Appendix C

Geotechnical Report

PREPARED FOR:

THE PRESERVE AT PACIFICA, LLC
231 W. FULTON STREET
GRAND RAPIDS, MICHIGAN 49503

PREPARED BY:

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GEOCON

GEOCON PROJECT NO. E8867-04-03 **DECEMBER 2018**

GEOCON
CONSULTANTS, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. E8867-04-03
December 10, 2018

The Preserve at Pacifica, LLC
231 W. Fulton Street
Grand Rapids, Michigan 49503

Attention: Mr. Paul C. Heule

Subject: ROCKAWAY QUARRY
PACIFICA, CALIFORNIA
GEOTECHNICAL INVESTIGATION FOR QUARRY RECLAMATION

Dear Mr. Heule:

In accordance with your authorization, we have performed a geotechnical investigation for the subject project in Pacifica, California. Our investigation was performed to observe the soil and geologic conditions that may impact the reclamation of Rockaway Quarry as presently planned. The accompanying report presents the results of our investigation and conclusions and recommendations pertaining to the geotechnical aspects of the reclamation. The findings of this study indicate the site is suitable for reclamation as planned provided the recommendations of this report are implemented during design and construction. Additional geotechnical studies will be required as plans emerge for the various areas of redevelopment at the site.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Sincerely,

GEOCON CONSULTANTS, INC.

DRAFT

DRAFT

Shane Rodacker, PE, GE
Senior Engineer

John Pfeiffer, PG, CEG
Senior Geologist

(1/e-mail) Addressee
(1/e-mail) Walsh Engineering
Attention: Mr. Matt Walsh

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GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for the proposed reclamation of Rockaway Quarry in Pacifica, California (see Vicinity Map, Figure 1). The purpose of this investigation was to evaluate the subsurface soil and geologic conditions in the areas of planned reclamation grading and provide conclusions and recommendations pertaining to the geotechnical and geologic aspects of the reclamation, based on the conditions encountered during our study.

This report is specific to the current December 2018 reclamation plan by Walsh Engineering (2018 Reclamation Plan) and supersedes our 2015 report that was prepared for a different plan. The current grading plans have been prepared at 200-scale. We understand the plans and accompanying reports will be submitted to the City of Pacifica for a "completeness review" and more-detailed, 40-scale grading plans will ultimately be prepared in advance of proposed grading associated with the 2018 Reclamation Plan. The recommendations in this report are based on the 200-scale grading plans and, therefore, should be considered conceptual but suitable for project planning purposes. The recommendations provided herein should be revisited once 40-scale grading plans are available. Additional or supplemental recommendations may be provided at that time. In particular, we should collaborate with the civil engineer to develop updated keyway, benching and subdrain details for the planned grading.

The scope of this investigation included field exploration, laboratory testing, engineering analysis and the preparation of this report. Our initial field exploration was performed from August 24 through 26, 2015 and included the excavation of 21 exploratory test pits to maximum depths of approximately 21 feet at the site. We subsequently performed six cone penetrometer tests (CPTs) to depths of approximately 51 feet or less on October 13, 2018 to evaluate liquefaction potential in the southeastern portion of the site. The locations of our test pits and CPTs are depicted on the Geologic Map, Figure 2. A detailed discussion of our field investigation, test pit logs and CPT profiles are presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to evaluate pertinent physical properties. Appendix B presents the laboratory test results in tabular and graphic format. Recommended grading specifications for the planned reclamation grading are presented in Appendix C. Figures 3 and 4 present the grading and drainage plans proposed for the quarry reclamation, respectively. Geologic cross-sections that are based on civil cross-sections from the Walsh Engineering reclamation plan are presented as Figures 5 through 8.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

The project site is comprised of approximately 87 acres generally located west of the Pacific Coast Highway (California SR 1) in Rockaway Beach. The site is divided into two parcels that are separated by Calera Creek. The eastern parcel is approximately 39 acres of relatively level terrain that slopes gradually to the southwest and is bordered by the City of Pacifica Wastewater Treatment Plant to the north and the Rockaway Beach district of Pacifica to the south. West of Calera Creek is an approximately 48-acre parcel that includes the formerly-mined

hillside that was the source of aggregate (limestone) for Rockaway Quarry. Historic mining operations at the quarry have resulted in various areas of undocumented fill and over-steepened cut slopes in the western parcel. It should be noted that, subsequent to the cessation of mining activity in the late 1980s, the City of Pacifica relocated Calera Creek approximately 300+ feet westward to its current location.

Various areas of the site have historically carried common names in prior reclamation plans and associated geotechnical studies. These areas are distinguishable on Figures 3 and 4 and include the following:

Quarry Pit

This area is the southeast-facing bowl to the west of Calera Creek and is essentially the remnant bottom of the former quarry. The Quarry Pit has two tiers – a western tier with surface elevations on the order of 40 to 50 feet MSL and a lower eastern tier with surface elevations on the order of 32 to 38 feet MSL.

Quarry Face

This south-facing cut slope was created by limestone mining operations in the quarry and extends from the Quarry Pit approximately 200 feet upslope to the Hilltop area.

East Flank

This east- to southeast-facing slope area is located between Calera Creek and the Hilltop area.

Hilltop

The Hilltop is a relatively flat area atop the Quarry Face and East Flank areas. The Hilltop is characterized by three notable promontories that remain from past quarry operations. Ground surface elevations in this area range from approximately 240 feet to 280 feet MSL.

Southern Bluff

The Southern Bluff is a prominent northwest-southeast trending ridgeline that separates the Quarry Pit from the Pacific Ocean. The Southern Bluff ridgeline is up to approximately 70 feet above the adjacent Quarry Pit. The Southern Bluff transitions (slopes downward) to the Quarry Pit and Calera Creek at its southeastern end and meets the Quarry Face at its northwestern end.

Eastern Parcel

The 39-acre Eastern Parcel is generally located east and south of Calera Creek, and bound by SR 1 and the Rockaway Beach district of Pacifica on its southeastern and southwestern sides, respectively. The Eastern Parcel is relatively flat with ground surface elevations of approximately 65 feet MSL at the northeastern margin to approximately 20 feet MSL at the extreme southwestern corner.

Earthwork for the current quarry reclamation grading plan will require approximately 1.2 million cubic yards of imported fill materials. Grading will generally consist of deep fills to in-fill the Quarry Pit, comparatively minor fills throughout a portion of the Eastern Parcel, and cuts to layback existing slopes below the Hilltop. Grading will also be required for a new multi-use trail that will access the Hilltop via the East Flank. The proposed reclamation plan grading is presented on Figure 3. Grading details are discussed below and depicted on the civil cross-sections used as the basis for our Geologic Cross-Sections A through I presented on Figures 5 through 8.

Maximum fill thickness on the order of 90 to 100 feet will be required to bring the Quarry Pit up to proposed grades. Grading of the Quarry Pit will result in a tall fill slope facing Calera Creek. The fill slope will be up to 130

feet high with inclinations of 2:1 (horizontal:vertical) or flatter. The slope configuration will be steepest at the northern end (above the existing Calera Creek crossing) and transition to a 4:1 fill slope over an approximately 50-foot-high 2:1 fill slope at the southwestern end where the fills meet the Southern Bluff. Finished ground surface elevations of 150 feet MSL are planned where the Quarry Pit fill meets the Quarry Face. The top of the Quarry Pit fill will slope gradually from north to south and transition to the fill slope that descends to Calera Creek, or meet the Southern Bluff along the southwestern margin of the pit.

Reclamation grading will include the placement of approximately 10 to 12 feet of fill or less across the southern portion of the Eastern Parcel. The fills will raise grade in this area in preparation for anticipated sea level rise. The area will be generally sheet graded to finished surface elevations ranging from approximately 28 feet MSL at the southwestern corner to a high of 57 feet MSL near the Calera Creek crossing.

Cuts below the Hilltop will form new east- and south-facing cut slopes with inclinations of 2:1 or flatter. Terrace benches for maintenance and drainage are proposed in the cut slopes. Two of the Hilltop promontories described above will be removed.

Several multi-use trails are proposed. One trail will begin at the existing approach at SR 1 (approximately 500 feet northeast of San Marlo Way) and extend to the existing Calera Creek crossing that connects the eastern and western parcels that comprise the site. This trail segment will be constructed at the northeastern margin of the fills planned for the Eastern Parcel, as described above. We understand the portion of the Eastern Parcel north of this trail will be used for wetlands mitigation.

Two new multi-use trails are proposed on benches in the slope face that will result from filling the Quarry Pit. The trails will be generally parallel to Calera Creek and extend from above the existing creek crossing southwest to the Southern Bluff. The upper of the two trails will continue on the inside of the Southern Bluff to the western limit of the Quarry Pit.

A new multi-use trail will be constructed to access the Hilltop. The trail will originate near the existing creek crossing and traverse the lower portion of the East Flank. The trail will turn westward at the northern end of the East Flank and wind upslope to the Hilltop. Minor cuts and fill slopes up to approximately 15 to 20 feet in maximum height will be required to establish proposed grades along the trail.

Drainage improvements associated with the reclamation plan grading include new concrete v-ditches along the multi-use trails and slope benches discussed above. New underground storm drain is proposed along the multi-use trail that accesses the Hilltop, and at the southern margin of the Quarry Pit fill. The proposed reclamation drainage improvements are shown on Figure 4.

3. GEOLOGIC SETTING AND FAULTING

3.1 Regional Geology

Pacifica is located within the Coast Ranges Geomorphic Province of California, on the west side of the San Francisco Peninsula. The Coast Ranges are a series of northwest trending mountains and valleys that extend along much of California's coast and inland to the Central Valley and Klamath Mountains. Topography within the Coast Ranges is controlled by the predominant geological structural trends that generally consist of northwest trending synclines, anticlines and faulted blocks. The dominant structure is a result of both active northwest trending strike-slip faulting, associated with the San Andreas Fault system, and east-west compression within the province.

The San Andreas Fault (SAF) is a major right-lateral strike-slip fault that extends from the Gulf of California in Mexico to Cape Mendocino in northern California. The SAF forms a portion of the boundary between two tectonic plates on the surface of the earth. To the west of the SAF is the Pacific Plate, which moves north relative to the North American Plate, located east of the fault. In the San Francisco Bay Area, movement across this plate boundary is concentrated on the SAF and also distributed, to a lesser extent, across a number of other faults including the Hayward, Calaveras and Rodgers Creek faults, among others. Together, these faults are referred to as the SAF system.

Basement rock west of the SAF is generally granitic, while to the east it consists of a chaotic mixture of highly deformed marine sedimentary, submarine volcanic and metamorphic rocks of the Franciscan Complex. Both are typically Jurassic to Cretaceous in age (205 to 65 million years old). Overlying the basement rocks are Cretaceous (about 140 to 65 million years old) marine, as well as Tertiary (about 65 to 1.6 million years old) marine and non-marine sedimentary rocks with some continental volcanic rock. These Cretaceous and Tertiary rocks have typically been extensively folded and faulted largely as a result of movement along the SAF system, which has been ongoing for about the last 25 million years, and regional compression during the last about 4 million years. The inland valleys, as well as the structural depression within which San Francisco Bay is located, are filled with unconsolidated to semi-consolidated deposits of Quaternary age (about the last 1.6 million years). Continental deposits (alluvium) consist of unconsolidated to semi-consolidated sand, silt, clay and gravel, while the bay deposits typically consist of soft organic-rich silt and clay (bay mud) or sand.

Based on geologic mapping by the United States Geological Survey (USGS), the site is generally mapped as limestone and greenstone of the Franciscan Complex to the west of Calera Creek with Quaternary age alluvium and terrace deposits to the east of the creek. The mapping (published in 1994) depicts areas of fill in the East Flank area and along the present alignment of Calera Creek, which was realigned subsequent to the USGS mapping.

3.2 Faulting and Seismicity

Geologists and seismologists recognize the San Francisco Bay Area as one of the most active seismic regions in the United States. The significant earthquakes that occur in the Bay Area are associated with crustal movements along well-defined active fault zones that generally trend in a northwesterly direction.

The site and the entire San Francisco Bay Area are seismically dominated by the presence of the active San Andreas Fault System. In the theory of plate tectonics, the San Andreas Fault System is a transform fault that forms the boundary between the northward moving Pacific Plate (west of the fault) and the southward moving North American Plate (east of the fault). In the Bay Area, the movement is distributed across a complex system of strike-slip, right lateral parallel and subparallel faults, which include the San Andreas, Hayward and Calaveras faults, among others.

The table below presents approximate distances to active faults in the site vicinity based on mapping by the California Geological Survey (CGS), as presented in an online fault database maintained by Caltrans. Site coordinates are 37.6137° N; 122.4932° W. Known active faults with 30 miles of the site are summarized in Table 3.2.

TABLE 3.2
REGIONAL FAULT SUMMARY

Fault Name	Distance to Site (miles)	Maximum Earthquake Magnitude, M_w
San Andreas (Peninsula)	2 ½	8.0
San Gregorio	3	7.4
San Andreas (North Coast)	15 ¼	8.0
Hayward (North)	21 ¼	7.3
Hayward (South)	22	7.3
Monte Vista – Shannon	22 ¼	6.4
Silver Creek	26 ¾	6.9
Contra Costa Shear Zone	29 ½	6.5
Calaveras (North of Calaveras Reservoir)	29 ½	6.9

The San Andreas Fault and numerous other faults in the Bay Area (San Gregorio, Hayward, etc.) are sources of potential ground motion. However, earthquakes that might occur on other faults within northern California are also potential generators of significant ground motion at the site.

3.3 Surface Fault Rupture

The site is not within a currently established State of California Earthquake Fault Zone for surface fault rupture hazards. In addition, web-based mapping by the USGS indicates that no Quaternary age faults are present at the site. No active faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site is considered low.

3.4 Liquefaction

The site is not located within a State of California Seismic Hazard Zone for liquefaction. Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary loss of shear strength due to pore pressure buildup under the cyclic shear stresses associated with intense earthquakes. Primary factors that trigger liquefaction are: moderate to strong ground shaking (seismic source), relatively clean, loose granular soils (primarily poorly graded sands and silty sands), and saturated soil conditions (shallow groundwater). Due to the increasing overburden pressure with depth, liquefaction of granular soils is generally limited to the upper 50 feet of a soil profile.

Web-based mapping by the USGS indicates the majority of the Eastern Parcel possesses a “high” susceptibility to liquefaction. We recently performed an evaluation of liquefaction potential in the southern portion of the Eastern Parcel using in-situ measurements obtained from our CPT soundings. The results of that evaluation are presented under separate cover.

3.5 Landslides

Our field exploration identified landslides at the site. As shown on the Geologic Map (Figure 2), landslides are present to the north of the East Flank area, just outside the limits of the planned new roadway to access the

Hilltop area. In addition, landslide deposits were observed below dumped fill materials in our Test Pit TP15. The landslide deposits observed in TP15 are likely associated with the eroded scarp immediately west of the mapped limits of dumped fill materials. Where not removed by cuts to attain design grades, landslide deposits will require remedial grading in the form of removal and recompaction. Additional discussion on landslide deposits is provided below in Section 4. The estimated limits of remedial grading for the landslide deposits encountered in TP15 are depicted on Geologic Cross-Sections H (see Figure 8). Remedial grading may also be required for the landslides north of the East Flank area.

3.6 Seacliff Retreat

A prior reclamation plan (Malcolm Carpenter Associates, 1996) indicated the local bluffs that overlook the Pacific Ocean are highly stable cliffs with erosion rates less than ½ foot per year. We have reviewed selected aerial photographs and observed the cliffs during our field exploration. We generally concur with the previously reported erosion rates and further opine that erosion rates in slopes or bluffs comprised of limestone will very likely be less than ½ foot per year.

It should be noted that a relatively shallow mantle of dumped fills is present on the outside (oceanside) face of the Southern Bluff. These materials are significantly more susceptible to erosion and show evidence of sloughing. However, the sloughing and erosion of these dumped fills appears to be of little consequence due to their shallow thickness and the absence of improvements that would derive support in the dumped fill materials.

4. SITE GEOLOGY AND GROUNDWATER CONDITIONS

4.1 Fill (Qf)

Fill material is present in the Quarry Pit, Eastern Parcel, East Flank, and on the Southern Bluff. Fill materials in the Quarry Pit and Eastern Parcel appear to have been placed and graded, but documentation of fill placement, quality, or compaction was not available during this investigation. Dumped fill, unconsolidated material associated with the former quarry operations, has been dumped or pushed down existing slopes in the East Flank and Southern Bluff areas, and is discussed separately in Section 4.2.

Existing fills in the Quarry Pit are on the order of 20+ feet thick over limestone bedrock and consists variously of loose to medium dense silty sandy gravel, clayey gravel, and gravel with sand, cobbles, boulders up to approximately 2 feet maximum dimension, and asphalt fragments. In the eastern tier of the Quarry Pit, fill is on the order of 11 feet thick.

Based on our exploratory test pits in the area, fills in the Eastern Parcel are at least 6 feet thick and extend to depths of 15 feet or more in some locations. As encountered in our test pits, the fills consisted of silty sands and clays with variable amounts of gravel and clayey to gravelly sands. Various debris were observed in the fills and included wire, fabric, asphalt fragments, and concrete chunks up to approximately 2½ feet in maximum dimension.

Geotechnical documentation of prior grading activities was not provided. As such, fill materials at the site may contain constituents that differ from those described above and/or deleterious materials. Additional areas of fill may be present. Remedial grading of the fills will be required in areas to receive structural loads or settlement-sensitive improvements; specific recommendations will be provided in future geotechnical investigations specific to planned development(s).

