E&B Oil Development Project

City of Hermosa Beach

Planning Application

Appendix D

Geotechnical Investigation

E&B Natural Resources

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E & B Oil Development Project

Geotechnical Exploration and Design Report
Hermosa Beach City Maintenance Yard
555 6th Street, Hermosa Beach, California 90254

prepared for

E & B Natural Resources Management Corporation

NMG
Geotechnical, Inc.

October 19, 2012

NMG
Geotechnical, Inc.

October 19, 2012

Project No. 12053-01

To: E&B Natural Resources
1600 Norris Road
Bakersfield, California 93308

Attention: Mr. Mike Finch

Subject: Geotechnical Exploration and Design Report for the Proposed E&B Oil Development Project Located at the Hermosa Beach City Maintenance Yard, 555 6th Street, City of Hermosa Beach, California

In accordance with your request and authorization, NMG Geotechnical, Inc. (NMG) has performed a geotechnical exploration at the site for the proposed E&B Oil Development Project in Hermosa Beach, California. The 1.3-acre site is currently a City of Hermosa Beach Maintenance Yard located at the northwest corner of 6th Street and Valley Drive. The main purpose of this study was to provide a subsurface exploration for preliminary geotechnical design of the proposed oil development project. This report was prepared in compliance with the California Environmental Quality Act (CEQA) and may also be used as the technical report for the CEQA documentation. We have reviewed a topographic map of the existing conditions prepared by Cornerstone Land Surveying, Inc. dated June 2012 which was used as the base for our Geotechnical Map (Plate 1). The conceptual grading plan prepared by ASHBA Engineers Limited and the Phase 4 Site Plan prepared by Processes Unlimited International (which represent the buildout of the proposed project) were combined for the base of our Geotechnical Map on Plot Plan (Plate 2).

The project aspects related to potential hazardous materials and environmental contamination are being handled by an environmental consultant, Brycon, LLC. NMG coordinated with representatives of Brycon during our site exploration. They provided subsurface data collected for their environmental study as well as input regarding the areas for our exploration. We understand Brycon is preparing a Phase I and II Environmental Site Assessment and remedial action plan. In addition, we understand that E&B has retained the services of GeoSyntec Consultants to evaluate the potential for regional subsidence as a result of oil extraction. They will also address the issue of produced water injection and its potential impact to regional seismicity. Therefore, these issues are excluded from this report.

The primary geotechnical constraints at the subject site include the presence of inert landfill materials and undocumented fill material, potential settlement of these materials, proximity of adjacent buildings and improvements, and the need for remedial earthwork to make the site suitable for planned structures.

This report provides our geotechnical findings and conclusions, and provides preliminary recommendations for the design, grading and construction of the proposed project at the subject site. Additional design and implementation level plan reviews, analyses, and possible exploration will be required once the final grading plan is available.

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

Respectfully submitted,

NMG GEOTECHNICAL, INC.

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EXECUTIVE SUMMARY

Based on NMG's geotechnical exploration and analyses, the development of the proposed oil development facility (the project) is considered geotechnically feasible provided the recommendations presented in this report are implemented for design, grading and construction of the project.

The subject 1.3-acre site lies approximately 0.4 mile inland from the beach in the City of Hermosa Beach, California. The site is underlain by windblown sand dunes that covered the region and occurred as an uneven ground surface in the natural conditions. In the 1920s/30s, the site had a large depression that was apparently mined for sand, and then used as the City Refuse Dump and Burner as early as 1927 and was apparently filled in by 1947. The resulting inert landfill consists of an approximately 45-foot deep excavation filled with glass, porcelain and ceramic toward the bottom and then with soils containing miscellaneous metals, wires, glass, etc. toward the top. An oil well drilled in 1931 in the southwestern portion of the site was abandoned in 2005. Adjacent properties have been developed for commercial/industrial use.

The grading at the site will include leveling of most of the site for the well drilling pad and oil processing equipment, with a tank farm in a depressed containment area (7 feet deep) in the eastern portion of the site. The containment area will be surrounded by a retaining wall with one ramp for access of smaller vehicles. The upper level will support the oil well cellars/pad, the office and electrical equipment, parking, loading areas, driveways and underground drain sump tanks. Access to the site will include entrances off of Valley Drive and 6th Street. A 16-foot-high block wall will be constructed around the facility; this free standing wall will be locally constructed on top of a retaining wall.

We understand the proposed facility will be developed in four phases. This report provides a summary of the geotechnical issues related to each phase. However, the report recommendations and options pertain to the Phase 4 Site Plan. Our geotechnical map is also presented on the Phase 4 Site Plan that shows the ultimate improvements.

The proposed grading at the site will include minor cuts and fills generally less than 10 feet thick/deep. In the area of the landfill, we have assumed that removals of the upper 15 feet are planned in the landfill area. After removal and recompaction there will be approximately 15 feet of compacted fill under the upper pad and 7 to 8 feet of compacted fill under the containment area. Outside the landfill area, removal and recompaction on the order of 2 to 4 feet deep to competent native soils are recommended. In addition, in cut areas exposing native soils, we recommend a minimum of 3 feet of removal and recompaction of the native soil to provide a uniform compacted fill below finish grade.

The primary geotechnical conditions and issues for the project consist of the following:

- The onsite native materials (dune sands) are dense and competent for support of structures but friable and prone to caving when excavated.
- Nearby earthquake faults will produce high ground shaking at the site during a large regional earthquake.

- The onsite inert landfill materials are loose and have high settlement potential with higher structural loads and with seismic shaking (seismic settlement).
- Shoring will be required to protect adjacent property along the north and northeast sides of the site for the planned 15-foot removals of contaminated soil.
- The 16-foot high block wall will likely required a pile foundation due to space constraints from adjacent properties and the left-in-place landfill.
- Due to the depth of the groundwater and the density of the native soils, the potential for secondary seismic hazards, such as liquefaction, is considered slight to nil.

Some of the tanks, equipment, and walls in the northern end of the site will not tolerate the relatively large potential seismic settlements of up to 3.5 inches that may result from the left in place landfill material. Either deep foundations to support these structures or some type of ground improvement to address these settlements will be necessary. Three of the most feasible options include:

1. Drilled-in-place, grouted pipe piles (Tubex brand),
2. Cast-in-drilled hole (CIDH) piles, and
3. Injection grouting of the landfill material (ground improvement).

The Tubex pile system has the advantage of low noise and vibration, high capacities and since they are drilled into the ground, they would not generate cuttings from the landfill material, which may need to be disposed offsite at an appropriate disposal facility.

CIDH piles typically would be less expensive than Options 1 and 3 but in this case, the piles would require casing due to the materials prone to caving at the site. The method also would generate contaminated spoils that would require offsite disposal at an appropriate disposal facility. These factors may push the cost of CIDH piles beyond the other options.

Injection grouting of the left-in-place landfill materials under the settlement sensitive structures would allow these structures to be constructed with conventional shallow foundations. Additional exploration to refine the landfill limits and thicknesses may be required to address some of the uncertainties associated with in-place treatment in this manner.

For lighter structures less sensitive to the estimated settlements, 15 feet of planned fill over the landfill areas will be sufficient for support of such structures on shallow conventional foundations. Stiffened foundations such as post-tensioned slabs may also be considered to address the settlement potentials for these structures.

