73	1165
84.65	83.83	83.86	3.28	3.07	1067
87.93	87.11	87.14	3.28	3.29	998
89.73	88.92	88.94	1.81	1.21	1492

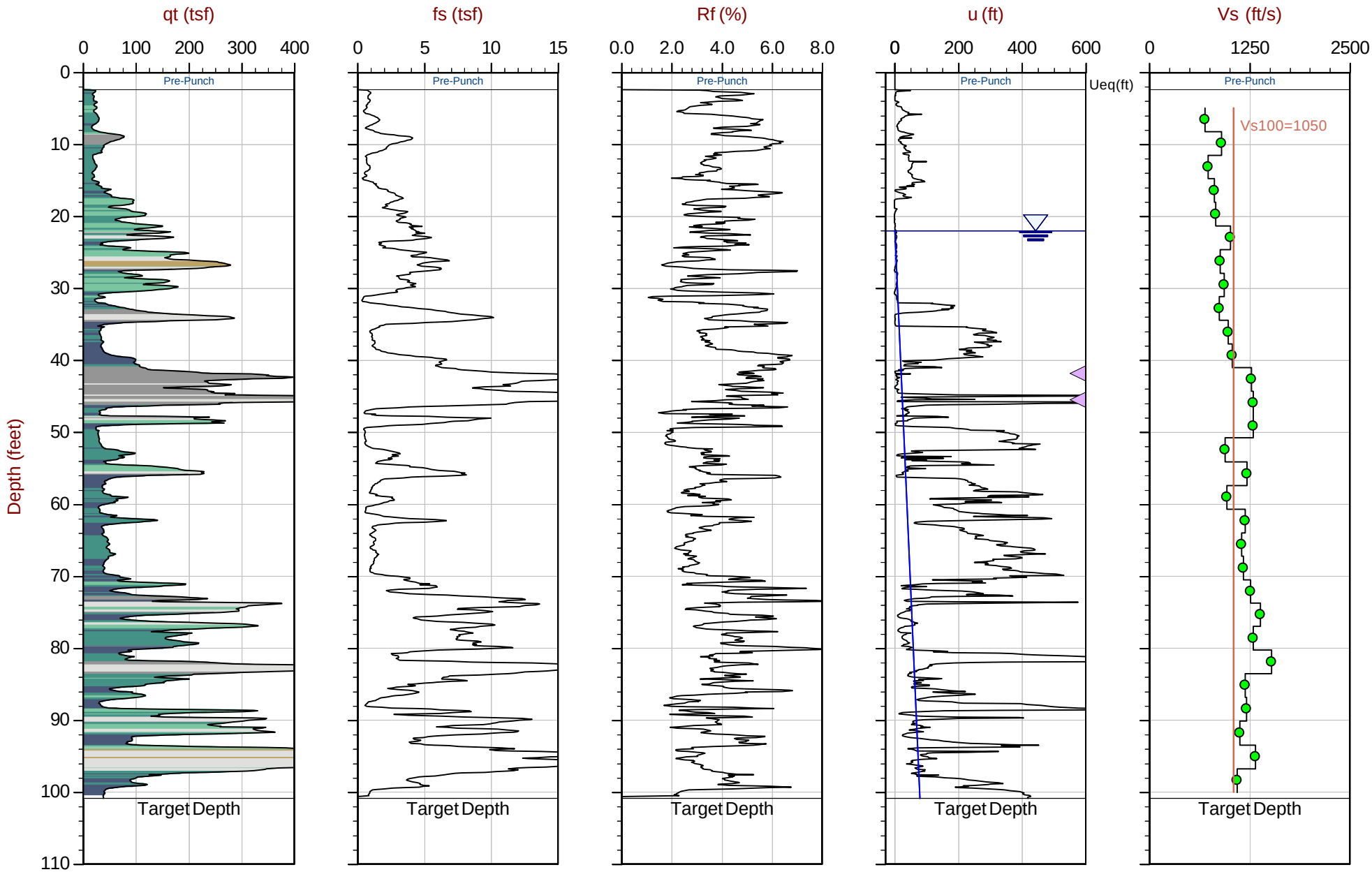
Seismic Cone Penetration Test Plots

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 09:18
Site: Tanforan Mall Redevelopment

Sounding: CPT-01
Cone: 813:T1500F15U35



Max Depth: 30.750 m / 100.88 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP01.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4166051m E: 551281m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

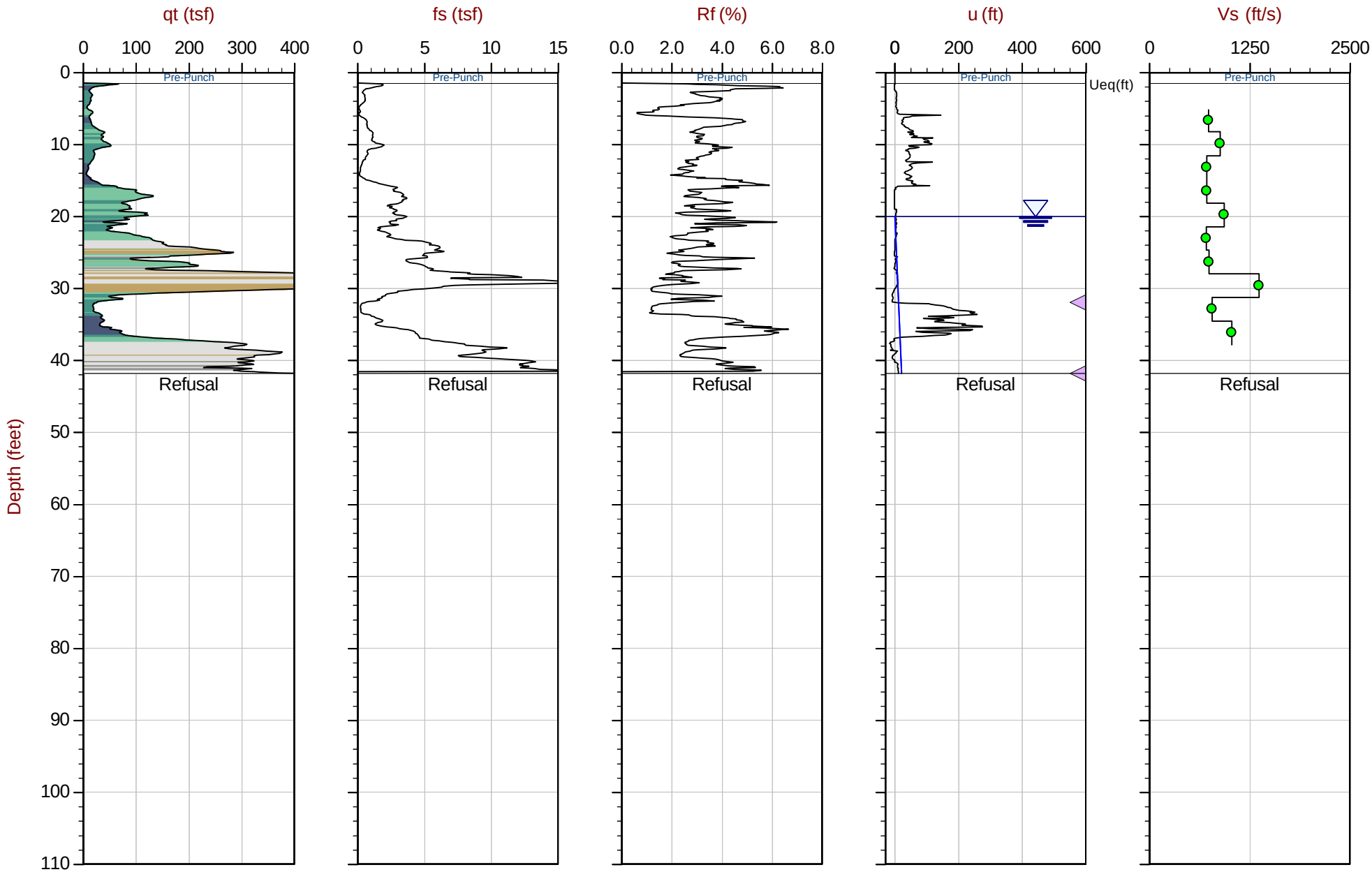
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 12:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-02
Cone: 813:T1500F15U35



Max Depth: 12.750 m / 41.83 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP02.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165928m E: 551335m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

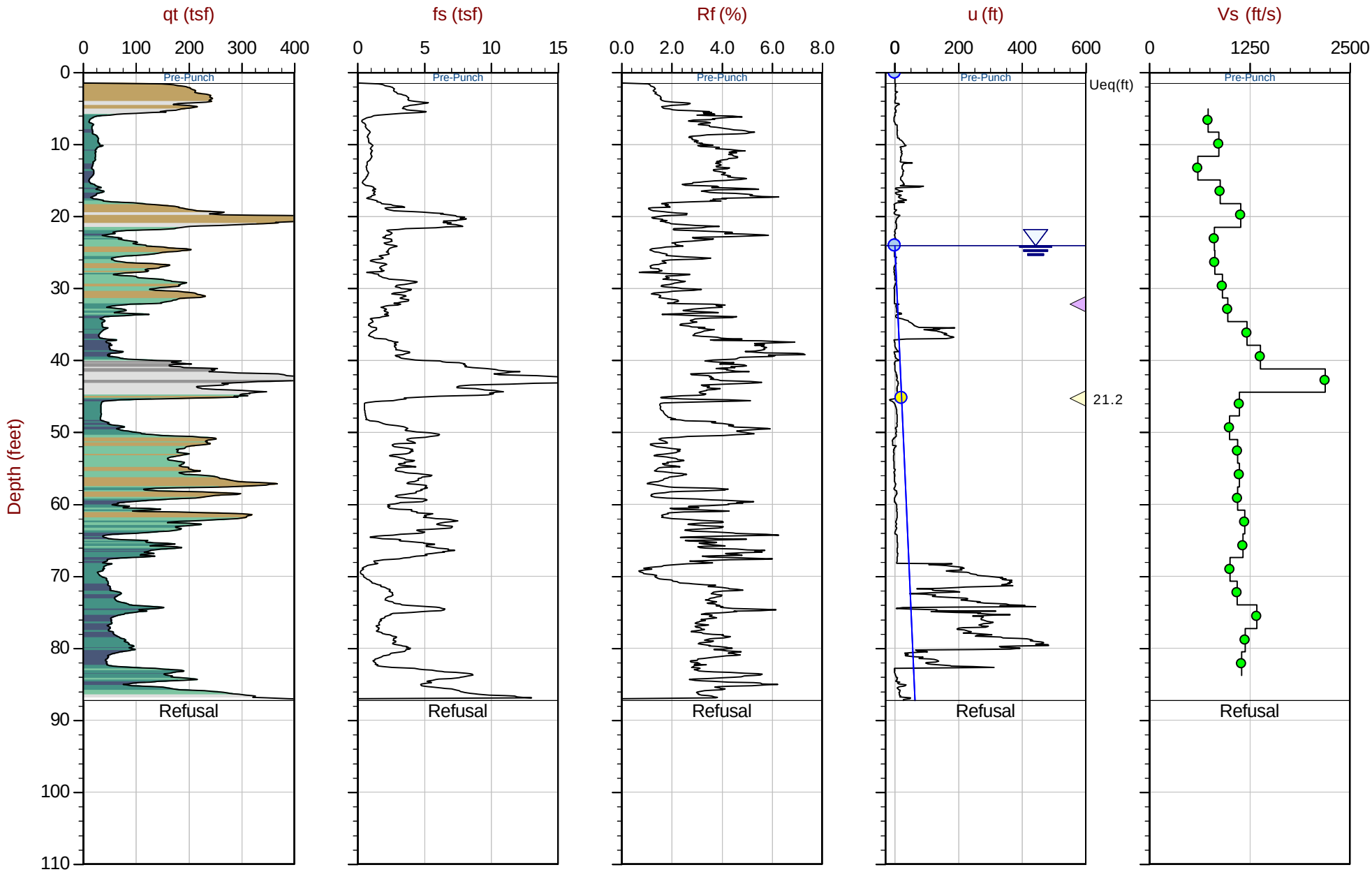
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 11:59
Site: Tanforan Mall Redevelopment

Sounding: CPT-03
Cone: 813:T1500F15U35



Max Depth: 26.600 m / 87.27 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165807m E: 551294m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

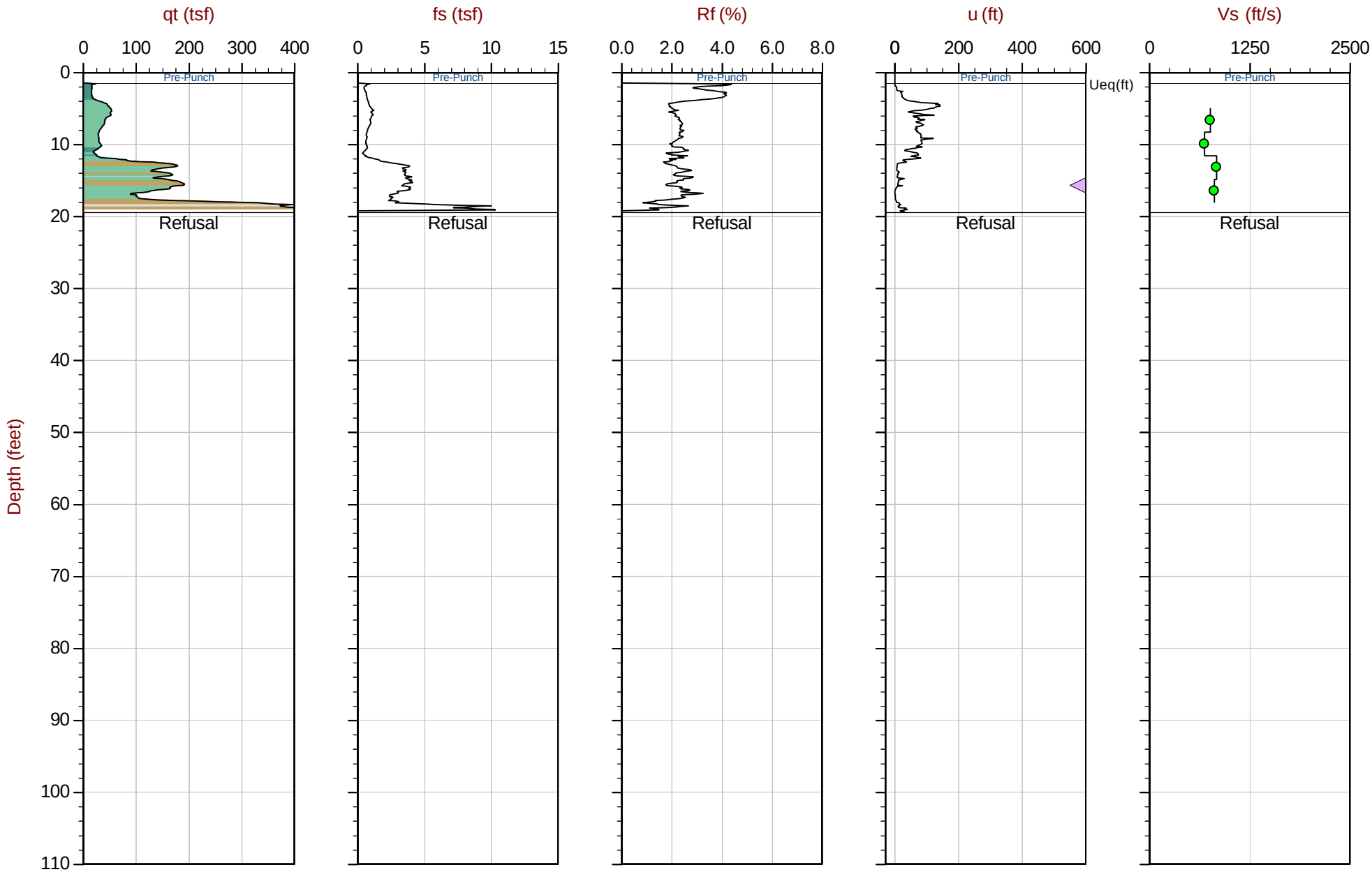
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 07:57
Site: Tanforan Mall Redevelopment

Sounding: CPT-04
Cone: 813:T1500F15U35



Max Depth: 5.925 m / 19.44 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165687m E: 551099m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

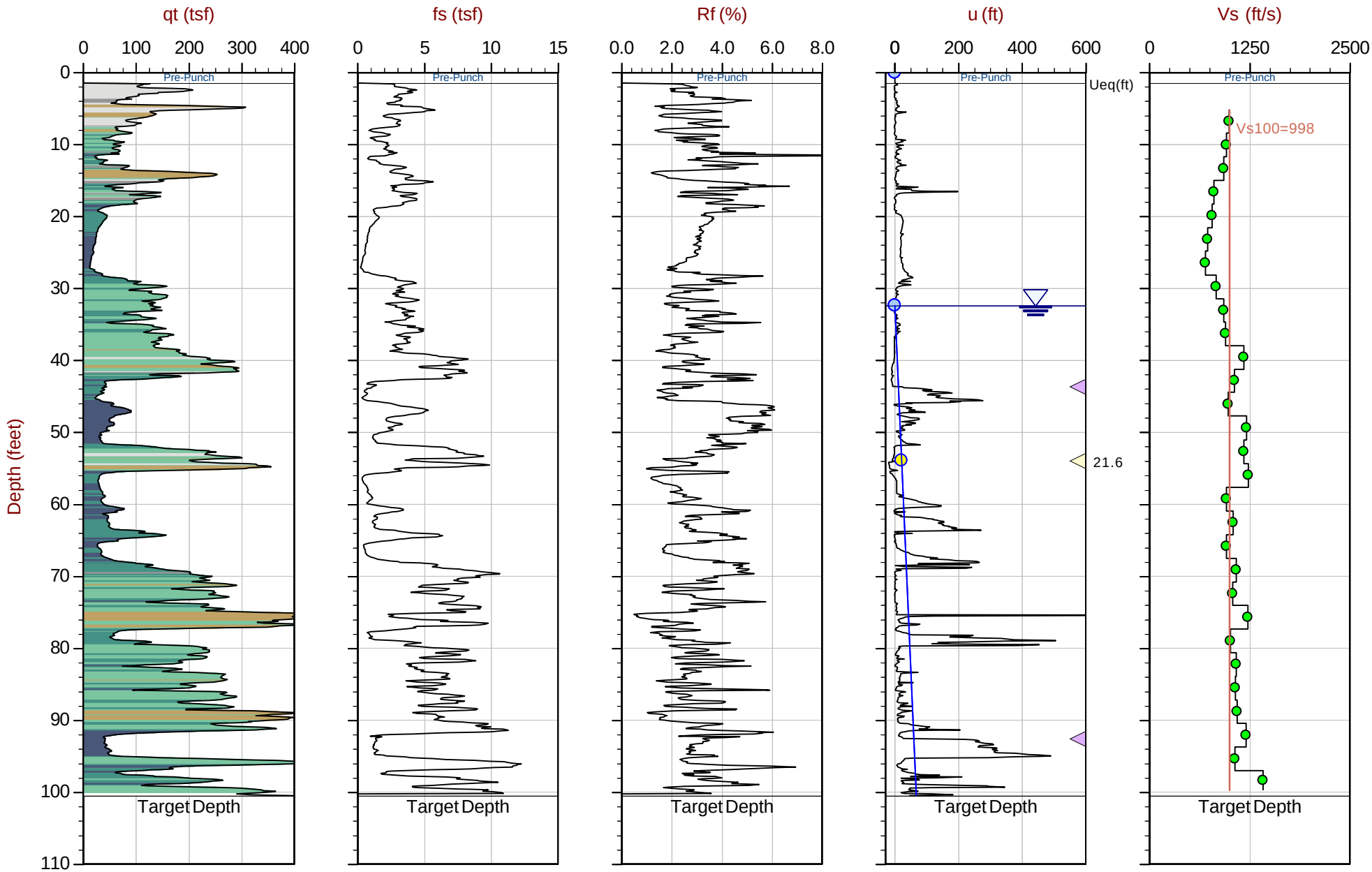
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-22 09:34
Site: Tanforan Mall Redevelopment

Sounding: CPT-05
Cone: 813:T1500F15U35



Max Depth: 30.650 m / 100.56 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165596m E: 551219m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

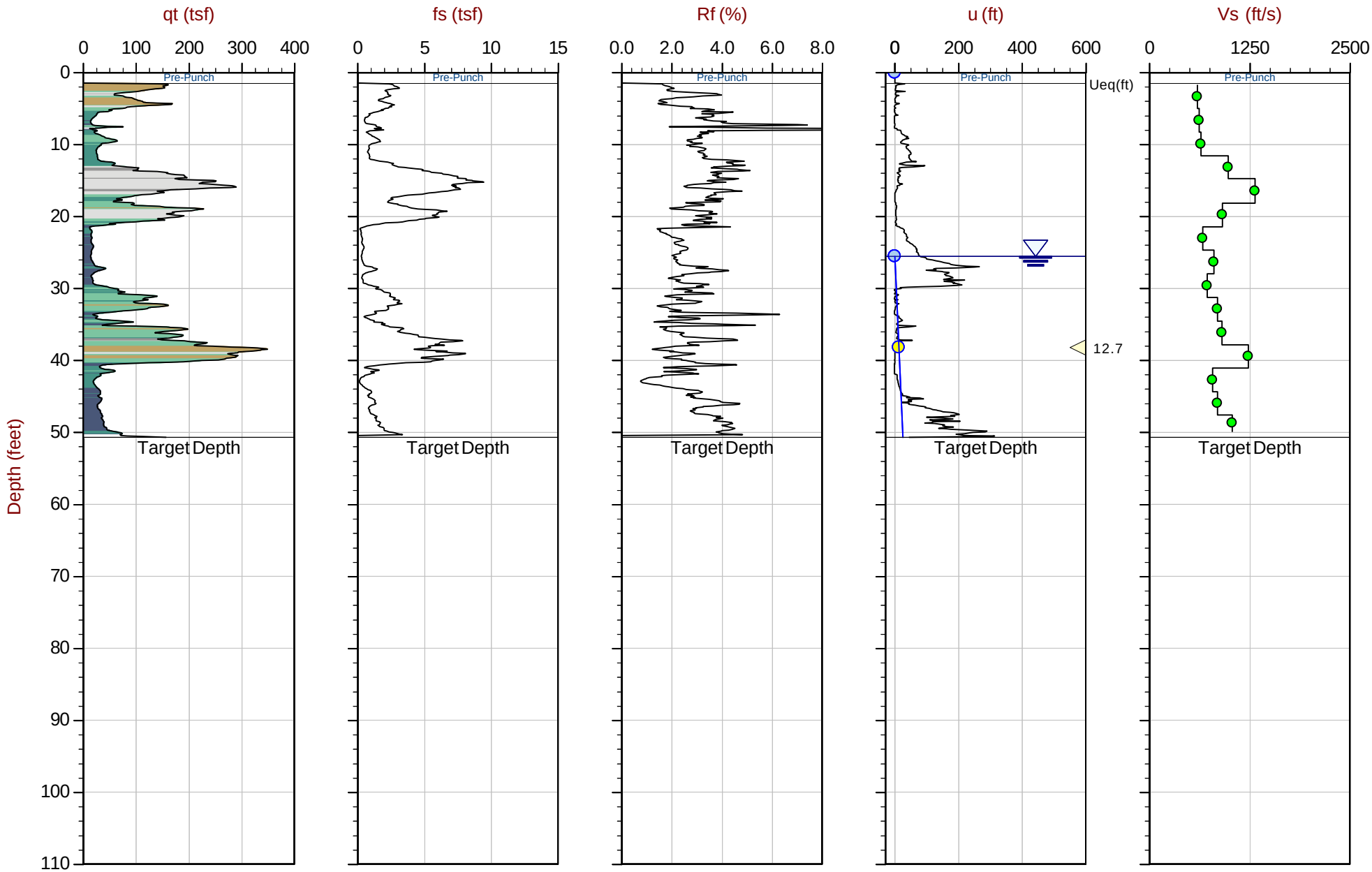
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-23 07:22
Site: Tanforan Mall Redevelopment

Sounding: CPT-08
Cone: 813:T1500F15U35



Max Depth: 15.450 m / 50.69 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165443m E: 551257m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

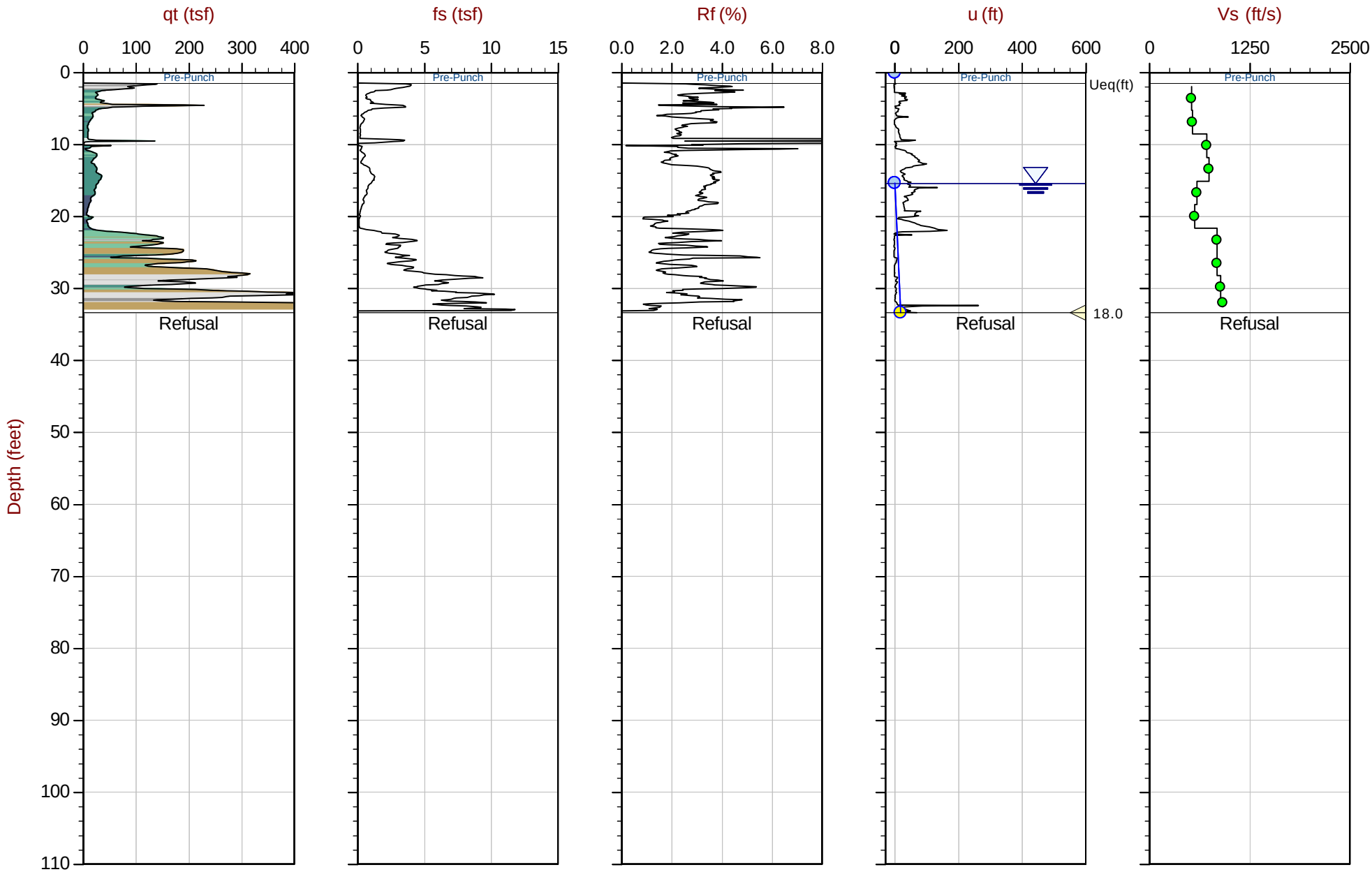
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 07:39
Site: Tanforan Mall Redevelopment

Sounding: CPT-09
Cone: 813:T1500F15U35



Max Depth: 10.175 m / 33.38 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP09.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165763m E: 551409m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