4.2 Dumped Fill (Qdf)

Dumped fill is considered herein to be material that was pushed or dumped down slopes at the site as waste material during former mining operations. Dumped fill is present as relatively thin cover (approximately 5 feet or less) over limestone bedrock along the top of the Southern Bluff and down much of the Southern Bluff's southwest (ocean-facing) slope, where it actively sloughs into the ocean. At the east end of the Quarry Face, dumped fill forms a ramp consisting of loose limestone gravel, cobbles, and boulders. Dumped fill on the East Flank consists variously of loose to medium dense silty sandy gravel, silty gravel, gravelly sand, and silty clay, with trace cobbles, boulders, and chunks of asphalt. Fill thicknesses in our test pits on the East Flank ranged from approximately 5 to 17 ½ feet. Where supporting settlement-sensitive improvements in the East Flank, the dumped fill will require remedial grading in the form of removal and recompaction.

4.3 Alluvium (Qa)

Alluvium was encountered below the fills that mantle the Eastern Parcel. As observed in our test pits, the alluvium consisted of silty to sandy lean to fat clays. Prior studies by others included soil borings that extended to maximum depths of approximately 40 feet and reported predominantly fine-grained soils (silts and clays) with some occurrences of dense to very dense sands and gravel. USGS mapping indicates the alluvial deposits are susceptible to liquefaction.

4.4 Landslide Deposits (Qls)

Landslide deposits are present on the north-central boundary of the site and below some of the dumped fills in the East Flank. We observed two coalesced debris flow-type landslides along the north site boundary (Test Pits TP17 and TP18). These landslide deposits are on the order of 6 to 8 feet thick and consist of silty clay overlying residual soil of generally similar composition.

We observed landslide deposits in the upper portion of the East Flank (Test Pit TP15) at a depth of approximately 5 to 9½ feet, underlying the dumped fill material and overlying residual soil. This landslide deposit consisted of brown sandy clay with gravel-sized clasts of brown siltstone. Test Pit TP15 was located approximately 50 feet downslope from an eroded and vegetated landslide scarp (see Geologic Map, Figure 2).

4.5 Franciscan Complex – Calera Limestone (fl)

Limestone at the site is identified in geologic references as the mid-Cretaceous age Calera Limestone. It is prominent south of the shear zone at the site, in the Quarry Face, the west end of the Quarry Pit, and the Southern Bluff, as a strong, light gray to dark gray layered rock with bedding on the order of 4 to 12 inches thick. The bedding orientation varies but generally dips to the north-northwest at inclinations of approximately 24 to 83 degrees below horizontal. It is intensely to moderately fractured but maintains relatively steep (even overhanging) slopes, owing to rough and calcite-cemented discontinuities. The existing approximately 1:1 (horizontal to vertical) limestone slopes in the Quarry Face and Southern Bluff appear to be performing well, exhibiting surficial raveling as would be anticipated, but not showing evidence of deep-seated instability.

In the central portion of the Quarry Pit (Test Pit TP11), limestone bedrock at the former quarry floor is present beneath approximately 20 feet of fill material, at an elevation of approximately 28 feet MSL. In the eastern tier of the Quarry Pit, we encountered limestone bedrock in Test Pit TP8 beneath approximately 11 feet of fill, at an approximate elevation of 22 feet MSL. Limestone blocks and fragments are also present within the shear zone along with other materials.

4.6 Franciscan Complex – Greenstone (fg)

Franciscan Complex greenstone in the region is described in published geologic references as altered mafic (dark) volcanic rock composed mostly of coarse pyroclastic deposits, but also some small intrusions (dikes) and flows. Geologic mapping by Kaldeveer and Associates (1983, included within the 1996 reclamation plan) depicts greenstone at the site within the limestone on the northeast side of the Southern Bluff, above the limestone in the western and upper portions of the Quarry Face, and extending northward from the shear zone. Our field observations of greenstone were generally consistent with Kaldeveer's 1983 map for the Southern Bluff and Quarry Face. We observed, however, that the slope and Hilltop area above the shear zone consist of brown, thinly to moderately-bedded siltstone with some interbedded chert. The siltstone in the Hilltop area is highly to moderately weathered and pervasively fractured, with varied bedding orientations. We interpret, based on observations elsewhere in the area (e.g. coastal bluffs near the northwest corner of the site) that greenstone in the region also includes some interbedded/associated sedimentary materials such as siltstone and sandstone. Therefore, the greenstone designation is retained for underlying geology of the northern portion of the site.

4.7 Shear Zone

A shear zone extends in an east-west trend across the site midway up the Quarry Face between approximate elevations of 170 and 200 feet MSL. The shear zone generally separates the Calera Limestone to the south and Franciscan greenstone and associated deposits to the north. The shear zone ranges from approximately 30 to 150 feet wide across the mid-slope bench and is approximately 400 feet wide at the west end where it meets the Pacific Ocean. The eastern visible extent of the shear zone is between the Quarry Face and East Flank, where bedrock disappears beneath dumped fill material. Materials within the shear zone include a disrupted mixture of limestone blocks and highly sheared shale and greenstone (mélange). Inactive faults bound the southern and northern edges of the shear zone at the interfaces with adjacent formational materials.

4.8 Groundwater

Groundwater was not encountered in any of our test pits to the maximum depth explored. Groundwater depths were estimated to be 9 to 12 feet below existing grade in our recent CPTs in the Eastern Parcel. Actual groundwater levels will fluctuate seasonally and with variations in rainfall, temperature and other factors and may be higher than observed during our study.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 General

5.1.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude the reclamation of Rockaway Quarry as presently planned provided the recommendations presented herein are followed and implemented during design and construction.

5.1.2 Key geotechnical constraints to the reclamation are the presence of undocumented fill materials and landslide deposits. Remedial grading will be performed to mitigate these constraints where necessary.

5.1.3 All references to relative compaction and optimum moisture content in this report are based on the latest edition of ASTM D 1557. Engineered fill materials should be moisture conditioned to above optimum moisture content where predominantly fine-grained (silts and clays) and near optimum where sands and gravels.

5.1.4 Earthwork contractors should be aware that excavations in formational materials, especially limestone, will encounter difficult digging conditions and special excavation techniques may be required. An evaluation of rippability was beyond the scope of this study.

5.1.5 Rockaway Quarry is one of the oldest quarries in California and aggregate mining occurred over many decades with little or no available records. As such, unknown underground improvements and areas of undocumented fill (not discussed herein) may be present. If encountered, supplemental recommendations will be provided during reclamation grading operations.

5.1.6 More than 20 feet of fill exists at the floor of the Quarry Pit. Given the presence of these fills and the planned thickness of new fills for the 2018 Reclamation Plan (up to approximately 100 feet), settlement should be anticipated in the Quarry Pit due to compression within the existing and new fill materials. The design of any improvements in the Quarry Pit area should consider the potential for future settlements.

5.1.7 Any changes in the reclamation plan grading, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

5.2 Soil and Excavation Characteristics

5.2.1 Based on the soils conditions encountered in our test pits, the onsite fill materials can be excavated with moderate effort using conventional excavation equipment. We do anticipate excavations in these materials will generate significant quantities of oversize material (greater than 12 inches in nominal dimension). In addition, the artificial fills that are present at the site are undocumented and may contain constituents not reported herein.

5.2.2 It is the responsibility of the contractor to ensure that all excavations are performed in accordance with applicable Occupational Safety and Health Administration (OSHA) rules and regulations to maintain safety and maintain the stability of adjacent existing improvements.

5.3 Materials for Fill

5.3.1 Excavated soils generated from cut operations at the site are geotechnically-suitable for use as engineered fill in structural areas provided they do not contain deleterious matter, organic material, or cementations larger than 24 inches in maximum dimension.

5.3.2 Import material should be well-graded with a very low to moderate expansion potential (Expansion Index less than 90), a Plasticity Index less than 20, be free of organic material and construction debris, and not contain rock larger than 6 inches in greatest dimension.

5.3.3 Materials used as engineered fill within 15 feet of slope faces (measured horizontally from the slope face) inclined at 3:1 or steeper should possess a minimum internal angle of friction (Ø) of 30° and cohesion of at least 200 pounds per square foot (psf) under drained conditions when tested in accordance with ASTM D 3080 or similar geotechnical laboratory test for shear strength.

5.3.4 Environmental characteristics and corrosion potential of import soil materials may also be considered. Proposed import materials should be sampled, tested, and approved by Geocon prior to its transportation to the site.

5.4 Grading

5.4.1 All earthwork should be observed and all fills tested for recommended compaction and moisture content by representatives of Geocon.

5.4.2 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, civil engineer and geotechnical engineer in attendance. Special soil handling requirements can be discussed at that time.

5.4.3 All dumped fills and landslide deposits should be removed to expose competent formational materials in areas to receive fills or settlement-sensitive improvements. After removals and where formational materials are exposed at grade, the exposed ground surface scarified to depth of approximately 1 foot and recompacted to at least 90% relative compaction at appropriate moisture content.

5.4.4 After removal of unsuitable materials is performed, the site should then be brought to final grades with structural fill compacted in layers. In general soils, soils derived from cuts in formational materials are suitable for re-use as fill if free of vegetation, debris or other deleterious materials. All structural fill should be placed in layers no thicker than will allow for adequate bonding and compaction (typically 8 to 12 inches with heavy duty grading equipment). Fill soils should be compacted to at least 90% relative compaction at appropriate moisture content. Where fills will be more than 10 feet below proposed grade, the materials should be compacted to at least 95% relative compaction.

5.4.5 Oversize material (defined has material greater than 12 inches in nominal dimension) may be generated during excavations in formational materials or encountered in dumped fills at the site. Placement of oversize material within fills should be conducted in accordance with the recommendations in Appendix C. Grading operations on the site should be scheduled and staged such that oversize materials are placed in designated rock disposal areas and/or deeper fills.

5.4.6 If grading commences in winter or spring, or in periods of precipitation, excavated and in-place soils may be, or become, wet. Earthwork contractors should be aware of moisture sensitivity of fine-grained soils and potential compaction/workability difficulties. The most effective site preparation alternatives

will depend on site conditions prior to and during grading operations; we should evaluate site conditions at those times and provide supplemental recommendations, if necessary.

5.4.7 The remedial grading, keyway and benching recommendations herein are general in nature and may be used for planning purposes. The actual depth and extent of remedial grading will be determined in the field during earthwork operations. In addition, supplemental field exploration and testing may be performed to evaluate the competency and extent of existing fills, particularly those in the Eastern Parcel. Updated remedial grading recommendations may be provided as a result of additional exploration and testing.

5.5 Earthwork Grading Factors

5.5.1 Estimates of embankment shrink-swell factors are based on our experience with similar materials and information included in past studies by others at the site. It should be emphasized that variations in natural soil density, as well as in compacted fill, render estimated shrink-swell estimates to be very approximate. As an example, the contractor can compact fills to 90% relative compaction or higher. Thus, the contractor has at least a 10% range of control over the fill volume. Considering the above discussion, the following earthwork factors may be used as a basis for estimating how much the on-site soils may shrink or swell when removed from their existing state and placed as compacted fill.

TABLE 5.5
EARTHWORK GRADING FACTORS

Geologic Unit	Approximate Shrink-Swell Factors
Fill	0 to 5 percent Shrinkage
Dumped Fill	5 to 15 Percent Shrinkage
Franciscan Greenstone	5 to 15 Percent Bulk
Calera Limestone	15 to 25 Percent Bulk

5.6 Slopes

5.6.1 Reclamation grading will result in cut slopes with maximum inclinations of 2:1 (horizontal:vertical) or flatter. Cut slope heights will be on the order of 70 feet or less below the Hilltop (see Geologic Cross-Sections A, B and C, Figure 5 and 6). Maximum fill slope heights of approximately 130 feet are proposed at the southeastern margin of the Quarry Pit. It is our opinion that slopes constructed as recommended herein should possess adequate factor of safety against global (deep-seated) instability.

5.6.2 Cut slopes excavated in Franciscan greenstone may expose materials that are susceptible to surficial slope instabilities. The potential for surficial instability is typically a function of weathering, fracturing and bedding orientations – all of which can be variable. Surficial slope instabilities can manifest in raveling, shallow slumps and other features that require ongoing maintenance. In extreme cases, surficial slumps can progress and lead to more significant slope failures. Although not expected, cut slopes in Franciscan Formation should be observed by our representatives during grading to evaluate the potential for surficial instability and remedial measures may be recommended at that time.

5.6.3 Benches with paved drainage ditches should be provided in the 2:1 cut slopes below the Hilltop. The current Reclamation Grading Plan generally incorporates our recommendations for bench spacing.

5.6.4 The use of cohesionless soils in the outer portion of fill slopes should be avoided. Fill slopes should be overbuilt a horizontal distance of two feet and cut back to finished grade or compacted by backrolling with a loaded sheepsfoot roller at vertical intervals not to exceed 4 feet and should be track-walked at the completion of each slope such that the fill soils are uniformly compacted to at least 90 percent relative compaction at appropriate moisture content.

5.6.5 Keyways will generally be required at the toe of the fill slopes proposed at the southeastern margin of the Quarry Pit and near the toe of embankment fills for the new multi-use trail in the East Flank. The general remedial grading concepts for these areas are depicted on geologic cross-sections in Figures 5 through 8. A typical keyway detail is presented as Figure 9. Approximate anticipated keyway locations are shown on the Reclamation Grading Plan, Figure 3. Keyway details will be refined in during the preparation of 40-scale grading plans.

5.6.6 Slopes should be landscaped with drought-tolerant vegetation, having variable root depths and requiring minimal landscape irrigation. In addition, all slopes should be drained and properly maintained to reduce erosion.

5.6.7 The disturbance and/or loosening of the surficial soils, as might result from root growth, soil expansion, or excavation for irrigation lines and slope planting, may also be a significant contributing factor to surficial instability. We recommend that, to the maximum extent practical: (a) disturbed/loosened surficial soils be either removed or properly recompacted, (b) irrigation systems be periodically inspected and maintained to eliminate leaks and excessive irrigation, and (c) surface drains on and adjacent to slopes be periodically maintained to preclude ponding or erosion. It should be noted that although the incorporation of the above recommendations should reduce the potential for surficial slope instability, it will not eliminate the possibility.

5.7 Subdrains

5.7.1 The planned reclamation grading will require the installation of subdrains. Subdrains will generally be required at the heel of keyways and at the heel of major benches in fill slope areas. In addition, subdrains are recommended at the existing Quarry Pit bottom and should be placed prior to any fill operations.

5.7.2 Conceptual subdrain locations are shown on the geologic cross-sections in Figures 5 through 8. Subdrain locations and other details will be formalized with the preparation of 40-scale grading plans. Subdrains should outlet to facilities deemed suitable by the civil engineer.

5.8 Surface Drainage

5.8.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of slopes. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change to important engineering properties. Proper drainage should be maintained at all times. Drainage should not be allowed to flow uncontrolled over any descending slope.

6. FURTHER GEOTECHNICAL SERVICES

6.1 Testing and Observation Services

6.1.1 The recommendations provided in this report are based on the assumption that we will continue as Geotechnical Engineer of Record and provide geotechnical testing and observation services during earthwork operations at the site. It is important to maintain continuity of geotechnical interpretation and confirm that field conditions encountered are similar to those anticipated during design. If we are not retained for these services, we cannot assume any responsibility for others interpretation of our recommendations, and therefore the future performance of the project.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Consultants, Inc. should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the geotechnical scope of services provided by Geocon Consultants, Inc.

This report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices used in the site area at this time. No warranty is provided, express or implied.