Final design of foundations and selection of the most appropriate option to address potential settlement of the remaining landfill materials will be required once site plans and structural plans are finalized. Cost comparisons between alternatives may be better performed with more precise structural layouts and requirements.

1.0 INTRODUCTION

1.1 Purpose and Scope of Services

NMG Geotechnical, Inc. (NMG) has performed a geotechnical exploration at the proposed E&B Oil Development Project (the project) located at 555 6th Street, in the City of Hermosa Beach, Los Angeles County, California. The primary purpose of our services was threefold:

1. Characterize the geology and geotechnical properties of the site considering the planned construction.
2. Provide sufficient geotechnical engineering parameters to support project earthwork design and structural designs.
3. Prepare a report suitable for use as a technical appendix for the CEQA documentation.

A topographic map by Cornerstone Land Surveying, Inc. dated June 2012 was used as the base for our Geotechnical Map (Plate 1). The conceptual grading plan by ASHBA Engineers Limited was combined with the Phase 4 Site Plan for the proposed project prepared by Processes Unlimited International (ProU) and used as the base for our Geotechnical Map on Plot Plan (Plate 2). The topographic map was received by NMG on May 28, 2012 and the grading and site plans were received by NMG on October 16, 2012. The site plan and the grading plan were reviewed in light of the geotechnical conditions at the site for this study.

The geotechnical/geologic data collected during our study was compiled to create a subsurface model of the site and this data is presented on the Geotechnical Map (Plate 1). Plate 2 was prepared to show the geologic conditions, locations of borings and cross-sections on the conceptual grading and site plan. Two geologic cross-sections were also prepared to present the subsurface model (see Plate 3). This report presents our geotechnical findings, conclusions, and recommendations for design, grading and construction.

Our scope of services for this study was based in part on the project RFP received by NMG on April 25, 2012; discussions with the project team; and our experience with the similar projects.

Tasks included were as follows:

- **Background and Aerial Photo Review:** The background review included researching and compiling geotechnical data related to the site, including both published and unpublished reports, maps, and records for the subject site. This study also included a review of stereoscopic pairs of aerial photographs dating back to 1952, historic aerial photographs dating back to 1928, review of topographic maps dating back to 1896, and review of Sanborn Maps dating back to 1927. A complete list of the referenced reports, stereoscopic and historical aerial photographs and topographic maps reviewed is included in Appendix A.
- **Site Reconnaissance:** NMG visited the site to meet with representatives of the City of Hermosa Beach and to mark the locations for our subsurface excavations and coordinate underground utility clearance. During these field visits, existing site conditions were noted, geologic conditions were mapped and equipment access was evaluated.

- **Subsurface Exploration:** The subsurface exploration consisted of excavation, sampling and surface logging by an engineering geologist of eight hollow-stem-auger borings, and four CPTs (one of which was a seismic CPT). More information regarding the geotechnical exploration is presented in Section 2.1 of this report. The logs of the borings, trenches and CPTs are presented in Appendix B and the locations are shown on Plates 1 and 2.
- **Geotechnical Laboratory Testing:** Laboratory testing of selected earth material was conducted in general conformance with applicable ASTM test standards for soil classification and evaluation of engineering properties. Results are discussed in Section 2.7. Test results are summarized and the data are presented in Appendix C. The in-situ moisture content and dry density data are included on the geotechnical boring logs (Appendix B).
- **Geotechnical Analysis:** Geotechnical analysis of the collected data included preparation of boring location maps, creating an overall geologic site model (Plates 1 and 2), developing geologic cross-sections (Plate 3) and preparation of geotechnical boring logs. We evaluated and analyzed the proposed site plan with respect to remedial grading measures, settlement, seismic exposure, lateral earth pressures and liquefaction potential. The analysis and design recommendations are based on consultation with the project team. Geotechnical analysis also included seismic settlement analysis utilizing the computer programs CLiq and CPet (Appendix E) and determination of the soil moduluses (Sections 2.10 and 3.11).
- **Site Specific Seismic Hazard Analysis:** Site specific hazard analysis was performed at the subject site for both horizontal and vertical site accelerations. This analysis is presented in Section 2.5 and the data is presented in Appendix D of this report.
- **Report Preparation:** We prepared this report that provides our geotechnical findings, conclusion and recommendations, with accompanying illustrations and appendices, for the design, grading and construction of the proposed project at the site.

Our scope of work did not include environmental evaluations at the site. NMG has worked closely with the environmental consultant for the site, Brycon, LLC. E&B has also retained GeoSyntec to address the issues related to potential regional subsidence as a result of oil extraction and the potential effects of produced water injection upon the regional seismicity.

1.2 Site Location and Description

The subject site (1.3 acres) is currently used as the City of Hermosa Beach's maintenance yard at 555 6th Street in Hermosa Beach, California. The site is bounded by 6th Street on the south and Valley Drive on the east. The site is essentially flat with the majority of drainage to the west. Elevations range from 55.5 feet above mean sea level (msl) in the central portion of the site to 48 feet above msl along the western edge. Current access to the site is via driveways off of 6th Street and Valley Drive.

The majority of the site is paved and three buildings as well as numerous trailers, storage containers and sheds are located throughout the site. The building structure in the southern portion of the property has a partial basement accessible via a driveway along its northern edge. In addition, a vehicle service pit is located along the eastern edge of the building. Retaining

walls up to 8 feet high are located along the western and southern sides of the site. It is our understanding that the City of Hermosa Beach has utilized the site since at least 1927.

The properties to the north and west of the site are commercial properties. There is one long building to the north of the site and several different buildings to the west of the site that will need to be protected in place during the grading and construction on the subject property.

1.3 Site History and Prior Studies

We have reviewed historic aerial photographs that date back to 1920's, historic topographic maps dating back to 1896, and Certified Sanborn Maps dating back to 1927. These documents have revealed the following history at the site:

- In the 1920's, the old topographic maps show a large depression on the site. It is difficult to tell on the topographic maps and historic aerial photos whether the depression was a natural feature on the sand dunes or if it was a man-made depression to mine the sands. Based on the 1927 Sanborn Map, the site is designated as the City Dump and Refuse Burner, between Bard Street and Railroad Drive. (Bard Street crossed the central portion of the site and is now abandoned and Railroad Drive is now Valley Drive.) The Topeka and Santa Fe Railway ran along the eastern edge of the site and the majority of the existing roads were in their present location (but some may have been dirt roads).
- During the early 1930's, an oil well (Sinnett Oil Well #1) was drilled in the western portion of the property; first shown on the 1934 topographic map. The remaining portion of the site remained largely undeveloped with the existing pit visible on historic topographic maps.
- On the 1946 Sanborn Maps, a building had been constructed in the southwest corner of the site, labeled as the City Garage & W. Ho. (warehouse). This map also shows that the portion of Bard Street through the site was "(not open)".
- In the1947 photographs, it appears the quarry pit had been filled and the City garage building was constructed.
- In the 1953 photographs, there are also buildings to the west (offsite) and residential structures to the north (along 8th Street).
- By the mid1960's the area to the west of the site has been fully developed.
- In 1970, the adjacent structure along the northern property line had been constructed. The subject site does not appear paved and numerous stockpiles and equipment are visible throughout the site.
- By the mid 1980's, the subject site appears paved and the existing steel building in the northern portion of the property has been constructed.
- Since the early 1990's the site has remained largely unchanged except for the addition of a few sheds, trailers and storage containers.