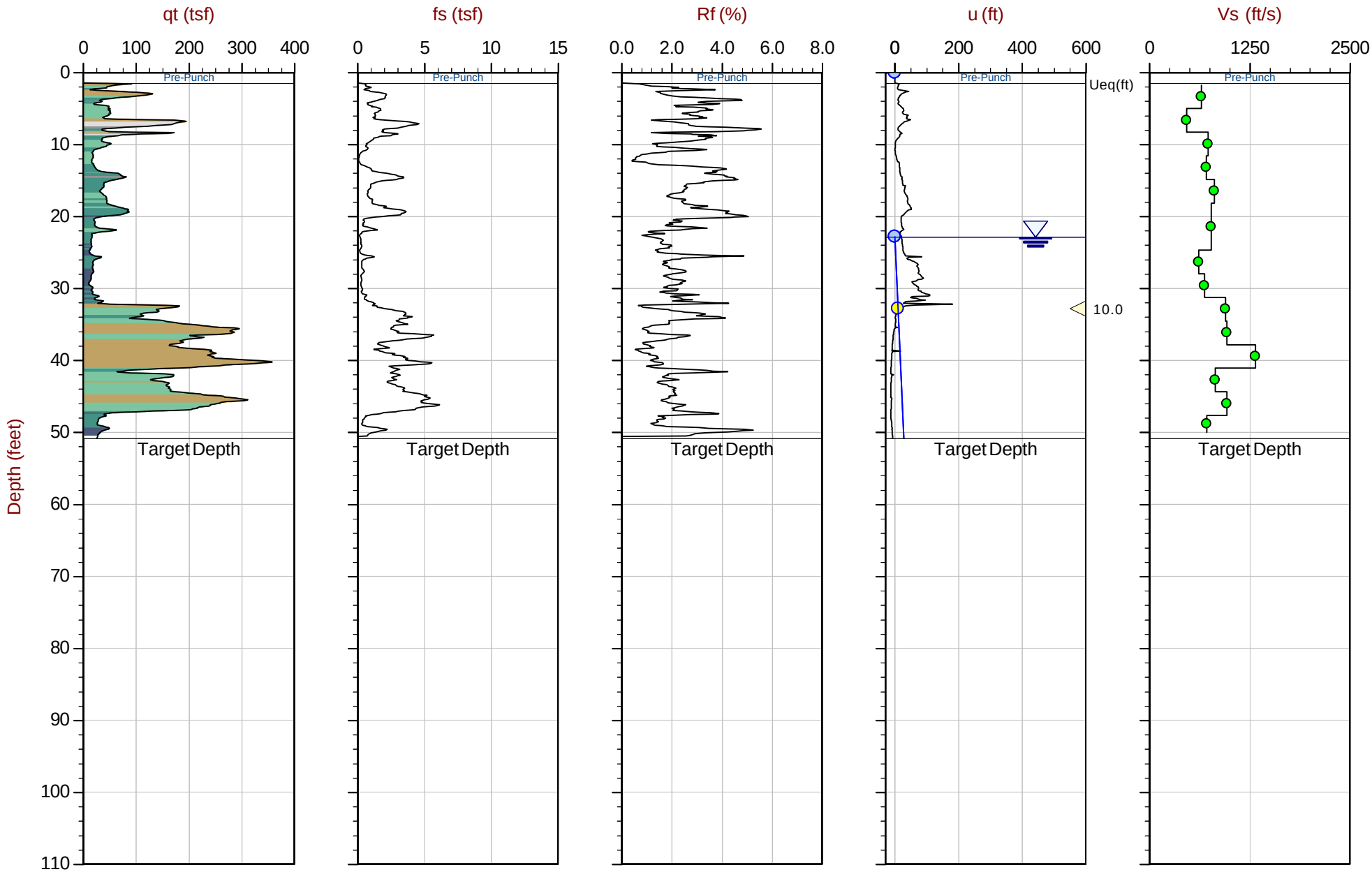
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 12:05
Site: Tanforan Mall Redevelopment

Sounding: CPT-10
Cone: 815:T1500F15U35



Max Depth: 15.500 m / 50.85 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP10.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165510m E: 551524m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

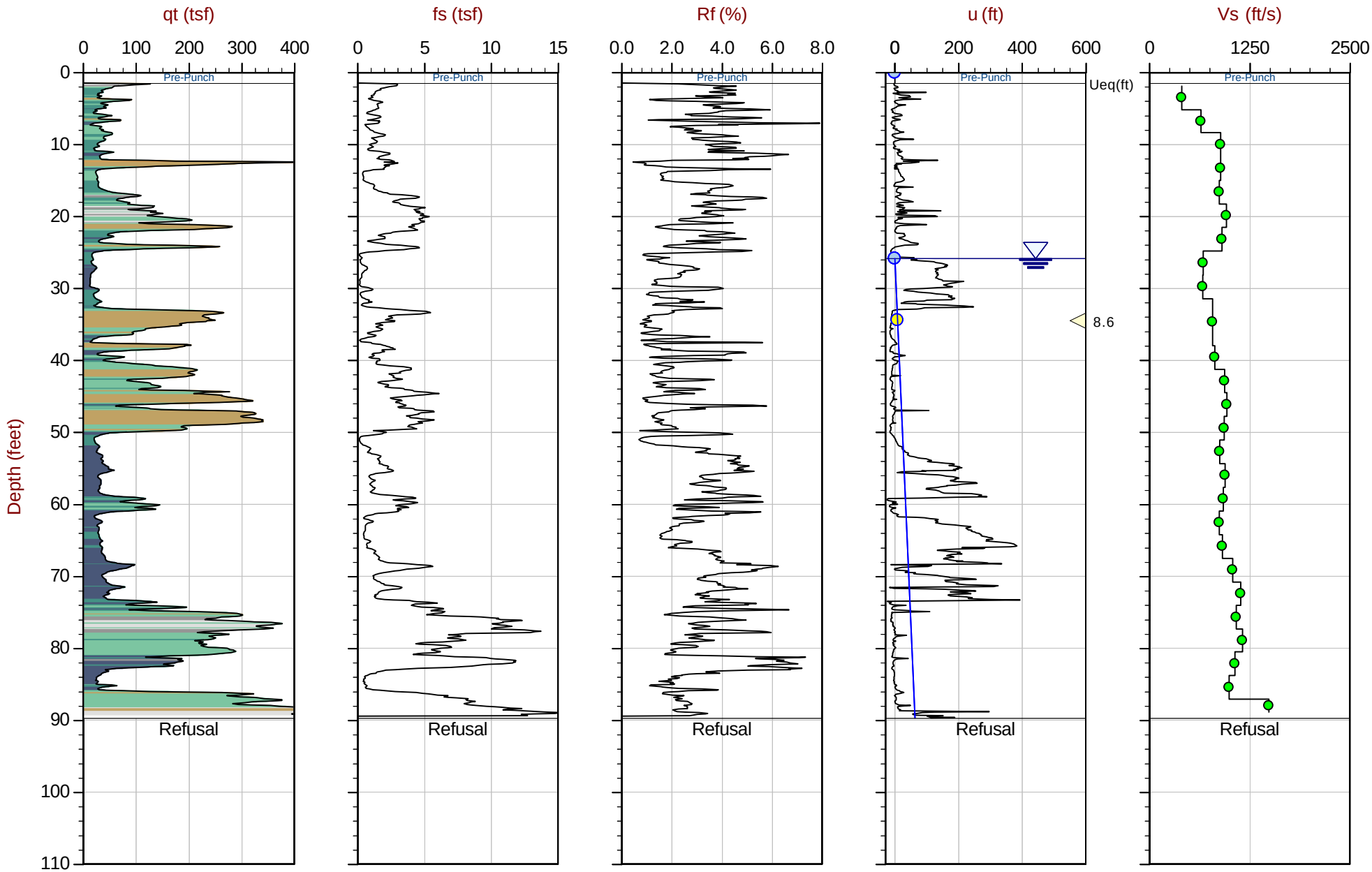
The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 22-56-24357
Date: 2022-06-24 13:38
Site: Tanforan Mall Redevelopment

Sounding: CPT-12
Cone: 815:T1500F15U35



Max Depth: 27.350 m / 89.73 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 22-56-24357_SP12.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM 10S N: 4165486m E: 551592m

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from consumer grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Shear Wave (Vs) Traces

CONETEC

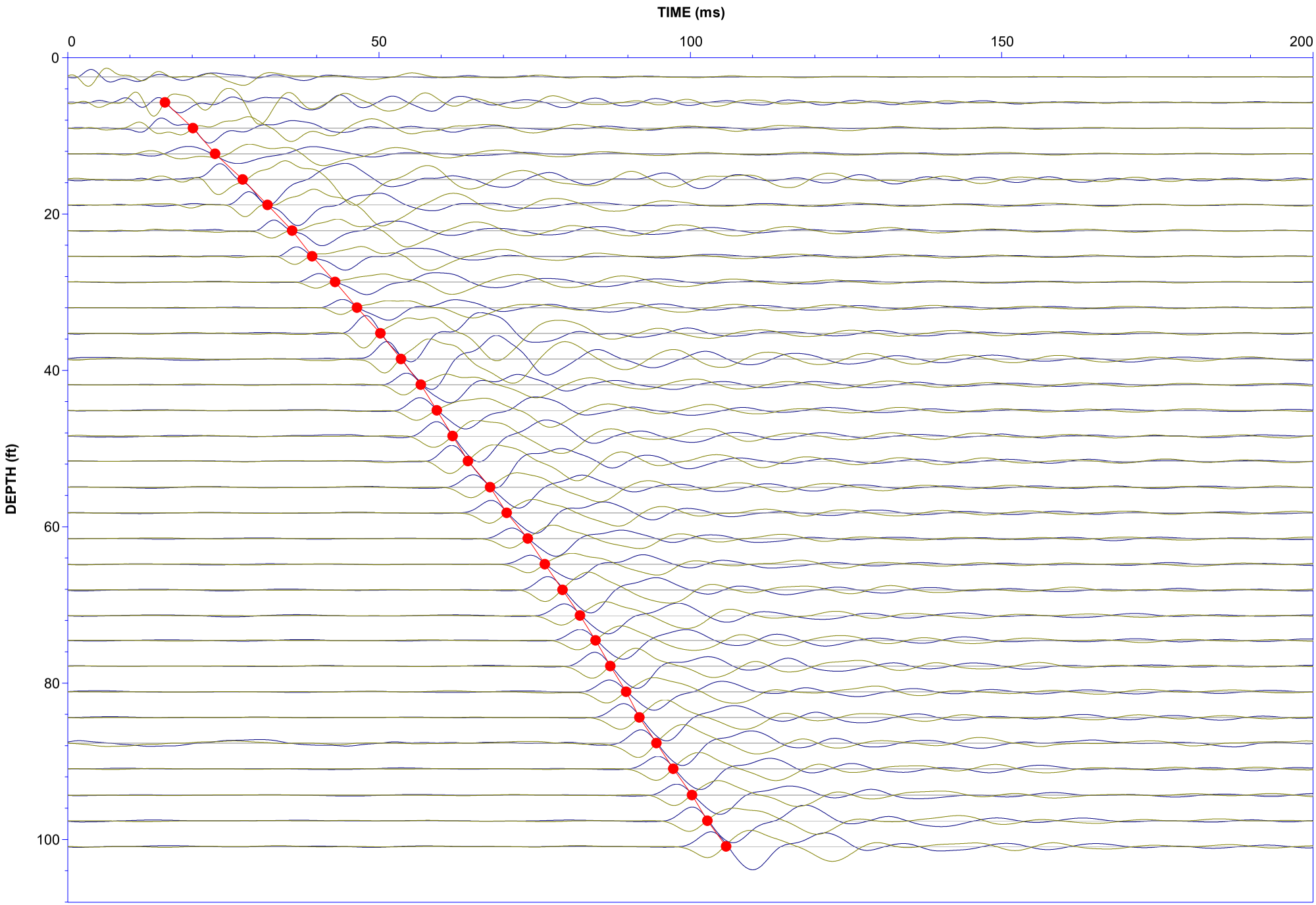
Job No: 22-56-24357
Analysis: Shear Wave

Client: Langan Engineering
Date: 06:24:22 09:18

Project: Tanforan Mall Redevelopment
Cone: 813:T1500F15U35

Filter: BP 0-250 Hz

Sounding: CPT-01



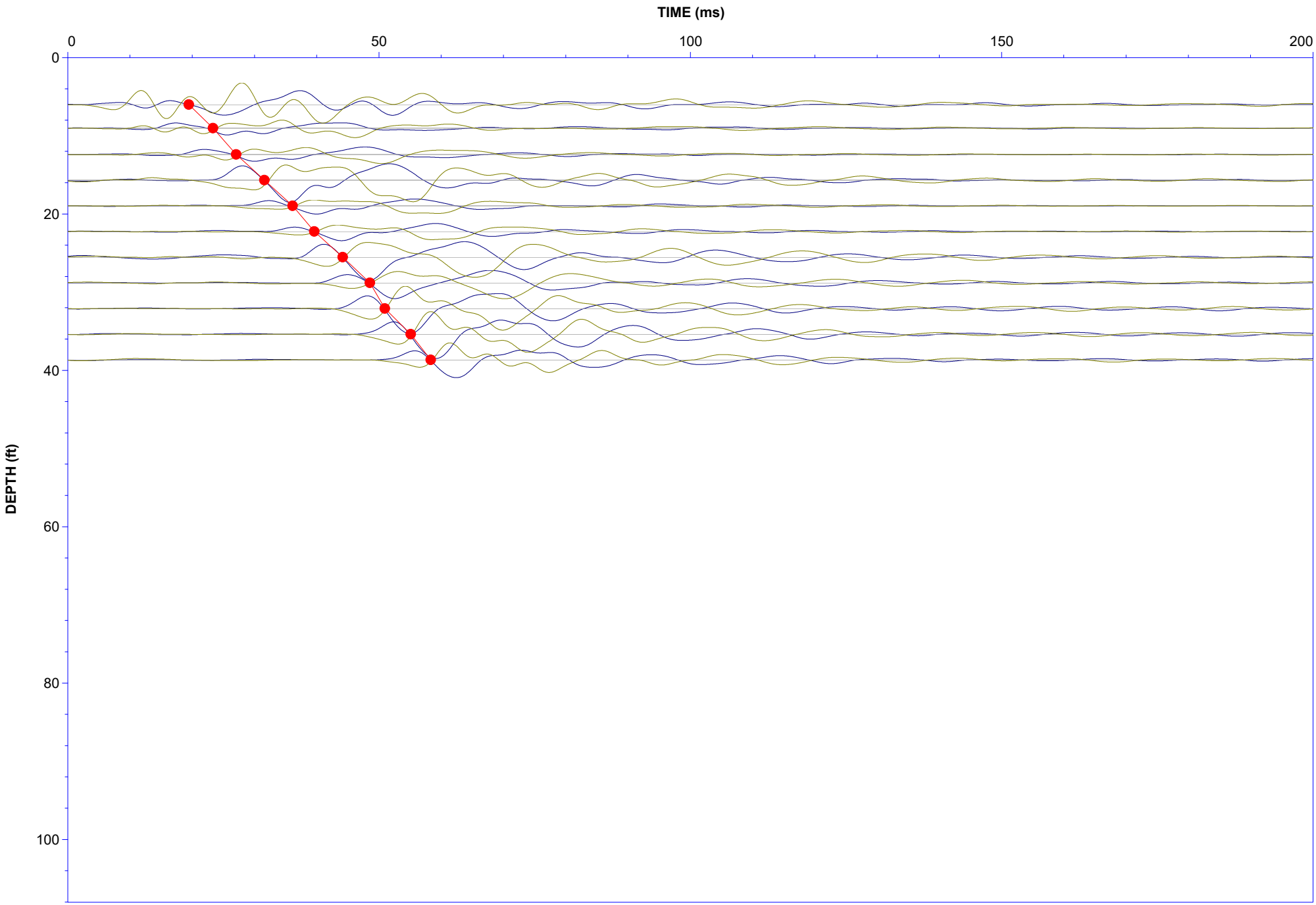
Job No: 22-56-24292
Analysis: Shear Wave

Client: Langan Engineering
Date: 06:23:22 12:32

Project: Tanforan Mall Redevelopment
Cone: 813:T1500F15U35

Filter: BP 0-200 Hz

Sounding: CPT-02



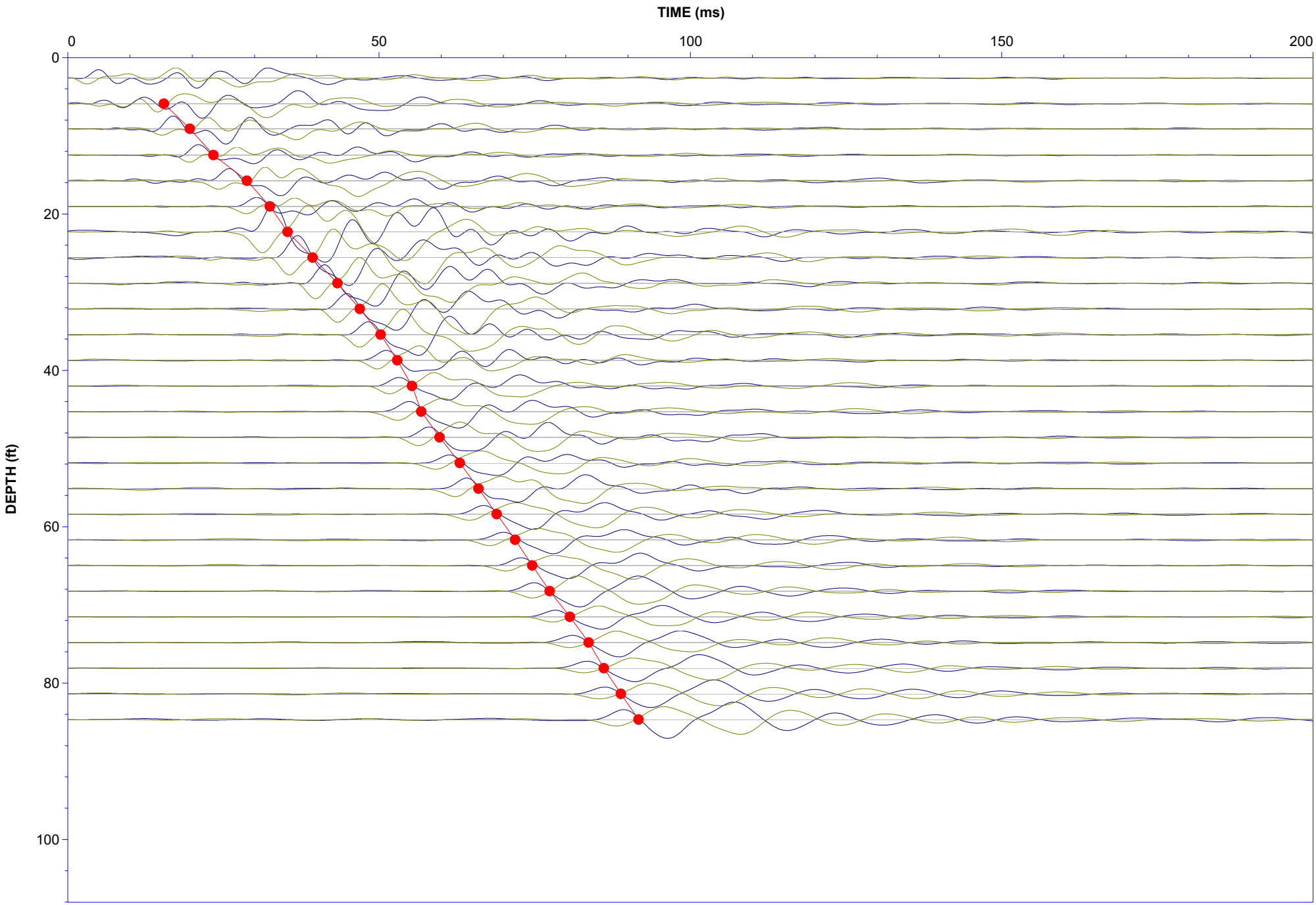
Job No: 22-56-24292
Analysis: Shear Wave

Client: Langan Engineering
Date: 06:22:22 11:36

Project: Tanforan Mall Redevelopment
Cone: 813:T1500F15U35

Filter: BP 0-250 Hz

Sounding: CPT-03



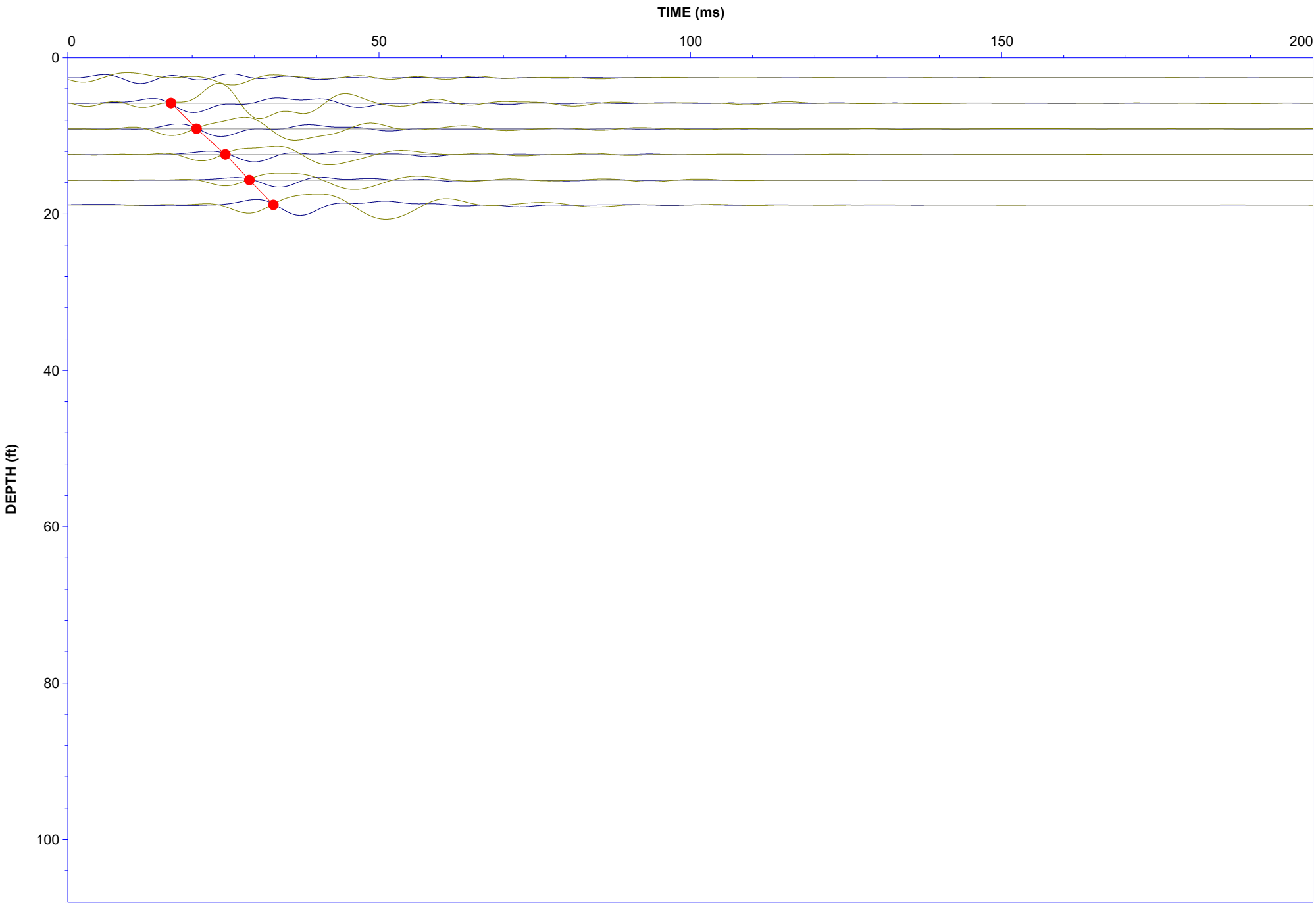
Job No: 22-56-24292
Analysis: Shear Wave

Client: Langan Engineering
Date: 06:22:22 07:42

Project: Tanforan Mall Redevelopment
Cone: 813:T1500F15U35

Filter: BP 0-125 Hz

Sounding: CPT-04



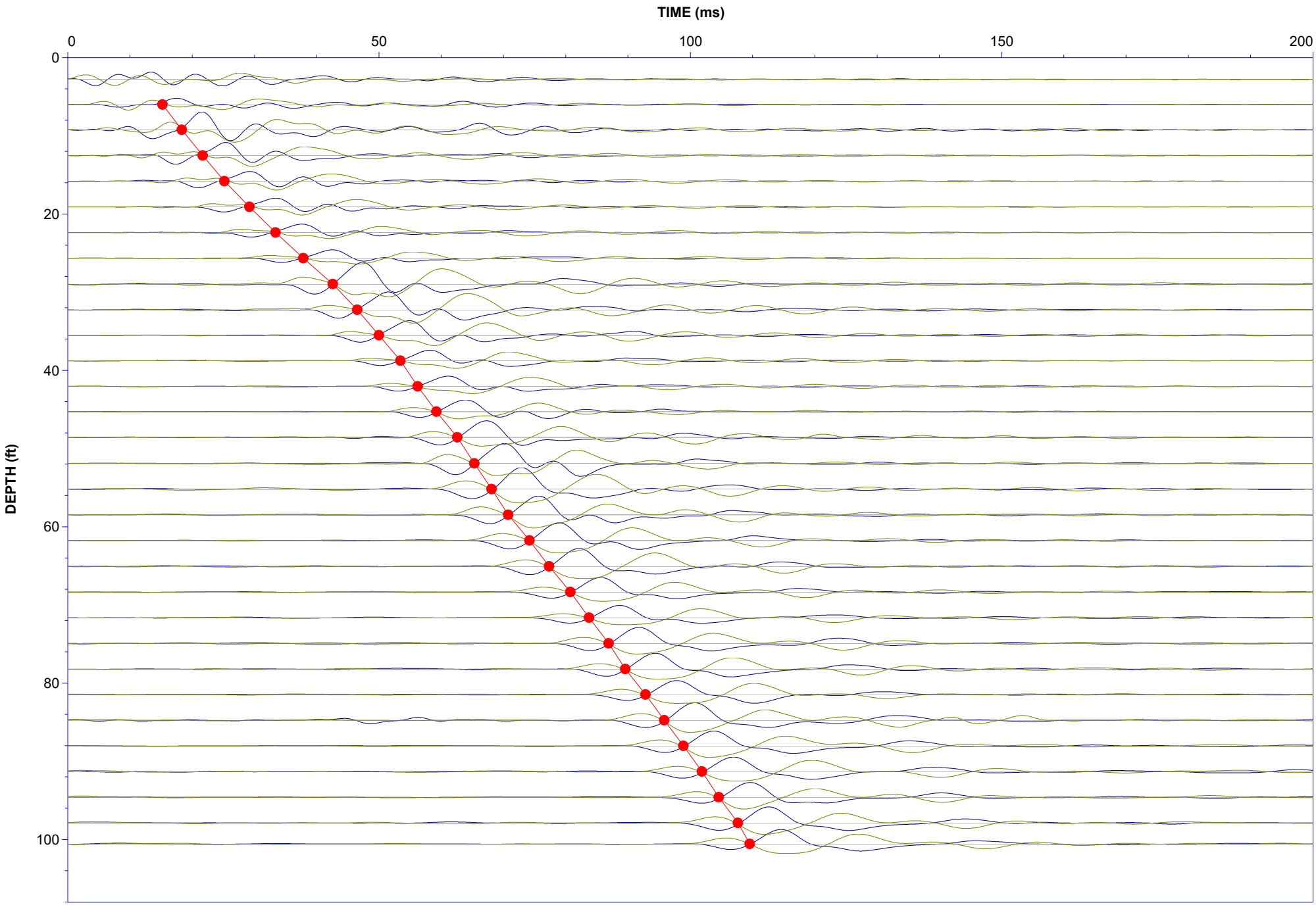
Job No: 22-56-24292
Analysis: Shear Wave

Client: Langan Engineering
Date: 06:22:22 09:24

Project: Tanforan Mall Redevelopment
Cone: 813:T1500F15U35

Filter: BP 0-200 Hz

Sounding: CPT-05



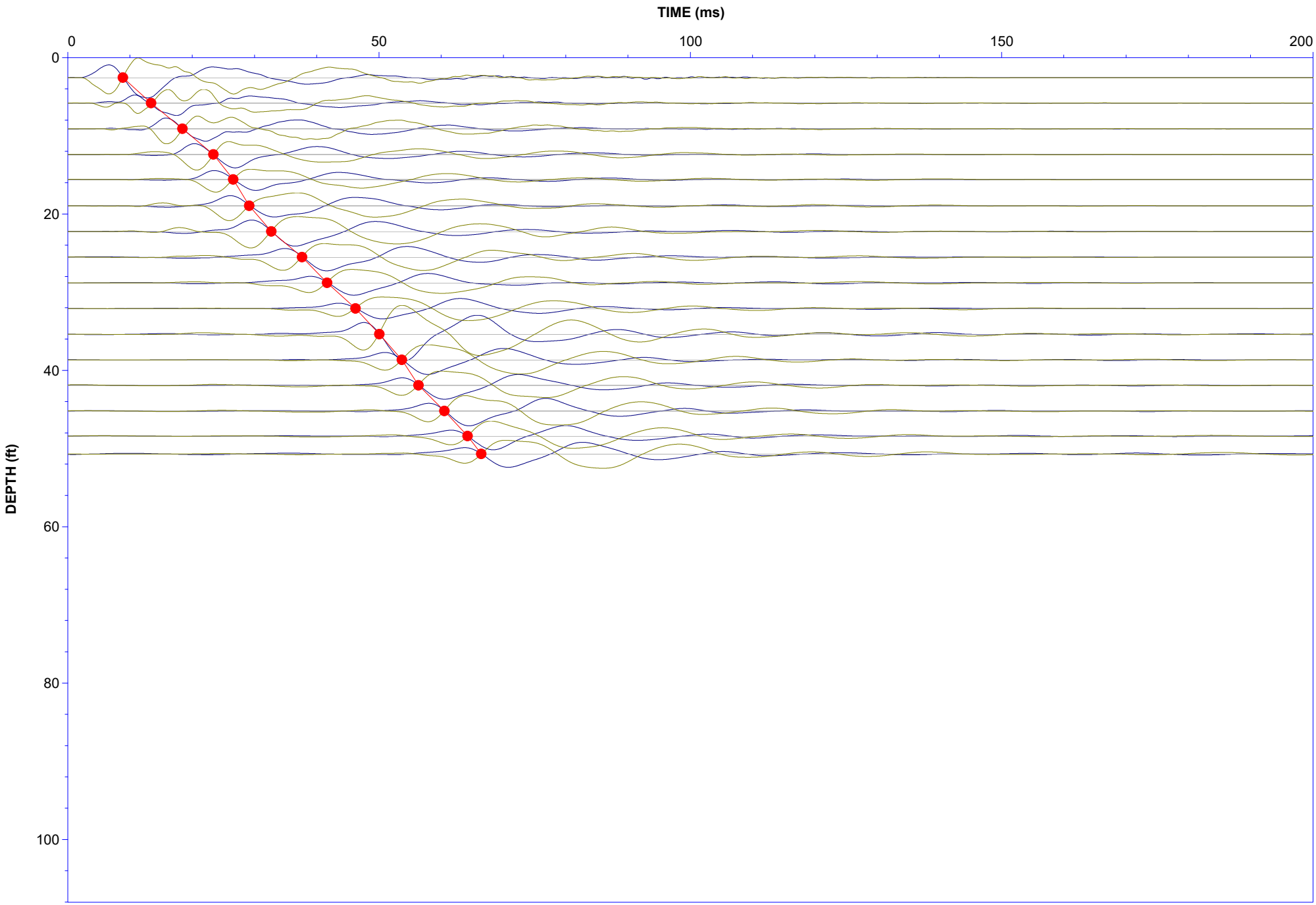
Job No: 22-56-24292
Analysis: Shear Wave