0 1

Scale in Miles

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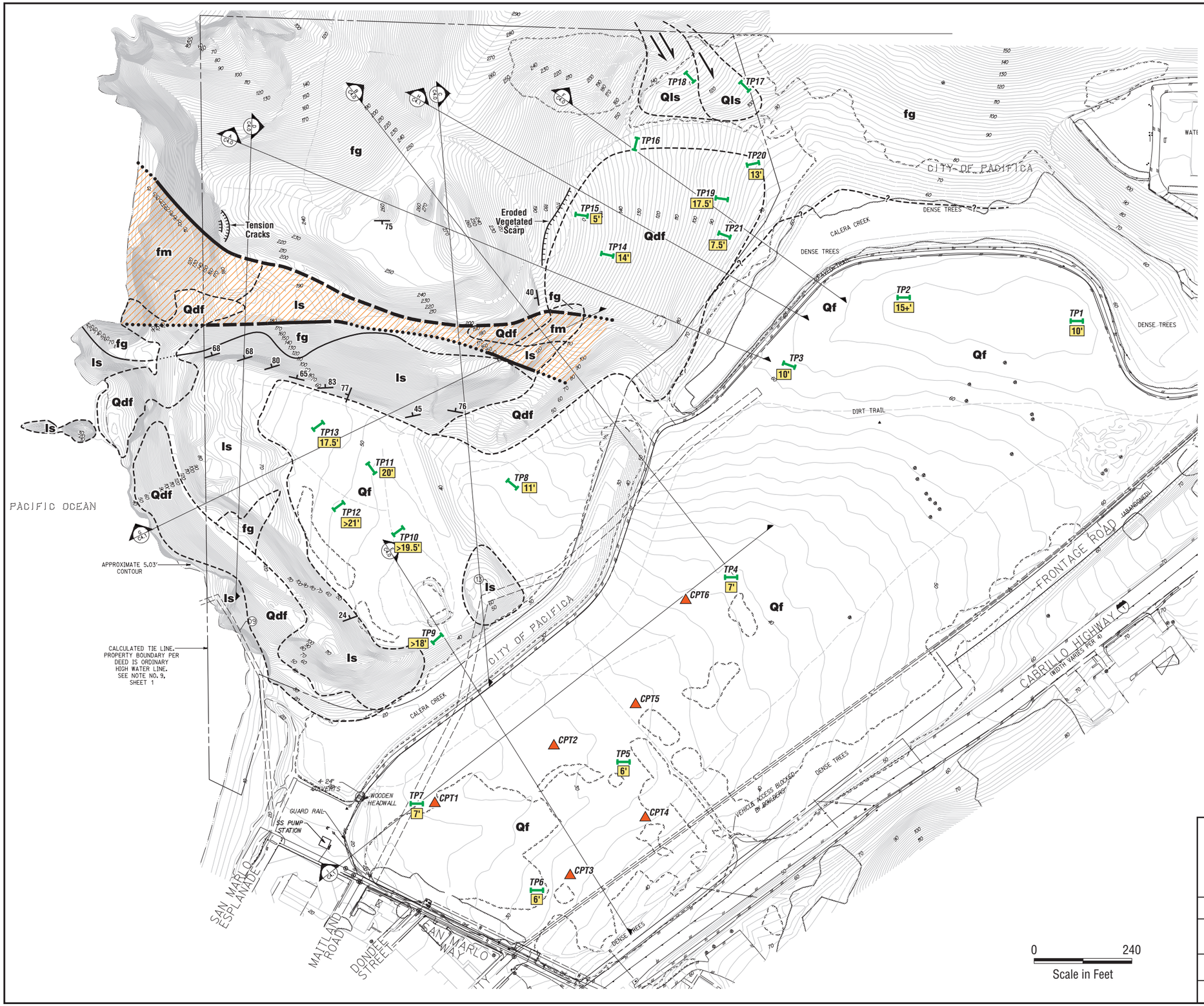
California

VICINITY MAP

E8867-04-03	December 2018	Figure 1



LEGEND:

- Approximate Location of Civil/Geologic Cross-Section
- CPT1 Approximate CPT Location
- TP1 Approximate Test Pit Location
- 10' Approximate Depth of Fill
- Geologic Contact (dashed where approximate; dotted where covered)
- Fault
- Shear Zone
- Landslide
- 75 Strike and Dip of Bedding
- **Qf** Fill
- **Qdf** Dumped Fill
- **Qls** Landslide Deposit

Franciscan Complex

- **fm** melange: highly sheared mixture of shale, greenstone and limestone
- **fg** greenstone: altered mafic volcanic with associated siltstone
- **ls** Calera Limestone: light to dark gray, moderately bedded

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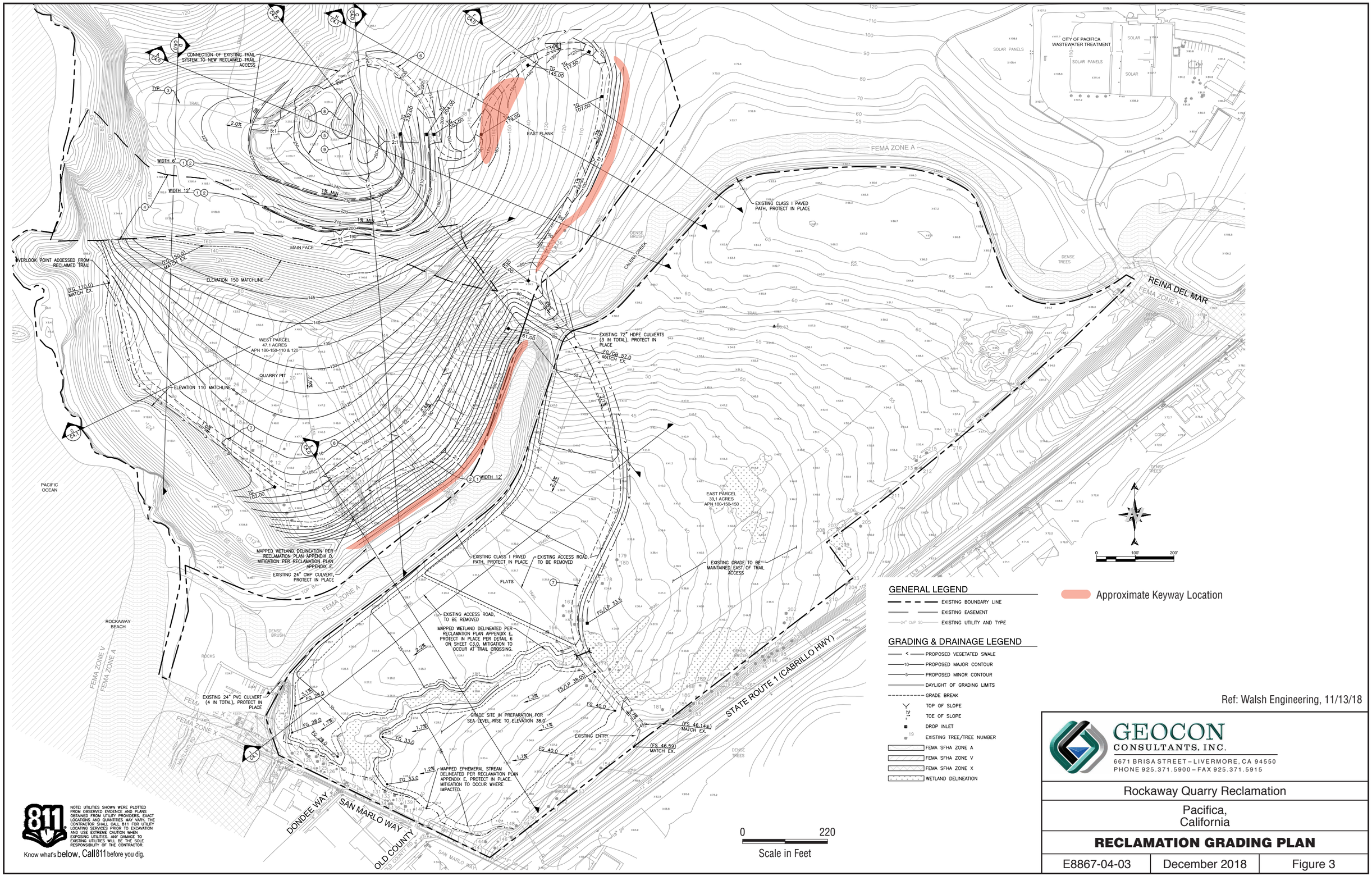
GEOLOGIC MAP

E8867-04-03	Decdember 2018	Figure 2



Ref: Walsh Engineering, 11/13/18

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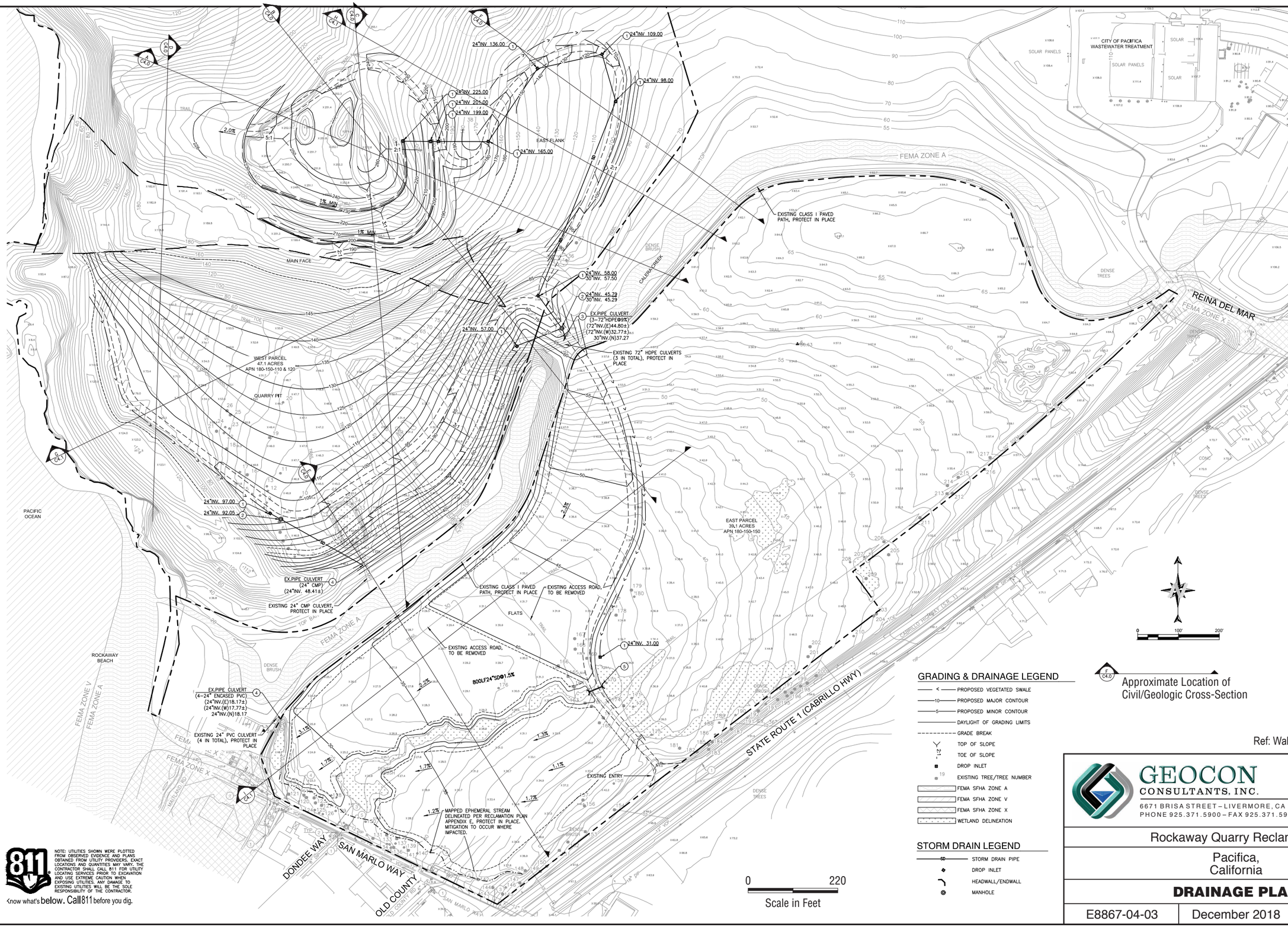
RECLAMATION GRADING PLAN

E8867-04-03	December 2018	Figure 3



Approximate Location of Civil/Geologic Cross-Section

GRADING & DRAINAGE LEGEND

- PROPOSED VEGETATED SWALE
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- DAYLIGHT OF GRADING LIMITS
- GRADE BREAK
- TOP OF SLOPE
- TOE OF SLOPE
- DROP INLET
- EXISTING TREE/TREE NUMBER
- FEMA SFHA ZONE A
- FEMA SFHA ZONE V
- FEMA SFHA ZONE X
- WETLAND DELINEATION

STORM DRAIN LEGEND

- STORM DRAIN PIPE
- DROP INLET
- HEADWALL/ENDWALL
- MANHOLE

Ref: Walsh Engineering, 11/13/18

NOTE: UTILITIES SHOWN WERE PLOTTED FROM OBSERVED EVIDENCE AND PLANS OBTAINED FROM UTILITY PROVIDERS. EXACT LOCATIONS AND QUANTITIES MAY VARY. THE CONTRACTOR SHALL CALL 811 FOR UTILITY LOCATING SERVICES PRIOR TO EXCAVATION AND USE EXTREME CAUTION WHEN EXPOSING UTILITIES. ANY DAMAGE TO EXISTING UTILITIES WILL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR.

811 Know what's below. Call 811 before you dig.

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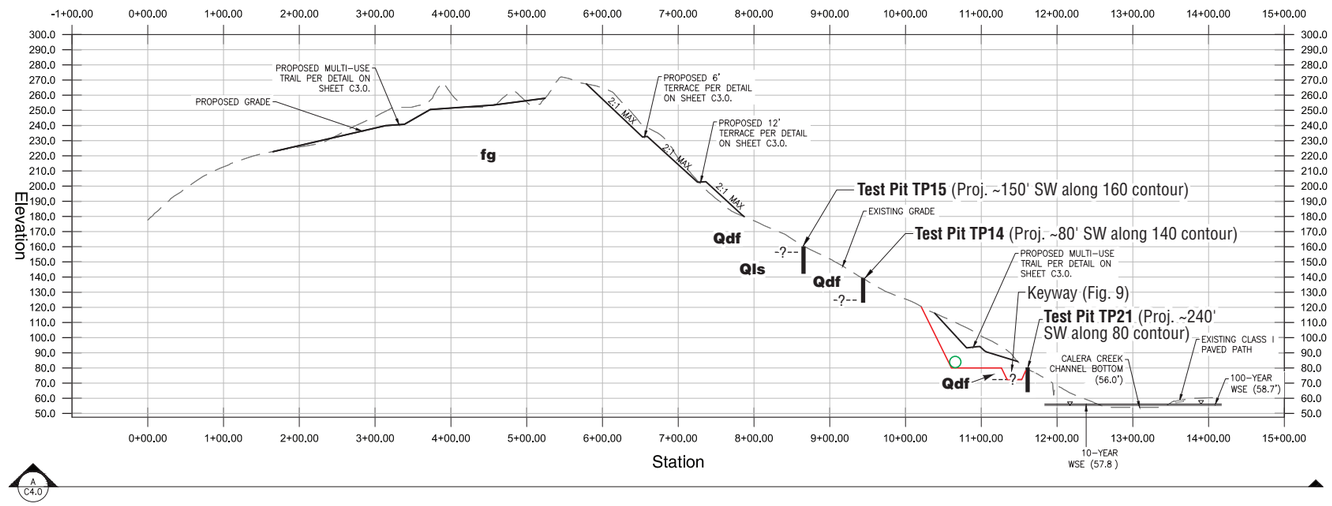
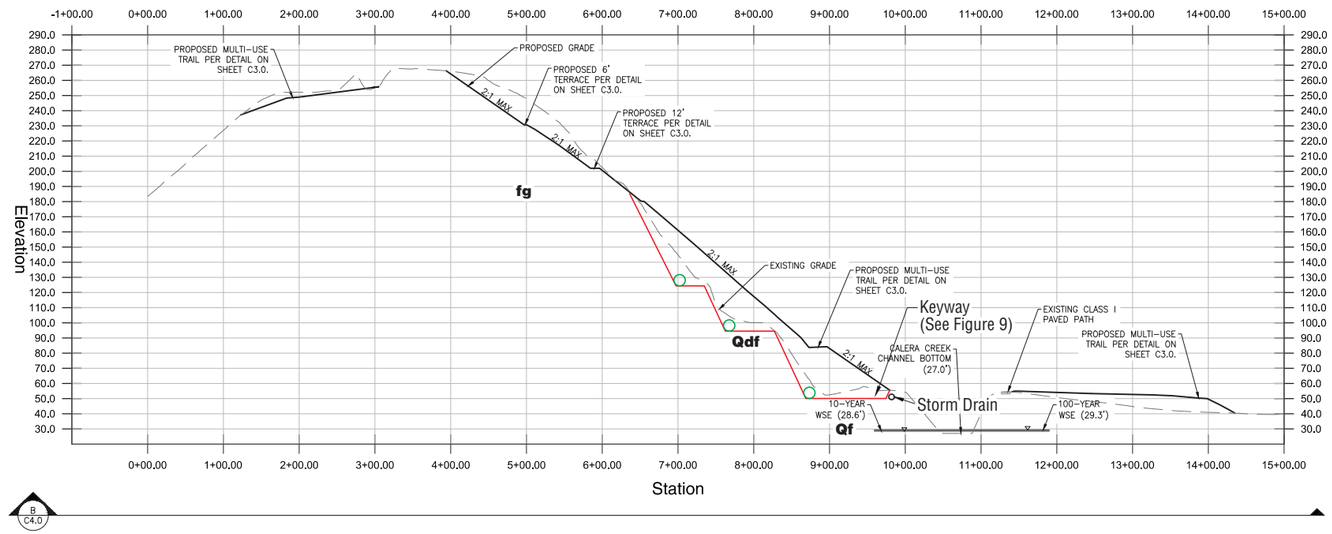
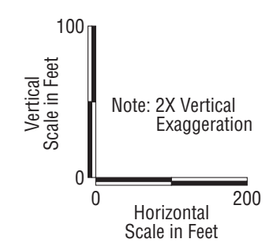
DRAINAGE PLAN

E8867-04-03	December 2018	Figure 4







LEGEND:

- Approximate Test Pit Location (projected where noted)
- --?-- Geologic Contact (queried where uncertain)
- Estimated Limit of Remedial Grading
- Approximate Subdrain Location