There have been prior studies at the site for both environmental and geotechnical purposes. In 1994/1995, environmental studies onsite included an environmental site assessment and then a subsurface investigation (Entrix, 1994, 1995). These studies included 15 geoprobes to depths of

up to 46 feet below existing ground. They delineated the area of the historic municipal landfill in the northeast portion of the site and estimated that it was between 15 and 30 feet deep. At the time of the investigation, there were also three active underground storage tanks (USTs) onsite at the western side of the property and two concrete filled abandoned USTs at the far south end of the maintenance building. The locations of their geoprobes, E-1 through E-15 are shown on Plates 1 and 2 and the logs are included in Appendix B.

Also in 1994, there were two geotechnical reports prepared by Associated Soils Engineers, Inc. (1994a and b). During their study, they drilled five hollow stem borings to depths of up to 35 feet below existing ground. Shallow fill soils of 1 to 3 feet overlying native sands were found in most borings, except for Boring ASE-2. In this boring the fill extended to a depth of 29 feet and consisted of silty sands and sand, with large quantities of glass, tile, porcelain, brick, concrete, clay pipe, wire and wood. The locations of their borings, ASE-1 through ASE-5 are shown on Plates 1 and 2 and the logs are included in Appendix B. In addition, their laboratory data is included in Appendix C.

1.4 Proposed Grading and Construction

The site will be developed and graded in four phases as follows:

Phase 1 Site Preparation: This phase will prepare the project site for exploratory drilling and testing. The existing structures at the site will be relocated or demolished, a portion of a well cellar will be constructed and the site will be graded to drain toward the well cellar. A portion of the retaining wall along the west and southwest sides of the project will be constructed. There will be a temporary sound attenuation wall around the project throughout this phase. Improvements can be made for the adjacent streets and intersection.

Grading and remedial grading should be performed in the western and southwestern portions of the site to accommodate the well cellar and the perimeter retaining walls to be constructed on the west and southwest sides of the project. In addition, the basement under the maintenance building should be removed and filled in with compacted fill. The remainder of the project will be graded to drain; however, remedial grading will not be performed in these areas during this phase.

Phase 2 Drilling and Testing: This phase will be to conduct the drilling and testing of exploratory wells in order to determine the potential productivity and economic viability of the proposed project. Temporary construction trailer with associated utilities and temporary oil, water and gas handling equipment will be installed at the site during this phase.

No additional grading is considered necessary during this phase. The temporary structures will include a trailer, Baker tanks, trailer mounted equipment and above ground piping. This equipment is designed to be temporary and can tolerate relatively large settlements.

Phase 3 Final Design and Construction: If Phase 2 yields the production that E&B deems economically viable, and then Phase 3 would proceed. Phase 3 will include the remaining grading at the site, including excavation for the containment area, excavation of the landfill

materials and unsuitable materials, and grading the site to the ultimate conditions. The retaining walls around the containment area will be built and the perimeter block wall will be constructed. The permanent well cellar and associated piping and equipment will be installed.

This is the main phase where the site will be graded in its entirety, with removal of the landfill material and onsite unsuitable materials and placement of fill to design finish grades. Excavation for the containment area will be performed along with construction of retaining walls around the containment area.

Phase 4 Development and Operations: The purpose of this phase is to maximize oil and gas recovery from the reservoir by drilling additional wells and activating the permanent facility. There is no additional grading or construction during this phase.

We understand that the upper 15 feet of the landfill material will be excavated and some of this material will be taken offsite to an appropriate disposal facility as determined by Brycon during grading. Some of these landfill soils will also remain onsite. The acceptable landfill materials that are not exported, along with the cut materials in the containment portion of the site, will be used to replace engineered fill up to finish grades. The overall grading earthwork as designed is planned to balance after the initial export of the contaminated soils.

The Phase 4 Site Plan provided by ProU on October 16, 2012, shows the ultimate industrial development will consist of numerous structures and equipment including two well cellars, two thirty-foot long buried sump tanks, three phase separators, compressors, transformers, steel tanks, an office/control room building, electrical switch gear station, and interior access roads. Pad grade for the majority of the site will be near an elevation of 51.8 to 53 feet above mean sea level (msl). Two north-south trending well cellars will be located in the western portion of this pad to accommodate the drilling of 34 wells (30 oil and 4 water injection). Access to the site will be from 6th Street and Valley Drive. Above ground tanks will be grouped in a tank farm and processing facility in the eastern portion of the site, in a containment area at elevation 45 to 46.2 feet msl. The containment area will have a perimeter concrete retaining wall, on the order of 5 to 8 feet high.

A 16-foot high free-standing masonry block wall is planned around the site. This wall will be constructed on the retaining walls along the west, south and east sides of the site. The wall will also be within 2 to 15 feet of existing buildings on the property to the west and north. Based on the sections prepared by the Civil Engineer, ASHBA, it appears that where larger spread footings are not feasible due to space constraints, a pile and grade beam foundation is planned for the wall.

The following Table 1 was provided by ProU with descriptions of the types of structures and production equipment planned at the site, their estimated dimensions and weights and sensitivities to settlement.

TABLE 1 – TYPES AND SIZES OF PROPOSED STRUCTURES AND EQUIPMENT

Structure	*Estimated Foundation Size (sq. ft.)*	*Estimated Soil Pressure (psf)*	*Estimated Structure Height (ft.)*	*Remarks*
Water Surge Tank (2)	700	1,000 psf	16	Total settlements limited to 1 inch and the differential settlement limited to ½"
Clarifier	1,250	1,000 psf	16	Total settlements limited to 1 inch and the differential settlement limited to ½"
Oil Shipping Tanks (2)	1,250	1,000 psf	16	Total settlements limited to 1 inch and the differential settlement limited to ½"
Three Phase Separator	275	200 psf	16	Sensitive to differential settlements
Micro-turbines	265	200 psf	16	Sensitive to differential settlements
Induced Gas Flotation Cell	145	50 psf	16	Sensitive to differential settlements
Water Filter System	450	150 psf	16	
Lease Automatic Custody Transfer	90	100 psf	5	
Refrigeration Unit	150	150 psf	10	
Control Admin Building	620	500 psf	12	
Vapor Recovery Unit	150	200 psf	12	Sensitive to differential settlements
Gas Compressors (3)	385	200 psf	16	Sensitive to differential settlements
Diethanolamine Skid	400	250 psf	16	
Low Temperature Separator	240	250 psf	16	
Gas Combustor	9' diameter	100 psf	16	High Temperature
Switchgear Building	800	1,000 psf	14	Perimeter wall foundation
Drill Rig	90	4,500 psf	87	
Air Compressor System	90	100 psf	15	
16' Perimeter Wall	940 lf		16	Subject to crack, Load to piers Est. weight per foot = 2,200lbs
Sulfur Scrub	120	400 psf	16	
Pump Skids		Varies up to 50 psf		Sensitive to differential settlements

Based on this information, the proposed structures and production equipment are relatively lightweight, except for the drilling rig when it is onsite. The structures that are most sensitive to settlements and differential settlements include the water surge tank (2), clarifier tank, and oil shipping tanks (2), three phase separator, micro-turbines, VRU, gas compressors (3), 16-foot-high yard wall, and the pump skids.