Client: Langan Engineering
Date: 06:23:22 07:14

Project: Tanforan Mall Redevelopment
Cone: 813:T1500F15U35

Filter: BP 0-500 Hz

Sounding: CPT-08



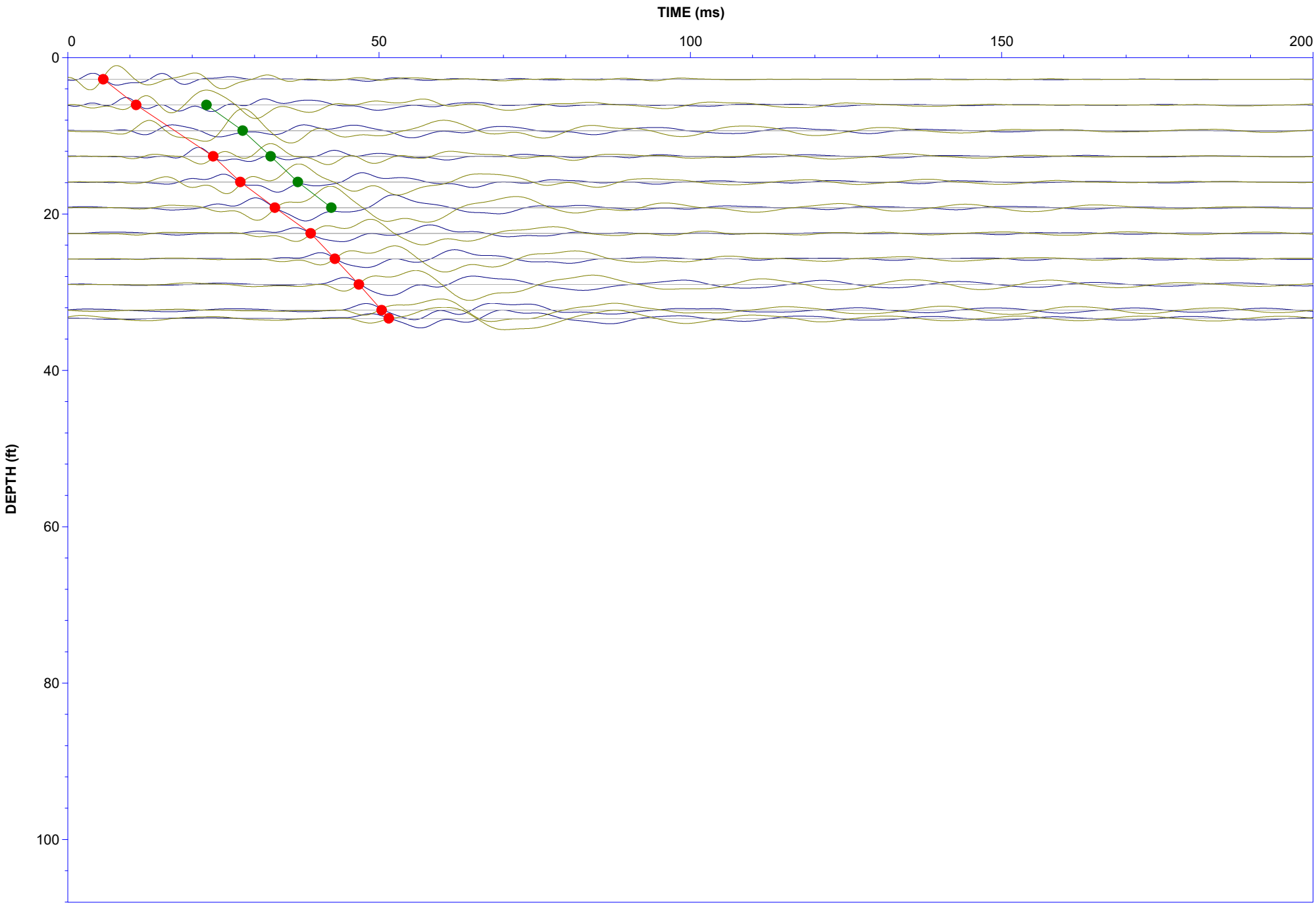
Job No: 22-56-24357
Analysis: Shear Wave

Client: Langan Engineering
Date: 06:24:22 07:39

Project: Tanforan Mall Redevelopment
Cone: 813:T1500F15U35

Filter: BP 0-200 Hz

Sounding: CPT-09



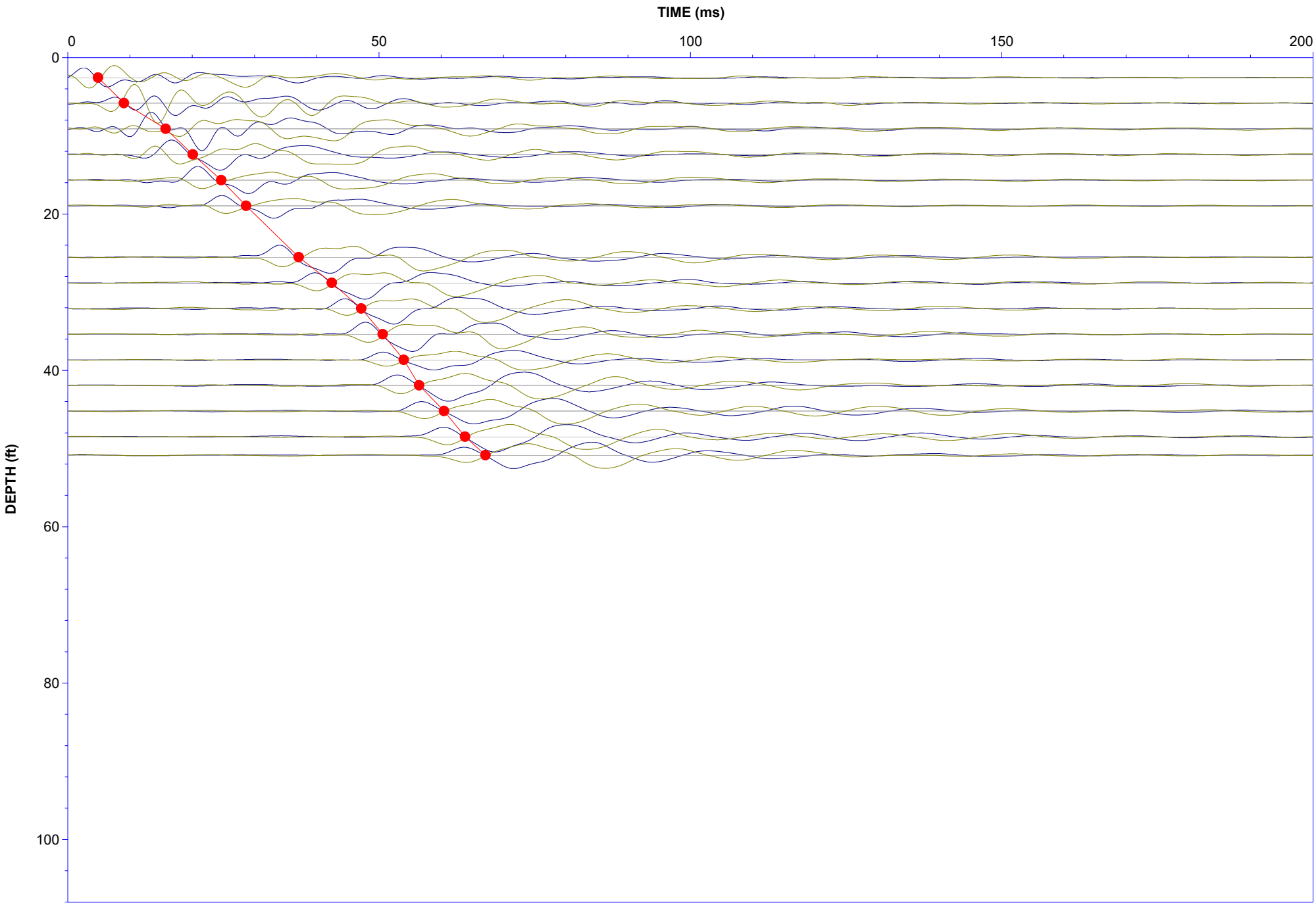
Job No: 22-56-24357
Analysis: Shear Wave

Client: Langan Engineering
Date: 06:24:22 12:05

Project: Tanforan Mall Redevelopment
Cone: 815:T1500F15U35

Filter: BP 0-500 Hz

Sounding: CPT-10



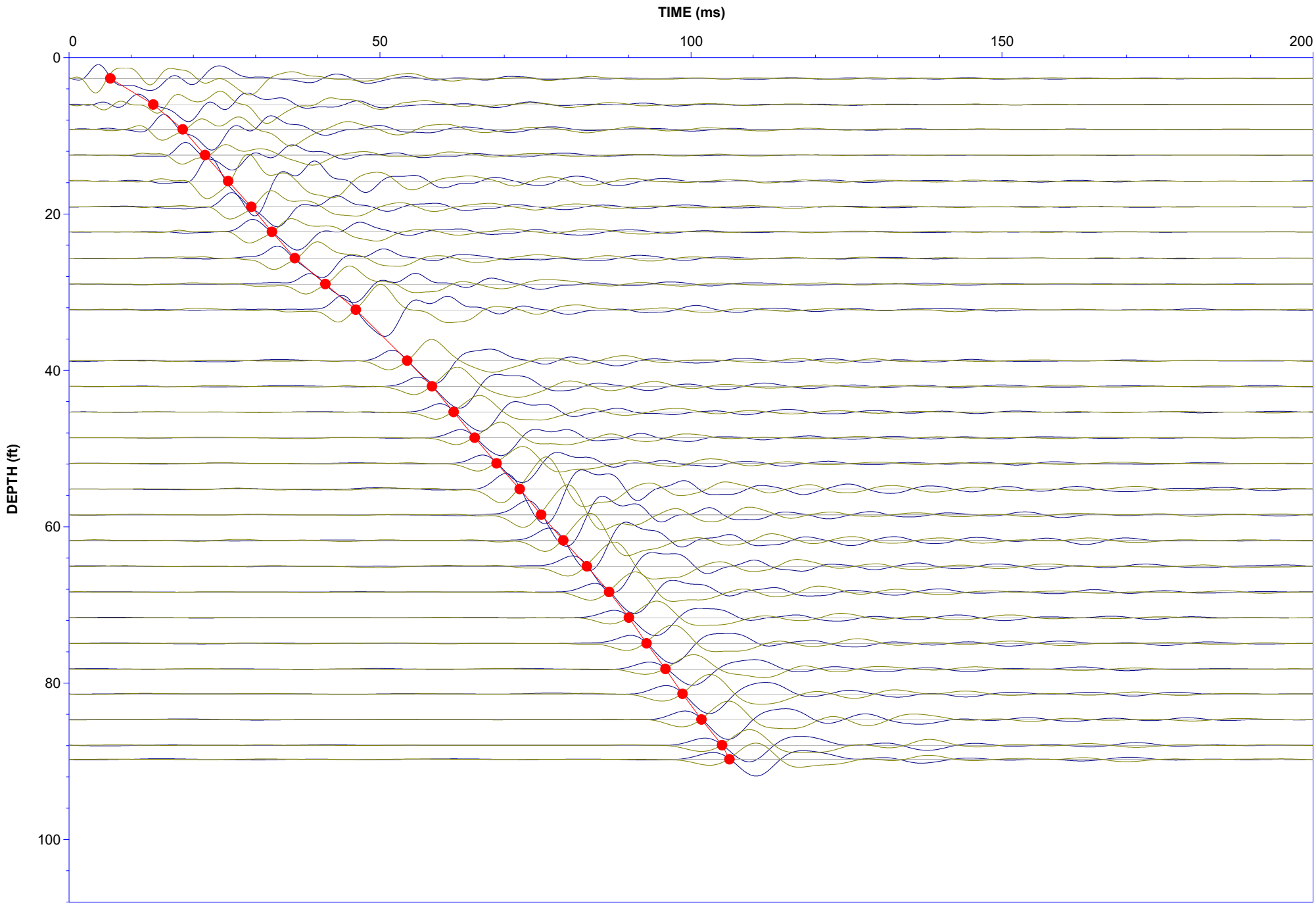
Job No: 22-56-24357
Analysis: Shear Wave

Client: Langan Engineering
Date: 06:24:22 13:38

Project: Tanforan Mall Redevelopment
Cone: 815:T1500F15U35

Filter: BP 0-250 Hz

Sounding: CPT-12



Methodology Statements and Data File Formats

CONETEC

Cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd., a subsidiary of ConeTec.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and two geophone sensors for recording seismic signals. All signals are amplified and measured with minimum sixteen-bit resolution down hole within the cone body, and the signals are sent to the surface using a high bandwidth, error corrected digital interface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm^2 and 15 cm^2 tip base area configurations in order to maximize signal resolution for various soil conditions. The specific piezocone used for each test is described in the CPT summary table presented in the first appendix. The 15 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm^2 piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 millimeters diameter over a length of 32 millimeters with tapered leading and trailing edges) located at a distance of 585 millimeters above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u_2" position (ASTM Type 2). The filter is six millimeters thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meets or exceeds those of the current ASTM D5778 standard. An illustration of the piezocone penetrometer is presented in Figure CPTu.

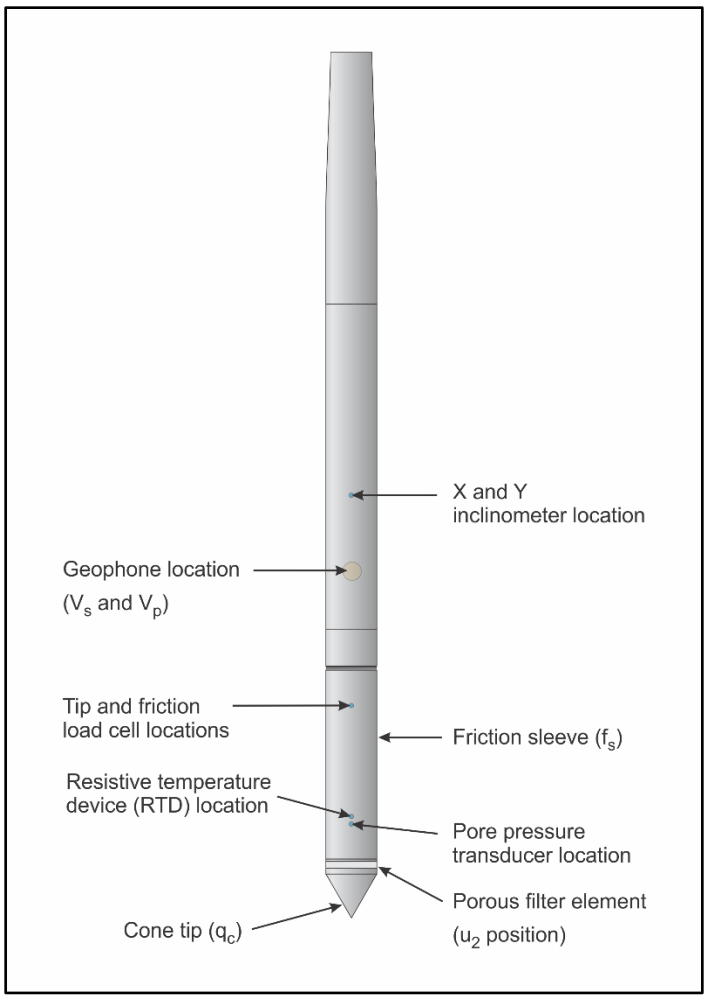


Figure CPTu. Piezocone Penetrometer (15 cm^2)

The ConeTec data acquisition systems consist of a Windows based computer and a signal interface box and power supply. The signal interface combines depth increment signals, seismic trigger signals and the downhole digital data. This combined data is then sent to the Windows based computer for collection and presentation. The data is recorded at fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording interval is 2.5 centimeters; custom recording intervals are possible.

The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPTu operating procedures which are in general accordance with the current ASTM D5778 standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of two centimeters per second, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches (38.1 millimeters) are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil under vacuum pressure prior to use
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by Robertson et al. (1986) and Robertson (1990, 2009). It should be noted that it is not always possible to accurately identify a soil behavior type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behavior type.

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in Robertson et al. (1986):

$$q_t = q_c + (1\text{-}a) \bullet u_2$$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (R_f) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

A summary of the CPTu soundings along with test details and individual plots are provided in the appendices. A set of files with calculated geotechnical parameters were generated for each sounding based on published correlations and are provided in Excel format in the data release folder. Information regarding the methods used is also included in the data release folder.

For additional information on CPTu interpretations and calculated geotechnical parameters, refer to Robertson et al. (1986), Lunne et al. (1997), Robertson (2009), Mayne (2013, 2014) and Mayne and Peuchen (2012).

Shear wave velocity (Vs) testing is performed in conjunction with the piezocone penetration test (SCPTu) in order to collect interval velocities. For some projects seismic compression wave velocity (Vp) testing is also performed.

ConeTec's piezocone penetrometers are manufactured with one horizontally active geophone (28 hertz) and one vertically active geophone (28 hertz). Both geophones are rigidly mounted in the body of the cone penetrometer, 0.2 meters behind the cone tip. The vertically mounted geophone is more sensitive to compression waves.

Shear waves are typically generated by using an impact hammer horizontally striking a beam that is held in place by a normal load. In some instances, an auger source or an imbedded impulsive source may be used for both shear waves and compression waves. The hammer and beam act as a contact trigger that initiates the recording of the seismic wave traces. For impulsive devices an accelerometer trigger may be used. The traces are recorded in the memory of the cone using a fast analog to digital converter. The seismic trace is then transmitted digitally uphole to a Windows based computer through a signal interface box for recording and analysis. An illustration of the shear wave testing configuration is presented in Figure SCPTu-1.

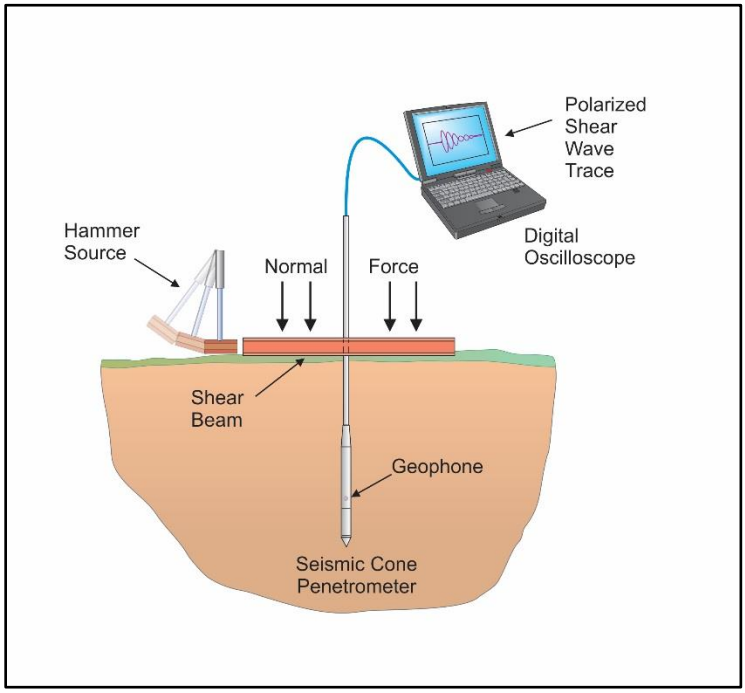


Figure SCPTu-1. Illustration of the SCPTu system

All testing is performed in accordance to ConeTec's SCPTu operating procedures which are in general accordance with the current ASTM D5778 and ASTM D7400 standards.

Prior to the start of a SCPTu sounding, the procedures described in the Cone Penetration Test section are followed. In addition, the active axis of the geophone is aligned parallel to the beam (or source) and the horizontal offset between the cone and the source is measured and recorded.

Prior to recording seismic waves at each test depth, cone penetration is stopped and the rods are decoupled from the rig to avoid transmission of rig energy down the rods. Typically, five wave traces for

each orientation are recorded for quality control and uncertainty analysis purposes. After reviewing wave traces for consistency the cone is pushed to the next test depth (typically one meter intervals or as requested by the client). Figure SCPTu-2 presents an illustration of a SCPTu test.

For additional information on seismic cone penetration testing refer to Robertson et al. (1986).

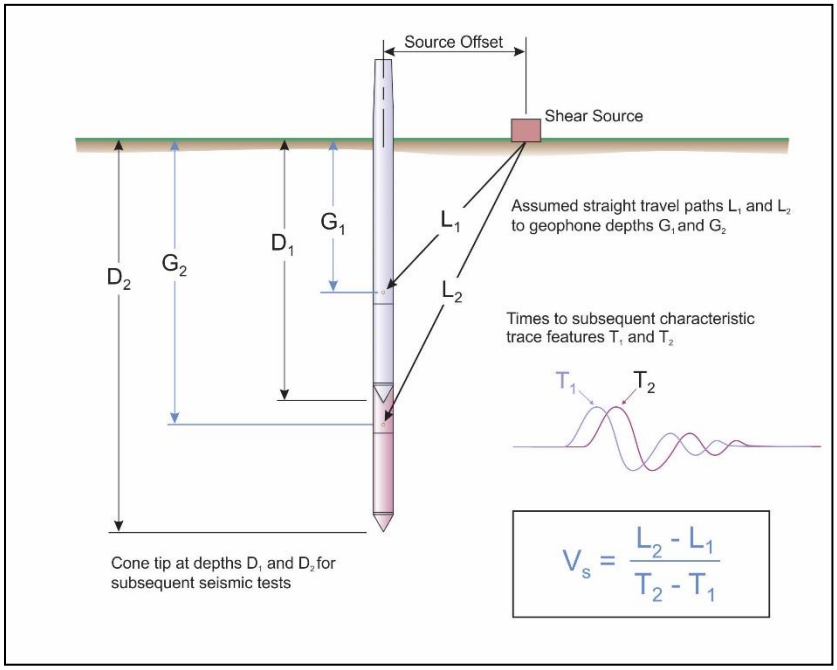


Figure SCPTu-2. Illustration of a seismic cone penetration test

Calculation of the interval velocities are performed by visually picking a common feature (e.g. the first characteristic peak, trough, or crossover) on all of the recorded wave sets and taking the difference in ray path divided by the time difference between subsequent features. Ray path is defined as the straight line distance from the seismic source to the geophone, accounting for beam offset, source depth and geophone offset from the cone tip.

For all SCPTu soundings that have achieved a depth of at least 100 feet (30 meters), the average shear wave velocity to a depth of 100 feet ($\bar{v}_s$) has been calculated and provided for all applicable soundings using the following equation presented in ASCE (2010).

$$\bar{v}_s = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{v_{si}}}$$

where: $\bar{v}_s$ = average shear wave velocity ft/s (m/s)
d_i = the thickness of any layer between 0 and 100 ft (30 m)
v_{si} = the shear wave velocity in ft/s (m/s)
$\sum_{i=1}^{n} d_i$ = the total thickness of all layers between 0 and 100 ft (30 m)

Average shear wave velocity, $\bar{v}_s$ is also referenced to V_{s100} or V_{s30}.

The layer travel times refers to the travel times propagating in the vertical direction, not the measured travel times from an offset source.

Tabular results and SCPTu plots are presented in the relevant appendix.

The cone penetration test is halted at specific depths to carry out pore pressure dissipation (PPD) tests, shown in Figure PPD-1. For each dissipation test the cone and rods are decoupled from the rig and the data acquisition system measures and records the variation of the pore pressure (u) with time (t).

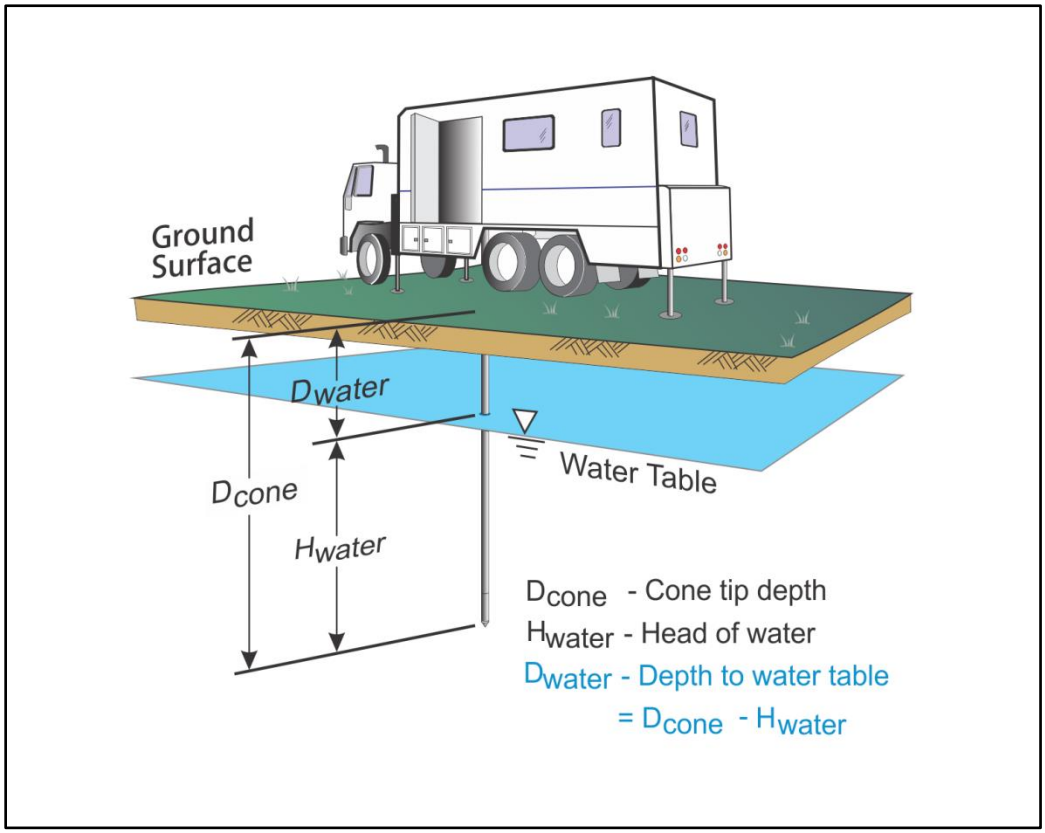


Figure PPD-1. Pore pressure dissipation test setup

Pore pressure dissipation data can be interpreted to provide estimates of ground water conditions, permeability, consolidation characteristics and soil behavior.

The typical shapes of dissipation curves shown in Figure PPD-2 are very useful in assessing soil type, drainage, in situ pore pressure and soil properties. A flat curve that stabilizes quickly is typical of a freely draining sand. Undrained soils such as clays will typically show positive excess pore pressure and have long dissipation times. Dilative soils will often exhibit dynamic pore pressures below equilibrium that then rise over time. Overconsolidated fine-grained soils will often exhibit an initial dilatory response where there is an initial rise in pore pressure before reaching a peak and dissipating.

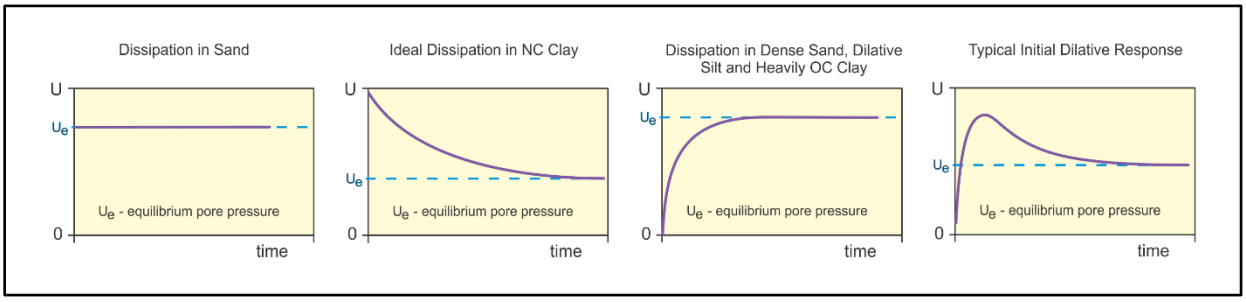


Figure PPD-2. Pore pressure dissipation curve examples

In order to interpret the equilibrium pore pressure (u_{eq}) and the apparent phreatic surface, the pore pressure should be monitored until such time as there is no variation in pore pressure with time as shown for each curve in Figure PPD-2.