Qf Fill
Qdf Dumped Fill
Qls Landslide Deposit

Franciscan Complex
fm melange
fg greenstone
ls Calera Limestone

Ref: Walsh Engineering, 11/13/18

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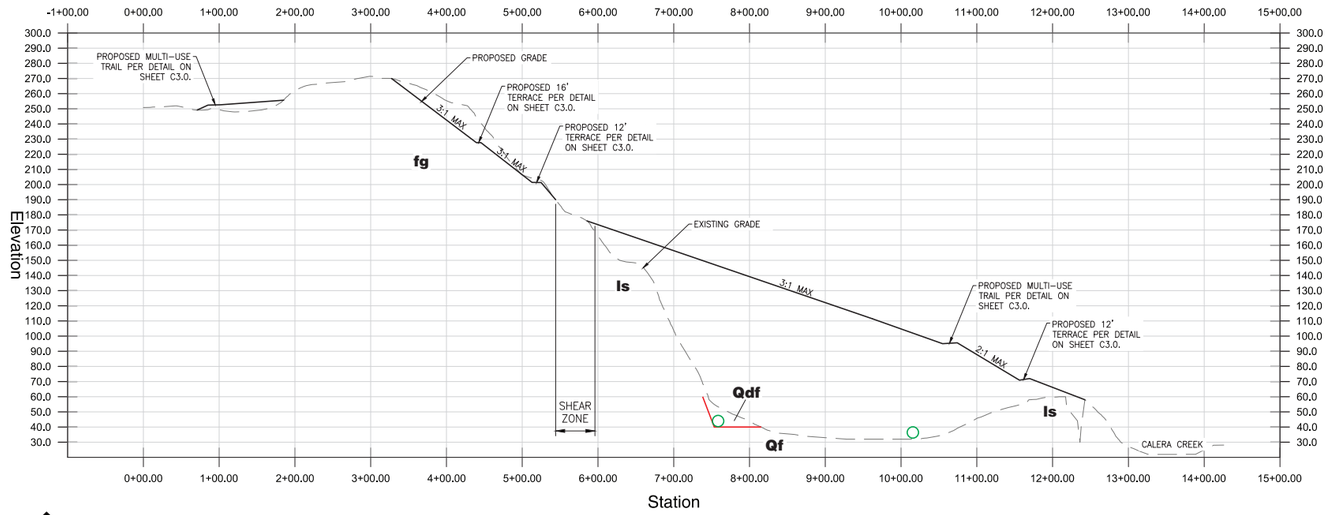
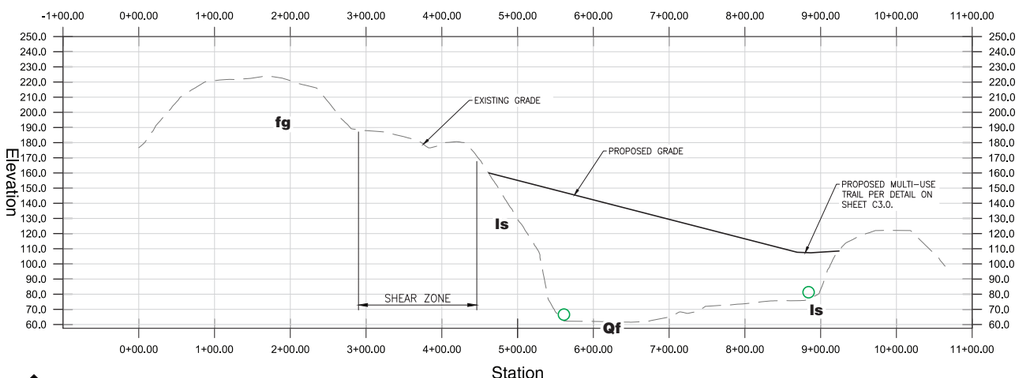
GEOLOGIC CROSS-SECTIONS A AND B

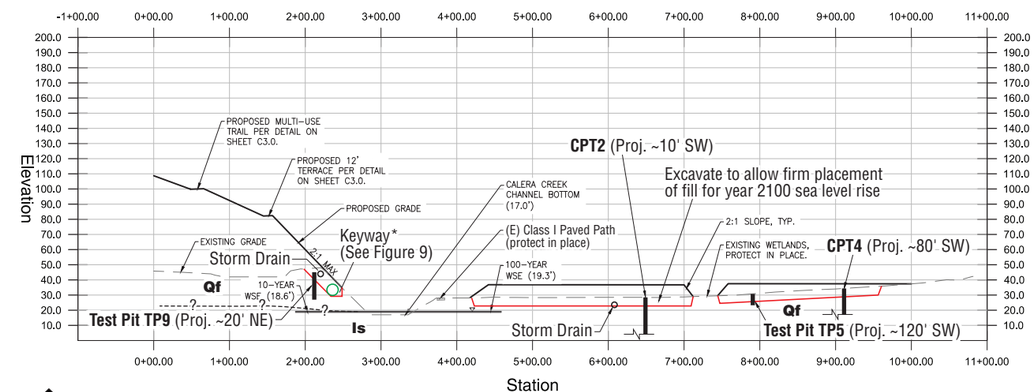
E8867-04-03	December 2018	Figure 5



C
C1.0



D
C1.0



E
C1.0

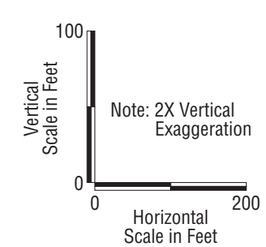
* Final depth and configuration of keyway to be determined by Geocon during grading

LEGEND:

- Approximate Test Pit Location (projected where noted)
- --?-- Geologic Contact (queried where uncertain)
- Estimated Limit of Remedial Grading
- Approximate Subdrain Location

Qf Fill
Qdf Dumped Fill
Qls Landslide Deposit

Franciscan Complex
fm melange
fg greenstone
ls Calera Limestone



Ref: Walsh Engineering, 11/13/18

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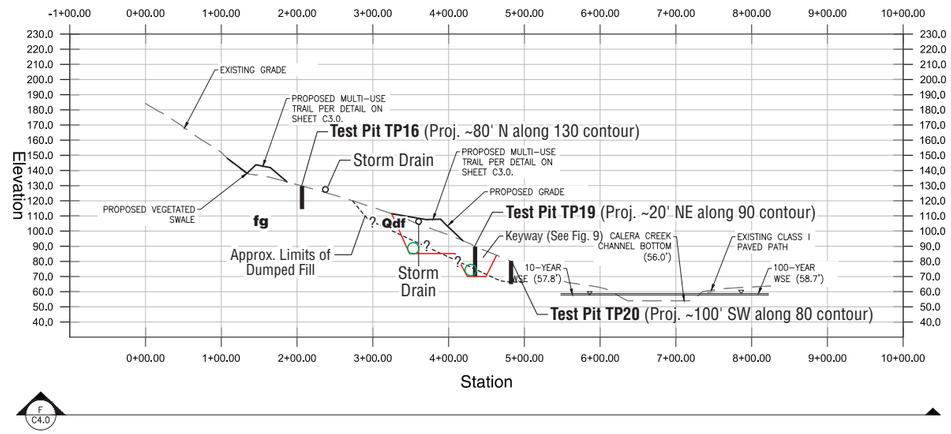
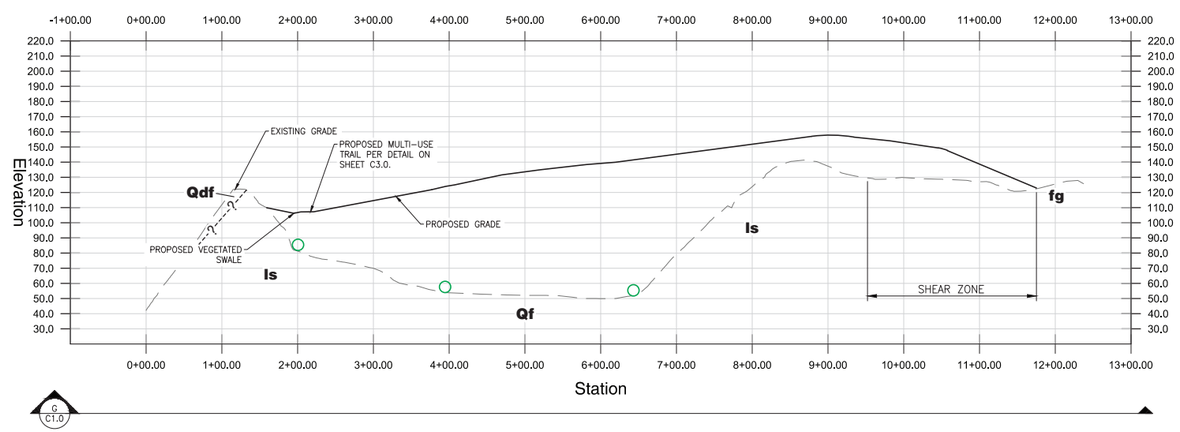
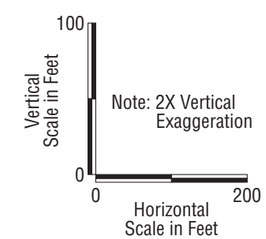
GEOLOGIC CROSS-SECTIONS C, D, AND E

E8867-04-03	December 2018	Figure 6







LEGEND:

- Approximate Test Pit Location (projected where noted)
- --?-- Geologic Contact (queried where uncertain)
- Estimated Limit of Remedial Grading
- Approximate Subdrain Location

Qf Fill
Qdf Dumped Fill
Qls Landslide Deposit

Franciscan Complex
fm melange
fg greenstone
ls Calera Limestone

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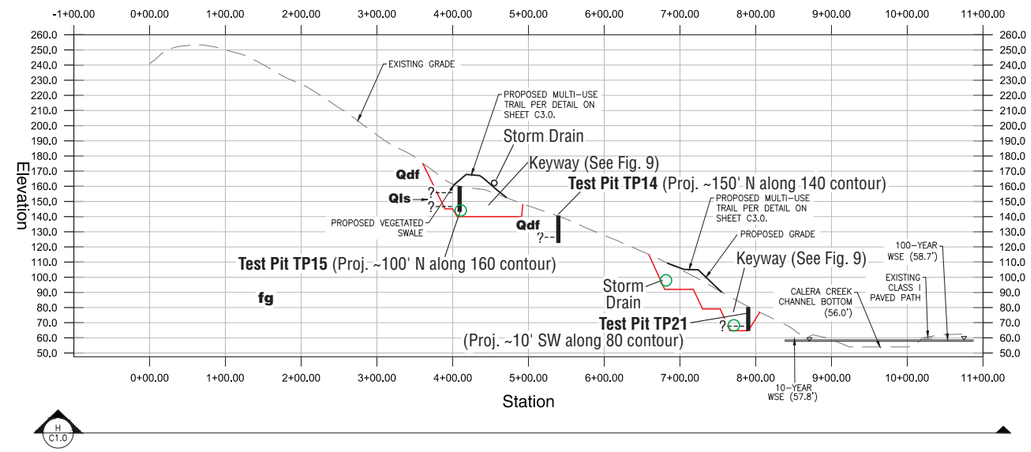
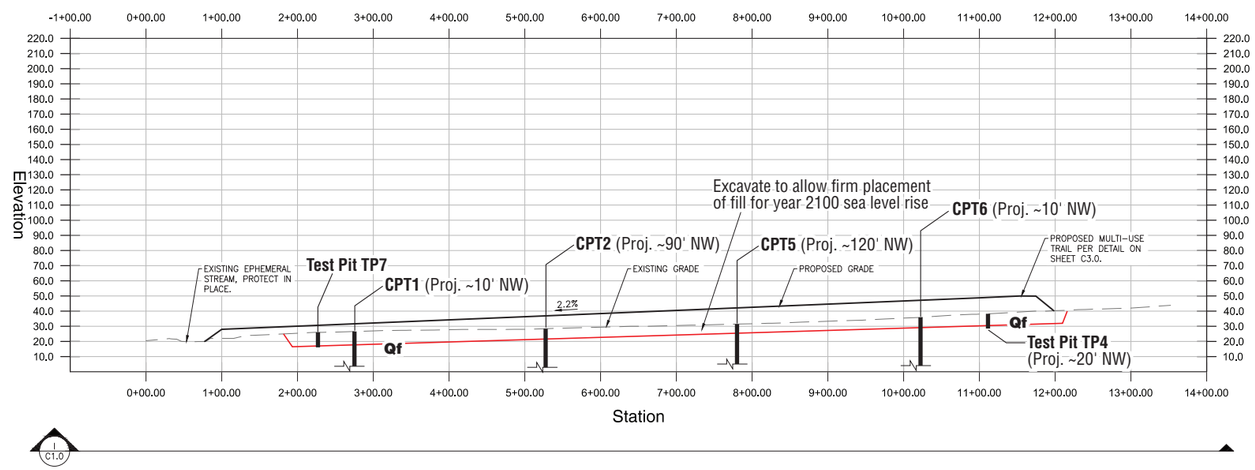
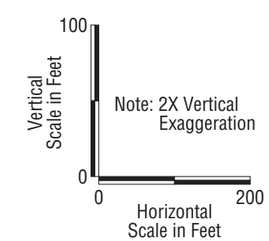
GEOLOGIC CROSS-SECTIONS F AND G

E8867-04-03	December 2018	Figure 7







LEGEND:

- Approximate Test Pit Location (projected where noted)
- --?-- Geologic Contact (queried where uncertain)
- Estimated Limit of Remedial Grading
- Approximate Subdrain Location

Qf Fill
Qdf Dumped Fill
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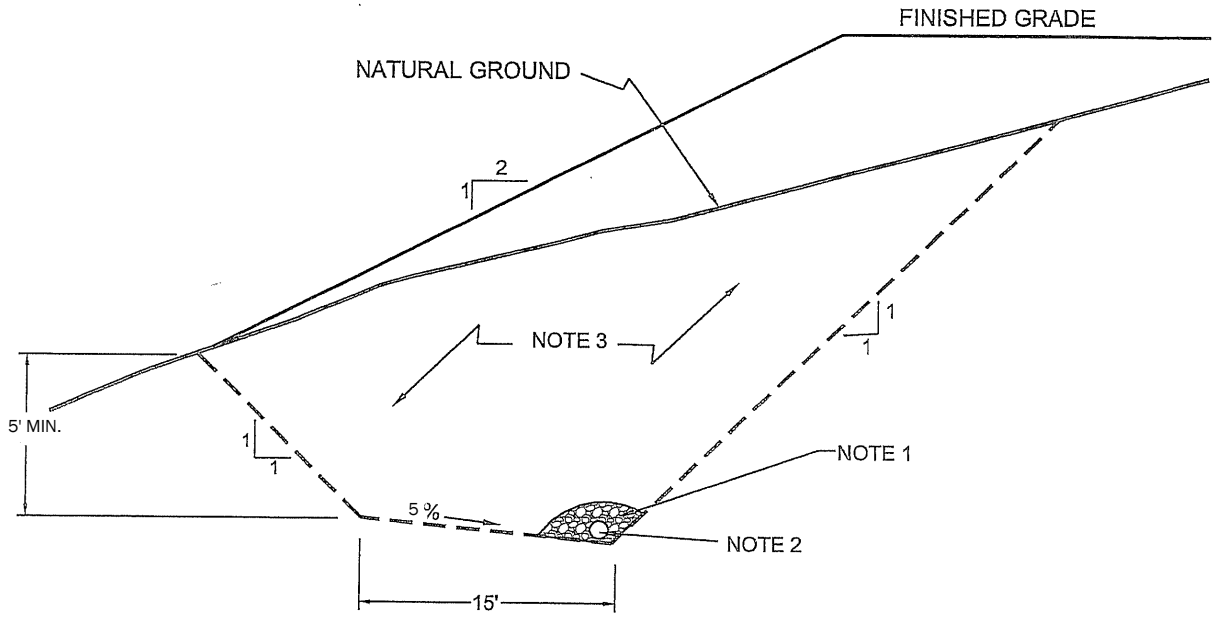
GEOLOGIC CROSS-SECTIONS H AND I

E8867-04-03	December 2018	Figure 8



NOTES:

1. 9 CUBIC FEET/FOOT OF OPEN-GRADED GRAVEL SURROUNDED BY MIRAFI 140n OR EQUIVALENT FILTER FABRIC.
2. 6-INCH DIAMETER SCHEDULE 40 PVC PERFORATED PIPE, SLOPING 1% MINIMUM TO SUITABLE TIGHT LINE OUTLET.
3. PROPERLY COMPACTED FILL WITH MINIMUM SHEAR STRENGTH SPECIFIED BY GEOTECHNICAL CONSULTANT.

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TYPICAL KEYWAY DETAIL

Rockway Quarry Reclamation

Pacifica, California

Project No. E8867-04-03 DECEMBER 2018 **FIGURE 9**

APPENDIX A

APPENDIX A
FIELD EXPLORATION

Fieldwork for our investigation included a site visit, subsurface exploration, and soil sampling. The locations of the exploratory test pits and CPTs are shown on the Geologic Map, Figure 2. Logs of our exploratory test pits and CPT profiles are presented in figures following the text in this appendix. Explorations were located in the field by pacing from existing reference points or using hand-held GPS equipment. Therefore, actual exploration locations may deviate slightly.

Our initial subsurface exploration was performed on August 24 through 26, 2015 and included the excavation of exploratory test pits at selected locations throughout the site. Test pits were excavated at 21 locations with a track-mounted Caterpillar 321D excavator equipped with a 36-inch bucket; representative bulk soil samples were obtained for further examination and laboratory testing. Test pit depths ranged from 7 to 21 feet below the existing ground surface. Upon completion, the test pits were backfilled with tamped lifts of excavation spoils.

Subsurface conditions encountered in the exploratory borings were visually examined, classified and logged in general accordance with the American Society for Testing and Materials (ASTM) Practice for Description and Identification of Soils (Visual-Manual Procedure D2488). This system uses the Unified Soil Classification System (USCS) for soil designations. The logs depict soil and geologic conditions encountered and depths at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, drill rig penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the field logs were revised based on subsequent laboratory testing.

Our field exploration also included the advancement of six CPT soundings to maximum depths of approximately 51 feet below the existing ground surface utilizing a truck-mounted CPT rig with a down- pressure capacity of approximately 20 tons. The CPTs were performed on October 13, 2018 by Middle Earth Geo Testing of Fremont, California using an integrated electronic cone system. The cone has a tip area of 10 square centimeters, a friction sleeve area of 150 square centimeters, and a ratio of friction sleeve area to tip end area equal to 0.85. The cone bearing (Q_C) and sleeve friction (F_S) were measured and recorded during tests at approximately 2-inch depth intervals. The CPT data consisting of cone bearing, sleeve friction, friction ratio and equivalent standard penetration blow counts (N) versus penetration depth below the existing ground surface for each location has been recorded and is presented in this appendix.