2.0 GEOTECHNICAL FINDINGS

2.1 Geotechnical Exploration

The field exploration consisted of a detailed site reconnaissance and geotechnical subsurface exploration. The exploration was conducted between May 16 and 17, 2012 and included hollow-stem-auger borings and cone penetrometer testing (CPT). Additionally, geoprobes (GP-1 through GP-11) were performed by a representative of Brycon on May 8 and 9 and were supplemented later on June 6, 2012.

Borings: Eight 8-inch-diameter borings (H-1 through H-8) were drilled by NMG on May 16 and 17, 2012 with a CME 75 hollow-stem-auger drill rig to depths ranging from 31.5 to 51.5 feet below the existing ground surface. The borings were sampled and surface-logged. Soil samples were taken at 2.5- to 5-foot intervals using a California split-barrel sampler. Samples in Borings H-2 and H-7 were taken at 2.5 to 5 foot intervals alternating between a California split-barrel sampler and a Standard Penetration Test (SPT) sampler. The California split-barrel sampler was used to collect relatively undisturbed ring samples (2.5-inch-outside-diameter rings). The SPT was used to test the density of the granular soils as well as to collect disturbed samples of the in-place soils. The hollow-stem samplers were driven with a 140-pound hammer, free falling 30 inches. Bulk samples of onsite soil were collected from the hollow stem borings and used for additional soil identification purposes and laboratory testing. Soil samples were visually classified in accordance with the Unified Soil Classification System (USCS).

Cone Penetrometers and Seismic Cone Penetrometers: Four CPT soundings (CPT-1 through CPT-4) were conducted on May 17, 2012 to depths of 43 to 50 feet below existing ground surface. The continuous CPT data was used for identifying the soil stratigraphy and for evaluating the settlement potential. The CPTs were planned to be deeper; however, none of the CPT's were able to be advanced below depths of 43 to 50 feet since they had refusal on a continuous gravelly sand layer near those depths. One of the CPTs (CPT-1), used seismic cones to collect shear wave velocities at 10-foot intervals.

2.2 Geologic Setting

The subject site is located along the coastal portion of the Santa Monica Bay, within the southwestern Los Angeles (LA) Basin, approximately 0.4 mile inland from the beach. The site is underlain by Holocene-age dune sands west of the adjacent older alluvial deposits in the Los Angeles basin to the east. The onsite deposits generally consist of dune and drift sands that were deposited as ancient eolian (wind-blown) deposits.

Based on our review of published geologic data pertaining to the site, there are no faults mapped directly at the site (CGS, 2010). The closest active faults are the Palos Verdes Fault located 3 km (1.9 miles) west of the site and the Newport Inglewood Fault located 9.4 km (5.8 miles) east of the site. An earthquake event on these nearby or other farther regionally active faults is anticipated to produce seismic ground shaking at the site. The site is not located in a seismic hazard zone for potential liquefaction. It is also not located in a tsunami hazard zone as mapped by the California Geological Survey.

2.3 Earth Units

Based on our background research and geotechnical exploration, the subject is underlain primarily by Holocene-age dune deposits. In addition, a large part of the northeast portion of the site is underlain by inert landfill material up to approximately 45 feet deep. Relatively small amounts of undocumented artificial fill were also located throughout the site during our onsite exploration. Descriptions of the earth units are provided below and are listed from oldest to youngest. The mapped earth units are shown on Plates 1 and 2, and on the cross-sections on Plate 3.

Dune Sands (Map Symbol: Qds): Holocene-age dune deposits underlie the entire site and were encountered in all of our borings at depths ranging from 0 to 45 feet bgs. The dune sands generally consist of yellowish brown slightly silty to clean well-sorted sands that were medium dense to very dense. The material was typically massive, damp and friable. The blow counts were generally high, on the order of 13 or more blows per foot and dry density test results were typically 100 to 120 pcf with a low of 96 pcf and a high of 129 pcf.

Inert Landfill Material (Map Symbol: Afl): Inert landfill material was encountered within the northeast portion of the site to a depth of approximately 45 feet bgs. The landfill material consists of large amounts of glass, concrete, brick and metal fragments in the upper 15 feet and becomes primarily pottery shards and glass fragments below 15 feet. We understand the landfill material was placed during the late 1930's and early 1940's as part of a municipal dump for the City of Hermosa Beach. The material was generally loose and unconsolidated and had poor sample recovery. Portions of the lower landfill material also contained oily residue as well as a strong hydrocarbon odor (below a depth of 15 feet in H-5).

Undocumented Artificial Fill (Map Symbol: Afu): Relatively thin amounts of artificial fill were encountered near surface throughout the site. These fill materials are associated with minor grading as well as backfill for the existing structures and retaining walls at the subject site. The material was generally derived from the underlying dune deposits and consists of pale yellowish brown to brown sand with trace silt. The material was generally loose to medium dense and damp. The undocumented fill material may exist to depths of up to 10 to 15 feet deep in the southern portion of the landfill area (the delineation in this area is questionable) and also along the basement walls.

2.4 Faulting and Seismicity

Regional Faults: The site is not located within a fault-rupture hazard zone as defined by the Alquist-Priolo Special Studies Zones Act (CDMG, 1999). Based on mapping by the State (CGS, 2010), there are no known major active faults mapped at the site, and no evidence of active faulting was observed during this exploration. A detailed review of available geologic maps, historic aerial photographs and historic topographic maps indicate that there are no geomorphic expressions, offset drainage channels, or visible lineaments associated with active faulting at the site. A list of historic aerial photographs and the reference for historic topographic maps are provided in Appendix A (EDR, 2012a and b).

Based on our site-specific ground motion hazard analysis and the site coordinates of 33.859 degrees north latitude and 118.395 degrees longitude, the closest major active faults to the site are the Palos Verdes Fault located 3 km (1.9 miles) west of the site and the Newport Inglewood Fault located 9.4 km (5.8 miles) east of the site (USGS, 2002 and 2008). The computer program EQFAULT (Blake, 2004) was used to determine a list of over 30 other regionally active faults within 60 miles of the subject site that could produce seismic ground shaking at the site (Appendix D). The regionally active faults within 20 miles of the site including the maximum moment magnitude and distance are listed in Table 2. Figure 2 (rear of text) shows the approximate site location in relation to these regionally active faults.

Seismicity: Properties in southern California are subject to seismic hazards of varying degrees depending upon the proximity, degree of activity, and capability of nearby faults. These hazards can be primary (i.e., directly related to the energy release of an earthquake, such as surface rupture and ground shaking) or secondary (i.e., related to the effect of earthquake energy on the physical world which can cause phenomena, such as liquefaction and ground lurching). Based on our ground motion hazard analysis and detailed review of historic aerial photographs and topographic maps, the potential for primary ground rupture is considered low. The primary seismic hazard for this site is ground shaking due to a future earthquake on one of the major regionally active faults.

The seismic design parameters presented in Section 3.11 of this report are based on the 2010 California Building Code (CBC), and were obtained for the site utilizing the computer programs Seismic Hazard Curves and Uniform Hazard Response Spectra version 5.1.0 (USGS, 2011) and EZFRISK (Risk Engineering, 2011). The site specific seismic hazard analysis performed for the site is discussed in Section 2.5 below.