In fine grained deposits the point at which 100% of the excess pore pressure has dissipated is known as t_{100}. In some cases this can take an excessive amount of time and it may be impractical to take the dissipation to t_{100}. A theoretical analysis of pore pressure dissipations by Teh and Houlsby (1991) showed that a single curve relating degree of dissipation versus theoretical time factor (T*) may be used to calculate the coefficient of consolidation (c_h) at various degrees of dissipation resulting in the expression for c_h shown below.

$$c_h = \frac{T^* \cdot a^2 \cdot \sqrt{I_r}}{t}$$

Where:
T* is the dimensionless time factor (Table Time Factor)
a is the radius of the cone
I_r is the rigidity index
t is the time at the degree of consolidation

Table Time Factor. T* versus degree of dissipation (Teh and Houlsby (1991))

Degree of Dissipation (%)	20	30	40	50	60	70	80
T* (u_2)	0.038	0.078	0.142	0.245	0.439	0.804	1.60

The coefficient of consolidation is typically analyzed using the time (t_{50}) corresponding to a degree of dissipation of 50% (u_{50}). In order to determine t_{50}, dissipation tests must be taken to a pressure less than u_{50}. The u_{50} value is half way between the initial maximum pore pressure and the equilibrium pore pressure value, known as u_{100}. To estimate u_{50}, both the initial maximum pore pressure and u_{100} must be known or estimated. Other degrees of dissipations may be considered, particularly for extremely long dissipations.

At any specific degree of dissipation the equilibrium pore pressure (u at t_{100}) must be estimated at the depth of interest. The equilibrium value may be determined from one or more sources such as measuring the value directly (u_{100}), estimating it from other dissipations in the same profile, estimating the phreatic surface and assuming hydrostatic conditions, from nearby soundings, from client provided information, from site observations and/or past experience, or from other site instrumentation.

For calculations of c_h (Teh and Houlsby (1991)), t_{50} values are estimated from the corresponding pore pressure dissipation curve and a rigidity index (I_r) is assumed. For curves having an initial dilatory response in which an initial rise in pore pressure occurs before reaching a peak, the relative time from the peak value is used in determining t_{50}. In cases where the time to peak is excessive, t_{50} values are not calculated.

Due to possible inherent uncertainties in estimating I_r, the equilibrium pore pressure and the effect of an initial dilatory response on calculating t_{50}, other methods should be applied to confirm the results for c_h.

Additional published methods for estimating the coefficient of consolidation from a piezocone test are described in Burns and Mayne (1998, 2002), Jones and Van Zyl (1981), Robertson et al. (1992) and Sully et al. (1999).

A summary of the pore pressure dissipation tests and dissipation plots are presented in the relevant appendix.

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Robertson, P.K., Sully, J.P., Woeller, D.J., Lunne, T., Powell, J.J.M. and Gillespie, D.G., 1992, “Estimating coefficient of consolidation from piezocone tests”, Canadian Geotechnical Journal, 29(4): 539-550. DOI: 10.1139/T92-061.

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CONE PENETRATION DIGITAL FILE FORMATS - eSeries

CPT Data Files (COR Extension)

ConeTec CPT data files are stored in ASCII text files that are readable by almost any text editor. ConeTec file names start with the job number (which includes the two digit year number) an underscore as a separating character, followed by two letters based on the type of test and the sounding ID. The last character position is reserved for an identifier letter (such as b, c, d etc) used to uniquely distinguish multiple soundings at the same location. The CPT sounding file has the extension COR. As an example, for job number 21-02-00001 the first CPT sounding will have file name 21-02-00001_CP01.COR

The sounding (COR) file consists of the following components:

1. Two lines of header information
2. Data records
3. End of data marker
4. Units information

Header Lines

Line 1: Columns 1-6 may be blank or may indicate the version number of the recording software
Columns 7-21 contain the sounding Date and Time (Date is MM:DD:YY)
Columns 23-38 contain the sounding Operator
Columns 51-100 contain extended Job Location information

Line 2: Columns 1-16 contain the Job Location
Columns 17-32 contain the Cone ID
Columns 33-47 contain the sounding number
Columns 51-100 may contain extended sounding ID information

Data Records

The data records contain 4 or more columns of data in floating point format. A comma and spaces separate each data item:

Column 1: Sounding Depth (meters)
Column 2: Tip (q_c), recorded in units selected by the operator
Column 3: Sleeve (f_s), recorded in units selected by the operator
Column 4: Dynamic pore pressure (u), recorded in units selected by the operator
Column 5: Empty or may contain other requested data such as Gamma, Resistivity or UVIF data

End of Data Marker

After the last line of data there is a line containing an ASCII 26 (CTL-Z) character (small rectangular shaped character) followed by a newline (carriage return / line feed). This is used to mark the end of data.

Units Information

The last section of the file contains information about the units that were selected for the sounding. A separator bar makes up the first line. The second line contains the type of units used for depth, q_c, f_s and u. The third line contains the conversion values required for ConeTec's software to convert the recorded data to an internal set of base units (bar for q_c, bar for f_s and meters for u). Additional lines intended for internal ConeTec use may appear following the conversion values.

CPT Data Files (XLS Extension)

Excel format files of ConeTec CPT data are also generated from corresponding COR files. The XLS files have the same base file name as the COR file with a -BSC suffix. The information in the file is presented in table format and contains additional information about the sounding such as coordinate information, and tip net area ratio.

The BSCI suffix is given to XLS files which are enhanced versions of the BSC files and include the same data records in addition to inclination data collected for each sounding.

CPT Dissipation Files (XLS Extension)

Pore pressure dissipation files are provided in Excel format and contain each dissipation trace that exceeds a minimum duration (selected during post-processing) formatted column wise within the spreadsheet. The first column (Column A) contains the time in seconds and the second column (Column B) contains the time in minutes. Subsequent columns contain the dissipation trace data. The columns extend to the longest trace of the data set.

Detailed header information is provided at the top of the worksheet. The test depth in meters and feet, the number of points in the trace and the particular units are all presented at the top of each trace column.

CPT Dissipation files have the same naming convention as the CPT sounding files with a "–PPD" suffix.

Data Records

Each file will contain dissipation traces that exceed a minimum duration (selected during post-processing) in a particular column. The dissipation pore pressure values are typically recorded at varying time intervals throughout the trace; rapidly to start and increasing as the duration of the test lengthens. The test depth in meters and feet, the number of points in the trace and the trace number are identified at the top of each trace column.

Cone Type Designations

Cone ID	Cone Description	Tip Cross Sect. Area (cm^2)	Tip Capacity (bar)	Sleeve Area (cm^2)**	Sleeve Capacity (bar)	Pore Pressure Capacity (bar)
EC###	A15T1500F15U35	15	1500	225	15	35
EC###	A15T375F10U35	15	375	225	10	35
EC###	A10T1000F10U35	10	1000	150	10	35

refers to the Cone ID number
**Outer Cylindrical Area

Description of Methods for Calculated CPT Geotechnical Parameters

CONETEC

CALCULATED CPT GEOTECHNICAL PARAMETERS

A Detailed Description of the Methods Used in ConeTec's CPT Geotechnical Parameter Calculation and Plotting Software



Revision SZW-Rev 14

Revised November 26, 2019
Prepared by Jim Greig, M.A.Sc, P.Eng (BC)

Limitations

The geotechnical parameter output was prepared specifically for the site and project named in the accompanying report subject to objectives, site conditions and criteria provided to ConeTec by the client. The output may not be relied upon by any other party or for any other site without the express written permission of ConeTec Group (ConeTec) or any of its affiliates. For this project, ConeTec has provided site investigation services, prepared factual data reporting and produced geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

To understand the calculations that have been performed and to be able to reproduce the calculated parameters the user is directed to the basic descriptions for the methods in this document and the detailed descriptions and their associated limitations and appropriateness in the technical references cited for each parameter.

ConeTec's Calculated CPT Geotechnical Parameters as of November 26, 2019

ConeTec's CPT parameter calculation and plotting routine provides a tabular output of geotechnical parameters based on current published CPT correlations and is subject to change to reflect the current state of practice. Due to drainage conditions and the basic assumptions and limitations of the correlations, not all geotechnical parameters provided are considered applicable for all soil types. The results are presented only as a guide for geotechnical use and should be carefully examined for consideration in any geotechnical design. Reference to current literature is strongly recommended. ConeTec does not warranty the correctness or the applicability of any of the geotechnical parameters calculated by the program and does not assume liability for any use of the results in any design or review. For verification purposes we recommend that representative hand calculations be done for any parameter that is critical for design purposes. The end user of the parameter output should also be fully aware of the techniques and the limitations of any method used by the program. The purpose of this document is to inform the user as to which methods were used and to direct the end user to the appropriate technical papers and/or publications for further reference.

The geotechnical parameter output was prepared specifically for the site and project named in the accompanying report subject to objectives, site conditions and criteria provided to ConeTec by the client. The output may not be relied upon by any other party or for any other site without the express written permission of ConeTec Group (ConeTec) or any of its affiliates.

The CPT calculations are based on values of tip resistance, sleeve friction and pore pressures considered at each data point or averaged over a user specified layer thickness (e.g. 0.20 m). Note that q_t is the tip resistance corrected for pore pressure effects and q_c is the recorded tip resistance. The corrected tip resistance (corrected using u_2 pore pressure values) is used for all of the calculations. Since all ConeTec cones have equal end area friction sleeves pore pressure corrections to sleeve friction, f_s, are not required.

The tip correction is: $q_t = q_c + (1-a) \bullet u_2$ (consistent units are implied)

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the cone (typically 0.80 for ConeTec cones)

The total stress calculations are based on soil unit weight values that have been assigned to the Soil Behavior Type (SBT) zones, from a user defined unit weight profile, by using a single uniform value throughout the profile, through unit weight estimation techniques described in various technical papers or from a combination of these methods. The parameter output files indicate the method(s) used.

Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (typically obtained from CPT dissipation tests) or a combination of the two. For over water projects the stress effects of the column of water above the mudline have been taken into account as has the appropriate unit weight of water. How this is done depends on where the instruments were zeroed (i.e. on deck or at the mudline). The parameter output files indicate the method(s) used.

A majority of parameter calculations are derived or driven by results based on material types as determined by the various soil behavior type charts depicted in Figures 1 through 5. The parameter output files indicate the method(s) used.

The Soil Behavior Type classification chart shown in Figure 1 is the classic non-normalized SBT Chart developed at the University of British Columbia and reported in Robertson, Campanella, Gillespie and Greig (1986). Figure 2 shows the original normalized (linear method) SBT chart developed by Robertson (1990). The Bq classification charts shown in Figures 3a and 3b incorporate pore pressures into the SBT classification and are based on the methods described in Robertson (1990). Many of these charts have been summarized in Lunne, Robertson and Powell (1997). The

Jefferies and Davies SBT chart shown in Figure 3c is based on the techniques discussed in Jefferies and Davies (1993) which introduced the concept of the Soil Behavior Type Index parameter, I_c. Please note that the I_c parameter developed by Robertson and Fear (1995) and Robertson and Wride (1998) is similar in concept but uses a slightly different calculation method than that used by Jefferies and Davies (1993) as the latter incorporates pore pressure in their technique through the use of the Bq parameter. The normalized Qtn SBT chart shown in Figure 4 is based on the work by Robertson (2009) utilizing a variable stress ratio exponent, n, for normalization based on a slightly modified redefinition and iterative approach for I_c. The boundary curves drawn on the chart are based on the work described in Robertson (2010).

Figure 5 shows a revised behavior based chart by Robertson (2016) depicting contractive-dilative zones. As the zones represent material behavior rather than soil gradation ConeTec has chosen a set of zone colors that are less likely to be confused with material type colors from previous SBT charts. These colors differ from those used by Dr. Robertson.

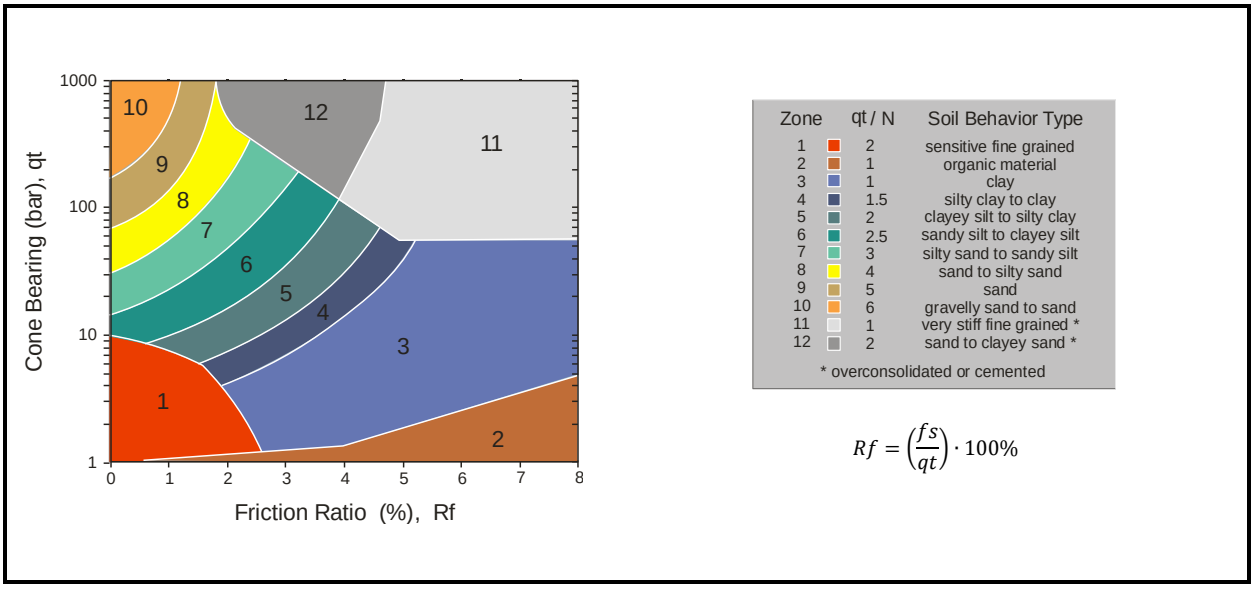


Figure 1. Non-Normalized Soil Behavior Type Classification Chart (SBT)

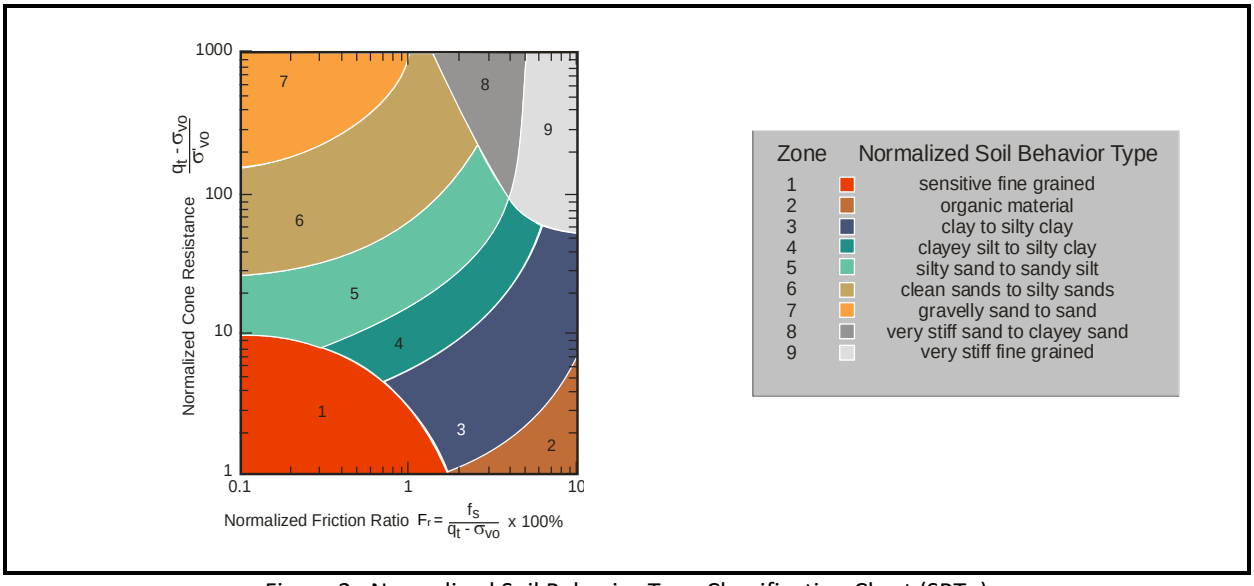


Figure 2. Normalized Soil Behavior Type Classification Chart (SBTn)

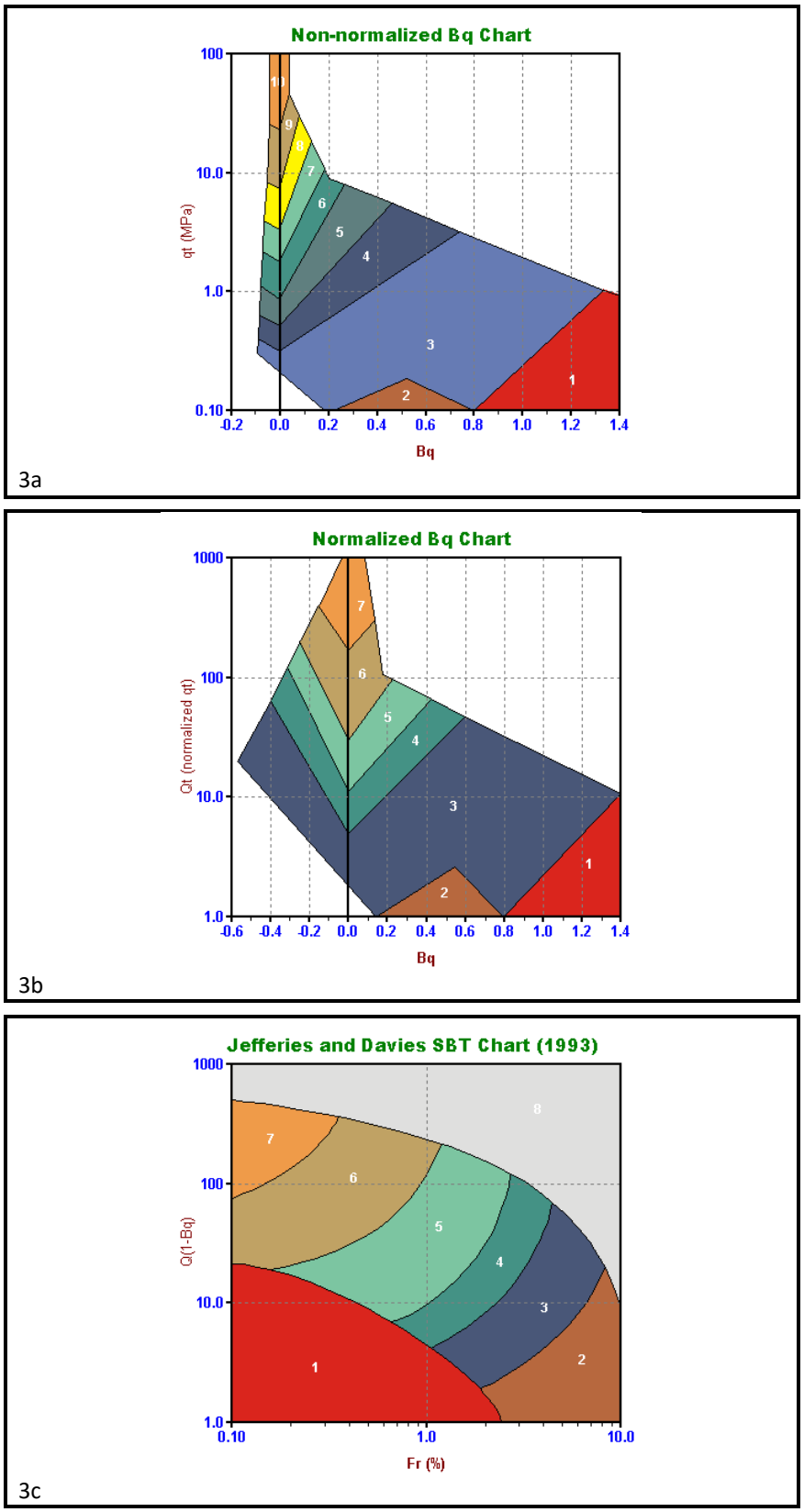


Figure 3. Alternate Soil Behavior Type Charts

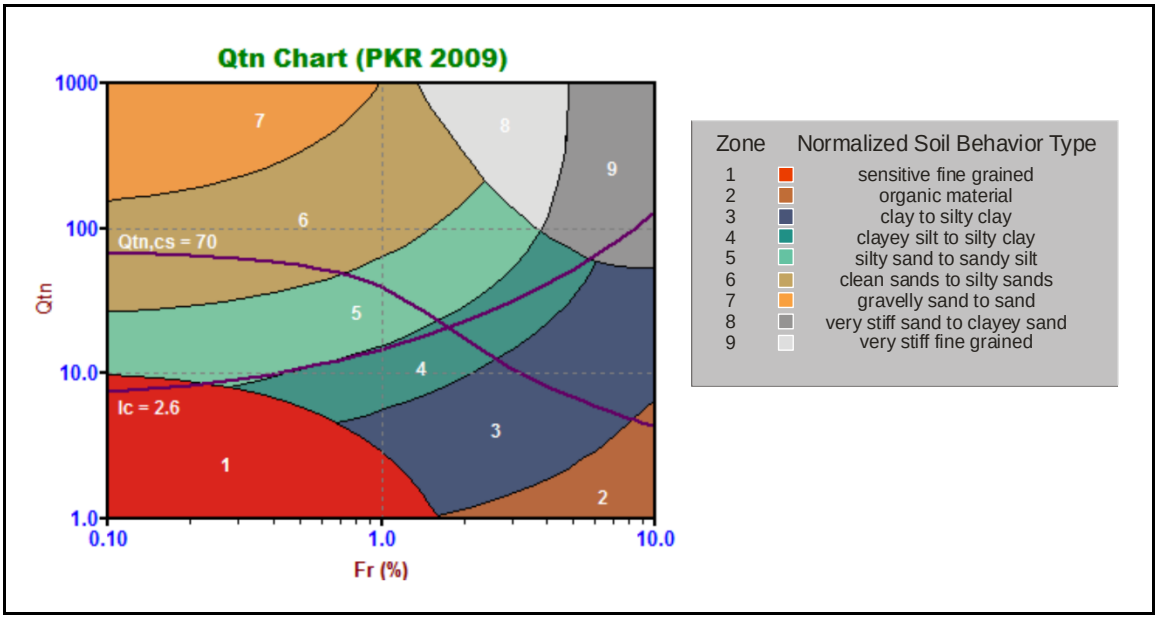


Figure 4. Normalized Soil Behavior Type Chart using Q_{tn} (SBT Qtn)

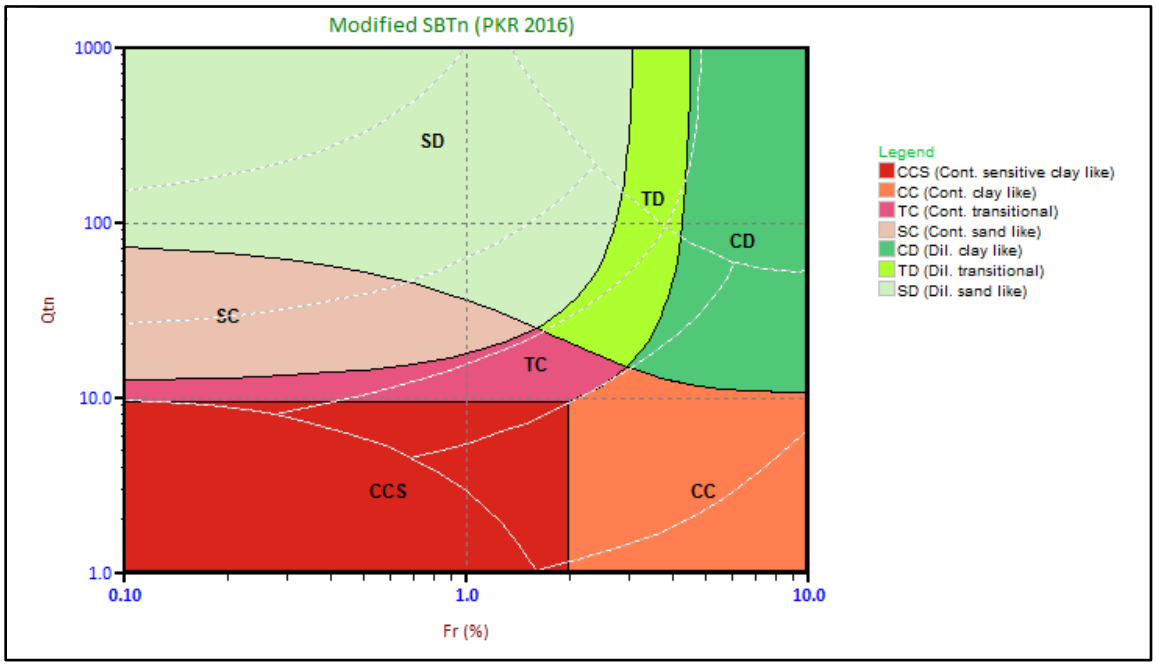


Figure 5. Modified SBTn Behavior Based Chart

Details regarding the geotechnical parameter calculations are provided in Tables 1a and 1b. The appropriate references cited are listed in Table 2. Non-liquefaction specific parameters are detailed in Table 1a and liquefaction specific parameters are detailed in Table 1b.

Where methods are based on charts or techniques that are too complex to describe in this summary the user should refer to the cited material. Specific limitations for each method are described in the cited material.

Where the results of a calculation/correlation are deemed *'invalid'* the value will be represented by the text strings "-9999", "-9999.0", the value 0.0 (Zero) or an empty cell. Invalid results will occur because of (and not limited to) one or a combination of:

1. Invalid or undefined CPT data (e.g. drilled out section or data gap).

2. Where the calculation method is inappropriate, for example, drained parameters in a material behaving as an undrained material (and vice versa).

3. Where input values are beyond the range of the referenced charts or specified limitations of the correlation method.

4. Where pre-requisite or intermediate parameter calculations are invalid.

The parameters selected for output from the program are often specific to a particular project. As such, not all of the calculated parameters listed in Table 1 may be included in the output files delivered with this report.

The output files are typically provided in Microsoft Excel XLS or XLSX format. The ConeTec software has several options for output depending on the number or types of calculated parameters desired or requested by the client. Each output file is named using the original COR file base name followed by a three or four letter indicator of the output set selected (e.g. BSC, TBL, NLI, NL2, IFI, IFI2) and possibly followed by an operator selected suffix identifying the characteristics of the particular calculation run.