UNIFIED SOIL CLASSIFICATION

MAJOR DIVISIONS				TYPICAL NAMES
COARSE-GRAINED SOILS MORE THAN HALF IS COARSER THAN NO. 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO.4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, SILTY GRAVELS WITH SAND
			GC	CLAYEY GRAVELS, CLAYEY GRAVELS WITH SAND
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO.4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS WITH OR WITHOUT GRAVEL
			SC	CLAYEY SANDS WITH OR WITHOUT GRAVEL
FINE-GRAINED SOILS MORE THAN HALF IS FINER THAN NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTS WITH SANDS AND GRAVELS
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, CLAYS WITH SANDS AND GRAVELS, LEAN CLAYS
			OL	ORGANIC SILTS OR CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OR CLAYS OF MEDIUM TO HIGH PLASTICITY
	HIGHLY ORGANIC SOILS		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

BORING/TRENCH LOG LEGEND

- No Recovery
- Shelby Tube Sample
- Bulk Sample
- SPT Sample
- Modified California Sample
- Groundwater Level (At Completion)
- Groundwater Level (Seepage)

PENETRATION RESISTANCE

SAND AND GRAVEL			SILT AND CLAY			
RELATIVE DENSITY	BLOWS PER FOOT (SPT)*	BLOWS PER FOOT (MOD-CAL)*	CONSISTENCY	BLOWS PER FOOT (SPT)*	BLOWS PER FOOT (MOD-CAL)*	COMPRESSIVE STRENGTH (tsf)
VERY LOOSE	0 - 4	0 - 6	VERY SOFT	0 - 2	0 - 3	0 - 0.25
LOOSE	5 - 10	7 - 16	SOFT	3 - 4	4 - 6	0.25 - 0.50
MEDIUM DENSE	11 - 30	17 - 48	MEDIUM STIFF	5 - 8	7 - 13	0.50 - 1.0
DENSE	31 - 50	49 - 79	STIFF	9 - 15	14 - 24	1.0 - 2.0
VERY DENSE	OVER 50	OVER 79	VERY STIFF	16 - 30	25 - 48	2.0 - 4.0
			HARD	OVER 30	OVER 48	OVER 4.0

*NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE LAST 12 INCHES OF AN 18-INCH DRIVE

MOISTURE DESCRIPTIONS

FIELD TEST	APPROX. DEGREE OF SATURATION, S (%)	DESCRIPTION
NO INDICATION OF MOISTURE; DRY TO THE TOUCH	S<25	DRY
SLIGHT INDICATION OF MOISTURE	25≤S<50	DAMP
INDICATION OF MOISTURE; NO VISIBLE WATER	50≤S<75	MOIST
MINOR VISIBLE FREE WATER	75≤S<100	WET
VISIBLE FREE WATER	100	SATURATED

QUANTITY DESCRIPTIONS

APPROX. ESTIMATED PERCENT	DESCRIPTION
<5%	TRACE
5 - 10%	FEW
11 - 25%	LITTLE
26 - 50%	SOME
>50%	MOSTLY

GRAVEL/COBBLE/BOULDER DESCRIPTIONS

CRITERIA	DESCRIPTION
PASS THROUGH A 3-INCH SIEVE AND BE RETAINED ON A NO. 4 SIEVE (#4 TO 3")	GRAVEL
PASS A 12-INCH SQUARE OPENING AND BE RETAINED ON A 3-INCH SIEVE (3"-12")	COBBLE
WILL NOT PASS A 12-INCH SQUARE OPENING (>12")	BOULDER

BEDDING SPACING DESCRIPTIONS

THICKNESS/SPACING	DESCRIPTOR
GREATER THAN 10 FEET	MASSIVE
3 TO 10 FEET	VERY THICKLY BEDDED
1 TO 3 FEET	THICKLY BEDDED
3 5/8-INCH TO 1 FOOT	MODERATELY BEDDED
1 1/4-INCH TO 3 5/8-INCH	THINLY BEDDED
3/8-INCH TO 1 1/4-INCH	VERY THINLY BEDDED
LESS THAN 3/8-INCH	LAMINATED

STRUCTURE DESCRIPTIONS

CRITERIA	DESCRIPTION
ALTERNATING LAYERS OF VARYING MATERIAL OR COLOR WITH LAYERS AT LEAST 1/2-INCH THICK	STRATIFIED
ALTERNATING LAYERS OF VARYING MATERIAL OR COLOR WITH LAYERS LESS THAN 1/2-INCH THICK	LAMINATED
BREAKS ALONG DEFINITE PLANES OF FRACTURE WITH LITTLE RESISTANCE TO FRACTURING	FISSURED
FRACTURE PLANES APPEAR POLISHED OR GLOSSY, SOMETIMES STRIATED	SLICKENSIDED
COHESIVE SOIL THAT CAN BE BROKEN DOWN INTO SMALLER ANGULAR LUMPS WHICH RESIST FURTHER BREAKDOWN	BLOCKY
INCLUSION OF SMALL POCKETS OF DIFFERENT SOIL, SUCH AS SMALL LENSES OF SAND SCATTERED THROUGH A MASS OF CLAY	LENSED
SAME COLOR AND MATERIAL THROUGHOUT	HOMOGENOUS

CEMENTATION/INDURATION DESCRIPTIONS

FIELD TEST	DESCRIPTION
CRUMBLES OR BREAKS WITH HANDLING OR LITTLE FINGER PRESSURE	WEAKLY CEMENTED/INDURATED
CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE	MODERATELY CEMENTED/INDURATED
WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE	STRONGLY CEMENTED/INDURATED

IGNEOUS/METAMORPHIC ROCK STRENGTH DESCRIPTIONS

FIELD TEST	DESCRIPTION
MATERIAL CRUMBLES WITH BARE HAND	WEAK
MATERIAL CRUMBLES UNDER BLOWS FROM GEOLOGY HAMMER	MODERATELY WEAK
1/8-INCH INDENTATIONS WITH SHARP END FROM GEOLOGY HAMMER	MODERATELY STRONG
HAND-HELD SPECIMEN CAN BE BROKEN WITH **ONE** BLOW FROM GEOLOGY HAMMER	STRONG
HAND-HELD SPECIMEN CAN BE BROKEN WITH **COUPLE** BLOWS FROM GEOLOGY HAMMER	VERY STRONG
HAND-HELD SPECIMEN CAN BE BROKEN WITH **MANY** BLOWS FROM GEOLOGY HAMMER	EXTREMELY STRONG

IGNEOUS/METAMORPHIC ROCK WEATHERING DESCRIPTIONS

DEGREE OF DECOMPOSITION	FIELD RECOGNITION	ENGINEERING PROPERTIES
SOIL	DISCOLORED, CHANGED TO SOIL, FABRIC DESTROYED	EASY TO DIG
COMPLETELY WEATHERED	DISCOLORED, CHANGED TO SOIL, FABRIC MAINLY PRESERVED	EXCAVATED BY HAND OR RIPPING (Saprolite)
HIGHLY WEATHERED	DISCOLORED, HIGHLY FRACTURED, FABRIC ALTERED AROUND FRACTURES	EXCAVATED BY HAND OR RIPPING, WITH SLIGHT DIFFICULTY
MODERATELY WEATHERED	DISCOLORED, FRACTURES, INTACT ROCK-NOTICEABLY WEAKER THAN FRESH ROCK	EXCAVATED WITH DIFFICULTY WITHOUT EXPLOSIVES
SLIGHTLY WEATHERED	MAY BE DISCOLORED, SOME FRACTURES, INTACT ROCK-NOT NOTICEABLY WEAKER THAN FRESH ROCK	REQUIRES EXPLOSIVES FOR EXCAVATION, WITH PERMEABLE JOINTS AND FRACTURES
FRESH	NO DISCOLORATION, OR LOSS OF STRENGTH	REQUIRES EXPLOSIVES

IGNEOUS/METAMORPHIC ROCK JOINT/FRACTURE DESCRIPTIONS

FIELD TEST	DESCRIPTION
NO OBSERVED FRACTURES	UNFRACTURED/UNJOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT 1 TO 3 FOOT INTERVALS	SLIGHTLY FRACTURED/JOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT 4-INCH TO 1 FOOT INTERVALS	MODERATELY FRACTURED/JOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT 1-INCH TO 4-INCH INTERVALS WITH SCATTERED FRAGMENTED INTERVALS	INTENSELY FRACTURED/JOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT LESS THAN 1-INCH INTERVALS; MOSTLY RECOVERED AS CHIPS AND FRAGMENTS	VERY INTENSELY FRACTURED/JOINTED

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Rockaway Quarry

Pacifica, California

KEY TO LOGS

E8867-04-02	October 2015	Figure A1

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP1

ELEV. (MSL.) _____ DATE COMPLETED **8/24/2015**

ENG./GEO. **SR** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				ML	FILL Medium-stiff to stiff, dry to humid, light-brown, (f) Sandy SILT with artificial 3 inch minus gravels, trace clay			
1	TP1-1-3							
2								
3								
4								
5					-old cable wire, north end of trench -medium-stiff			
6								
7								
8	TP1-8			CL	Soft, moist, medium to dark-brown CLAY			
9								
10	TP1-10			CH	ALLUVIUM Soft to medium-stiff, black fat CLAY with trace (f) SAND and thread-sized rootlets			
11								
12					END OF TEST PIT AT 12 FEET NO FREE WATER ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A2, Log of Test Pit TP1, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP2

ELEV. (MSL.) _____ DATE COMPLETED **8/24/2015**

ENG./GEO. **SR** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				ML	FILL Medium-stiff to stiff, dry to humid, light-brown, (f) Sandy SILT with 1 inch rock in upper 3 feet			
1								
2								
3								
4								
5	TP2-5			CL	Medium-stiff, moist, medium-brown and orange, CLAY with angular gravel; moderate plasticity			
6								
7								
8					-asphalt layer in the trench wall			
9								
10	TP2-10				-stiff, moist, dark-gray, sandy to gravelly			
11								
12					-varicolored sand-clay-gravel mixtures			
13								
14								
15					-asphalt and concrete chunks			

END OF TEST PIT AT 15 FEET
NO FREE WATER ENCOUNTERED
BACKFILLED IN LIFTS WITH TAMPED SPOILS

Figure A3, Log of Test Pit TP2, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP3

ELEV. (MSL.) _____ DATE COMPLETED **8/24/2015**

ENG./GEO. **SR** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	FILL Medium dense, dry to humid, varicolored, Clayey Gravelly SAND with concrete chunks in upper 3 feet			
1								
2								
3	TP3-3-4							
4								
5					-stiff, moist, more clayey			
6								
7								
8								
9								
10				CL	ALLUVIUM Soft to medium-stiff, brown (f) Sandy CLAY with trace organics			
11	TP3-11							
12								
13					-with lenses of (f) medium-gray sand below 13 feet			
14	TP3-14				-TP3-14 sample is sand only			
15					END OF TEST PIT AT 15 FEET NO FREE WATER ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A4, Log of Test Pit TP3, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP4

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	FILL Estimated loose, dry, brown, Silty SAND with fine gravel			
1								
2					- becomes damp, trace clay			
3					- wire in fill			
4	TP4-4			CL-ML	- concrete slab chunk, approximately 30", filter fabric, asphalt			
5				SM	Moist, brown, Silty CLAY, trace sand, no roots			
6					Damp, dark grey-brown, damp, Silty SAND, fine to coarse angular sand, trace fine gravel, trace clay (resembles asphalt, but no odor and friables)			
7	TP4-7			CL-ML	ALLUVIUM/RESIDUAL SOIL Moist, drak grey-brown, Silty CLAY, few red-brown root traces, trace fine to medium-grained sand			
8								

TEST PIT TERMINATED AT 8 FEET
GROUNDWATER NOT ENCOUNTERED
BACKFILLED IN LIFTS WITH TAMPED SPOILS

Figure A5, Log of Test Pit TP4, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP5

ELEV. (MSL.) _____ DATE COMPLETED **8/24/2015**

ENG./GEO. **SR** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				ML	FILL Stiff to hard, dry, light-brown, Sandy SILT with (f) angular gravel			
1								
2	TP5-2							
3								
4								
5								
6	TP5-6			CL	ALLUVIUM Medium-stiff, moist, black CLAY with roots of approximately 1 inch and seams/mottles of dark red clay -pinholing throughout			
7					END OF TEST PIT AT 7 FEET NO FREE WATER ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A6, Log of Test Pit TP5, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP6

ELEV. (MSL.) _____ DATE COMPLETED **8/24/2015**

ENG./GEO. **SR** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL	FILL Stiff, humid, reddish-brown gravelly CLAY -dark gray at 1 foot -frequent occurences of asphalt in upper 5 to 6 feet			
1								
2								
3								
4								
5								
6	TP6-6			SC	ALLUVIUM Medium dense, humid to moist, dark-gray to black, Clayey Sand			
7	TP6-7-8				-moist, orange-brown mottles, with (f) angular gravels			
8								
9								
10					END OF TEST PIT AT 10 FEET NO FREE WATER ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A7, Log of Test Pit TP6, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP7

ELEV. (MSL.) _____ DATE COMPLETED **8/24/2015**

ENG./GEO. **SR** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				ML	FILL Stiff to hard, dry to humid, light to medium-brown, Sandy SILT with clay			
1								
2								
3					-more clayey			
4	TP7-4							
5								
6					-approximately 1 foot thick zone of 3 inch minus angular gravel			
7	TP7-7			CL	ALLUVIUM Medium-stiff, moist, black (f) Sandy CLAY			
8								
					END OF TEST PIT AT 8½ FEET NO FREE WATER ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A8, Log of Test Pit TP7, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... DISTURBED OR BAG SAMPLE
... STANDARD PENETRATION TEST
... CHUNK SAMPLE
... DRIVE SAMPLE (UNDISTURBED)
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP8

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	FILL Dry to damp, brown, Silty GRAVEL with sand, trace clay, few cobble (24" max), average gravel approximately 2"			
1								
2								
3								
4								
5					- caving from 5' to 8'			
6	TP8-6							
7	TP8-7-11				- becomes moist, dark brown-grey			
8								
9								
10					- becomes dark brown			
11					- refusal on limestone bedrock			

TEST PIT TERMINATED AT 11 FEET
GROUNDWATER NOT ENCOUNTERED
BACKFILLED IN LIFTS WITH TAMPED SPOILS

Figure A9, Log of Test Pit TP8, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP9

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	TP9-0			GM	FILL Estimated medium dense, dry, brown, Silty Sandy GRAVEL, fine to coarse sand, fine to coarse sub-angular gravel, trace cobble (10")			
1								
2								
3					- becomes damp below 3'			
4								
5	TP9-5-11							
6								
7								
8								
9								
10								
11								
12	TP9-12			GC	Moist, dark brown-grey, Clayey GRAVEL			
13								
14								
15								
16								
17								
18					- limit of reach at 18'			

TEST PIT TERMINATED AT 18 FEET
GROUNDWATER NOT ENCOUNTERED
BACKFILLED IN LIFTS WITH TAMPED SPOILS

Figure A10, Log of Test Pit TP9, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... DISTURBED OR BAG SAMPLE
... STANDARD PENETRATION TEST
... CHUNK SAMPLE
... DRIVE SAMPLE (UNDISTURBED)
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP10

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	FILL Estimated loose to medium dense, dry to damp, green-brown, Silty Sandy GRAVEL, fine to coarse sand, fine to coarse gravel, trace cobbles (8")			
1								
2	TP10-2							
3				GM/GC	Moist, multicolor: brown, gray, green, Silty to Clayey GRAVEL			
4								
5								
6								
7								
8					- trace asphalt pieces			
9								
10								
11								
12					- trace wet soil at 12'			
13								
14	TP10-14							
15								
16								
17					- becomes very moist to wet			
18								
19					- limit of reach			

TEST PIT TERMINATED AT 19½ FEET
GROUNDWATER NOT ENCOUNTERED
BACKFILLED IN LIFTS WITH TAMPED SPOILS

Figure A11, Log of Test Pit TP10, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... DISTURBED OR BAG SAMPLE
... STANDARD PENETRATION TEST
... CHUNK SAMPLE
... DRIVE SAMPLE (UNDISTURBED)
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP11

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	FILL Estimated medium dense, dry, green-brown, brown, red-brown, Silty Sandy GRAVEL, trace cobble (10"), trace asphalt (6"), trace to little clay			
1								
2								
3					- becomes damp 3' to 7'			
4	TP11-4-18							
5								
6								
7								
8					- becomes moist to very moist			
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20					Hard, limestone cobbles and bedrock			
21					TEST PIT TERMINATED AT 21 FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A12, Log of Test Pit TP11, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP12

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	FILL Estimated loose to medium dense, dry to damp, multicolored, Silty Sandy GRAVEL, fine to coarse-grained sand, fine to coarse sub-angular to angular gravel (average medium gravel), trace cobble "greenstone" (metavolcanic) (13" max), trace asphalt			
1								
2								
3	TP12-3							
4								
5								
6								
7								
8	TP12-8							
9								
10								
11								
12								
13								
14	TP12-14							
15								
16								
17					- increasing proportion limestone and metavolcanic gravel and cobbles (24" max)			
18								
19								
20								
21					TEST PIT TERMINATED AT 21 FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A13, Log of Test Pit TP12, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP13

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	FILL Estimated loose, dry, brown/green-brown/red-brown, Silty Sandy GRAVEL, trace cobble (10" max), trace asphalt chunks (12")			
1								
2								
3					- becomes estimated medium dense, damp			
4								
5								
6								
7								
8								
9								
10								
11								
12				GP	Estimated loose, GRAVEL with sand, trace silt, brown angular limestone, caving, increasing coarse gravel and cobble			
13								
14								
15								
16								
17								
					TEST PIT TERMINATED AT 17½ FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A14, Log of Test Pit TP13, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP14

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	TP14-0-14			GM	FILL Estimated loose to medium dense, dry to damp, brown, Silty Sandy GRAVEL/Gravelly SAND, fine to coarse-grained sand, fine to coarse gravel, trace to little cobble and boulders (24" max)			
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14				CL-ML	RESIDUAL SOIL Moist, dark brown, Silty CLAY, trace sand and fine gravel -grades to dark grey-brown clay at 16'			
15	TP14-15							
16	TP14-16				Dark gray-brown CLAY, yellowish at 17'			
17					TEST PIT TERMINATED AT 17 FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A15, Log of Test Pit TP14, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP15