The maximum moment magnitude (M_W) for the Controlling Fault is 7.7, which would be generated from the Palos Verdes Fault (assuming the connected alternative). The site-specific seismic evaluation, including the output from EZFRISK (Risk Engineering, 2011), USGS (2002 and 2008) and EQFAULT (Blake 2000b), are included in Appendix D.

TABLE 2 – REGIONAL ACTIVE FAULTS			
Fault	***Maximum Moment Magnitude (M_W)***	***Approximate Distance and Direction from Site***	****Source***
Palos Verdes	7.7	3.0 km / 1.9 miles West	USGS, 2002 (updated 2008)
Newport Inglewood	7.0	9.4 km / 5.8 miles East	USGS, 2002
Santa Monica	6.6	21.1 km / 13.1 miles North	Blake, 2000b (updated 2004)
Malibu Coast	6.7	22.9 km / 14.2 miles North	Blake, 2000b (updated 2004)
Puente Hills Blind Thrust	7.1	22.9 km / 14.2 miles east-southeast	Blake, 2000b (updated 2004)
Hollywood	6.4	25.0 km / 15.5 miles northeast	Blake, 2000b (updated 2004)
Upper Elysian Park Blind Thrust	6.4	27.5 km / 17.1 miles	Blake, 2000b (updated 2004)
Anacapa - Dume	7.5	31.0 km / 19.3 miles	Blake, 2000b (updated 2004)
Northridge	7.0	33.0 km / 20.5 miles North	Blake, 2000b (updated 2004)
Raymond	6.5	33.2 km / 20.6 miles East	Blake, 2000b (updated 2004)

**Sources are referenced in Appendix A*

The secondary seismic hazards of tsunami or seiche are considered nil, as the site is near an elevation of over 50 feet msl and the site is not located within a State-mapped tsunami hazard zone (CGS, 2009) and there no confined bodies of water or reservoirs within the vicinity of the site. The site is also not located within a seismic hazard zone for liquefaction (CDMG, 1998 and 1999). Figure 1 shows the location of the site with respect to mapped zones of liquefaction near the beach. Due to the density of the native soils and the depth to groundwater, the potential for liquefaction at the site is very slight. There is a slight to moderate potential for seismic settlement of the landfill materials being left in place (see further discussion in Section 2.9).

2.5 Site Specific Seismic Analysis

NMG performed a site-specific analysis to provide horizontal and vertical seismic response spectra for the site. This includes determining site class, selection of appropriate attenuation relationships, probabilistic analysis and deterministic analysis. The seismic (ground motion) hazard analyses were performed using the computer program EZFRISK, version 7.62 (Risk Engineering, 2011) in conjunction with data from the US Geological Survey National Seismic Hazards Mapping Program (USGS, 2011) and in accordance with the appropriate methods

described in the American Water Works Association (AWWA) D-100-05 Section 13, the American Society of Civil Engineers (ASCE) Standard 7-05, the 2010 California Building Code (CBC) and Division of State Architect (DSA) requirements.

Site Class and Attenuation Relationships: Based on review of the subsurface data and shear wave velocities measured during our exploration, the subject site is classified as Site Class D (very stiff soil profile) in accordance with Table 1613.5.2 of the 2010 CBC. An average shear wave velocity of 250 meters per second for the upper 100 feet of soil (Vs_{30}) was used by the program for our analysis.

The regional attenuation relationships developed by Boore-Atkinson (2008), Campbell-Bozorgnia (2008) and Chiou-Youngs (2008) were used in our analyses for horizontal accelerations. For preparation of vertical acceleration response spectra, we used the vertical attenuation relationships by Abrahamson-Silva (1997), Cambell-Bozorgnia (2003), Somerville (2001) and Ambraseys et.al. (2005). These attenuation relationships, corrected for maximum rotated component of ground motion, were selected based upon their compatibility with the site-specific earth materials and seismic source conditions. The average spectral acceleration values from these attenuation relationships were used to generate the site-specific response spectra.

Probabilistic Analysis: Probabilistic seismic hazard analysis was performed to estimate the peak and spectral accelerations for the Maximum Considered Earthquake (MCE) ground motion values for all active faults within a 60-mile radius. Above attenuation relationships were used for our probabilistic analysis. We also used the maximum rotated component of the ground motion per California Division of State Architect (DSA) requirements. The probabilistic analysis was conducted for the MCE having a 2-percent chance of exceedance in 50 years, with a statistical return period of 2,475 years.

Deterministic Analysis: A deterministic seismic hazard analysis, assumed to attenuate to the site per the same attenuation relationships as the probabilistic method, was performed by evaluating the ground motions generated by maximum earthquakes on each of the active faults within the same search radius. The 84th percentile of the maximum rotated component of ground motion was used for this analysis. Using this methodology, the maximum earthquake resulting in the highest peak horizontal accelerations at the site would be a magnitude 7.7Mw event on the Palos Verdes Fault.

Site-Specific Design Response Spectra: For the site-specific analysis, the deterministic accelerations of the 84th percentile of the maximum rotated component of ground motion, at 5-percent damped, were compared to the results of the probabilistic analysis. The lesser of the probabilistic and larger of the 84th percentile deterministic and MCE deterministic lower limit spectrum is termed the Site-Specific MCE. The Site-Specific Design Response Spectrum is derived by taking 2/3 of the Site-Specific MCE spectral values (provided the results are not less than 80 percent of the Design Earthquake (DE) Response Spectrum).

Vertical Accelerations: Bozorgnia, et al. (1999) concluded that "the standard engineering practice of assigning the vertical/horizontal ratio a value of 2/3 is unconservative at short periods, especially for unconsolidated soil and in the near-source region, but conservative at long periods and should be modified." This indicates that the vertical component can equal or exceed

the horizontal component at shorter periods (higher frequencies). Site-specific spectrum plots for the vertical ground accelerations were generated using the previously described horizontal method and attenuation relationships for vertical accelerations in bedrock. The spectrum plots for vertical accelerations reflect higher accelerations at higher frequencies.

The seismic hazard analysis and graphs, including probabilistic and deterministic spectra and the final site-specific design response spectrum for horizontal and vertical accelerations, are presented in the attachment. The recommended site-specific seismic design parameters are tabulated in Section 3.11.

2.6 Groundwater Conditions

The site is located in the West Coast Groundwater Basin in the coastal area of Los Angeles County (SCHR, 2004, MWD, 2007, LADPW, 2012 and WRD, 2012). The West Coast Basin is bounded on the west and south by the Pacific Ocean, on the north by the Ballona Escarpment (an abandoned erosional contact from the LA River) and on the east by the Newport Inglewood Fault Zone (a natural groundwater barrier). The basin is underlain by deep alluvial deposits over 800 feet deep. This groundwater basin is primarily recharged from the barrier projects, from limited underflow from the Central Basin, and from the LA and San Gabriel Rivers.

In 1995, the West Coast Basin Barrier Project was expanded from its original 1953 experimental investigation. This sea water intrusion barrier consists of an approximate 9 mile long line of injection wells, extending from LA International Airport to Palos Verdes, where a combination of recycled and imported water is injected into the "200-foot sand", the "Silverado", and the "Lower San Pedro" Aquifers. This injection both adds water to the West Coast Groundwater Basin and mitigates sea water intrusion into the basin. This barrier is located east of the subject site. We understand that municipal groundwater wells for potable water source are located east of the barrier and that there are no municipal wells in use west of the barrier.