Table 1a. CPT Parameter Calculation Methods – Non liquefaction Parameters

Calculated Parameter	Description	Equation	Ref
Depth	Mid Layer Depth *(where calculations are done at each point then Mid Layer Depth = Recorded Depth)*	*[Depth (Layer Top) + Depth (Layer Bottom)]/ 2.0*	CK*
Elevation	Elevation of Mid Layer based on sounding collar elevation supplied by client or through site survey	Elevation = Collar Elevation - Depth	CK*
Avg qc	Averaged recorded tip value (q_c)	$Avgqc = \frac{1}{n}\sum_{i=1}^{n} q_c$ *n=1 when calculations are done at each point*	CK*
Avg qt	Averaged corrected tip (q_t) where: $q_t = q_c + (1-a) \bullet u_2$	$Avgqt = \frac{1}{n}\sum_{i=1}^{n} q_t$ *n=1 when calculations are done at each point*	1
Avg fs	Averaged sleeve friction (f_s)	$Avgfs = \frac{1}{n}\sum_{i=1}^{n} fs$ *n=1 when calculations are done at each point*	CK*
Avg Rf	Averaged friction ratio (R_f) where friction ratio is defined as: $Rf = 100\% \bullet \frac{fs}{q_t}$	$AvgRf = 100\% \cdot \frac{Avgfs}{Avgqt}$ *n=1 when calculations are done at each point*	CK*
Avg u	Averaged dynamic pore pressure *(u)*	$Avgu = \frac{1}{n}\sum_{i=1}^{n} u_i$ *n=1 when calculations are done at each point*	CK*

Calculated Parameter	Description	Equation	Ref
Avg Res	Averaged Resistivity (this data is not always available since it is a specialized test requiring an additional module)	$AvgRes = \frac{1}{n}\sum_{i=1}^{n} Resistivity_i$ *n=1 when calculations are done at each point*	CK*
Avg UVIF	Averaged UVIF ultra-violet induced fluorescence (this data is not always available since it is a specialized test requiring an additional module)	$AvgUVIF = \frac{1}{n}\sum_{i=1}^{n} UVIF_i$ *n=1 when calculations are done at each point*	CK*
Avg Temp	Averaged Temperature (this data is not always available since it requires specialized calibrations)	$AvgTemp = \frac{1}{n}\sum_{i=1}^{n} Temperature_i$ *n=1 when calculations are done at each point*	CK*
Avg Gamma	Averaged Gamma Counts (this data is not always available since it is a specialized test requiring an additional module)	$AvgGamma = \frac{1}{n}\sum_{i=1}^{n} Gamma_i$ *n=1 when calculations are done at each point*	CK*
SBT	Soil Behavior Type as defined by Robertson et al 1986 (often referred to as Robertson and Campanella, 1986)	See Figure 1	1, 5
SBTn	Normalized Soil Behavior Type as defined by Robertson 1990 (linear normalization)	See Figure 2	2, 5
SBT-Bq	Non-normalized Soil Behavior type based on the Bq parameter	See Figure 3	1, 2, 5
SBT-Bqn	Normalized Soil Behavior based on the Bq parameter	See Figure 3	2, 5
SBT-JandD	Soil Behavior Type as defined by Jeffries and Davies	See Figure 3	7
SBT Qtn	Soil Behavior Type as defined by Robertson (2009) using a variable stress ratio exponent for normalization based on I_c	See Figure 4	15
Modified SBTn (contractive /dilative)	Modified SBTn chart as defined by Robertson (2016) indicating zones of contractive/dilative behavior.	See Figure 5	30
Unit Wt.	Unit Weight of soil determined from one of the following user selectable options: 1) uniform value 2) value assigned to each SBT zone 3) value assigned to each SBTn zone 4) value assigned to SBTn zone as determined from Robertson and Wride (1998) based on q_{c1n} 5) values assigned to SBT Qtn zones 6) Mayne fs (sleeve friction) method 7) Robertson 2010 method 8) user supplied unit weight profile The last option may co-exist with any of the other options	See references	3, 5, 15, 21, 24, 29

Calculated Parameter	Description	Equation	Ref
TStress σ_v	Total vertical overburden stress at Mid Layer Depth *A layer is defined as the averaging interval specified by the user where depths are reported at their respective mid-layer depth.* *For data calculated at each point layers are defined using the recorded depth as the mid-point of the layer. Thus, a layer starts half-way between the previous depth and the current depth unless this is the first point in which case the layer start is at zero depth. The layer bottom is half-way from the current depth to the next depth unless it is the last data point.* *Defining layers affects how stresses are calculated since the unit weight attributed to a data point is used throughout the entire layer. This means that to calculate the stresses the total stress at the top and bottom of a layer are required. The stress at mid layer is determined by adding the incremental stress from the layer top to the mid-layer depth. The stress at the layer bottom becomes the stress at the top of the subsequent layer. Stresses are NOT calculated from mid-point to mid-point.* *For over-water work the total stress due to the column of water above the mud line is taken into account where appropriate.*	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ *where* γ_i is layer unit weight h_i is layer thickness	CK*
EStress σ_v'	Effective vertical overburden stress at mid-layer depth	$\sigma_v' = \sigma_v - u_{eq}$	CK*
Equil u u_{eq} or u_0	Equilibrium pore pressure determined from one of the following user selectable options: 1) hydrostatic below water table 2) user supplied profile 3) combination of those above When a user supplied profile is used/provided a linear interpolation is performed between equilibrium pore pressures defined at specific depths. If the profile values start below the water table then a linear transition from zero pressure at the water table to the first defined pointed is used. Equilibrium pore pressures may come from dissipation tests, adjacent piezometers or other sources. Occasionally, an extra equilibrium point ("assumed value") will be provided in the profile that does not come from a recorded value to smooth out any abrupt changes or to deal with material interfaces. These "assumed" values will be indicated on our plots and in tabular summaries.	For hydrostatic option: $u_{eq} = \gamma_w \cdot (D - D_{wt})$ where u_{eq} is equilibrium pore pressure γ_w is unit weight of water D is the current depth D_{wt} is the depth to the water table	CK*
K_0	Coefficient of earth pressure at rest, K_0	$K_0 = (1 - \sin\Phi') OCR^{\sin\Phi'}$	17
C_n	Overburden stress correction factor used for $(N_1)_{60}$ and older CPT parameters	$C_n = (P_a/\sigma_v')^{0.5}$ where $0.0 < C_n < 2.0$ *(user adjustable, typically 1.7)* P_a *is atmospheric pressure (100 kPa)*	12
C_q	Overburden stress normalizing factor	$C_q = 1.8 / (0.8 + (\sigma_v'/P_a))$ where $0.0 < C_q < 2.0$ *(user adjustable)* P_a *is atmospheric pressure (100 kPa)*	3, 12

Calculated Parameter	Description	Equation	Ref
N_{60}	SPT N value at 60% energy calculated from q_t/N ratios assigned to each SBT zone. This method has abrupt N value changes at zone boundaries.	*See Figure 1*	5
(N1)60	SPT N_{60} value corrected for overburden pressure	$(N_1)_{60} = C_n \bullet N_{60}$	4
N60Ic	SPT N_{60} values based on the I_c parameter [as defined by Roberston and Wride 1998 (5), or by Robertson 2009 (15)].	$(q_t/P_a)/ N_{60} = 8.5 (1 – I_c/4.6)$ $(q_t/P_a)/ N_{60} = 10^{(1.1268 – 0.2817Ic)}$ Pa being atmospheric pressure	5 15, 31
(N1)60Ic	SPT N_{60} value corrected for overburden pressure (using N_{60} I_c). User has 3 options.	1) $(N_1)_{60}Ic = C_n \bullet (N_{60} I_c)$ 2) $q_{c1n}/ (N_1)_{60}I_c = 8.5 (1 – I_c/4.6)$ 3) $(Q_{tn})/ (N_1)_{60}I_c = 10^{(1.1268 – 0.2817Ic)}$	4 5 15, 31
Su or Su (Nkt)	Undrained shear strength based on q_t S_u factor N_{kt} is user selectable	$Su = \frac{qt - \sigma_v}{N_{kt}}$	1, 5
Su or Su (Ndu)	Undrained shear strength based on pore pressure S_u factor $N_{\Delta u}$ is user selectable	$Su = \frac{u_2 - u_{eq}}{N_{\Delta u}}$	1, 5
Dr	Relative Density determined from one of the following user selectable options: a) Ticino Sand b) Hokksund Sand c) Schmertmann (1978) d) Jamiolkowski (1985) - All Sands e) Jamiolkowski et al (2003) (various compressibilities, K_o)	See reference (methods a through d) Jamiolkowski et al (2003) reference	5 14
PHI ϕ	Friction Angle determined from one of the following user selectable options (methods a through d are for sands and method e is for silts and clays): a) Campanella and Robertson b) Durgunoglu and Mitchel c) Janbu d) Kulhawy and Mayne e) NTH method (clays and silts)	See appropriate reference	5 5 5 11 23
Delta U/qt	Differential pore pressure ratio (older parameter used before B_q was established)	$= \frac{\Delta u}{qt}$ *where:* $\Delta u = u - u_{eq}$ *and* u = dynamic pore pressure u_{eq} = equilibrium pore pressure	CK*
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{qt - \sigma_v}$ where : $\Delta u = u - u_{eq}$ *and* u = dynamic pore pressure u_{eq} = equilibrium pore pressure	1, 2, 5
Net qt or qtNet	Net tip resistance (used in many subsequent correlations)	$qt - \sigma_v$	CK*
qe	Effective tip resistance (using the dynamic pore pressure u_2 and not equilibrium pore pressure)	$qt - u_2$	CK*

Calculated Parameter	Description	Equation	Ref
qeNorm	Normalized effective tip resistance	$\frac{qt-u_2}{\sigma_v}$	CK*
Q_t or Norm: Qt	Normalized q_t for Soil Behavior Type classification as defined by Robertson (1990) using a linear stress normalization. Note this is different from Q_{tn}.	$Qt=\frac{qt-\sigma_v}{\sigma_v}$	2, 5
F_r or Norm: Fr	Normalized Friction Ratio for Soil Behavior Type classification as defined by Robertson (1990)	$Fr=100\%\cdot\frac{fs}{qt-\sigma_v}$	2, 5
Q(1-Bq)	Q(1-Bq) grouping as suggested by Jefferies and Davies for their classification chart and the establishment of their I_c parameter	$Q\cdot(1-Bq)$ *where Bq is defined as above and Q is the same as the normalized tip resistance, Q_t, defined above*	6, 7
qc1	Normalized tip resistance, q_{c1}, using a fixed stress ratio exponent, n (this method has stress units)	$q_{c1} = q_t \cdot (Pa/\sigma_v')^{0.5}$ where: Pa = atmospheric pressure	21
qc1 (0.5)	Normalized tip resistance, q_{c1}, using a fixed stress ratio exponent, n (this method is unit-less)	$q_{c1}\ (0.5)= (q_t/P_a) \cdot (Pa/\sigma_v')^{0.5}$ where: Pa = atmospheric pressure	5
qc1 (Cn)	Normalized tip resistance, q_{c1}, based on C_n (this method has stress units)	$q_{c1}(Cn) = C_n * q_t$	5, 12
qc1 (Cq)	Normalized tip resistance, q_{c1}, based on C_q (this method has stress units)	$q_{c1}\ (Cq)= C_q * q_t$ (some papers use q_c)	5, 12
qc1n	normalized tip resistance, q_{c1n}, using a variable stress ratio exponent, n (where n=0.0, 0.70, 1.0) (this method is unit-less)	$q_{c1n} = (q_t / P_a)(P_a/\sigma_v')^n$ where: P_a = atm. Pressure and n varies as described below	3, 5
I_c or Ic (RW1998)	Soil Behavior Type Index as defined by Robertson and Fear (1995) and Robertson and Wride (1998) for estimating grain size characteristics and providing smooth gradational changes across the SBTn chart	$I_c = [(3.47 - \log_{10}Q)^2 + (\log_{10} Fr + 1.22)^2\ ]^{0.5}$ *Where:* $Q=\left(\frac{qt-\sigma_v}{P_a}\right)\left(\frac{P_a}{\sigma_v'}\right)^n$ *Or* $Q=q_{c1n}=\left(\frac{qt}{P_a}\right)\left(\frac{P_a}{\sigma_v'}\right)^n$ *depending on the iteration in determining I_c* *And* *Fr is in percent* *P_a = atmospheric pressure* *n varies between 0.5, 0.70 and 1.0 and is selected in an iterative manner based on the resulting I_c*	3, 5, 21
Ic (PKR 2009)	Soil Behavior Type Index, I_c (PKR 2009) based on a variable stress ratio exponent n, which itself is based on I_c (PKR 2009). An iterative calculation is required to determine Ic (PKR 2009) and its corresponding n (PKR 2009).	I_c (PKR 2009) = $[(3.47 - \log_{10}Q_{tn})^2 + (1.22 + \log_{10}F_r)^2]^{0.5}$	15

Calculated Parameter	Description	Equation	Ref
n (PKR 2009)	Stress ratio exponent n, based on I_c (PKR 2009). An iterative calculation is required to determine n (PKR 2009) and its corresponding Ic (PKR 2009).	*n (PKR 2009) = 0.381 (I_c) + 0.05 (σ_v'/P_a) – 0.15*	15
Qtn (PKR 2009)	Normalized tip resistance using a variable stress ratio exponent based on I_c (PKR 2009) and n (PKR 2009). An iterative calculation is required to determine Qtn (PKR 2009).	$Q_{tn} = [(qt - \sigma_v)/P_a](P_a/\sigma_v')^n$ *where P_a = atmospheric pressure (100 kPa)* *n = stress ratio exponent described above*	15
FC	Apparent fines content (%)	*FC=1.75($Ic^{3.25}$) - 3.7* *FC=100 for $I_c > 3.5$* *FC=0 for $I_c < 1.26$* *FC = 5% if $1.64 < I_c < 2.6$ AND $F_r<0.5$*	3
I_c Zone	This parameter is the Soil Behavior Type zone based on the I_c parameter (valid for zones 2 through 7 on SBTn or SBT Qtn charts)	$I_c < 1.31$ Zone = 7 $1.31 < I_c < 2.05$ Zone = 6 $2.05 < I_c < 2.60$ Zone = 5 $2.60 < I_c < 2.95$ Zone = 4 $2.95 < I_c < 3.60$ Zone = 3 $I_c > 3.60$ Zone = 2	3
State Param or State Parameter or ψ	The state parameter index, ψ, is defined as the difference between the current void ratio, e, and the critical void ratio, e_c. Positive ψ - contractive soil Negative ψ - dilative soil This is based on the work by Been and Jefferies (1985) and Plewes, Davies and Jefferies (1992) - vertical effective stress is used rather than a mean normal stress	See reference	6, 8
Yield Stress σ_p'	Yield stress is calculated using the following methods a) General method b) 1st order approximation using q_tNet (clays) c) 1st order approximation using Δu_2 (clays) d) 1st order approximation using q_e (clays)	All stresses in kPa a) $\sigma_p' = 0.33 \cdot (q_t - \sigma_v)^{m'} (\sigma_{atm}/100)^{1-m'}$ where $m' = 1 - \frac{0.28}{1 + (I_c/2.65)^{25}}$ b) $\sigma_p' = 0.33 \cdot (q_t - \sigma_v)$ c) $\sigma_p' = 0.54 \cdot (\Delta u_2)$ $\Delta u_2 = u_2 - u_0$ d) $\sigma_p' = 0.60 \cdot (q_t - u_2)$	19 20 20 20
OCR OCR(JS1978) OCR(Mayne2014) OCR (qtNet) OCR (deltaU) OCR (qe) OCR (Vs) OCR (PKR2015)	Over Consolidation Ratio based on a) Schmertmann (1978) method involving a plot plot of S_u/σ_v' /($S_u/\sigma_v')_{NC}$ and OCR b) based on Yield stresses described above c) approximate version based on qtNet d) approximate version based on Δu e) approximate version based on effective tip, q_e f) approximate version based on shear wave velocity, V_s g) based on Qt	 a) requires a user defined value for NC Su/P_c' ratio b through f) *based on yield stresses* g) $OCR = 0.25 \cdot (Qt)^{1.25}$	 9 19 20 20 20 18 32

Calculated Parameter	Description	Equation	Ref
Es/qt	Intermediate parameter for calculating Young's Modulus, E, in sands. It is the Y axis of the reference chart.	Based on Figure 5.59 in the reference	5
Es Young's Modulus E	Young's Modulus based on the work done in Italy. There are three types of sands considered in this technique. The user selects the appropriate type for the site from: a) OC Sands b) Aged NC Sands c) Recent NC Sands Each sand type has a family of curves that depend on mean normal stress. The program calculates mean normal stress and linearly interpolates between the two extremes provided in the E_s/q_t chart. Es is evaluated for an axial strain of 0.1%.	Mean normal stress is evaluated from: $\sigma'_m = \frac{1}{3}(\sigma'_v + \sigma'_h + \sigma'_h)$ where σ_v'= vertical effective stress σ_h'= horizontal effective stress *and* $\sigma_h = K_o \bullet \sigma_v'$ with K_o assumed to be 0.5	5
Delta U/TStress	Differential pore pressure ratio with respect to total stress	$= \frac{\Delta u}{\sigma_v}$ *where:* $\Delta u = u - u_{eq}$	CK*
Delta U/Estress, P Value, Excess Pore Pressure Ratio	Differential pore pressure ratio with respect to effective stress. Key parameter (P, Normalized Pore Pressure Parameter, Excess Pore Pressure Ratio) in the Winckler et. al. static liquefaction method.	$= \frac{\Delta u}{\sigma'_v}$ *where:* $\Delta u = u - u_{eq}$	25, 25a, CK*
Su/EStress	Undrained shear strength ratio with respect to vertical effective overburden stress using the S_u (N_{kt}) method	$= Su\ (N_{kt}) / \sigma_v'$	CK*
Gmax	G_{max} determined from SCPT shear wave velocities (not estimated values)	$G_{max} = \rho V_s^2$ where ρ is the mass density of the soil determined from the estimated unit weights at each test depth	27
qtNet/Gmax	Net tip resistance ratio with respect to the small strain modulus G_{max} determined from SCPT shear wave velocities (not estimated values)	$= (qt - \sigma_v) / G_{max}$ where $G_{max} = \rho V_s^2$ and ρ is the mass density of the soil determined from the estimated unit weights at each test depth	15, 28, 30

*CK – common knowledge

Table 1b. CPT Parameter Calculation Methods – Liquefaction Parameters

Calculated Parameter	Description	Equation	Ref
K_{SPT}	Equivalent clean sand factor for $(N_1)60$	$K_{SPT} = 1 + ((0.75/30) \bullet (FC - 5))$	10
K_{CPT} or K_C (RW1998)	Equivalent clean sand correction for q_{c1N}	$K_{cpt} = 1.0$ for $I_c \leq 1.64$ $K_{cpt} = f(I_c)$ for $I_c > 1.64$ (see reference) $K_c = -0.403\ I_c^4 + 5.581\ I_c^3 - 21.63 I_c^2 + 33.75\ I_c - 17.88$	3, 10
Kc (PKR 2010)	Clean sand equivalent factor to be applied to Q_{tn}	$K_c = 1.0$ for $I_c \leq 1.64$ $K_c = -0.403\ I_c^4 + 5.581\ I_c^3 - 21.63 I_c^2 + 33.75\ I_c - 17.88$ for $I_c > 1.64$	16
$(N_1)_{60cs}Ic$	Clean sand equivalent SPT $(N_1)_{60}I_c$. User has 3 options.	1) $(N_1)_{60cs}Ic = \alpha + \beta((N_1)_{60}I_c)$ 2) $(N_1)_{60cs}Ic = K_{SPT} * ((N_1)_{60}I_c)$ 3) $(q_{c1ncs})/(N_1)_{60cs}I_c = 8.5\ (1 - I_c/4.6)$ FC ≤ 5%: $\alpha = 0,\ \beta = 1.0$ FC ≥ 35% $\alpha = 5.0,\ \beta = 1.2$ 5% < FC < 35% $\alpha = exp[1.76 - (190/FC^2)]$ $\beta = [0.99 + (FC^{1.5}/1000)]$	10 10 5
q_{c1ncs}	Clean sand equivalent q_{c1n}	$q_{c1ncs} = q_{c1n} \bullet K_{cpt}$	3
Qtn,cs (PKR 2010)	Clean sand equivalent for Q_{tn} described above - Q_{tn} being the normalized tip resistance based on a variable stress exponent as defined by Robertson (2009)	$Q_{tn,cs} = Q_{tn} \cdot K_c$ (PKR 2016)	16
Su(Liq)/ESv	Liquefied shear strength ratio as defined by Olson and Stark	$\frac{Su(Liq)}{\sigma_v'} = 0.03 + 0.0143(q_{c1})$ Note: σ_v' and s_v' are synonymous	13
Su(Liq)/ESv (PKR 2010)	Liquefied shear strength ratio as defined by Robertson (2010)	$\frac{Su(Liq)}{\sigma_v'}$ Based on a function involving $Q_{tn,cs}$	16
Su (Liq) (PKR 2010)	Liquefied shear strength derived from the liquefied shear strength ratio and effective overburden stress		16
Cont/Dilat Tip	Contractive / Dilative qc1 Boundary based on $(N_1)_{60}$	$(\sigma_v')_{boundary} = 9.58 \times 10^{-4}\ [(N_1)_{60}]^{4.79}$ *qc1* is calculated from specified qt(MPa)/N ratio	13
CRR	Cyclic Resistance Ratio (for Magnitude 7.5)	$q_{c1ncs} < 50$: $CRR_{7.5} = 0.833\ [q_{c1ncs}/1000] + 0.05$ $50 \leq q_{c1ncs} < 160$: $CRR_{7.5} = 93\ [q_{c1ncs}/1000]^3 + 0.08$	10
Kg	Small strain Stiffness Ratio Factor, Kg	[Gmax/qt]/[qc1n^{-m}] m = empirical exponent, typically 0.75	26

Calculated Parameter	Description	Equation	Ref
SP Distance	State Parameter Distance, Winckler static liquefaction method	Perpendicular distance on Qtn chart from plotted point to state parameter Ψ = -0.05 curve	25
URS NP Fr	Normalized friction ratio point on Ψ = -0.05 curve used in SP Distance calculation		25
URS NP Qtn	Normalized tip resistance (Qtn) point on Ψ = -0.05 curve used in SP Distance calculation		25

Table 2. References

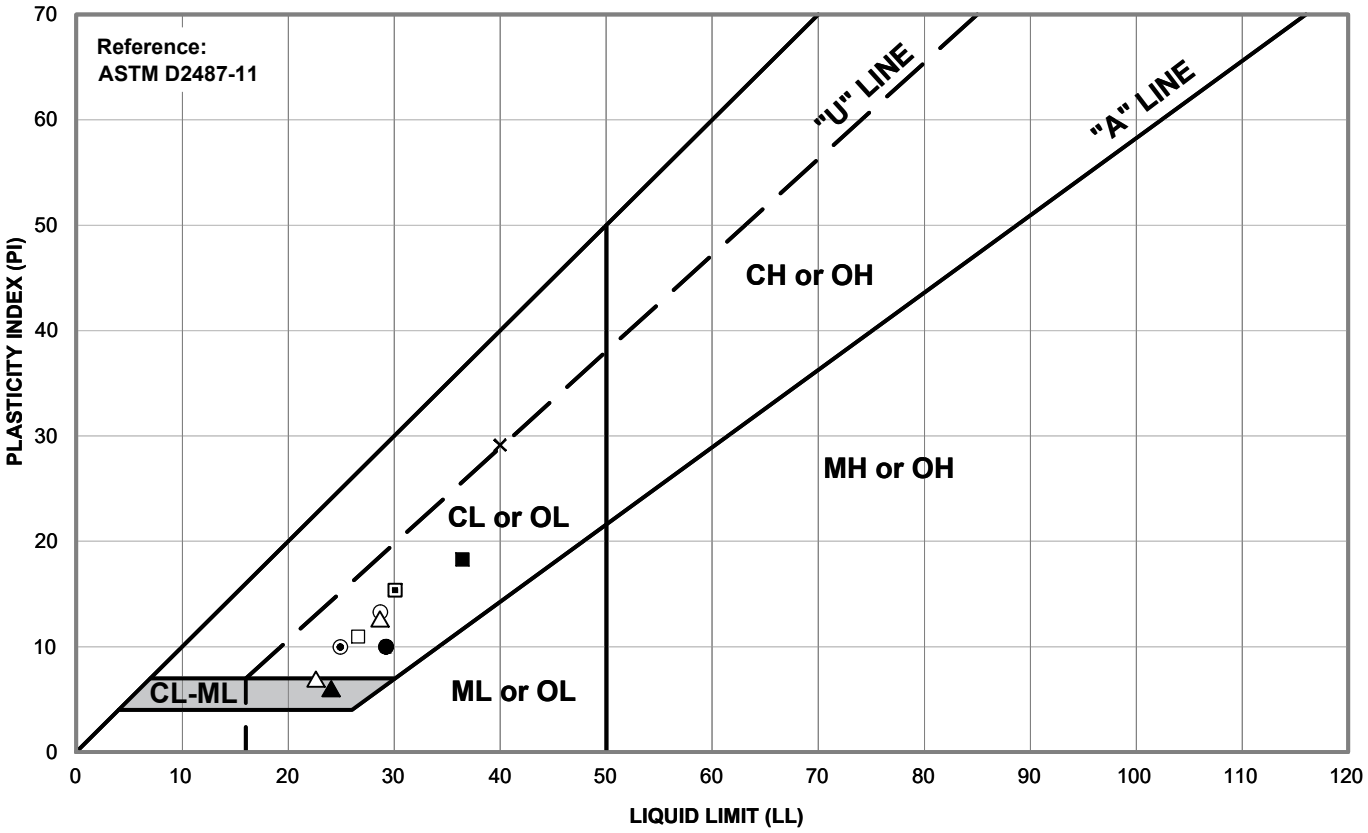
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APPENDIX C

LABORATORY TEST RESULTS

PLASTICITY CHART



Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	B-1 at 14.5 feet	SANDY CLAY (CL), gray-brown to yellow-brown with yellow mottling	23.2	29	10	--
■	B-1 at 24.5 feet	CLAYEY SILTY SAND (SC-SM), gray	20.6	24	6	22.7
□	B-1 at 34.5 feet	SANDY CLAY (CL), gray-brown to olive-gray	18.3	27	11	--
○	B-1 at 39.5 feet	CLAY with SAND (CL), gray-brown to olive-gray	--	31	14	--
▲	B-1 at 44.5 feet	CLAYEY SILTY SAND (SC-SM), gray-brown with orange-brown mottling	22.5	24	6	35.3
△	B-2 at 4.5 feet	CLAYEY SILTY SAND (SC-SM), dark brown	20.6	23	7	--
×	B-2 at 9.5 feet	CLAY (CL), yellow-brown with yellow and dark brown mottling	22.9	40	29	--
⊡	B-2 at 14.5 feet	CLAY with SAND (CL), gray-brown to olive-brown	--	30	15	--

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SAN BRUNO
SAN MATEO COUNTY CALIFORNIA

Figure Title
PLASTICITY CHART

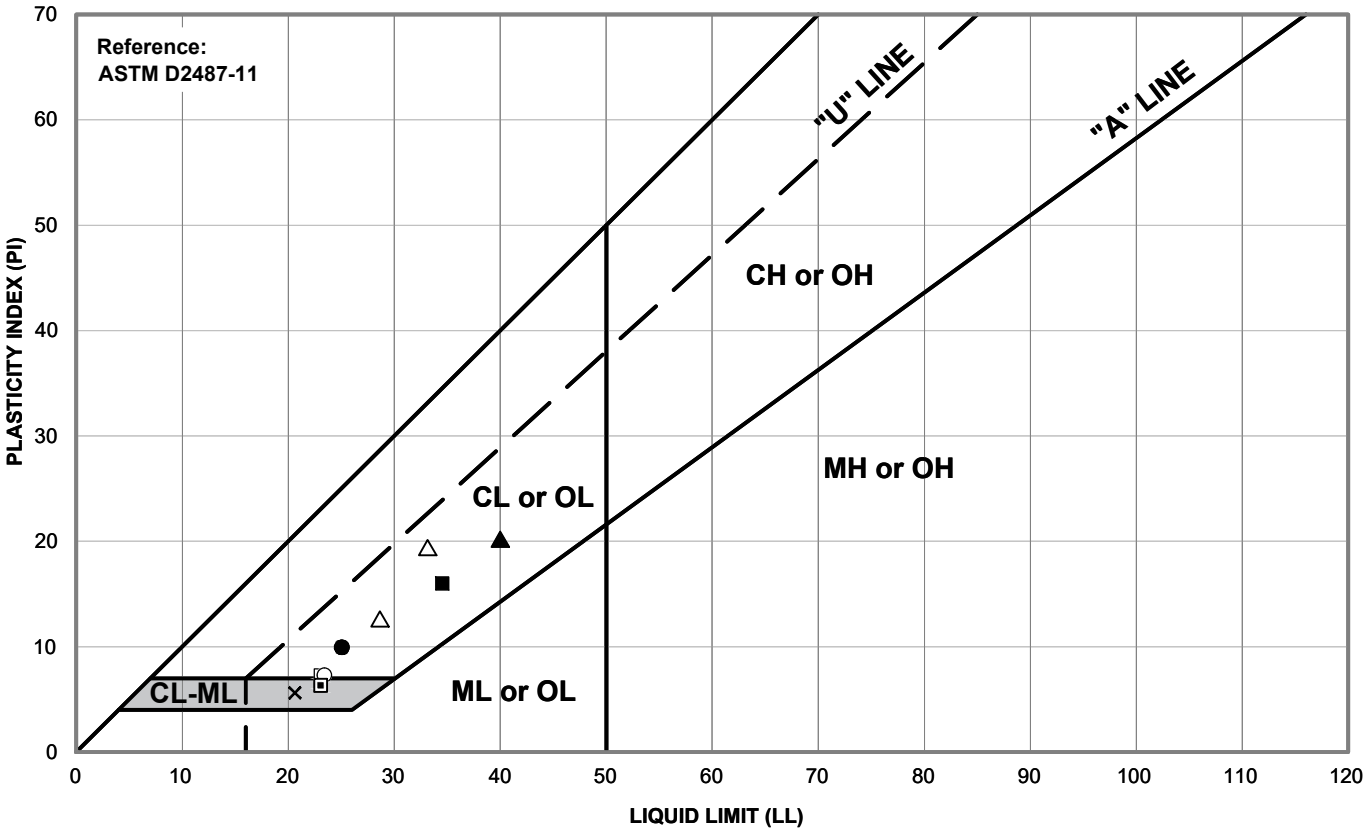
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Checked By TG

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PLASTICITY CHART



Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	B-2 at 34.5 feet	CLAY with SAND (CL), gray	--	25	10	--
■	B-2 at 54 feet	CLAY with SAND (CL), gray-brown to olive-brown	--	34	16	--
□	B-2 at 59.5 feet	CLAYEY SILTY SAND (SC-SM), yellow-brown	21.2	23	7	43.3
○	B-2 at 74.5 feet	SANDY SILTY CLAY (CL-ML), gray	29.8	23	7	58.7
▲	B-2 at 98.5 feet	CLAY with SAND (CL), gray with red-brown mottling	--	40	20	--
△	B-3 at 4.5 feet	CLAY with SAND (CL), gray-brown	--	33	19	--
×	B-3 at 18.5 feet	CLAYEY SILTY SAND with GRAVEL (SC-SM), gray-brown	14.0	21	5	22.8
⊡	B-3 at 23.5 feet	CLAYEY SILTY SAND with GRAVEL (SC-SM), yellow-brown to gray-brown	11.9	23	6	25.0

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Figure Title: PLASTICITY CHART