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM-SM	FILL Dry to damp, brown, Silty Sandy GRAVEL, trace cobble and boulders (36") to Silty Gravelly SAND, trace to little clay, clasts of limestone			
1								
2								
3								
4								
5	TP15-5-9			CL	LANDSLIDE/DEBRIS FLOW Damp to mosit, brown, Sandy CLAY with gravel (brown siltstone)			
6								
7								
8								
9								
10	TP15-10			CL-ML	RESIDUAL SOIL Moist, dark gray, Silty CLAY - becomes yellow			
11								
12								
13								
14	TP15-14							
					TEST PIT TERMINATED AT 14 FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A16, Log of Test Pit TP15, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP16

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	TP16-0-3			CL-ML	RESIDUAL SOIL Gray-brown, Clayey SILT/Silty CLAY, trace fine roots, trace porosity, trace sand, trace gravel/cobbles in first 12"			
1								
2								
3								
4	TP16-4							
5					- grades to moist, yellow, silty clay			
6								
7	TP16-7							
8								
9								
10	TP16-10-12							
11					- becomes completely weathered claystone, excavates as: estimated stiff, very moist, multicolor: yellow and pale yellow-brown, silty clay, fine blocky soil structure			
12								
13								
14	TP16-14				TEST PIT TERMINATED AT 14 FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A17, Log of Test Pit TP16, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP17

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL-ML	DEBRIS FLOW/SLIDE DEBRIS Dry, dark gray, Silty CLAY, trace fine roots			
1								
2					- becomes moist, yellow			
3					- increasing moisture from 3' to 8'			
4					- wet zone at 8' (2-3" thick)			
5								
6								
7								
8				CL-ML	RESIDUAL SOIL Silty CLAY, trace black mottling, trace medium-grained sand			
9	TP17-8.5							
10					- moist from 10' to 17'			
11					- becomes completely weathered claystone, excavates as: estimated stiff, very moist, multicolor: yellow and pale yellow-brown, silty clay, fine blocky soil structure			
12								
13								
14								
15								
16	TP17-16							
17	TP17-17.5							
					TEST PIT TERMINATED AT 17½ FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A18, Log of Test Pit TP17, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... DISTURBED OR BAG SAMPLE
... STANDARD PENETRATION TEST
... CHUNK SAMPLE
... DRIVE SAMPLE (UNDISTURBED)
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP18

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				CL-ML	LANDSLIDE DEBRIS Dry to damp, dark brown-gray, Silty CLAY, trace roots			
1								
2					- becomes moist, yellow			
3								
4	TP18-4							
5								
6	TP18-6			CL-ML	RESIDUAL SOIL Moist, yellow and yellow-brown, Silty CLAY - slide plane at 6' (1" thick moist yellow CLAY)			
7								
8	TP18-8							
9					TEST PIT TERMINATED AT 9 FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A19, Log of Test Pit TP18, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP19

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	FILL Dry to damp, brown and dark brown, Silty GRAVEL, with cobble and boulders (30" max), trace clay			
1								
2								
3								
4								
5								
6								
7				CL-ML	Mixed, moist, dark brown and yellow, Silty CLAY			
8								
9								
10								
11	TP19-11			CL	Moist, multicolor: black and green, CLAY			
12								
13								
14	TP19-14			GP	Estimated loose, damp, gray, Sandy GRAVEL, 1/2" crushed baserock (man-made), caving			
15								
16								
17	TP19-17.5			CL-ML	RESIDUAL SOIL Moist, multicolor: brown, dark gray, yellow, Silty CLAY			
18	TP19-18			CL	Dark gray and dark brown, CLAY with sand, and fine sub-round gravel -limit of reach			
19								

TEST PIT TERMINATED AT 19½ FEET
GROUNDWATER NOT ENCOUNTERED
BACKFILLED IN LIFTS WITH TAMPED SPOILS

Figure A20, Log of Test Pit TP19, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP20

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				GM	FILL Dry, brown, Silty GRAVEL, trace cobble and boulder (30" max), trace clay			
1								
2				CL-ML	Damp to moist dark gray-brown and yellow-brown, Silty CLAY			
3								
4	TP20-4							
5								
6								
7				CL-ML	Dark gray, Silty CLAY, trace chunks asphalt, lens of asphalt (18" max, 4-5" wide)			
8								
9								
10								
11								
12					- becomes yellow and dark gray			
13				CL-ML	RESIDUAL SOIL Dark gray to dark gray-brown, Silty CLAY, trace sand and sub-round gravel -grades to yellow			
14								
15	TP20-15-16							
16					TEST PIT TERMINATED AT 16 FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED IN LIFTS WITH TAMPED SPOILS			

Figure A21, Log of Test Pit TP20, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **E8867-04-02** PROJECT NAME: **Rockaway Quarry**

TEST PIT TP21

ELEV. (MSL.) _____ DATE COMPLETED **8/25/2015**

ENG./GEO. **JP** OPERATOR **Geocon**

EQUIPMENT **CAT 321D w/ 36" bucket** HAMMER TYPE _____

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (TONS/SQFT)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	TP21-0-6			GM	FILL Estimated loose, dry to damp, brown to dark brown, Silty Sandy GRAVEL, with trace to little cobble			
1								
2								
3								
4								
5								
6	TP21-6			CL	Yellow to yellow-brown, Silty CLAY irregular abrupt boundary with vegetation imprints			
7								
8	TP21-8			ML	RESIDUAL SOIL Dark brown, Clayey SILT, fine, pale yellow roots at boundary			
9								
10				CL	Moist, yellow, Silty CLAY			
11								
12	TP21-12							

TEST PIT TERMINATED AT 12½ FEET
GROUNDWATER NOT ENCOUNTERED
BACKFILLED IN LIFTS WITH TAMPED SPOILS

Figure A22, Log of Test Pit TP21, page 1 of 1

GEOCON TEST PIT LOG E8867-04-02 ROCKAWAY QUARRY TEST PIT 8.25.2015.GPJ 10/21/15

GEOCON

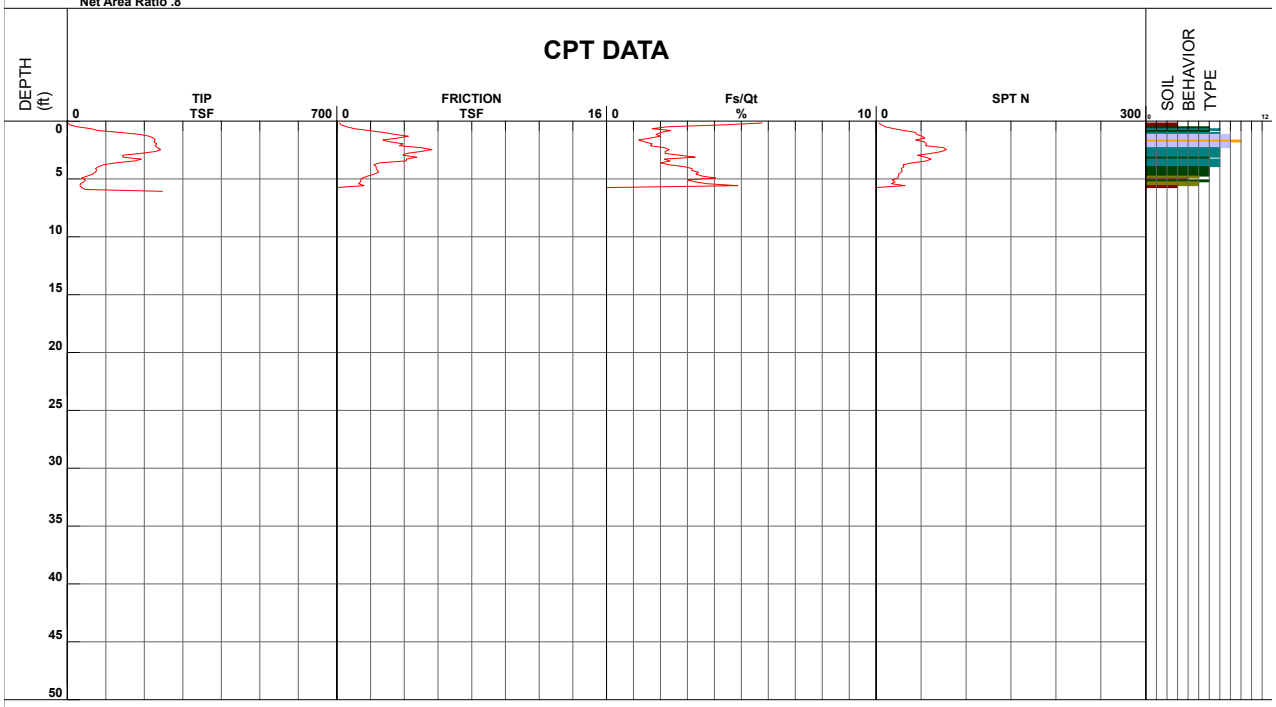
SAMPLE SYMBOLS

... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

Project	Rockaway Quarry	Operator	BH-JM	Filename	SDF(356).cpt
Job Number	E8867-04-03	Cone Number	DDG1448	GPS	
Hole Number	CPT-01	Date and Time	10/13/2018 11:04:02 AM	Maximum Depth	6.07 ft
EST GW Depth During Test	12.00 ft				

Net Area Ratio .8



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

GEOCON CONSULTANTS, INC.
6671 BRISA STREET – LIVERMORE, CA 94550
PHONE 925.371.5900 – FAX 925.371.5915

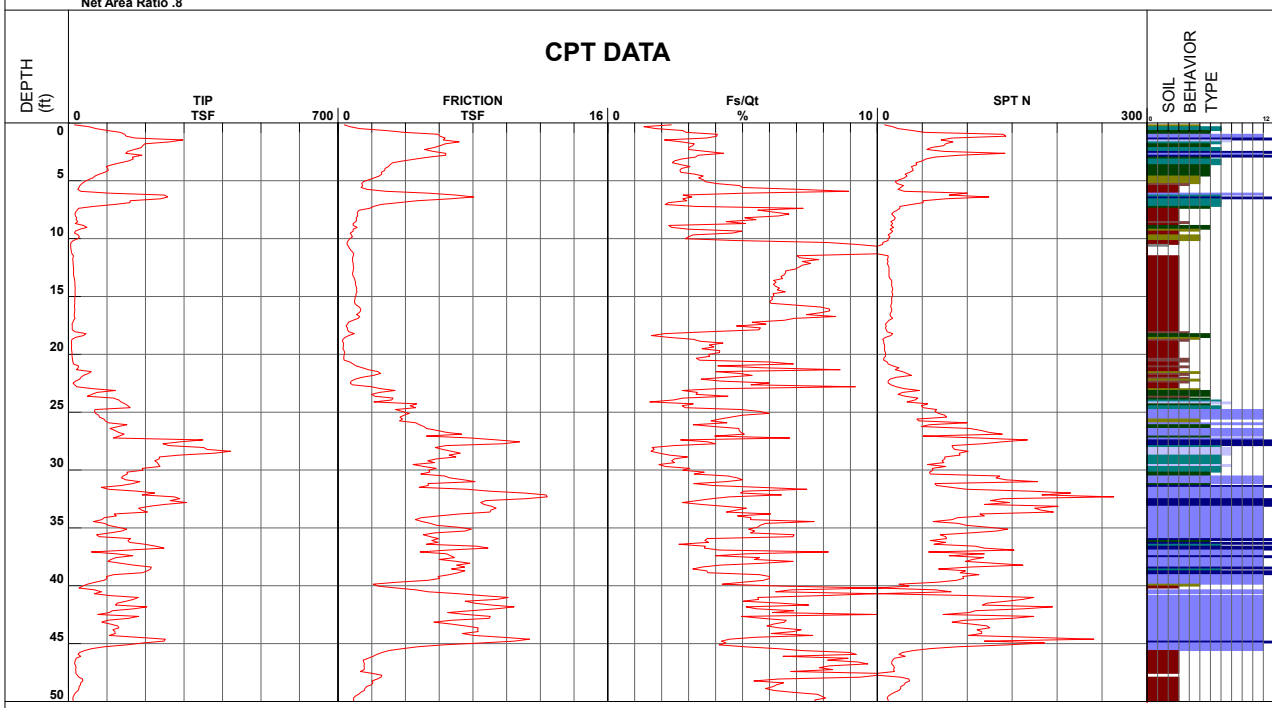
CONE PENETROMETER TEST 1

Project: Rockaway Quarry Reclamation
Location: Pacifica, CA
Project No. E8867-04-03
Date: December 2018

FIGURE A23

Project	Rockaway Quarry	Operator	BH-JM	Filename	SDF(355).cpt
Job Number	E8867-04-03	Cone Number	DDG1448	GPS	
Hole Number	CPT-02B	Date and Time	10/13/2018 10:17:38 AM	Maximum Depth	50.69 ft
EST GW Depth During Test	12.00 ft				

Net Area Ratio .8



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

GEOCON CONSULTANTS, INC.
6671 BRISA STREET – LIVERMORE, CA 94550
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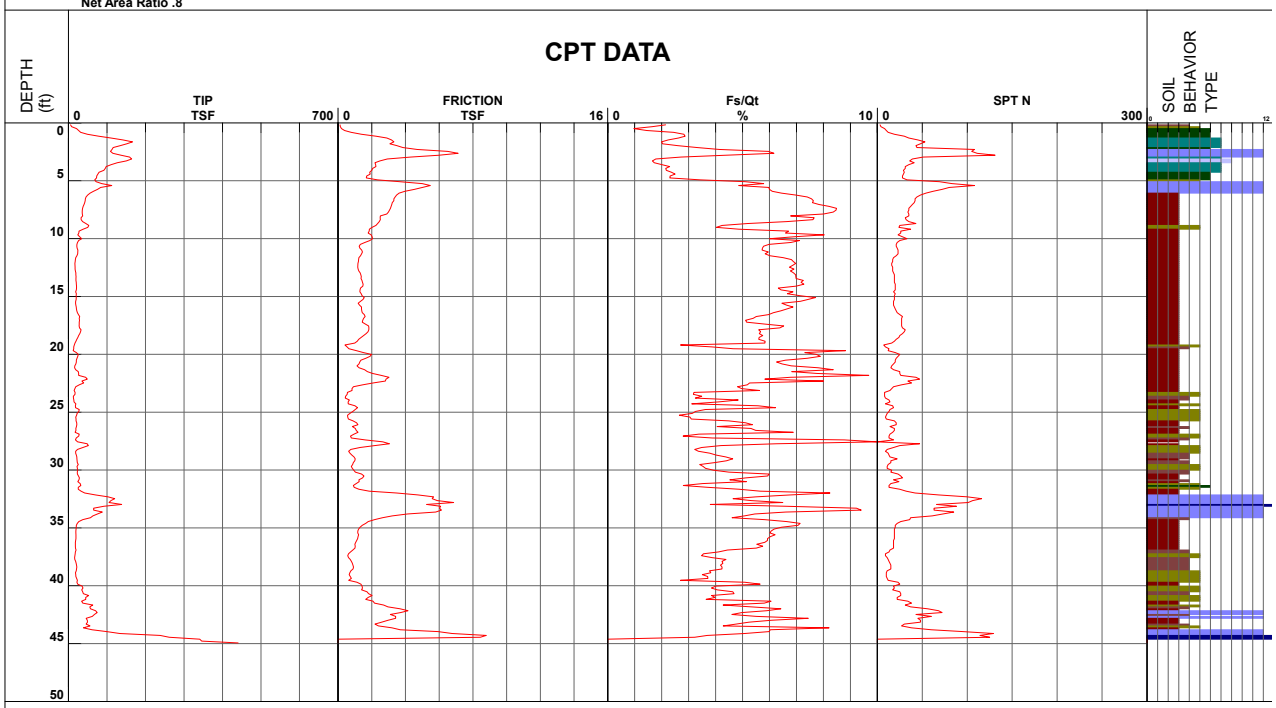
CONE PENETROMETER TEST 2B

Project: Rockaway Quarry Reclamation
Location: Pacifica, CA
Project No. E8867-04-03
Date: December 2018

FIGURE A24

Project	Rockaway Quarry	Operator	BH-JM	Filename	SDF(352).cpt
Job Number	E8867-04-03	Cone Number	DDG1448	GPS	
Hole Number	CPT-03	Date and Time	10/13/2018 9:12:12 AM	Maximum Depth	44.95 ft
EST GW Depth During Test		15.00 ft			