Groundwater was encountered within the native dune sand deposits in the four deeper geotechnical borings (H-2, H-5, H-7 and H-8) drilled at the site. Groundwater was found at depths between 47.7 and 49.3 feet below ground surface or at elevations of 4.5 to 5.3 feet above mean sea level. Based on these levels, the groundwater table at the site apparently has a very low gradient (0.005 percent) toward the north-northwest. The description of the earth materials below the groundwater table was pale yellow sand with gravel and cobbles; samples were disturbed and/or with no recovery. Also, CPTs probes were planned to go to 50 feet to 100 feet deep; however, all had refusal at depths between 43 and 50 feet deep on gravelly sand. Most of the prior borings and geoprobes excavated onsite were shallow (less than 40 feet deep) and only one boring (E-5) extended to a depth of 46 feet that did not note groundwater. To our knowledge, there have been no borings extended to depths below 51.5 feet deep at the site. Therefore, we cannot determine whether this is a perched groundwater table. Minor fluctuations in groundwater depth based on seasonal precipitation and offsite irrigation should be anticipated.

2.7 Laboratory Testing and Engineering Soil Properties

Geotechnical Testing: Laboratory testing was performed on representative samples of onsite soils collected during our field exploration to characterize their engineering properties. Tests performed on selected relatively undisturbed, SPT and bulk soil samples included:

- In-situ moisture content and dry density;
- Grain-size distribution;
- Maximum dry density and optimum moisture content;
- Consolidation;
- Direct Shear (undisturbed and remolded samples);
- R-Value;
- Sulfate content; and
- Corrosivity to metals.

Laboratory tests were conducted in general conformance with applicable American Society for Testing and Materials (ASTM) standard test methods.

The vast majority of native soils (Qds) at the site are sandy: mixtures of sands, silty and clayey sands, consisting of SM, SC and SP per the Unified Soil Classification System. The sands are generally friable and dense. The dry densities vary from 96.0 to 126.8 pounds per cubic foot (pcf) and the moisture contents vary from 0.6 to 24.6 percent which represent dry to very moist conditions. Significant hydro-consolidation (collapse) was not generally observed in our tests. The native soils have very low expansion potential.

The inert landfill materials are believed to be by-products of the glass factory that existed near the site and consists of mixtures of glass, porcelain, ceramics and other similar materials. Where these materials did not have a soil matrix, samples could not be recovered for laboratory testing due to their looseness.

Test results for this study are presented and summarized in Appendix C. In-situ moisture content and dry density data are included on the geotechnical boring logs (Appendix B). Other major properties are summarized below:

Shear Strengths: Shear strength tests were conducted on five relatively undisturbed soil samples representative of the native sandy materials. We also tested remolded samples intended to evaluate strength properties of fill that will be created by removing and recompacting some of onsite soil. All strength tests were direct shear tests.

Ultimate friction angles of the dune sands (Qds) ranged from 27 to 35 degrees (average of approximately 30 degrees) with cohesions of 0 to 30 pounds per square foot (psf). The peak values ranged from 32 to 43 degrees and 0 to 30 psf for friction angle and cohesion, respectively.

The remolded sample of the dune sand material had ultimate and peak internal friction angles of 30 and 32 degrees with zero cohesion.

Soluble Sulfates: Three samples were tested for soluble sulfates which can be detrimental to concrete. These samples were from the native sandy materials collected from depths of 0 to 10 feet. All samples had negligible sulfate exposure (16 to 52 parts per million, ppm).

R-Value: Three R-Value tests for evaluating pavement subgrades were performed on selected samples of the sandy native material. These soils have relatively high R-values which were in the range of 57 to 63.

Corrosion Potential: Soil corrosivity testing with respect to metals in contact with earth was conducted on three samples of the onsite soils collected from depths of 0 to 10 feet. The soils were tested for chloride, pH, electrical resistivity, and other chemical contents. The following Table 3 shows the test results:

TABLE 3 – SOIL CORROSIVITY RESULTS

Soil Corrosion Test	*Test Results*
Resistivity (ohm-cm)	2,640 to 10,800
pH	7.5 to 8.1
Chloride Content (ppm)	4.0 to 8.5

The corrosion protection recommendations provided by HDR Schiff are included with the laboratory test results in Appendix C.

2.8 Temporary Excavations

Temporary excavations will be required at the subject site during the demolition of the existing structures, as well as during removal of landfill materials. During Phase 1 demolition, the existing maintenance building in the southeast portion of the site has a basement on the north side of the structure. As this building is removed, there will be an approximate 10 foot deep excavation exposing uncertified artificial fill over dune sand. This excavation will need to be filled in during Phase 1 in order to place the temporary equipment over this area during Phase 2.

Also during Phase 3 grading, shoring will be needed when removing the landfill materials along the northern and eastern site perimeters. The excavations will be up to 15 feet deep (see Cross-Sections A-A' and B-B'). There are other utilities and structures such as the underground storage tanks that will require excavations to depths of over 10 feet for installation. Also, retaining walls will need temporary excavations into the native sands during construction.
The dune sands are typically clean and friable and the landfill materials are generally loose. These materials are subject to failure when excavated near vertical and are also subject to erosion during rains. Where shoring is utilized around the perimeter of the site during remedial removals, the sands will likely require lagging.

2.9 Settlement Potential

Three types of settlement were analyzed for this study:

1. Static settlement due to fill loads,
2. Static settlements due to weight of structures, and
3. Seismic settlement as the result of ground shaking from the design earthquake event.

Note that NMG has only addressed settlement issues related to the upper 50 to 100 feet of earth units below the site and the potential impacts to the future development. E&B has retained the services of GeoSyntec to study potential regional subsidence as a result of oil extraction.

Static Fill Loading: Because site grades are either being lowered (tank containment area) or will remain close to existing grades, little or no new fill loads are anticipated. Therefore, settlement from static fill loading is not expected to be significant.

Static Structural Loads: Some static settlement issues may arise from the heavier tanks that will be constructed over left-in-place landfill. However, the seismic settlement potential discussed below will be more significant and govern the design of these structures. Following removal and replacement of the contaminated landfill soil, the 15 foot compacted fill blanket will provide significant support of other structures and equipment at the site to mitigate potential settlement from static foundation loads. For lighter structures and equipment, conventional shallow foundations and slabs on grade will be sufficient.

Seismic Settlement: Strong seismic shaking can cause the densification of soils, resulting in local or regional settlement of the ground surface. During strong shaking, soil grains may become more tightly packed due to collapse of voids or pore spaces. This type of failure typically occurs in loose, granular, cohesionless soil and can occur in either wet or dry conditions. From our exploration, the native earth materials, aside from those that will be removed and recompacted, are relatively dense and therefore not prone to significant seismically induced settlements. Based on the results of our site exploration and analysis, we estimate that the native material will settle less than ½ of an inch during seismic ground shaking.

However, the existing inert landfill materials may be prone to significant seismic settlement. The seismic settlement of the inert land fill material could be up to 8.5 inches at their current conditions/thickness. After the remedial removal and replacement of the upper 15 feet of these materials, we anticipate total seismically induced settlement from the deepest remaining landfill material to be on the order of 3.5 inches. Such settlement and potential differential settlement are outside the tolerable limits of the surge tanks and clarifier tank as well as possibly some of the other smaller equipment that are planned over the landfill material that will be left in place. These potential settlements may be addressed by methods discussed in Sections 3.6 and 3.7.