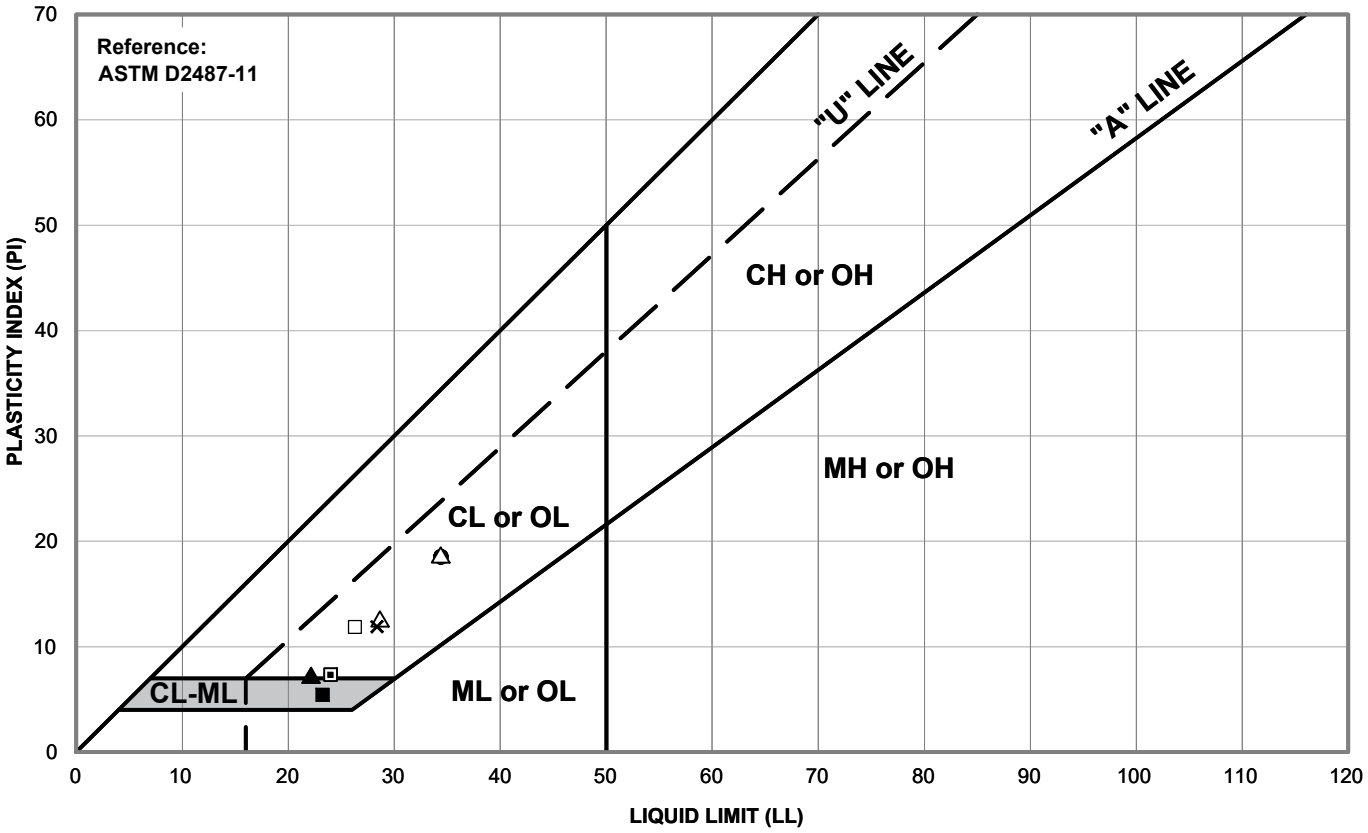
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PLASTICITY CHART



Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	B-3 at 36 feet	CLAY with SAND (CL), brown to red-brown	16.2	34	18	--
■	B-3 at 44.5 feet	CLAYEY SILTY SAND (SC-SM), gray-brown with red-brown mottling	22.1	23	5	38.5
□	B-4 at 6 feet	CLAYEY SAND (SC), gray-brown to yellow-brown with dark brown mottling	15.2	27	12	45.8
○	B-4 at 15 feet	SILTY SAND (SM), gray-brown with red-yellow mottling	17.3	--	NP	33.0
▲	B-4 at 20 feet	CLAYEY SILTY SAND with GRAVEL (SC-SM), yellow-brown to gray-brown	10.4	22	7	20.8
△	B-4 at 38.5 feet	SANDY CLAY (CL), yellow-brown to brown	15.0	34	18	53.5
×	B-5 at 4 feet	CLAYEY SAND (SC), yellow-brown to gray-brown with red-brown mottling	12.1	28	12	36.1
⊡	B-5 at 9 feet	CLAYEY SILTY SAND (SC-SM), gray-brown to olive-gray with yellow-brown mottling	18.4	24	7	40.6

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Figure Title: PLASTICITY CHART

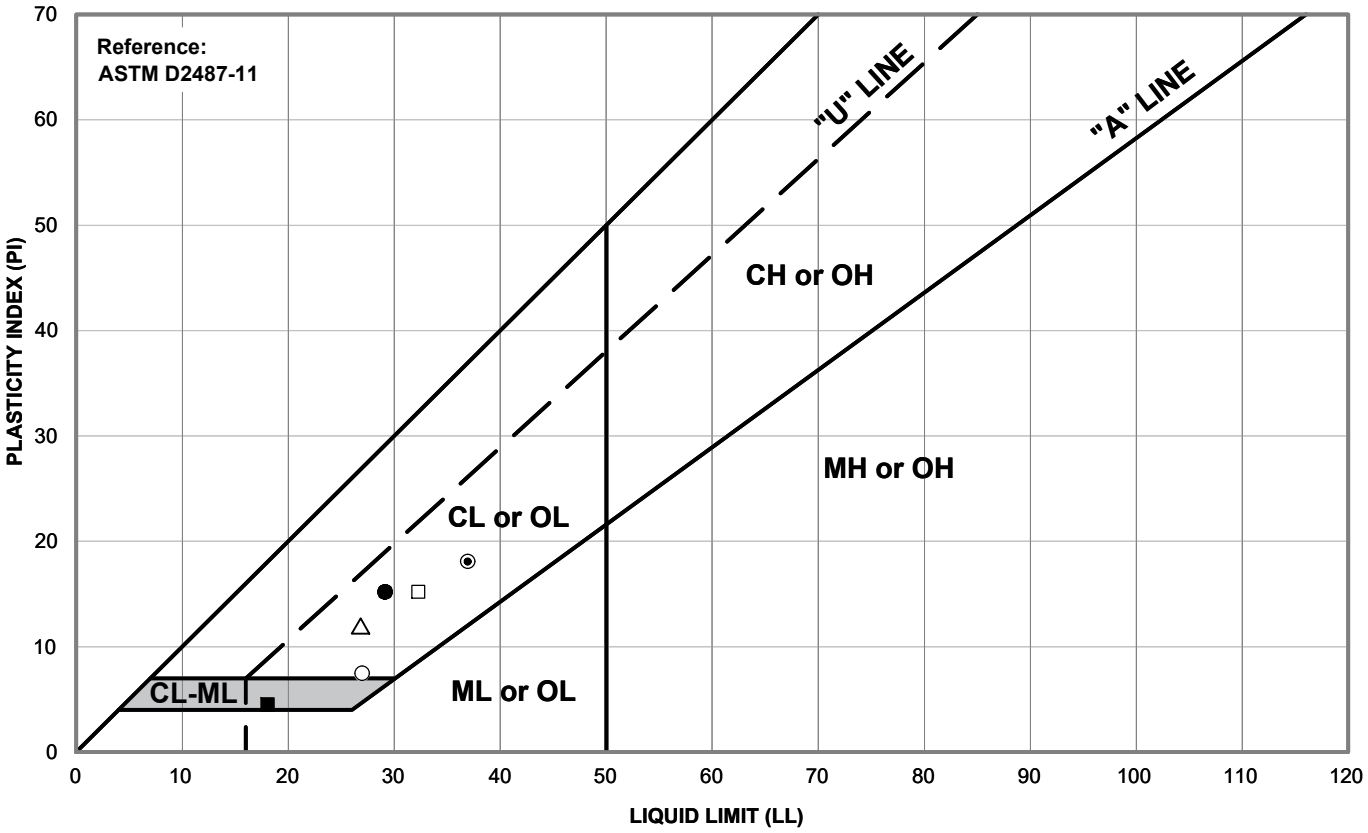
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Figure C-3

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PLASTICITY CHART



Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	B-5 at 14.5 feet	CLAY (CL), blue-gray to gray-brown with gray and yellow mottling	--	29	15	--
■	B-5 at 14.75 feet	CLAYEY SILTY SAND (SC-SM), gray	--	18	4	--
□	B-5 at 24.5 feet	CLAY with SAND (CL), blue-gray to gray brown with yellow-brown mottling	--	32	15	--
○	B-5 at 29.5 feet	SILTY CLAY with SAND (CL-ML), gray-brown to yellow-brown	--	27	7	--
▲	B-5 at 33.5 feet	SILTY SAND (SM), yellow-brown to gray-brown	17.6	--	NP	26.4
△	B-5 at 59.5 feet	CLAYEY SAND (SC), gray-brown	17.1	27	12	31.5
×	B-5 at 69 feet	SILTY SAND (SM), gray brown with red-brown mottling	19.0	--	NP	35.5
⊡	B-6 at 4.5 feet	SILTY SAND (SM), yellow-brown	14.8	--	NP	29.7
◉	B-6 at 49.5 feet	SANDY CLAY (CL), gray-brown to yellow-brown	22.9	37	18	20.9

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Figure Title
PLASTICITY CHART

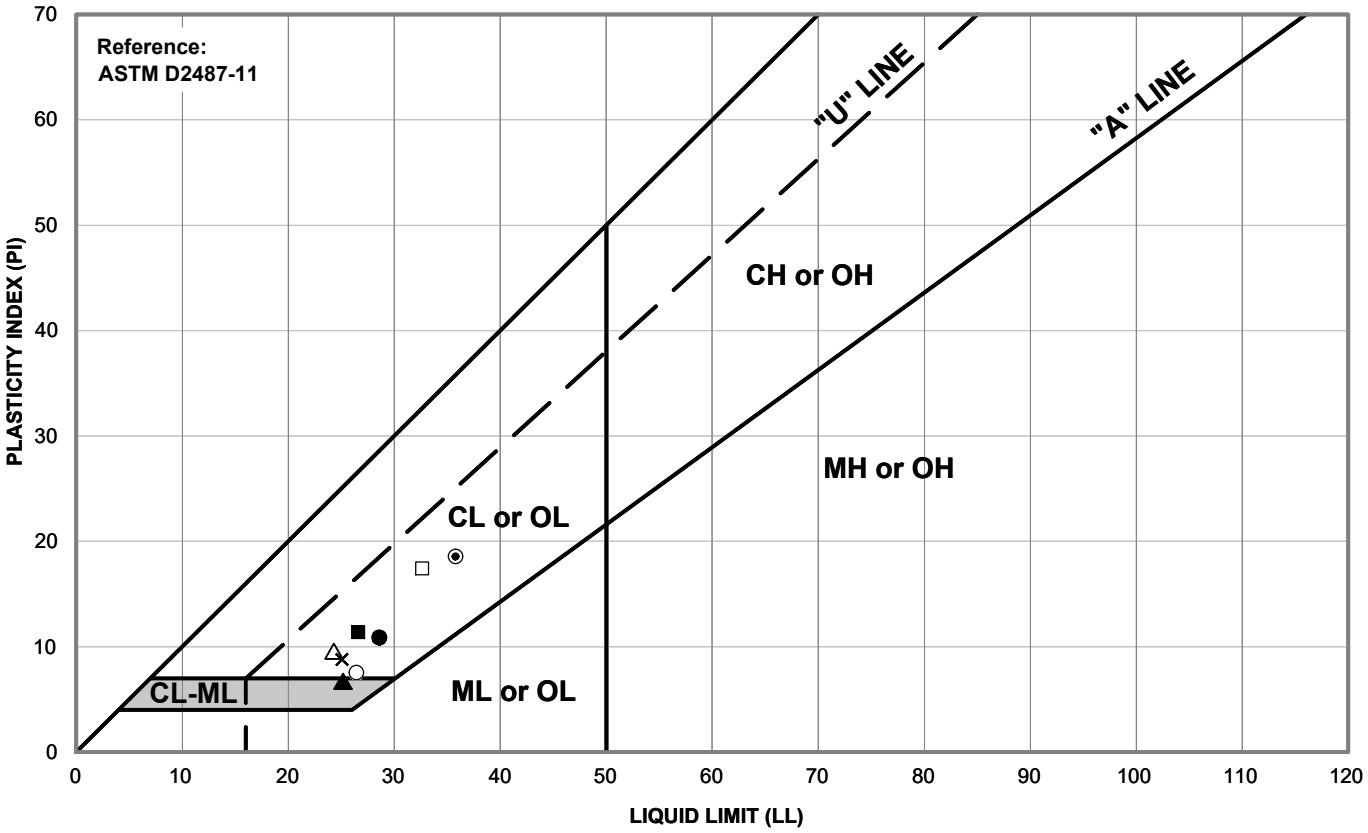
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Figure
C-4

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PLASTICITY CHART



Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
■	B-7 at 15 feet	CLAY with SAND (CL), dark-gray with gray mottling	--	27	12	--
□	B-7 at 31 feet	CLAY (CL), yellow to yellow-brown with gray-brown and dark brown mottling	--	33	17	--
○	B-7 at 45 feet	CLAYEY SILTY SAND (SC-SM), yellow-brown	22.6	26	7	49.4
▲	B-7 at 55.5 feet	CLAYEY SILTY SAND with GRAVEL (SC-SM), yellow-brown to red-brown	18.1	25	6	18.3
△	B-8 at 4.5 feet	SILTY SAND (SM), yellow to yellow-brown	7.4	24	9	12.9
×	B-8 at 23.5 feet	SANDY CLAY (CL), yellow-brown to gray-brown with red-yellow mottling	--	25	8	--
⊡	B-8 at 34.5 feet	SILTY SAND (SM), yellow to yellow-brown	19.5	--	NP	22.9
●	B-8 at 59 feet	SANDY CLAY (CL), gray to blue-gray	--	28	11	--
◉	B-8 at 64.5 feet	CLAY (CL), gray to blue-gray	--	36	18	--

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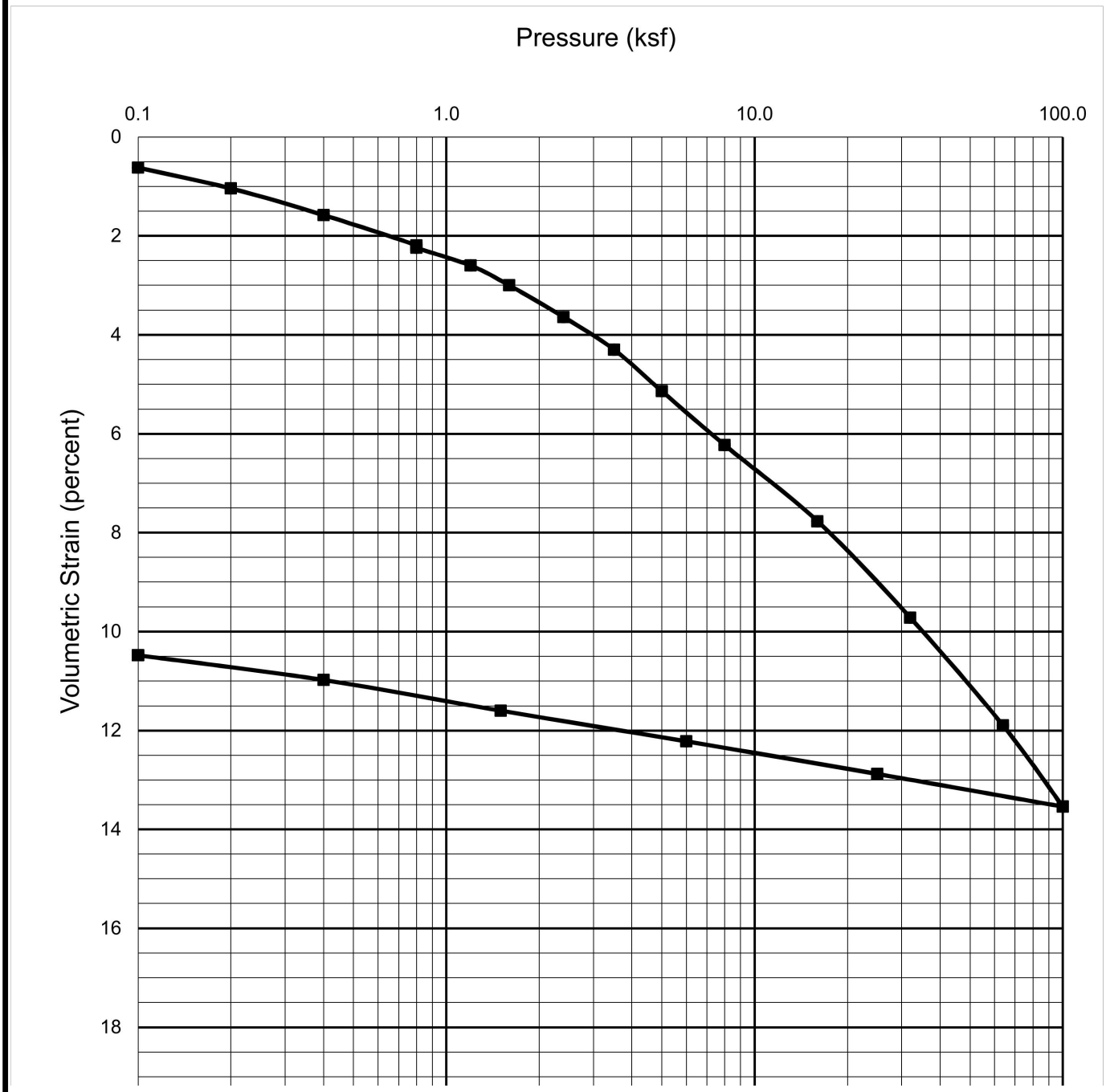
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Figure
C-5

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Sampler Type: S&H				Condition		Before Test			After Test		
Diameter (in)	2.42	Height (in)	1.00	Water Content	w_o	18.7	%	w_f	14.0	%	
Overburden Pressure, p_o	2,990	psf		Void Ratio	e_o	0.54		e_f	0.38		
Preconsol. Pressure, p_c	4,500	psf		Saturation	S_o	94	%	S_f	100	%	
Compression Ratio, $C_{\varepsilon c}$	0.09			Dry Density	γ_d	110	pcf	γ_d	122	pcf	
LL	27	PL	16	PI	11			G_s	2.70	(assumed)	
Classification	SANDY CLAY (CL), gray-brown to olive-gray			Source	B-1 at 34.5 feet						

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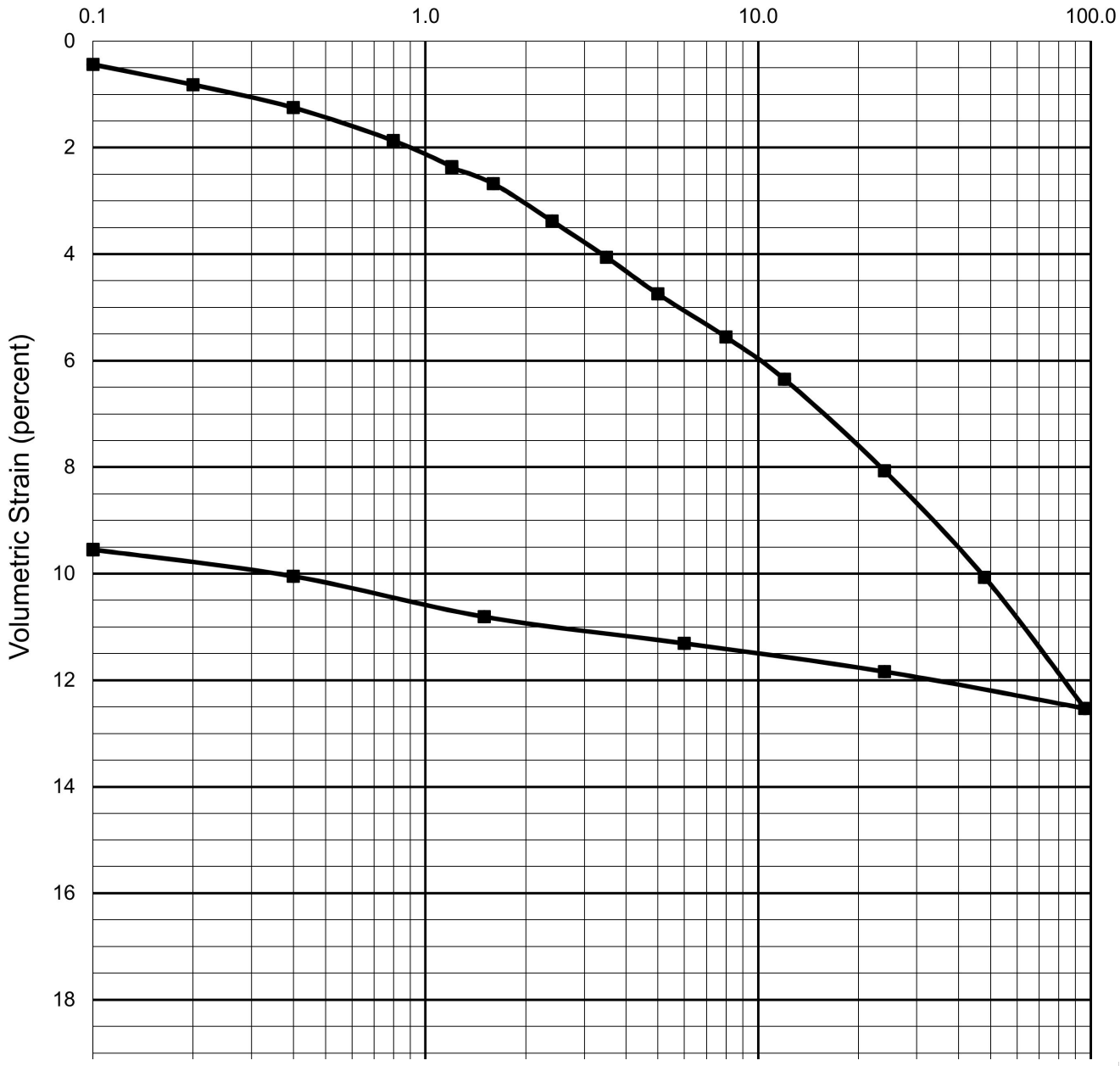
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C-6

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Sampler Type: S&H				Condition		Before Test			After Test	
Diameter (in)	2.42	Height (in)	1.00	Water Content	w_o	21.6	%	w_f	16.9	%
Overburden Pressure, p_o	2,010	psf		Void Ratio	e_o	0.61		e_f	0.46	
Preconsol. Pressure, p_c	4,050	psf		Saturation	S_o	96	%	S_f	100	%
Compression Ratio, $C_{\varepsilon c}$	0.08			Dry Density	γ_d	105	pcf	γ_d	116	pcf
LL --	PL --		PI --			G_s	2.70	(assumed)		
Classification	CLAY with SAND (CL), gray-brown to olive-brown			Source	B-2 at 19.5 feet					

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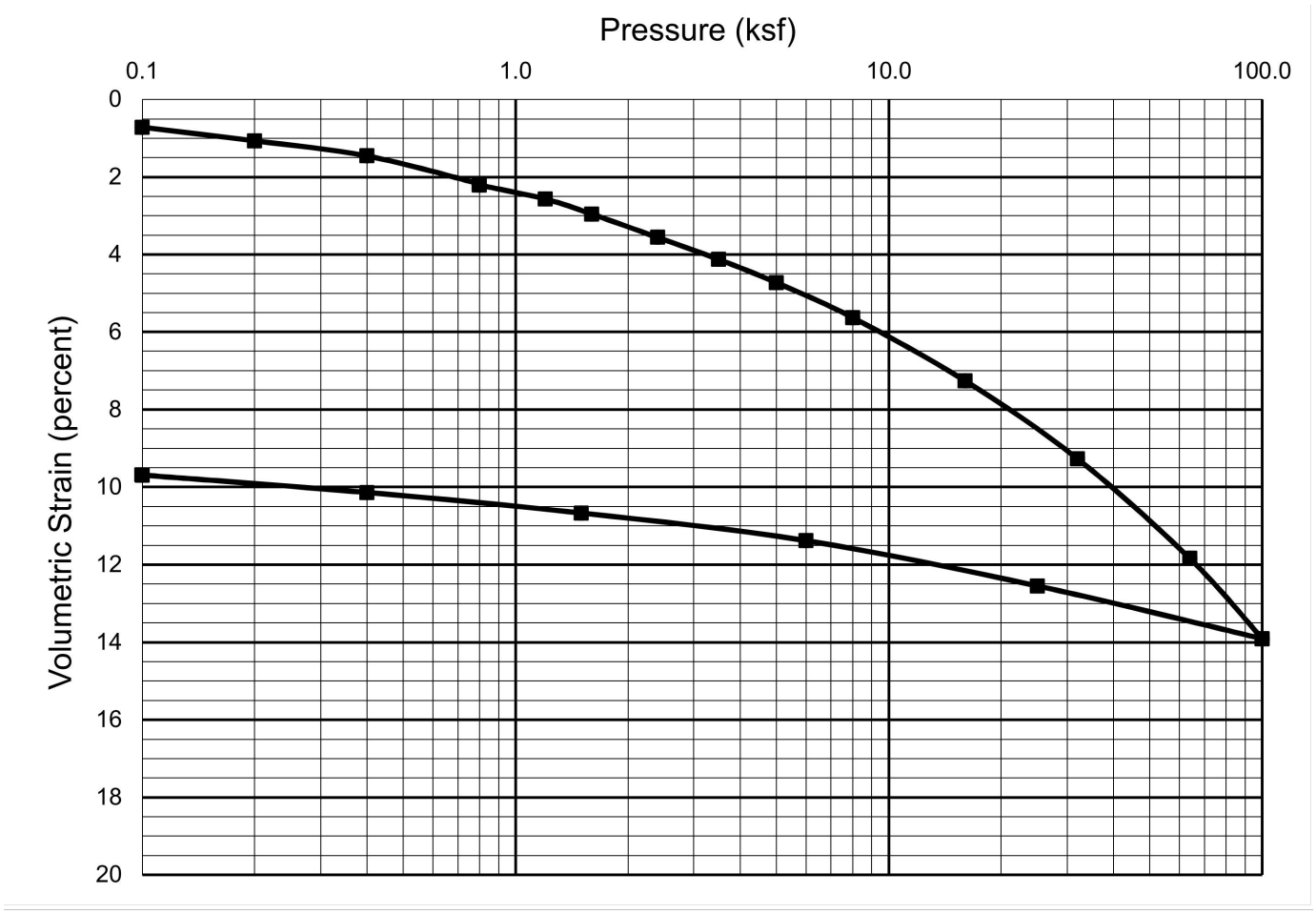
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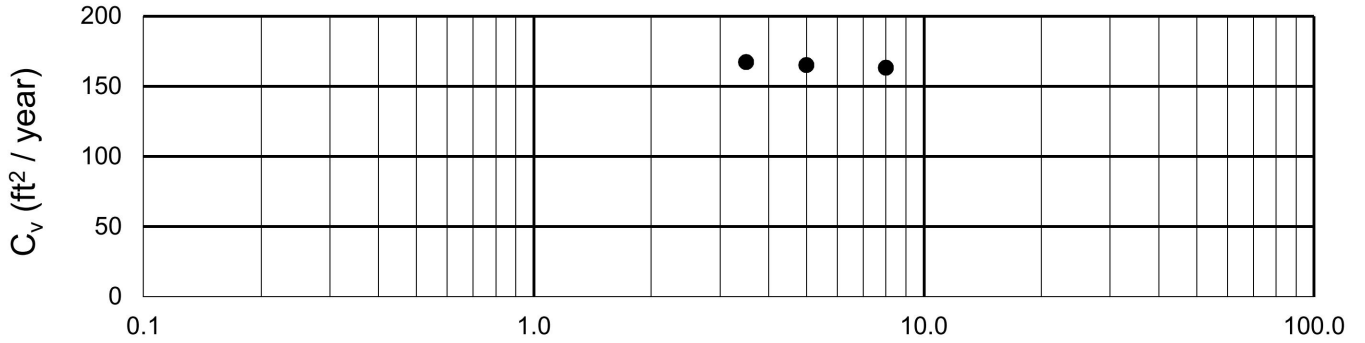
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C-7

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Sampler Type: S&H			Condition	Before Test		After Test	
Diameter (in) 2.42	Height (in) 1.00		Water Content	w_o	19.7 %	w_f	15.0 %
Overburden Pressure, p_o	2,790	psf	Void Ratio	e_o	0.56	e_f	0.40
Preconsol. Pressure, p_c	9,250	psf	Saturation	S_o	96 %	S_f	100 %
Compression Ratio, $C_{\varepsilon c}$	0.12		Dry Density	γ_d	108 pcf	γ_d	120 pcf
LL --	PL --		PI --		G_s 2.70 (assumed)		
Classification SANDY CLAY (CL), gray-brown with red-brown mottling				Source B-3 at 29.3 feet			