Net Area Ratio .8



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

GEOCON CONSULTANTS, INC.
6671 BRISA STREET – LIVERMORE, CA 94550
PHONE 925.371.5900 – FAX 925.371.5915

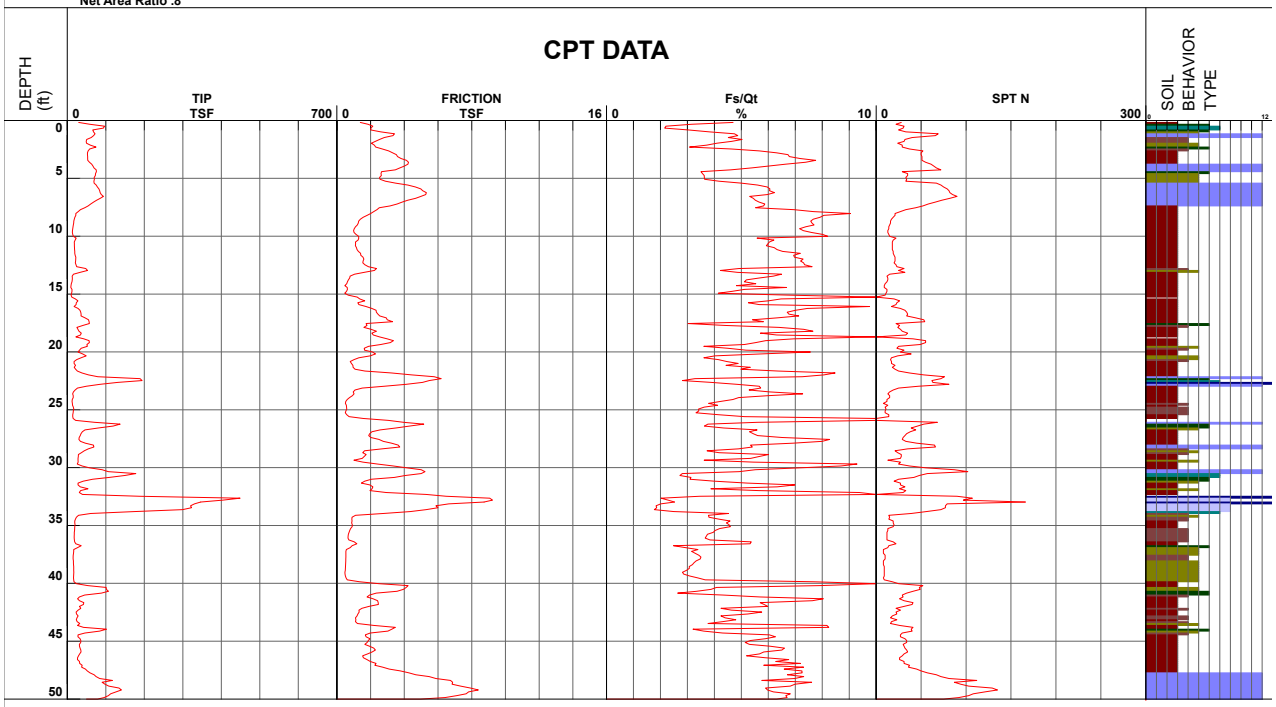
CONE PENETROMETER TEST 3

Project: Rockaway Quarry Reclamation
Location: Pacifica, CA
Project No. E8867-04-03
Date: December 2018

FIGURE A25

Project	Rockaway Quarry	Operator	BH-JM	Filename	SDF(351).cpt
Job Number	E8867-04-03	Cone Number	DDG1448	GPS	
Hole Number	CPT-04	Date and Time	10/13/2018 8:29:47 AM	Maximum Depth	50.52 ft
EST GW Depth During Test	15.00 ft				

Net Area Ratio .8



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

GEOCON CONSULTANTS, INC.
6671 BRISA STREET – LIVERMORE, CA 94550
PHONE 925.371.5900 – FAX 925.371.5915

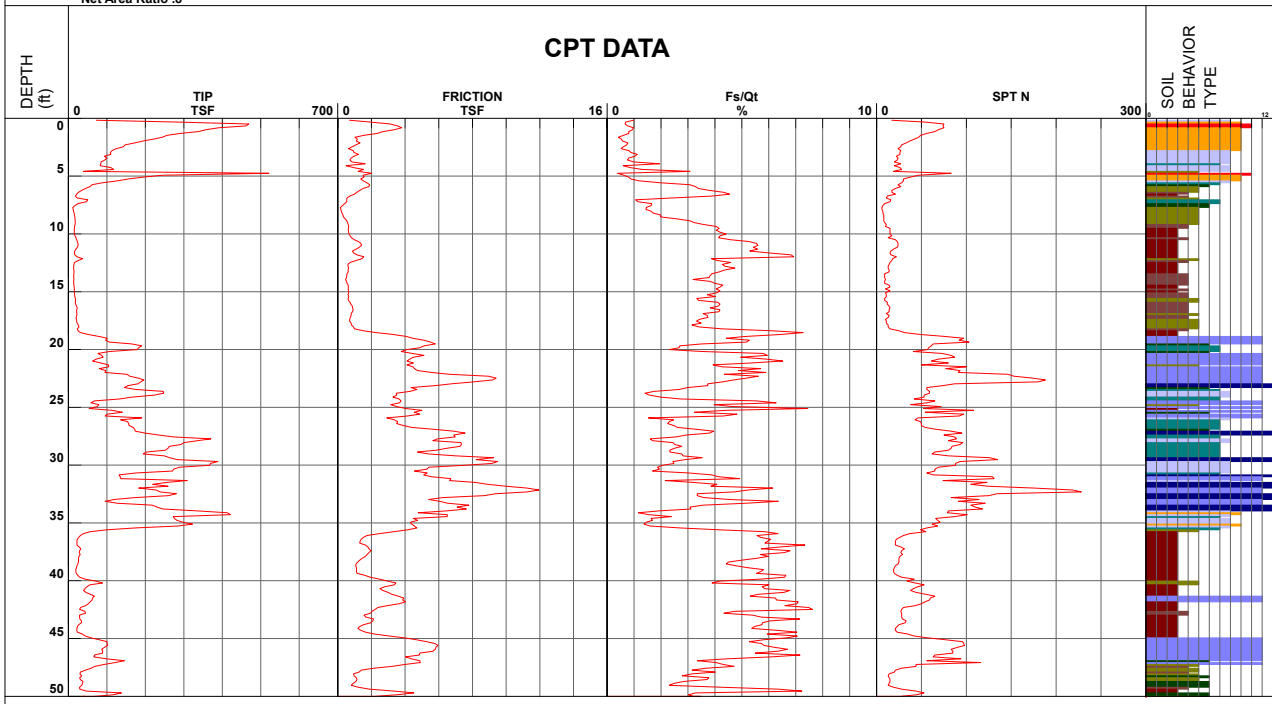
CONE PENETROMETER TEST 4

Project: Rockaway Quarry Reclamation
Location: Pacifica, CA
Project No. E8867-04-03
Date: December 2018

FIGURE A26

Project	Rockaway Quarry	Operator	BH-JM	Filename	SDF(350).cpt
Job Number	E8867-04-03	Cone Number	DDG1448	GPS	
Hole Number	CPT-05	Date and Time	10/13/2018 7:46:07 AM	Maximum Depth	50.69 ft
EST GW Depth During Test	10.00 ft				

Net Area Ratio .8



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

GEOCON CONSULTANTS, INC.
6671 BRISA STREET – LIVERMORE, CA 94550
PHONE 925.371.5900 – FAX 925.371.5915

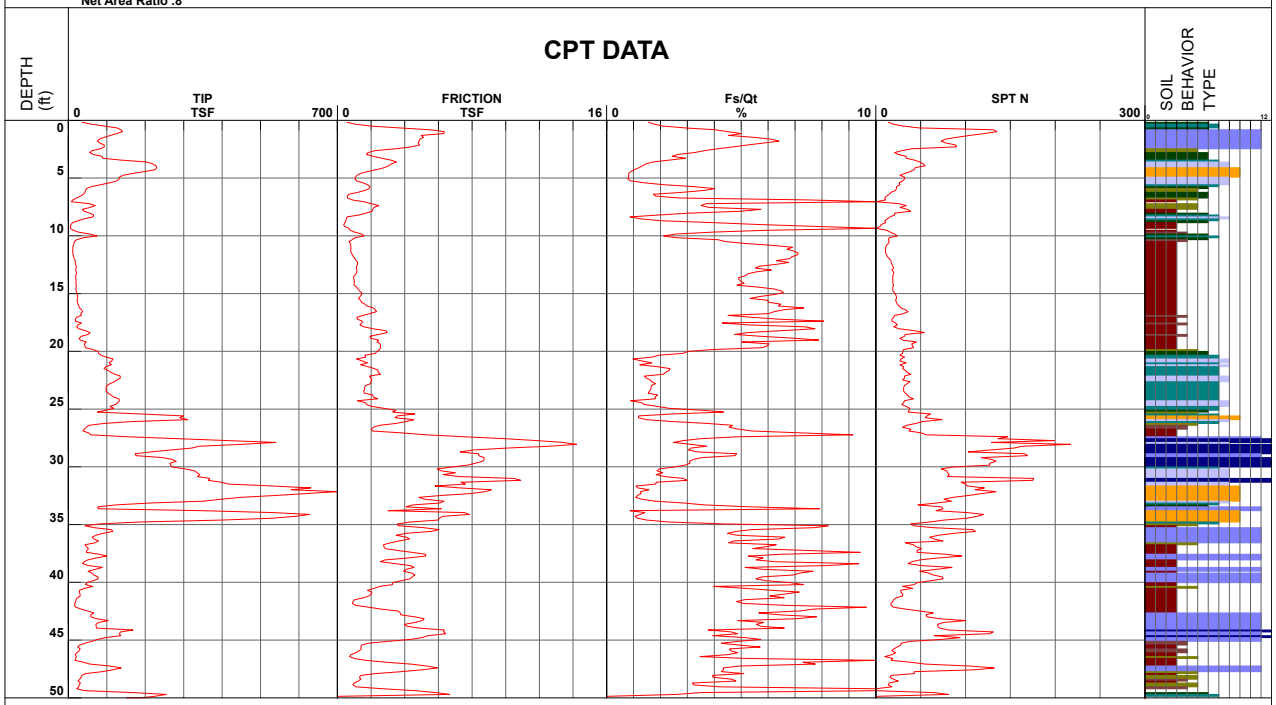
CONE PENETROMETER TEST 5

Project: Rockaway Quarry Reclamation
Location: Pacifica, CA
Project No. E8867-04-03
Date: December 2018

FIGURE A27

Project	Rockaway Quarry	Operator	BH-JM	Filename	SDF(360).cpt
Job Number	E8867-04-03	Cone Number	DDG1448	GPS	
Hole Number	CPT-06	Date and Time	10/13/2018 11:45:52 AM	Maximum Depth	50.20 ft
EST GW Depth During Test	10.00 ft				

Net Area Ratio .8



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

GEOCON CONSULTANTS, INC.
6671 BRISA STREET – LIVERMORE, CA 94550
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CONE PENETROMETER TEST 6

Project: Rockaway Quarry Reclamation
Location: Pacifica, CA
Project No. E8867-04-03
Date: December 2018

FIGURE A28

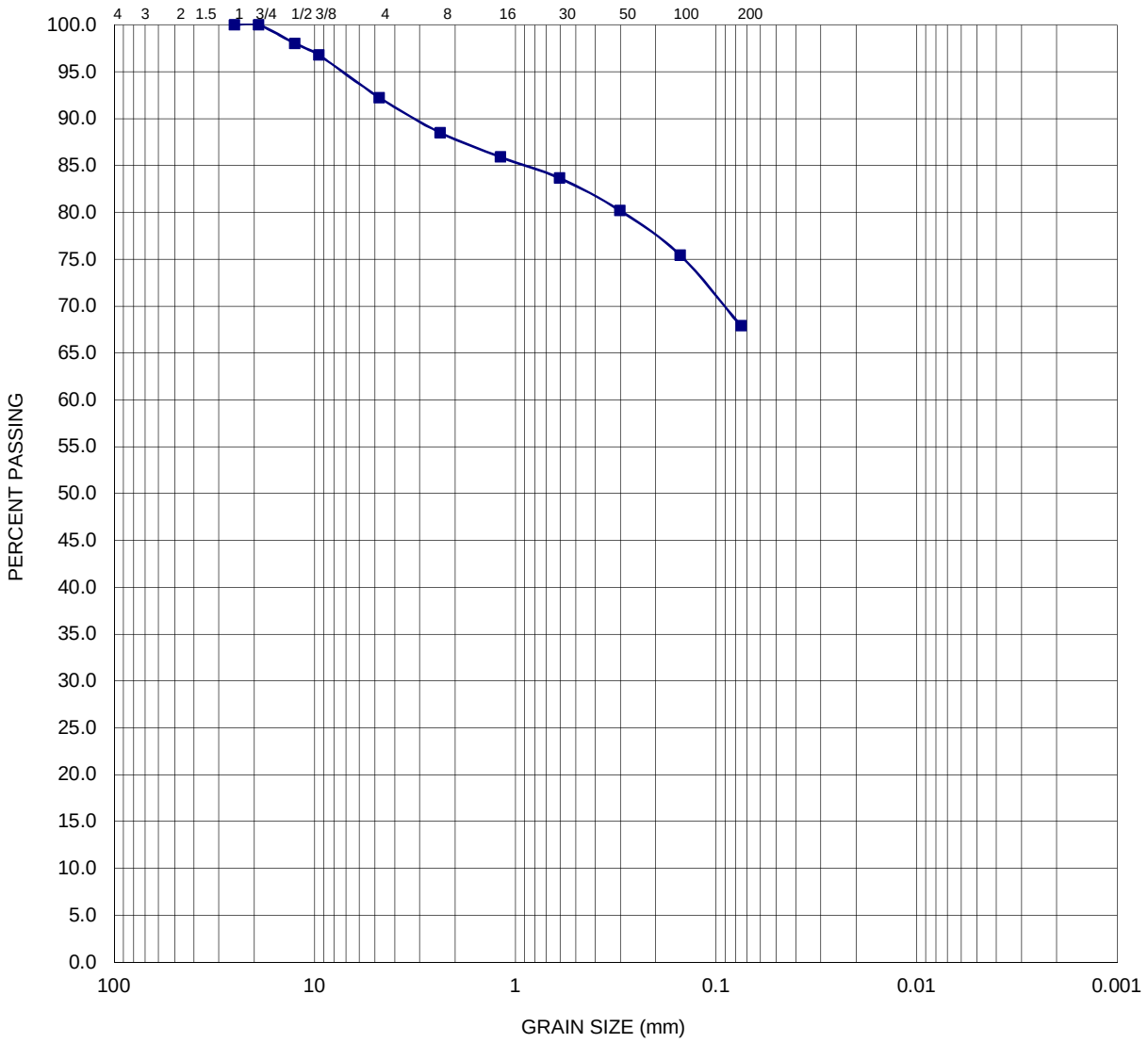
APPENDIX B

APPENDIX B
LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM). Selected samples were tested for Atterberg Limits and grain size distribution. The results of the laboratory tests are summarized in tabular format below and the following figures.

TABLE B-I
SUMMARY OF LABORATORY ATTERBERG LIMITS TEST RESULTS
ASTM D 4318

Sample No.	Liquid Limit	Plastic Limit	Plasticity Index
TP1-8	24	16	8
TP2-5	45	23	22
TP7-4	22	15	7



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Pit: TP1

Depth To Sample: 1 - 3'

Sieve Date: 9/30/2015

Tested and Computed by: PG/JBM

Test Data

Sieve Number	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
% Passing	100	100	100	97.999	96.8	92.2	88.5	85.9	83.6	80.2	75.4	67.9

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Fax: (925) 371-5915

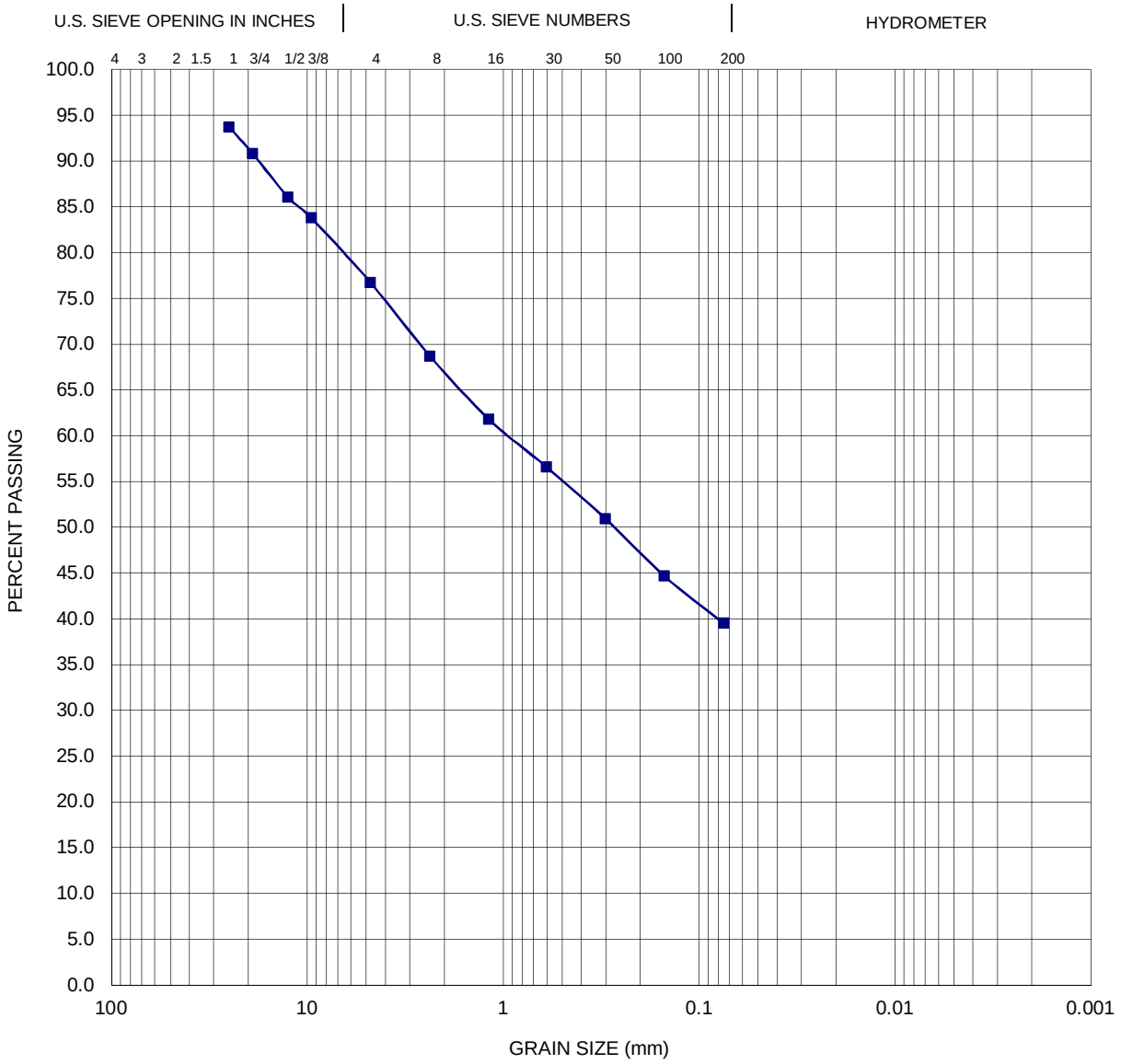
Particle Size Analysis - ASTM D422

Project: Rockaway Quarry

Location: Pacifica, California

Project No.: E8867-04-02

Figure B1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Pit: TP3

Depth To Sample: 3 - 4"