2.10 Dynamic Soil Properties

Soil properties for dynamic foundation design were evaluated using the shear wave velocities measured at the site and in CPT-1. The following equations (from Bowles, 1996) were used for

calculation of the small strain dynamic parameters including Shear Modulus (G_o), Constrained Modulus (M_o) and Young's Elastic Modulus (E_o):

$$\nu = 0.5\frac{\left[\left(\frac{V_p}{V_s}\right)^2 - 2\right]}{\left[\left(\frac{V_p}{V_s}\right)^2 - 1\right]}$$

$$G_{\max} = \frac{\gamma}{(32.174)(144)}(V_s)^2$$

$$M_o = \frac{\gamma}{(32.174)(144)}(V_p)^2$$

$$E_o = 2(1+\nu)G_{\max}$$

Where γ is the total unit weight of the soil in kips per cubic foot (kcf), a value of 0.120 kcf was used based on the average and median values obtained from the borings. The number 32.174 converts the unit weight into mass density and the number 144 converts the moduli from kips per square foot to kips per square inch. Please note that in order to determine the compression wave velocity, we used a Poisson's ratio (ν) of 0.30.

Table 4 shows the low strain dynamic soil moduleses for various soil types at different depths.

TABLE 4 DYNAMIC SOIL PROPERTIES FROM CPT DATA			
Layer Depth[1] (ft.)	Low Strain Dynamic Moduli (ksi)		
	Shear G_o	*Constrained Mo*	*Young's* E_o
Inert Landfill	0.8	3	2
Compacted Artificial Fill	17	60	44
Native Soil 0-10'	14	49	36
Native Soil 10-20'	17	60	44
Native Soil Below 20'	26	90	67

2.11 Earthwork Bulking and Shrinkage

Due to the variability of earth materials at the site, earthwork volume changes are difficult to accurately quantify. The following estimates in Table 5 are based on laboratory testing of the onsite soil and our experience with similar materials:

TABLE 5 – BULKING AND SHRINKAGE ESTIMATES	
Material	*Approximate Percent Shrink/Bulk*
Undocumented Fill and Stockpiles (Afu)	5 to 10 percent shrink
Dune Sands (Qds)	0 to 5 percent shrink

2.12 Existing Utilities and Adjacent Structures

Numerous existing utilities cross the site and will need to be removed and/or relocated during onsite grading. Existing buildings, improvements and utilities adjacent to the site that are to be protected in place should be located and visibly marked prior to demolition and grading operations. Excavations adjacent to improvements to be protected in-place or any utility easement should be performed with care, so as not to undermine existing foundations or destabilize the adjacent ground.

Stockpiling of soils (more than 5 feet in height) at or near existing structures and over utility lines should not be allowed. Where deeper removals are required, shoring or other special measures (i.e., setback or laybacks) for safety and to mitigate the potential for lateral/vertical soil movements may be required.

2.13 Existing Abandoned Oil Well and Underground Storage Tanks

There is an existing oil well (Stinnet #1) that was drilled in 1931 in the western portion of the site. It is first mapped on the USGS Quadrangle map in 1934. This well was later abandoned on April 1, 2005 to the current standards of California Division of Oil, Gas, and Geothermal Resources (DOGGR). We also understand the casing was cut 10 feet below the surface of the lot prior to welding of the steel plate, so it is not anticipated to be encountered during grading and construction.

There are also former underground storage tanks that were reportedly abandoned in place by filling with concrete. The locations of these structures are not known at this time. These structures may be encountered during grading at the site and may require removal if in the way of grading or improvements.

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 General Conclusion and Recommendation

Based on our geotechnical exploration, analyses, and our understanding of the project, the development and construction of the proposed production facility is considered geotechnically feasible provided the recommendations presented in this report are implemented for design, grading and construction of the project.

The recommendations herein should be considered minimum to make the site suitable for the planned structures and site development. They may be superseded by more stringent requirements of others. In addition to the preliminary recommendations herein, General Earthwork and Grading Specifications are also provided as Appendix E.

3.2 Demolition, Site Clearing and Preparation

Significant amounts of building materials, abandoned equipment, concrete structures, pipelines and other deleterious materials to be demolished should be removed and disposed of offsite prior to the start of grading of Phase 1. The onsite utilities and structures that are to be removed may have trenches at depths below the recommended removal depths. These deeper trenches and excavations should be backfilled with compacted fill below the removal or overexcavation depth.

Demolished asphalt and concrete that is crushed and sufficiently free of deleterious material may be used at the site for engineered fill or aggregate base, provided it meets project specifications.

There is an abandoned oil well approximately 10 feet below existing ground surface in the western portion of the site. We anticipate that this well will not be encountered during grading. However, if it is found to be in the way of grading or construction, the contractor may need to contact DOGGR and then lower the well head and re-weld the steel plate over the top of the well casing. The previously mentioned underground storage tanks (UST) may be may remain in place provided they are filled with concrete slurry, as reported, and are not in the way of grading or future structures/equipment.

3.3 Remedial Grading Removals and Overexcavation

Remedial Removals: Unsuitable earth materials, including undocumented fill (Afu) and weathered dune sand (Qds) should be removed prior to placement of new fill. Estimated removal depths vary from 2 to 4 feet over most of the site. Removals in the landfill area will extend to a depth of 15 feet below existing grades for environmental purposes. Approximate remedial removal depths estimated from exploration data are presented on Plate 1.

The actual depths of remedial removals from a geotechnical standpoint (rather than environmental) should be determined in the field by the geotechnical consultant during grading based on the exposed conditions. Removal bottoms outside the landfill area should expose competent native dune sand deposits. The removal bottoms should be observed, mapped and accepted by the geotechnical consultant prior to placement of fill.

Remedial grading and removal of contaminated soil from the landfill will require temporary shoring along the northern and eastern site boundaries to protect adjacent property. This is addressed in Section 3.14.

Overexcavation: The majority of the eastern portion of the site will be excavated approximately 7 feet deeper than the majority of the pad with a retaining wall around the lower pad area; as containment around the proposed tanks. This design cut area should be overexcavated a minimum of 3 feet below design grades and recompacted in order to provide a uniform fill blanket for the proposed tanks and compressors and other equipment.

3.4 Grading and Earthwork Specifications

Grading and excavations should be performed in accordance with the County of Los Angeles Grading Manual and the NMG General Earthwork and Grading Specifications in Appendix F. Some specifications are reiterated below with additional recommendations:

Fill Placement and Compaction: After completion of acceptable remedial removal or overexcavation, the approved bottom should be scarified, moisture-conditioned, as needed, and recompacted prior to placement of fill. Fill should be placed in nearly horizontal lifts less than 8 inches in loose thickness, moisture-conditioned and compacted to a minimum 90 percent of the maximum density as determined by Test Method ASTM D1557 (except as discussed in following sections). Fills placed against ground sloping more than 5H:1V should be keyed and benched into competent material. Moisture content of compacted fill should be over optimum-moisture content and relatively uniform throughout the fill material.