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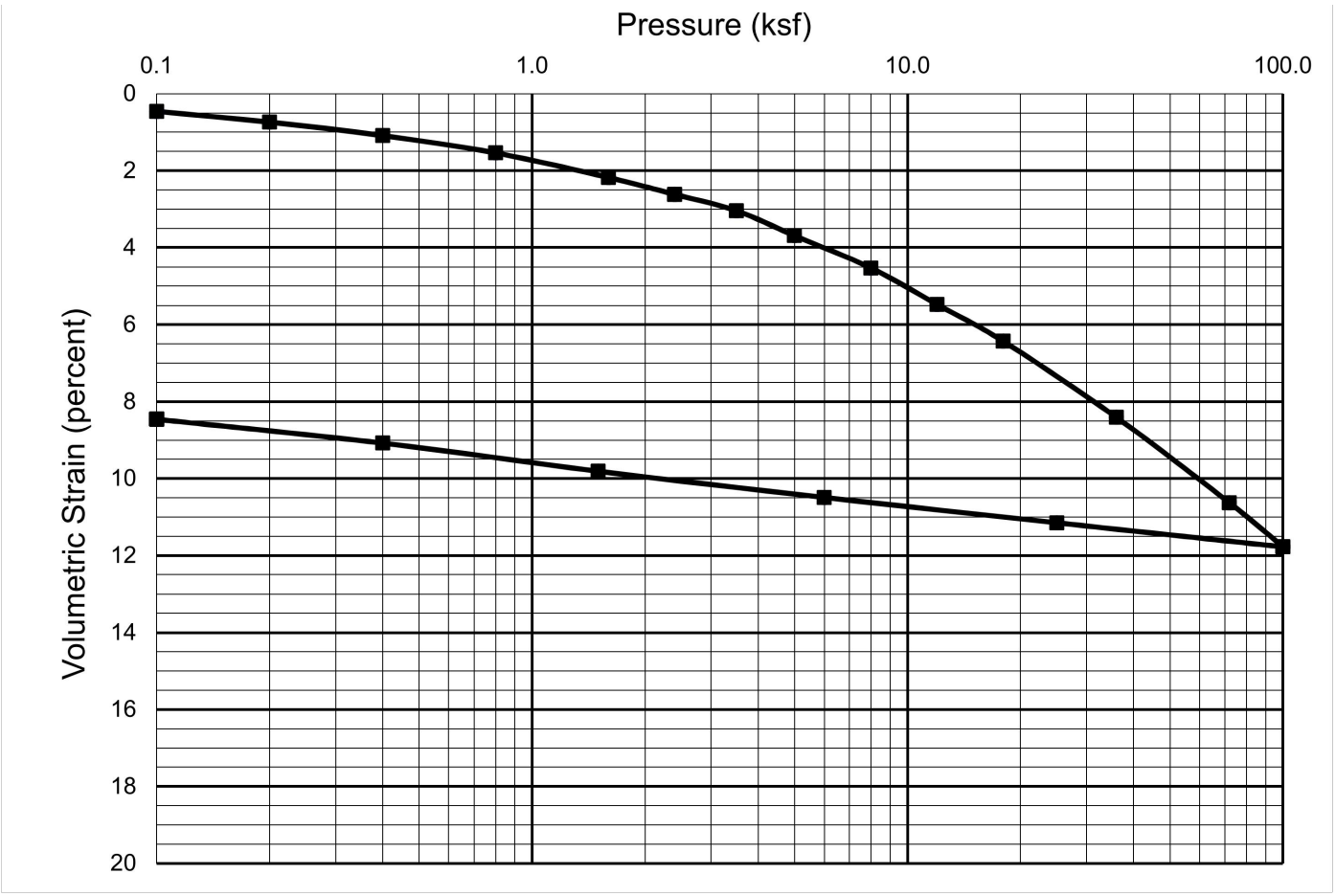
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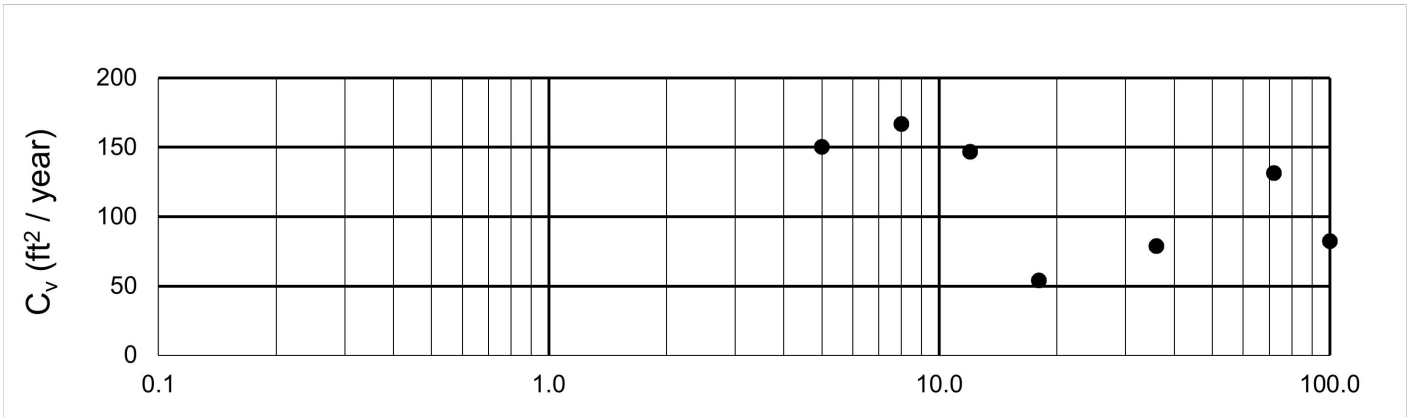
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Figure
C-8

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Sampler Type: S&H			Condition	Before Test			After Test	
Diameter (in) 2.42	Height (in)	1.00	Water Content	w_o	17.3 %	w_f	14.4	%
Overburden Pressure, p_o	4,600	psf	Void Ratio	e_o	0.51	e_f	0.39	
Preconsol. Pressure, p_c	6,750	psf	Saturation	S_o	91 %	S_f	100	%
Compression Ratio, $C_{\varepsilon c}$	0.09		Dry Density	γ_d	111 pcf	γ_d	122	pcf
LL --	PL --		PI --		G_s	2.70	(assumed)	
Classification SANDY CLAY (CL), gray-brown with yellow-brown mottling					Source	B-5 at 44.5 feet		

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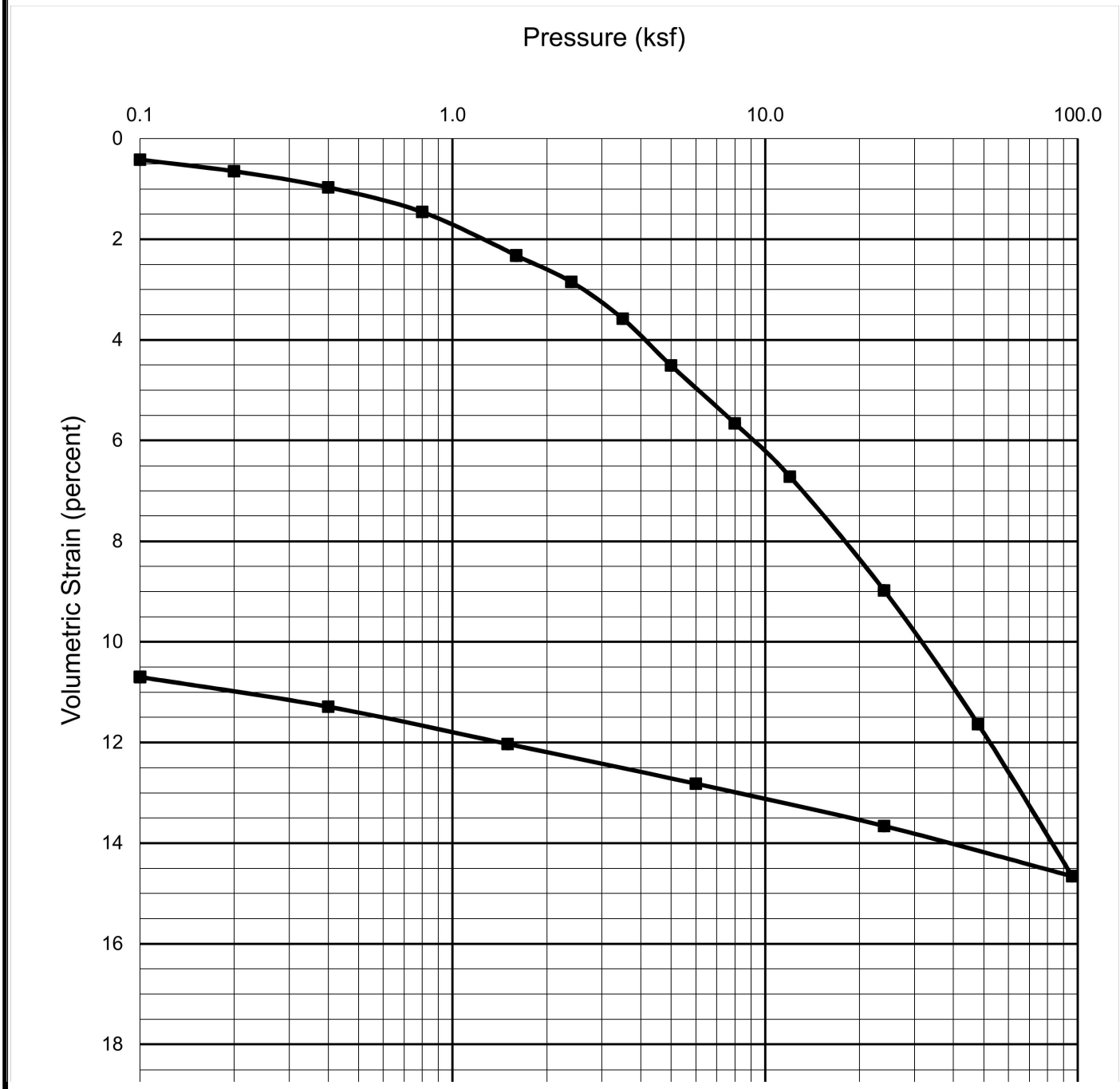
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C-9

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Sampler Type: S&H				Condition	Before Test			After Test		
Diameter (in)	2.42	Height (in)	1.00	Water Content	w_o	20.3	%	w_f	15.1	%
Overburden Pressure, p_o	5,290	psf		Void Ratio	e_o	0.58		e_f	0.41	
Preconsol. Pressure, p_c	6,300	psf		Saturation	S_o	95	%	S_f	100	%
Compression Ratio, $C_{\varepsilon c}$	0.11			Dry Density	γ_d	107	pcf	γ_d	120	pcf
LL	- -	PL	- -	PI	- -			G_s	2.70	(assumed)
Classification	SANDY CLAY (CL), gray to blue-gray			Source	B-8 at 54.5 feet					

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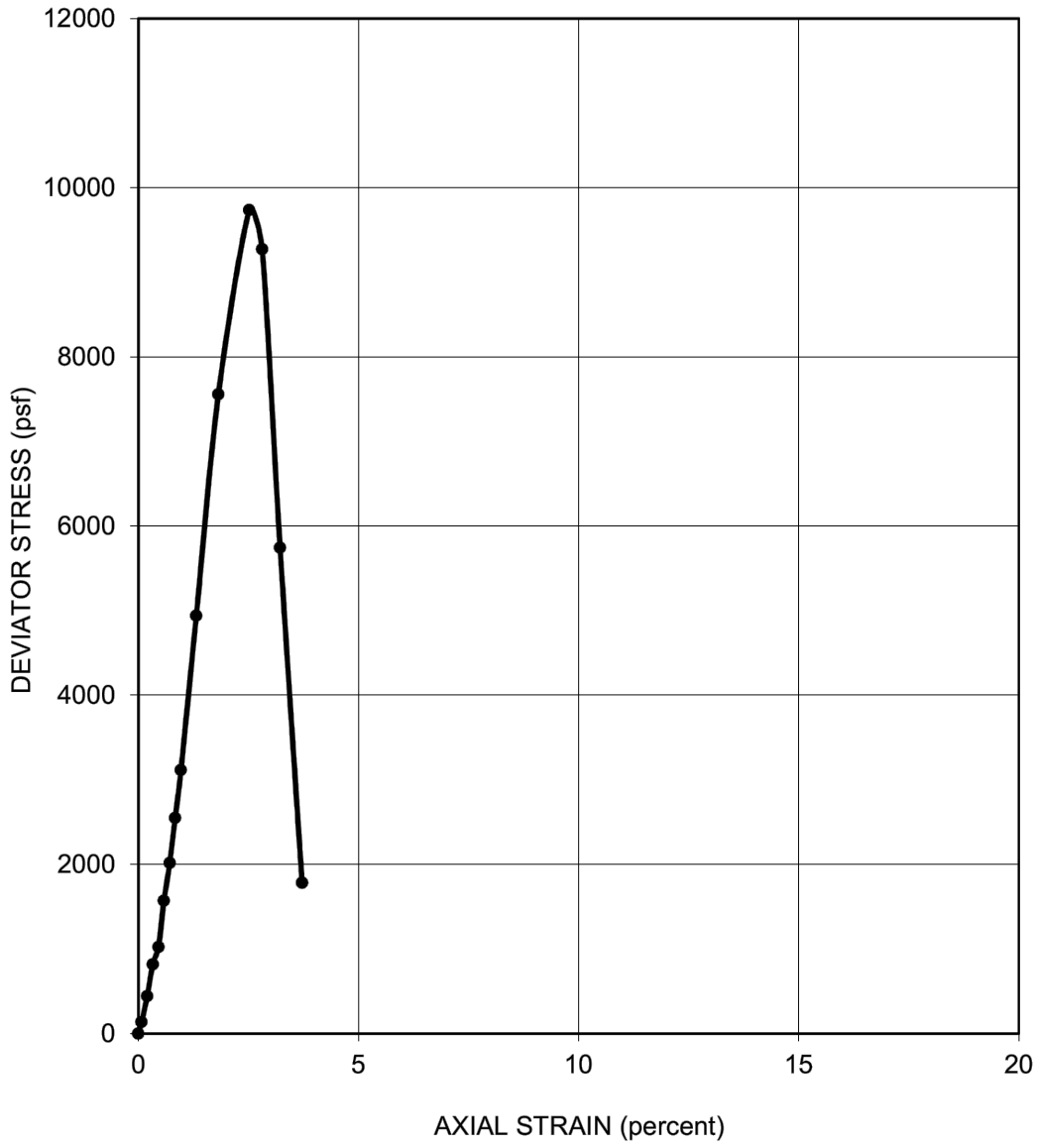
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C-10

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SAMPLER TYPE	S&H			SHEAR STRENGTH	4,870	psf
DIAMETER (in.)	2.38	HEIGHT (in.)	5.48	STRAIN AT FAILURE	2.5	%
MOISTURE CONTENT		10.9	%	CONFINING PRESSURE	480	psf
DRY DENSITY		127	pcf	STRAIN RATE	0.50	% / min
DESCRIPTION	CLAY with SAND (CL), dark brown to gray-brown			SOURCE	B-1 @ 4 feet	

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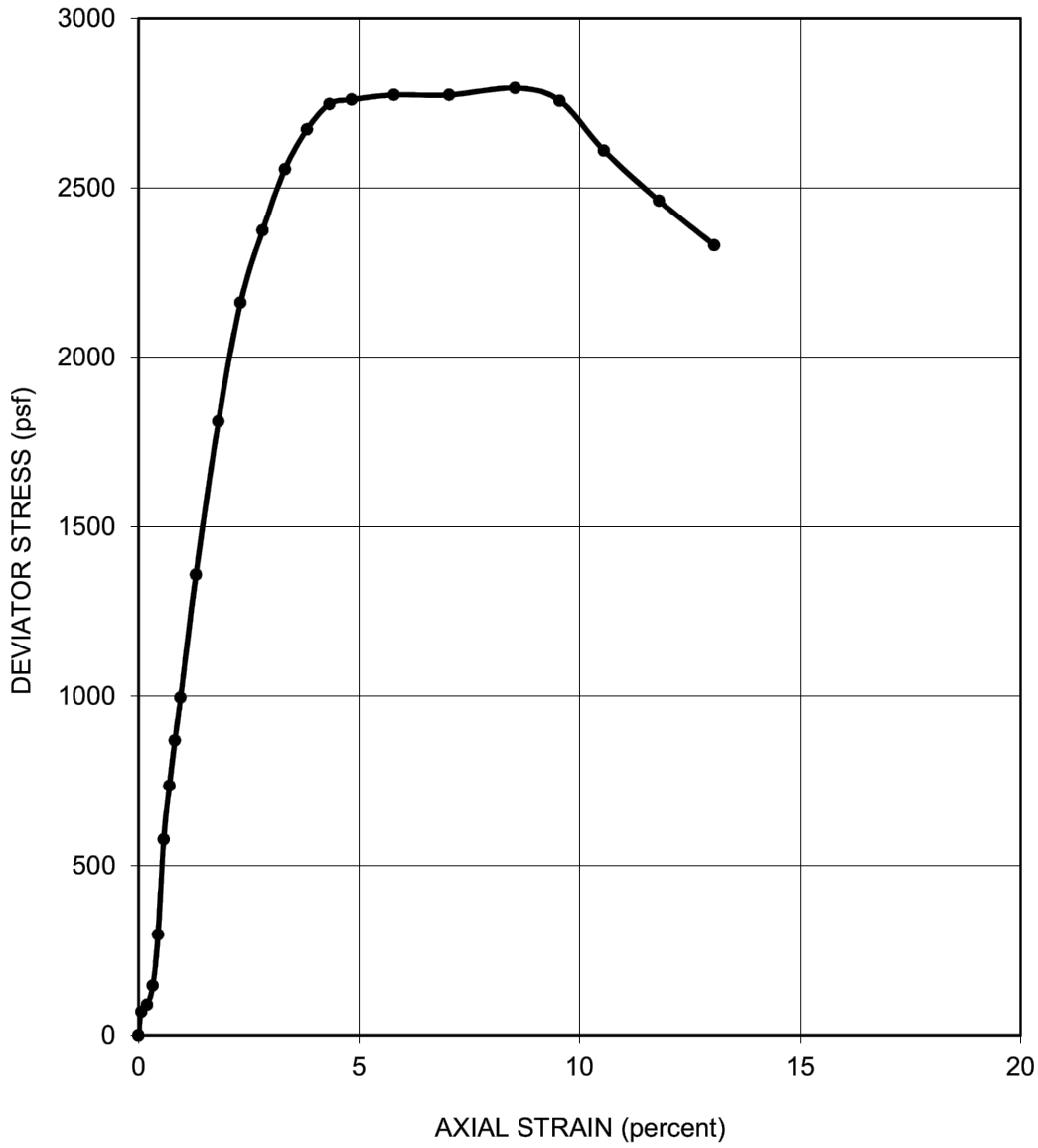
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SAMPLER TYPE	S&H		SHEAR STRENGTH	1,400	psf
DIAMETER (in.)	2.39	HEIGHT (in.) 5.08	STRAIN AT FAILURE	8.5	%
MOISTURE CONTENT		22.9 %	CONFINING PRESSURE	1,140	psf
DRY DENSITY		104 pcf	STRAIN RATE	0.75	% / min
DESCRIPTION	CLAY (CL), yellow-brown with yellow and dark brown mottling		SOURCE	B-2 @ 9.5 feet	

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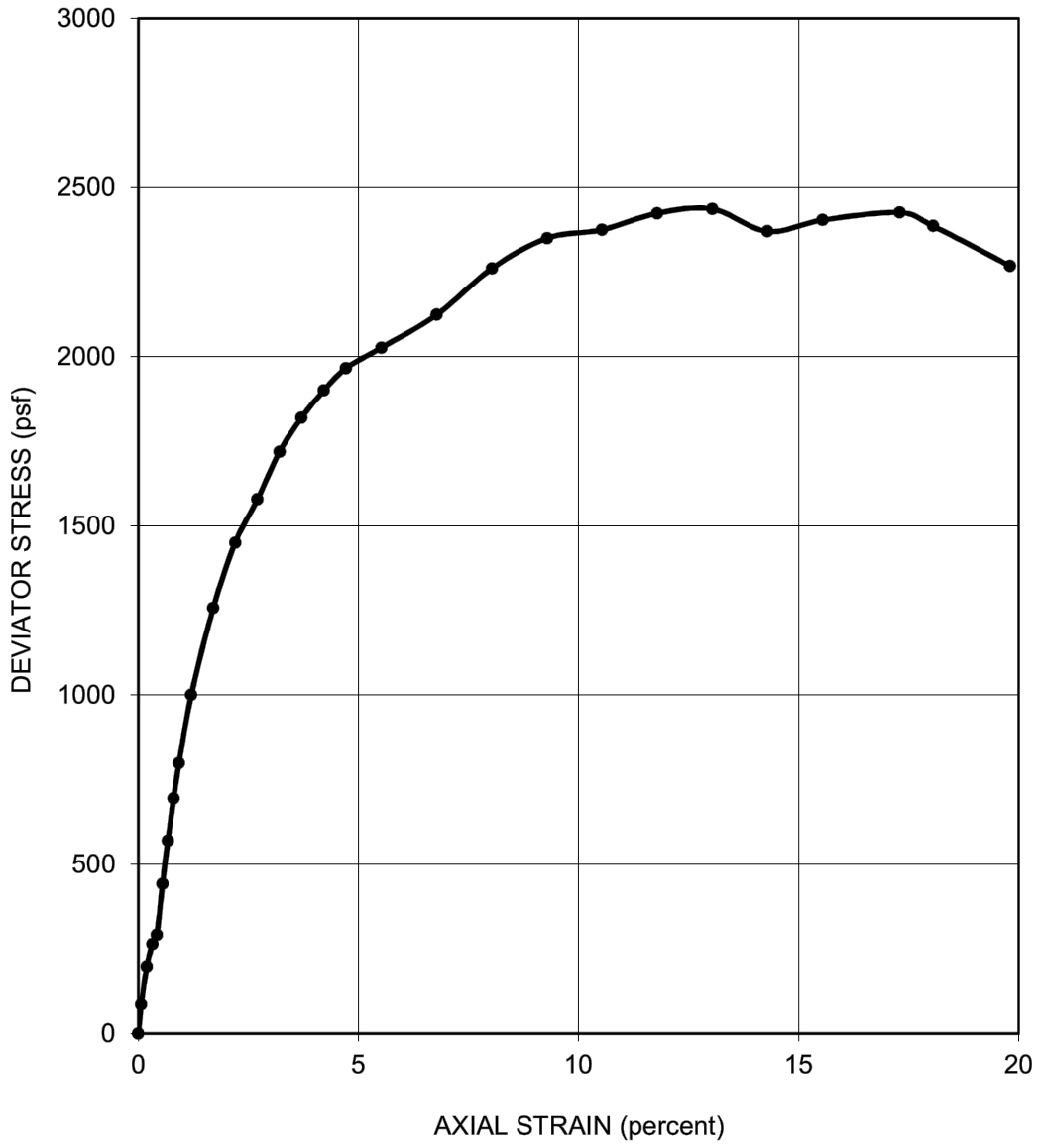
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Figure
C-12

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SAMPLER TYPE	S&H		SHEAR STRENGTH	1,220	psf
DIAMETER (in.)	2.38	HEIGHT (in.) 5.51	STRAIN AT FAILURE	13.0	%
MOISTURE CONTENT		22.5 %	CONFINING PRESSURE	1,140	psf
DRY DENSITY		105 pcf	STRAIN RATE	0.75	% / min
DESCRIPTION	CLAY with SAND (CL), gray-brown		SOURCE	B-3 @ 9.5 feet	

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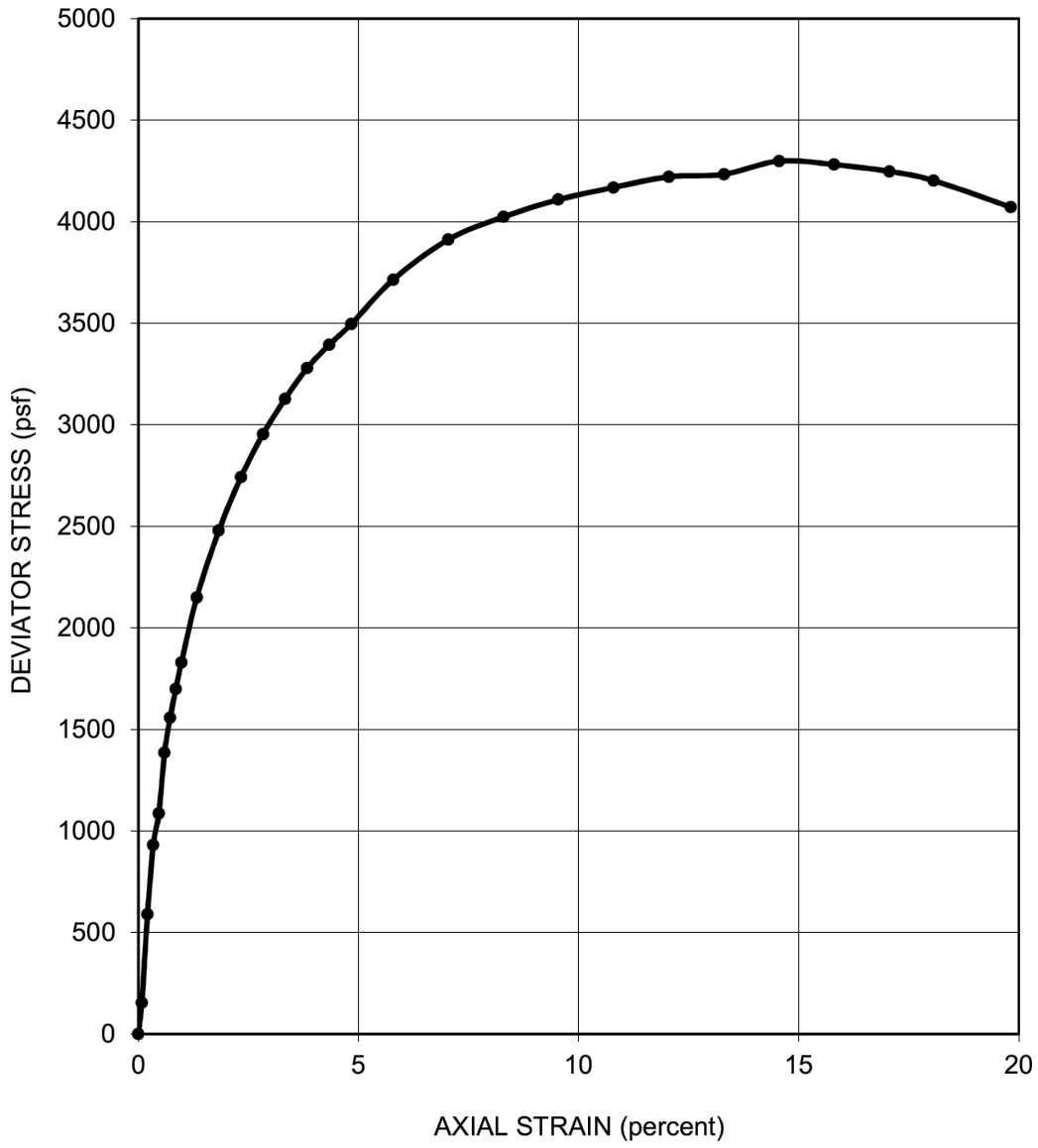
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SAMPLER TYPE	S&H			SHEAR STRENGTH	2,150	psf
DIAMETER (in.)	2.38	HEIGHT (in.)	5.51	STRAIN AT FAILURE	14.6	%
MOISTURE CONTENT		21.8	%	CONFINING PRESSURE	540	psf
DRY DENSITY		107	pcf	STRAIN RATE	0.50	% / min
DESCRIPTION	CLAY with SAND (CL), dark gray			SOURCE	B-4 @ 4.5 feet	