Sieve Date: 9/30/2015

Tested and Computed by: PG/JBM

Test Data

Sieve Number	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
% Passing	95.194	93.717	90.812	86.002	83.8	76.7	68.7	61.8	56.6	50.9	44.6	39.5

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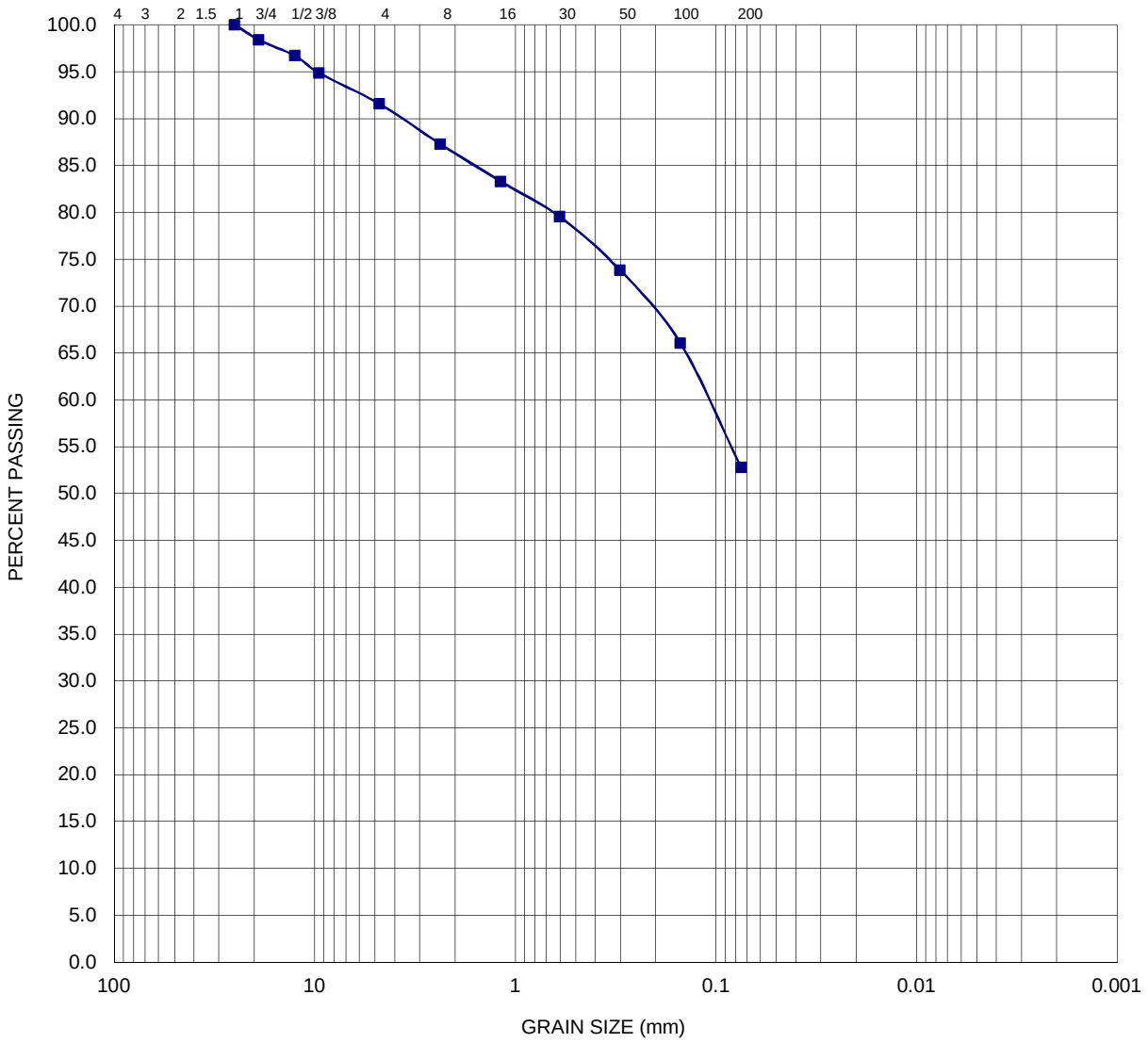
Particle Size Analysis - ASTM D422

Project: Rockaway Quarry

Location: Pacifica, California

Project No.: E8867-04-02

Figure B2



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Pit: TP5

Sieve Date: 9/28/2015

Depth To Sample: 2'

Tested and Computed by: PG/JBM

Test Data

Sieve Number	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
% Passing	100	100	98.403	96.684	94.9	91.6	87.3	83.3	79.5	73.8	66.0	52.8

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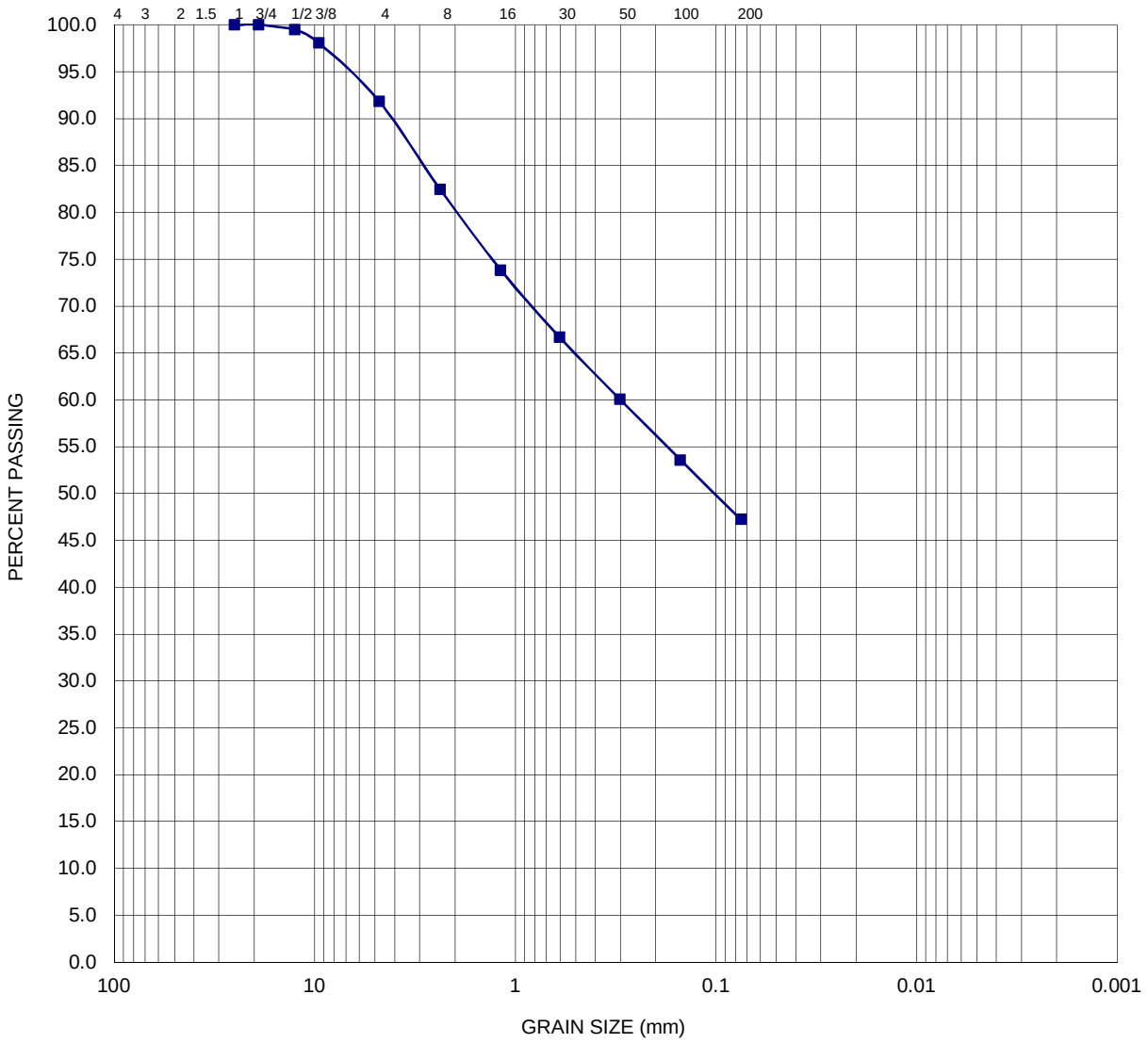
Particle Size Analysis - ASTM D422

Project: Rockaway Quarry

Location: Pacifica, California

Project No.: E8867-04-02

Figure B3



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Test Pit: TP6

Depth To Sample: 7 - 8'

Sieve Date: 9/28/2015

Tested and Computed by: PG/JBM

Test Data

Sieve Number	1 1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
% Passing	100	100	100	99.46	98.0	91.8	82.4	73.8	66.6	60.0	53.5	47.2

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Particle Size Analysis - ASTM D422

Project: Rockaway Quarry

Location: Pacifica, California

Project No.: E8867-04-02

Figure B4

APPENDIX C

APPENDIX C
RECOMMENDED GRADING SPECIFICATIONS

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, Geocon (Consultant) shall be engaged for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills or *soil-rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9 and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition.

4. CLEARING AND PREPARING AREAS TO BE FILLED

4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

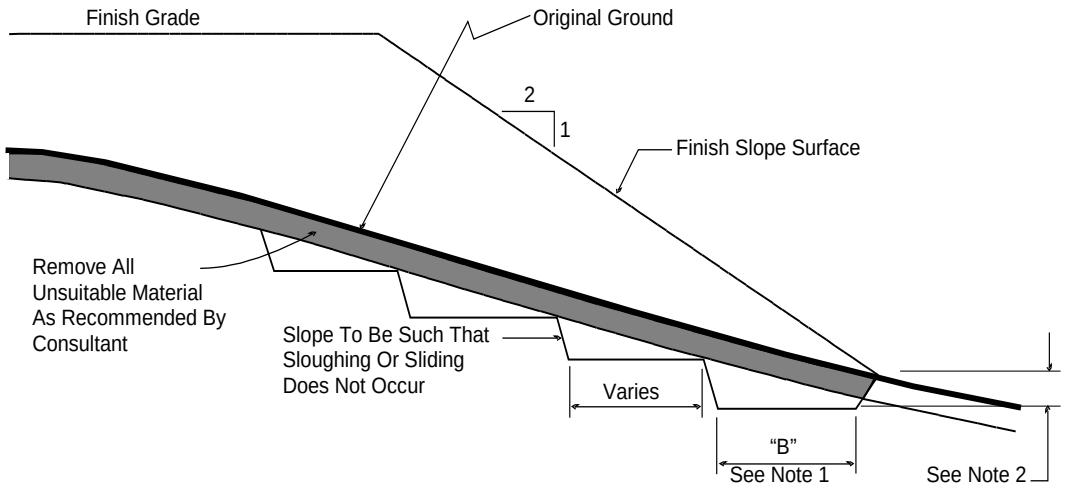
4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the

property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



No Scale

DETAIL NOTES:

(1) Key width "B" should be a minimum of 15 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 5 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 2 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 2 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 2 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 5 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 2 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 4 feet wide and 3 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

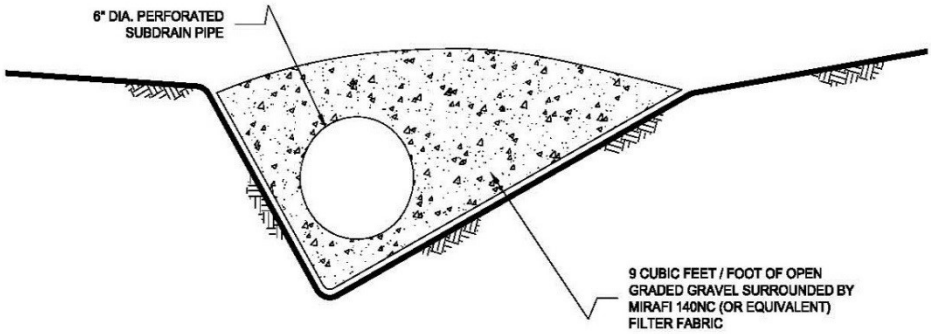
6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL SUBDRAIN DETAIL



NOTES:

1.....8-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2.....6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

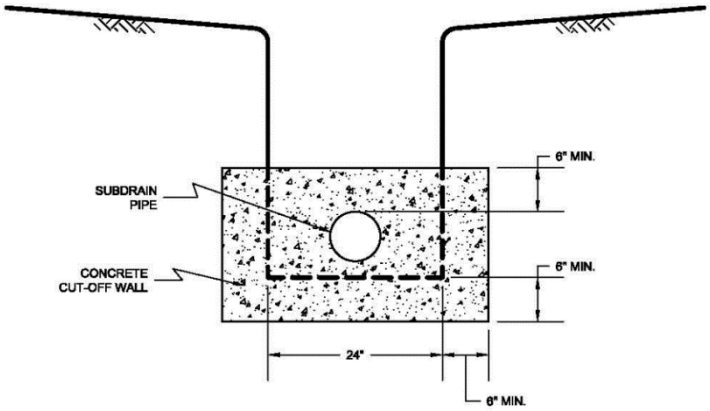
7.2 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.3 S*oil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric.

7.4 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

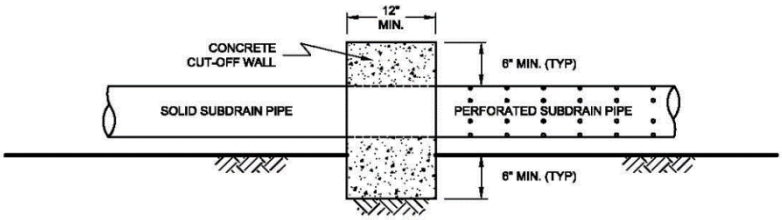
TYPICAL CUT OFF WALL DETAIL

FRONT VIEW



NO SCALE

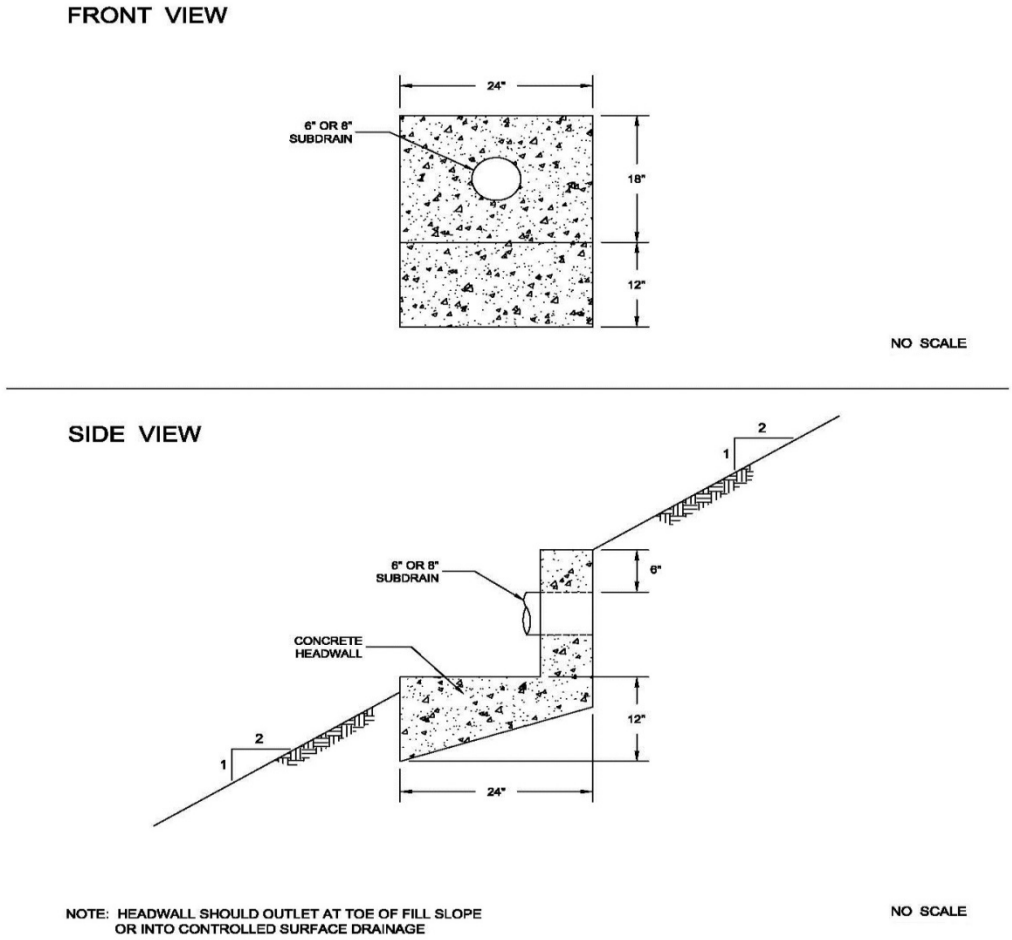
SIDE VIEW



NO SCALE

7.5 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

TYPICAL HEADWALL DETAIL



7.6 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an "as-built" map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. The testing interval should be increased to at least one test for every 1 foot of vertical elevation in fills that will support settlement sensitive improvements. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.4 Testing procedures shall conform to the following Standards as appropriate:

- Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*
- Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*
- Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop*.
- Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

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