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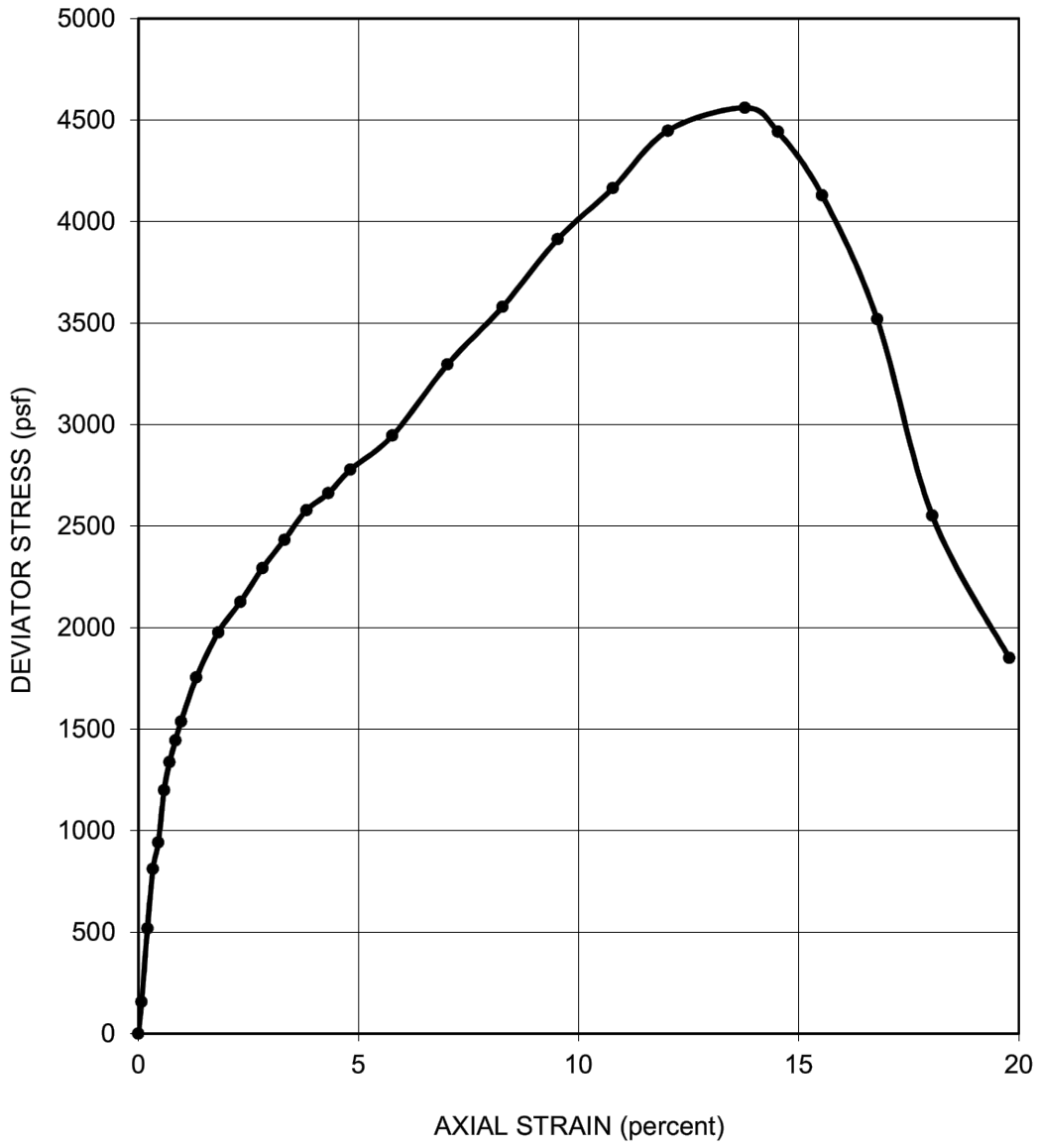
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SAMPLER TYPE	S&H			SHEAR STRENGTH	2,280	psf
DIAMETER (in.)	2.39	HEIGHT (in.)	5.22	STRAIN AT FAILURE	13.8	%
MOISTURE CONTENT		13.3	%	CONFINING PRESSURE	2,220	psf
DRY DENSITY		121	pcf	STRAIN RATE	0.50	% / min
DESCRIPTION	CLAY with GRAVEL (CL), dark gray			SOURCE	B-6 @ 18.5 feet	

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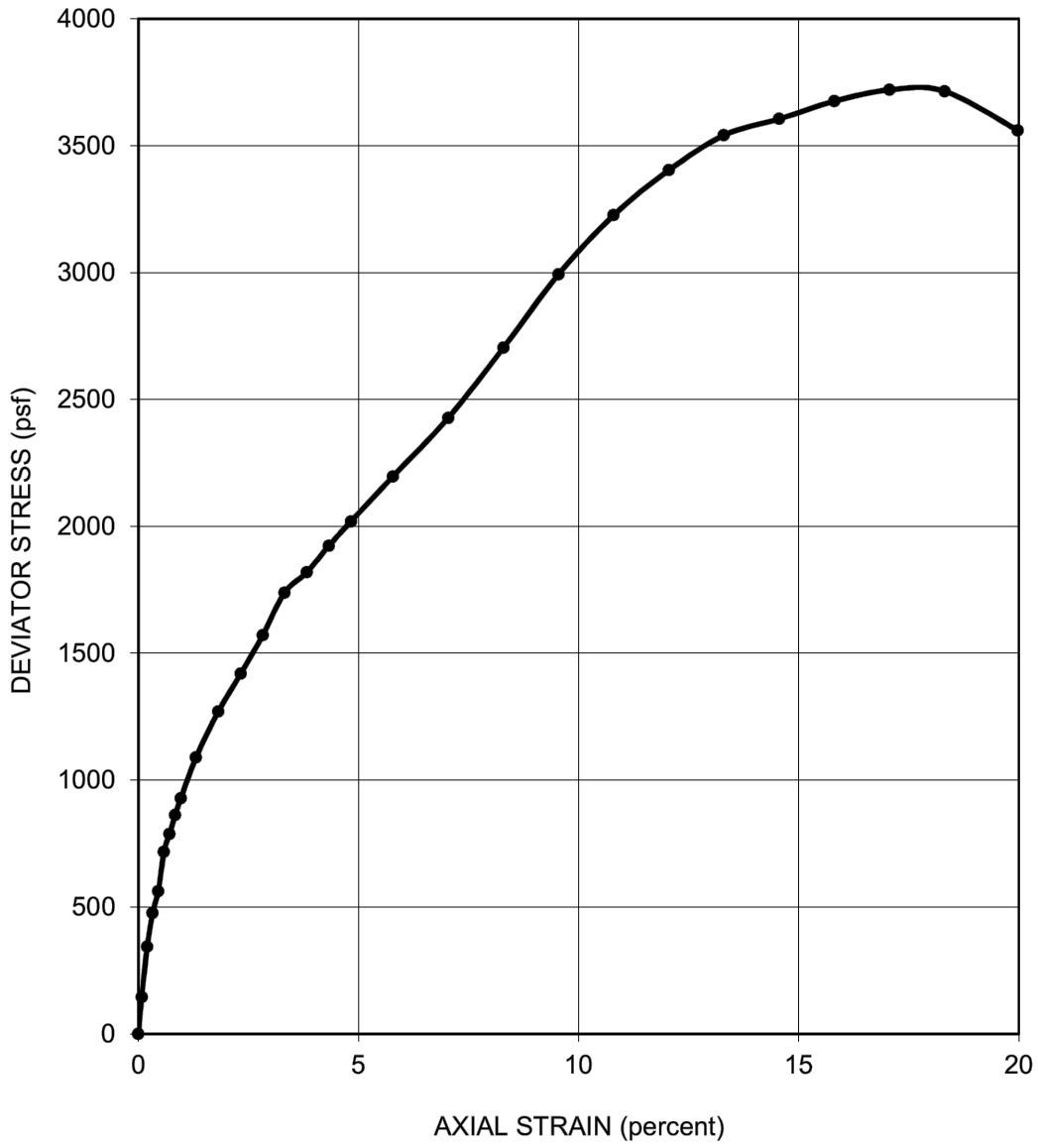
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SAMPLER TYPE	S&H			SHEAR STRENGTH	1,860	psf
DIAMETER (in.)	2.38	HEIGHT (in.)	5.62	STRAIN AT FAILURE	17.1	%
MOISTURE CONTENT		21.7	%	CONFINING PRESSURE	4,800	psf
DRY DENSITY		108	pcf	STRAIN RATE	0.75	% / min
DESCRIPTION	CLAY with SAND (CL), yellow-brown to gray-brown			SOURCE	B-7 @ 41 feet	

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SAN MATEO COUNTY CALIFORNIA

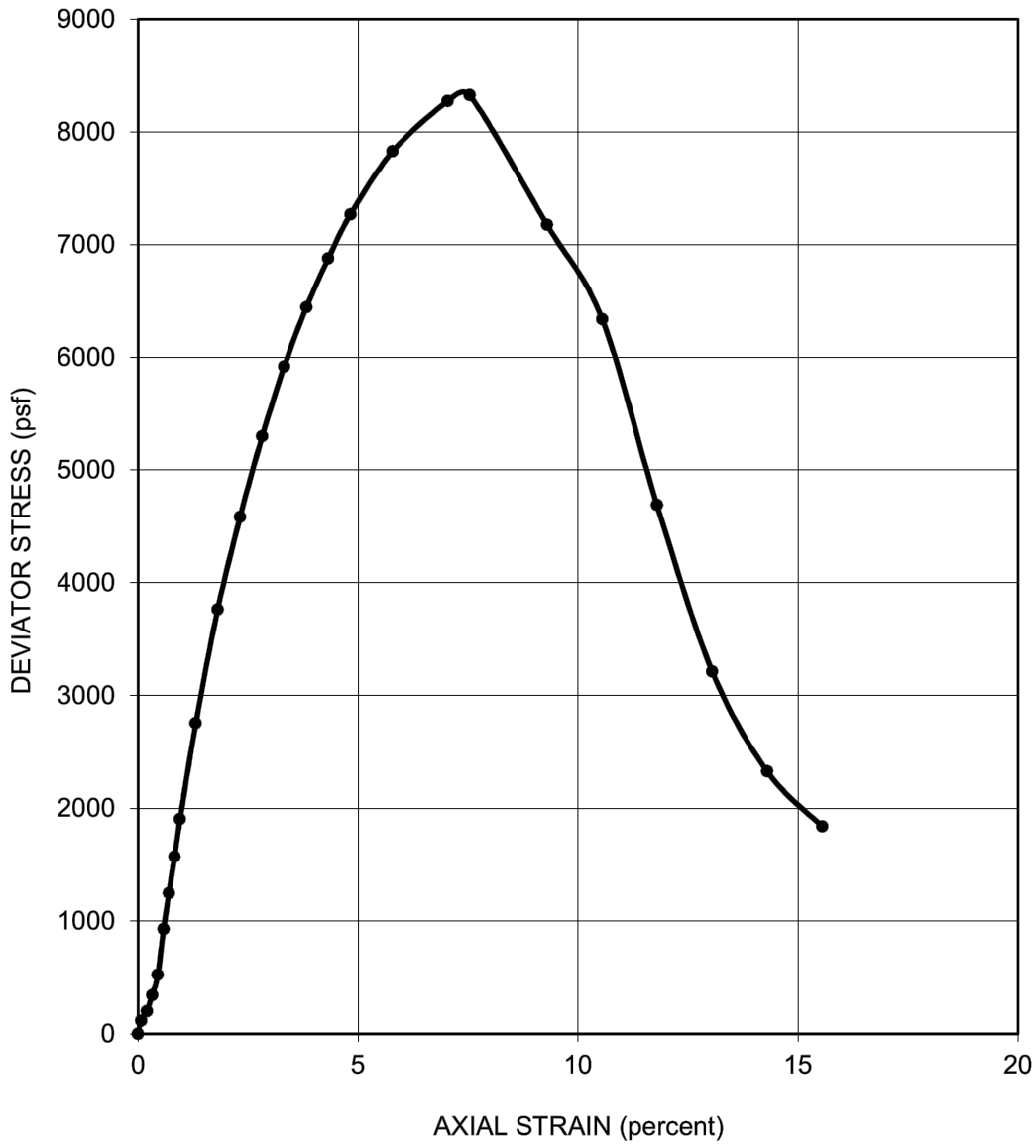
Figure Title
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

Project No. 750673801
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Checked By TG

Figure
C-16

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SAMPLER TYPE	S&H		SHEAR STRENGTH	4,160	psf
DIAMETER (in.)	2.38	HEIGHT (in.) 5.33	STRAIN AT FAILURE	7.5	%
MOISTURE CONTENT	14.5	%	CONFINING PRESSURE	1,140	psf
DRY DENSITY	121	pcf	STRAIN RATE	0.75	% / min
DESCRIPTION	CLAY with SAND (CL), dark gray to dark brown		SOURCE	B-8 @ 9.5 feet	

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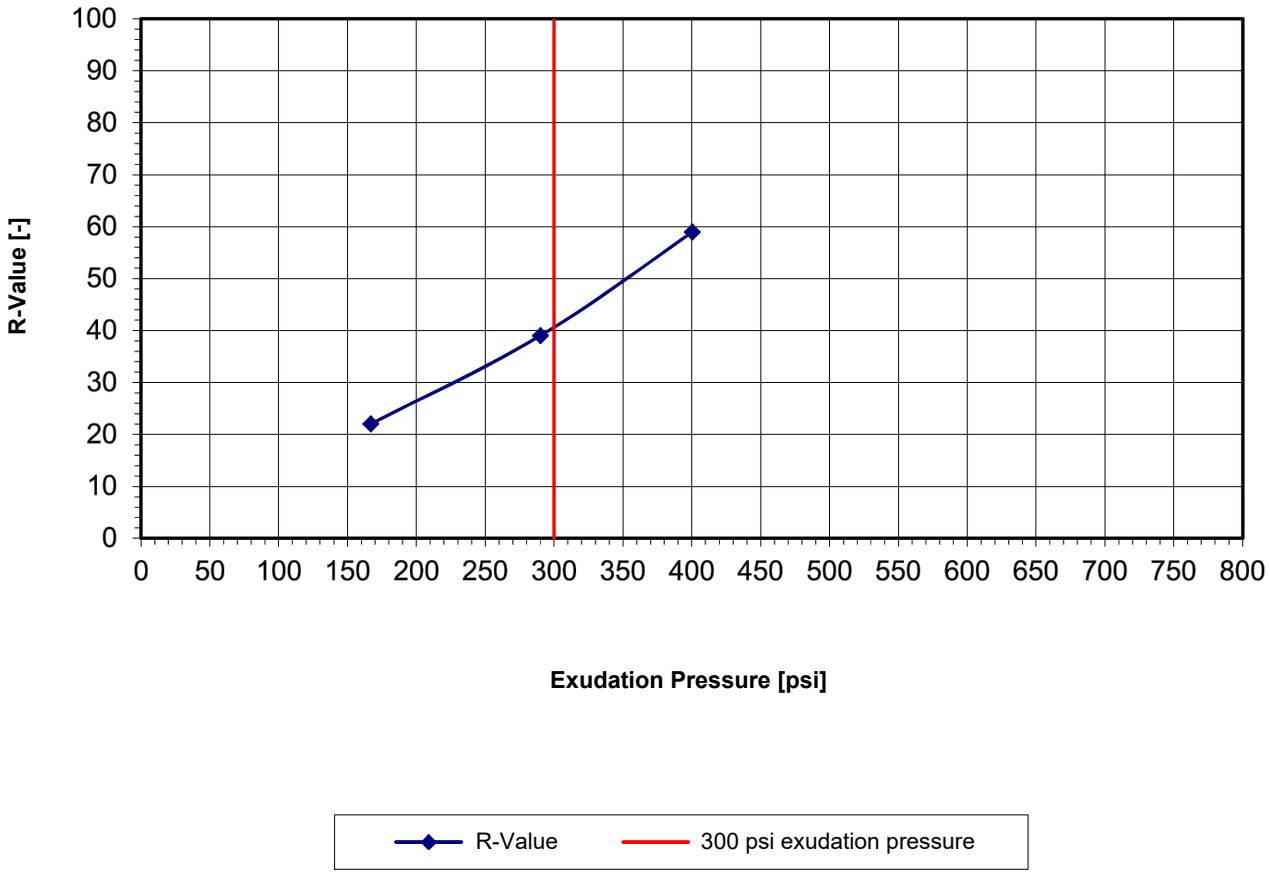
Figure Title
UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION TEST

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Figure
C-17

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Sample ID	A	B	C	D
Water Content (%)	11.9	10.6	9.6	--
Dry Density (pcf)	122.3	124.4	125.6	--
Exudation Pressuer (psi)	167	290	400	--
Expansion Pressure (psf)	0.0	0.0	0.0	--
Resistance Value (R)	21.5	41.1	60.4	--

Sample Source	Sample Description	Sand Equivalent	Expansion Pressure	R-Value
B-2 at 1 to 3 feet	SILTY SAND with GRAVEL (SM), dark brown	--	--	41

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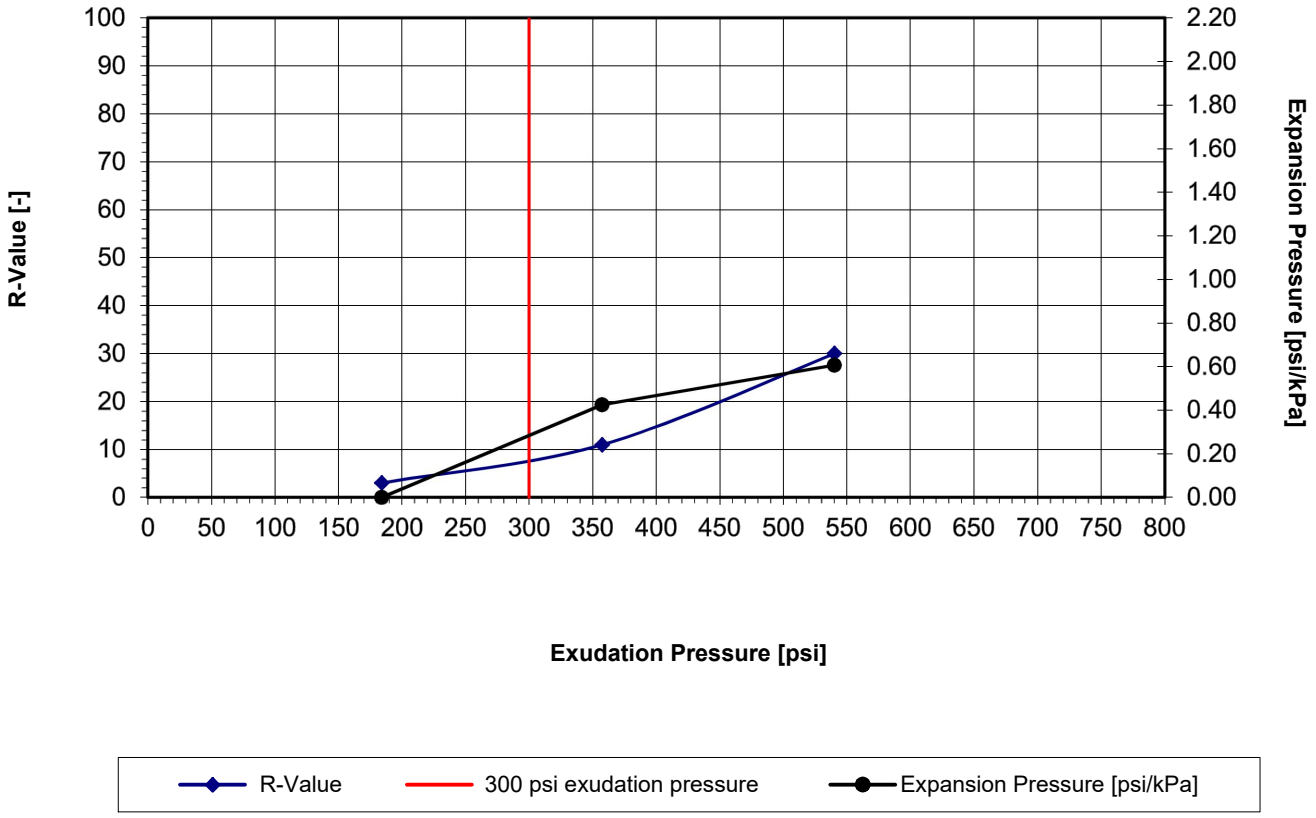
Figure Title
RESISTANCE VALUE TEST REPORT

Project No. 750673801
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Figure
C-18

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Sample ID	A	B	C	D
Water Content (%)	13.7	12.0	11.0	--
Dry Density (pcf)	119.4	121.1	122.2	--
Exudation Pressuer (psi)	184	358	540	--
Expansion Pressure (psf)	0.0	0.4	0.6	--
Resistance Value (R)	2.9	11.0	30.4	--

Sample Source	Sample Description	Sand Equivalent	Expansion Pressure	R-Value
B-3 at 1 to 3 feet	CLAY with SAND (CL), yellow-brown to brown	--	--	7

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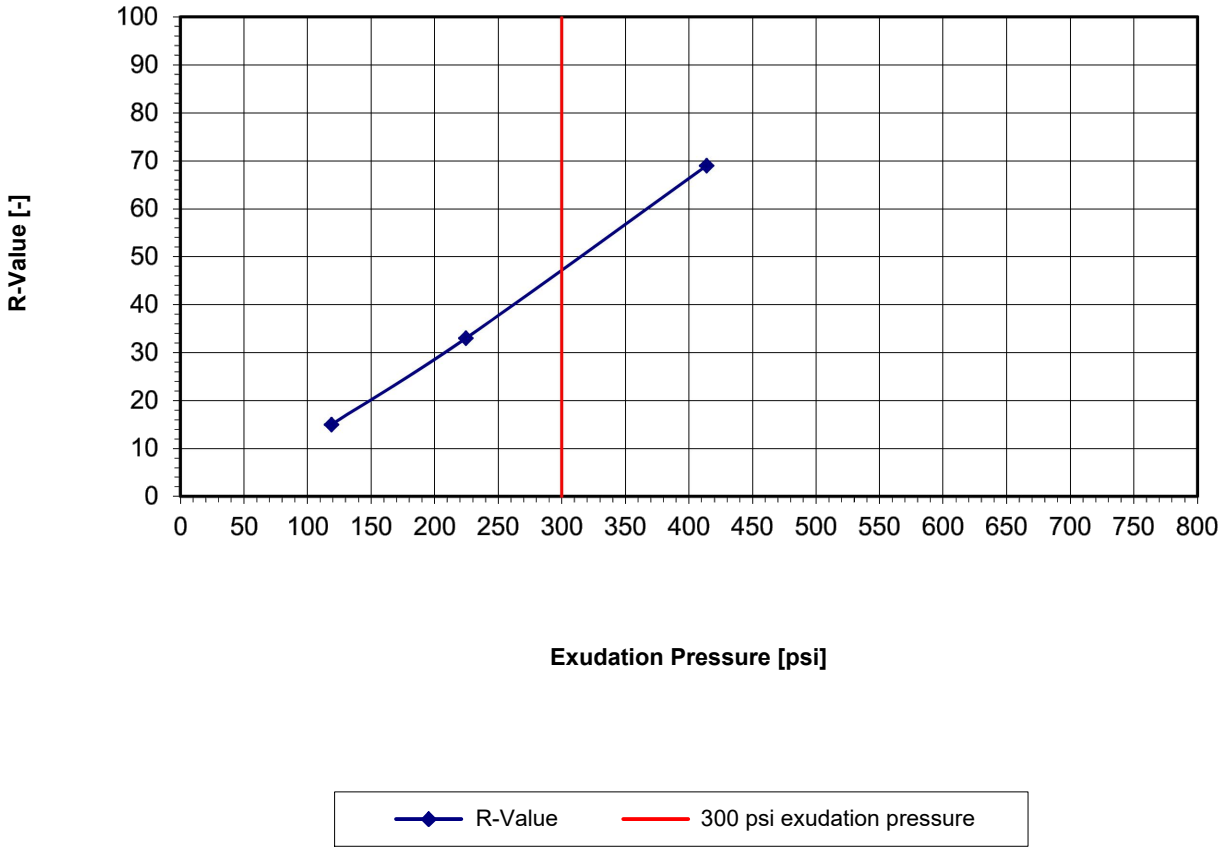
Figure Title
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Figure
C-19

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Sample ID	A	B	C	D
Water Content (%)	13.1	11.4	9.9	--
Dry Density (pcf)	120.2	121.7	123.7	--
Exudation Pressuer (psi)	119	225	414	--
Expansion Pressure (psf)	0.0	0.0	0.0	--
Resistance Value (R)	13.0	31.2	69.7	--

Sample Source	Sample Description	Sand Equivalent	Expansion Pressure	R-Value
B-6 at 1 to 3 feet	SILTY SAND (SM), yellow-brown	--	--	47

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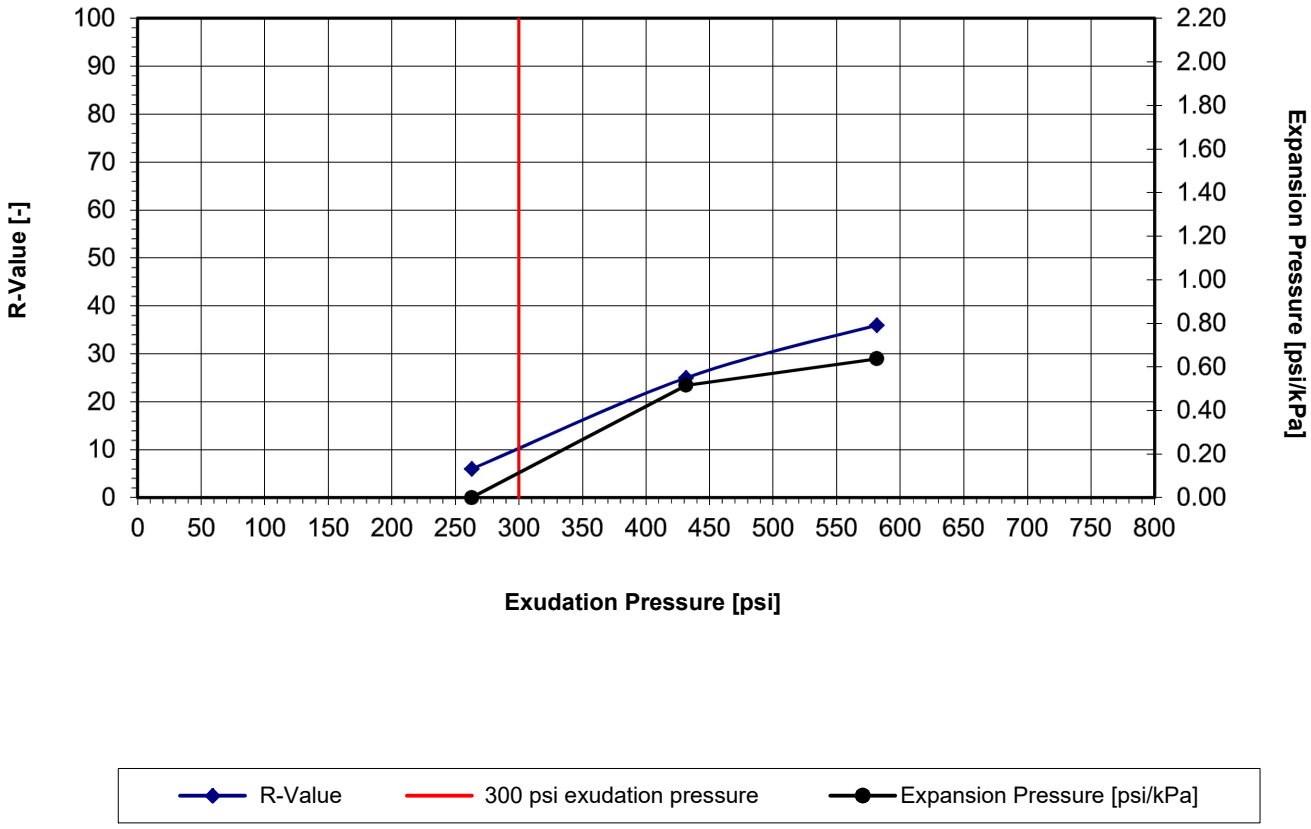
Figure Title
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Figure
C-20

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Sample ID	A	B	C	D
Water Content (%)	12.3	10.8	9.9	--
Dry Density (pcf)	120.7	122.8	123.8	--
Exudation Pressuer (psi)	263	432	582	--
Expansion Pressure (psf)	0.0	0.5	0.6	--
Resistance Value (R)	6.4	25.8	38.2	--

Sample Source	Sample Description	Sand Equivalent	Expansion Pressure	R-Value
B-8 at 1 to 3 feet	SILTY SAND (SM), yellow-brown	--	--	10

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APPENDIX D

CORROSIVITY RESULTS

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

27 July, 2022

Job No. 2207020
Cust. No. 11308

Mr. Taylor Gater
Langan
501 14th Street, 3rd Floor
Oakland, CA 94612

Subject: Project No.: 750673801.700.004.00
Project Name: Tanforan Mall Redevelopment
Corrosivity Analysis – ASTM Test Methods

Dear Mr. Gater:

Pursuant to your request, CERCO Analytical has analyzed the soil samples submitted on July 18, 2022. Based on the analytical results, a brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurements, Samples No.002 and No.003 are classified as "corrosive", Sample No.001 is classified as "moderately corrosive" and Sample No.004 is classified as "mildly corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentrations reflect none detected with a reporting limit of 15 mg/kg.

The sulfate ion concentrations ranged from none detected to 420 mg/kg and are determined to be sufficient to potentially be detrimental to reinforced concrete structures and cement mortar-coated steel at these locations. Therefore, concrete that comes into contact with this soil should use sulfate resistant cement such as Type II, with a maximum water-to-cement ratio of 0.55.

The pH of the soils ranged from 6.25 to 8.13, which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potentials ranged from 290-mV to 340-mV. All samples are indicative of potentially "slightly corrosive" soils resulting from anaerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call JDH Corrosion Consultants, Inc. at (925) 927-6630.

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: Langan
Client's Project No.: 750673801.700.004.00
Client's Project Name: Tanforan Mall Redevlopment
Date Sampled: Not Indicated
Date Received: 18-Jul-2022
Matrix: Soil
Authorization: Signed Chain of Custody

Date of Report: 27-Jul-2022

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Resistivity (As Received) (ohms-cm)	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
2207020-001	B-1, 1A	330	7.62	-	2,200	-	N.D.	28
2207020-002	B-4, 1A	340	6.25	-	910	-	N.D.	420
2207020-003	B-5, 1A	290	8.13	-	1,600	-	N.D.	160
2207020-004	B-7, 1A	300	7.40	-	8,200	-	N.D.	N.D.

Method:	ASTM D1498	ASTM D4972	ASTM G57	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	-	-	50	15	75
Date Analyzed:	26-Jul-2022	26-Jul-2022	-	25-Jul-2022	-	26-Jul-2022	26-Jul-2022

Sherri Moore
Chemist

* Results Reported on "As Received" Basis
N.D. - None Detected

Quality Control Summary - All laboratory quality control parameters were found to be within established limits