Suitable Fill Materials: Onsite earth materials including dune sands, artificial fill and some of the uncontaminated landfill materials should be suitable for use as compacted fill provided they are relatively free of deleterious materials such as tires, wood, and metal. Concrete (without reinforcing steel) and asphalt concrete that is encountered onsite should be evaluated by the geotechnical consultant and owner who in turn may allow it to be crushed at an offsite location and placed in the onsite fills; larger pieces of concrete and asphalt may be placed at the geotechnical consultant's discretion in deeper fill areas as long as the material does not conflict with the installation of the proposed improvements. Oversize material placed in the deeper fills should be completely surrounded by and mixed in with fill soil without voids.

3.5 Settlement

As discussed in Section 2.9, static settlement from fill loading is not expected to be significant for the project.

Foundation Loading: The planned overexcavation and replacement of unsuitable soil described in this report should provide sufficient support for lighter structures, equipment, and paving both within and outside the landfill area. However, the larger and heavier tanks constructed over the left in place landfill area may induce settlements greater than the reported tolerances of 1 inch total and ½ inch differential. Seismic settlements could be even greater, therefore remedial options such as deep foundations or ground improvement are recommended and discussed in following sections.

Seismic Settlement: As discussed in Section 2.9, seismically induced settlement on the order of 3.5 inches may result from the landfill material that will be left in place. From the subsurface information gathered by NMG and Brycon, the seismic settlement may affect the two surge tanks and possibly the clarifier tank. Several other pieces of equipment including the oil-water-gas separator, micro-turbines , pump skids and VRU are also planned in the landfill area and may be affected by the seismic settlements.

The most feasible ground improvement option to address the seismic settlement of left-in-place landfill material would be insitu grout injection, discussed in the next section.

3.6 Ground Improvement Option

We have consulted with a geotechnical specialty contractor to determine that the most feasible ground improvement technique to mitigate the settlement potential of the left-in-place landfill material would be high pressure grout injection (compaction grouting). This technique involves driving grout tubes into the zone being treated and injecting cement grout to fill voids and densify the surrounding material by displacing it with grout. The grout tube is incrementally withdrawn and successive zones of soil are grouted until the entire vertical column of soil to be treated is grouted. For the subject project, grout injection points would be spread out below the areas where settlement sensitive structures are planned. With this technique, structures over the treated areas could be constructed on conventional shallow foundations.

To implement this ground improvement technique, the area to be treated and the targeted zones below ground to be grouted should be defined, based on the subsurface model of the landfill and final tank and equipment layout. Additional exploration may be recommended to refine the model of the landfill (limits, depths, and material distribution). The specialty contractor shall submit a plan of treatment including injection point locations, grout intervals and acceptance criteria for review by the geotechnical consultant.

3.7 Deep Foundation Options

The seismic settlement potential of the landfill may be mitigated by supporting the more settlement sensitive structures and equipment of deep foundations that would extend below the landfill material into the competent native soil below (dune sands). We understand that driven piles are not feasible due to noise and vibration. Therefore cast-in-drilled-hole (CIDH) piles or drilled-in-place piles are the remaining deep foundation options.

3.7.1 Drilled-in-place Piles

A drilled-in-place pile is installed by drilling the pile into the ground, much like an auger. The advantages of this type of pile is that they do not generate drill cuttings, do not produce much noise or ground vibration, and can develop very high load capacities. The drilled-in-place piles most applicable to this project would be pipe piles that can also be grouted after installation. The specific piles that were evaluated and deemed most suitable for this project are referred to as Tubex Grout Injection Piles. Feasibility analysis indicates that 16-inch diameter Tubex piles (grouted diameter of 22 inches) on

the order of up to 45 feet deep (into the competent native soil below the landfill) could have axial capacities of 400 kips.

3.7.2 CIDH Piles

As an alternative to drilled-in-place piles, the cast-in-drilled-hole pile may be used. CIDH piles will generate soil cuttings that will need to be disposed of in the same manner as the contaminated landfill material. The friable sands and the landfill materials such as glass are also highly prone to caving and therefore the CIDH borings will most likely require casing. The pile designs presented below assumes that any casing will be removed and the piles will be in direct contact with surrounding earth and landfill material.

The geotechnical design analysis for CIDH piles was performed using the computer programs SHAFT and LPILE. The geotechnical aspects of the caisson design are intended to assist and supplement the structural aspects of design. SHAFT was used to evaluate the axial capacity and settlement of the piles. LPILE was used to evaluate the lateral capacity of the piles. The results of the computer analysis are summarized below.

Axial Capacity: The design axial capacity curves were developed for 24- and 36-inch diameter cast-in-drilled hole caissons. In developing the axial capacity curves, the upper 2 feet of the onsite soil is considered to be deformable and is not relied upon for the development of skin friction. The allowable and ultimate (factor of safety of 2.5 for skin friction and 3.0 for end bearing) capacity of the piles are shown on Table 6.

For our axial analysis we used 55-foot-deep caissons with 24- and 36-inch diameters.

Table 6 provides the allowable and ultimate axial load conditions for compression and uplift cases with the specified embedment.

TABLE 6 – CAST-IN-PLACE CAISSON DESIGN RECOMMENDATIONS

Caisson Diameter	*Embedment*	*Allowable Axial Load (compression) (kips)*	*Ultimate Axial Load (Compression) (kips)*	*Allowable Axial Load (uplift) (kips)*	*Ultimate Axial Load (uplift) (kips)*
24"	55'	125	315	100	220
36"	55'	190	480	165	360

The depths are provided as a preliminary guideline and may require modification based upon the actual location of the piles.

Lateral Capacity: The lateral design analysis for the cast-in-drill caissons used the following parameters as provided by the structural engineer:

- Concrete ultimate strength, f'_c, of 4,000 psi;

- Assume a non-yielding elastic section; and
- Axial loads per Table 6 (125 kips for 24" caisson and 190 kips for 36" caisson).

Once the caissons are designed and the actual cracked moment of inertias are calculated we may need to revise our design parameters provided in Table 7. We do not anticipate significant changes for the free-head conditions; however, the change in moment of inertia will significantly impact the shear and moment parameters for the fixed-head caisson.

The calculated LPILE results are tabulated below.

TABLE 7 – CAST-IN-PLACE CAISSON LATERAL DESIGN PARAMETERS

Caisson Size	*Pile Head Deflection (in.)*	*Pile Head Shear (kips)*	*Maximum Moment (k-in.)*	*Depth to Maximum Moment from Pile Top (ft.)*
24 in diameter, 55 ft Deep Free-Head	0.1	5.9	302	7.2
	0.25	14.7	755	7.2
	0.50	28.8	1,507	7.2
24 in diameter, 55 ft Deep Fixed-Head	0.1	13.1	809	0
	0.25	32.7	2,022	0
	0.50	56.8	3,681	0
36 in diameter, 55 ft Deep Free-Head	0.1	9.7	599	8.0
	0.25	24.3	1,498	8.0
	0.50	48.5	2,996	8.0
36 in diameter, 55 ft Deep Fixed-Head	0.1	19.0	1,695	0
	0.25	47.6	4,238	0
	0.50	95.1	8,475	0

Caisson Spacing and Clearance: We recommend that the caissons be spaced a minimum of five diameters apart. This will minimize the group effect of the caissons. If the caissons are to be located at closer spacing than recommended above, then the group effect of the caissons (and the arching effect) will need to be taken into consideration and analyzed.

Caisson Settlement: Our calculations indicate that the total settlement for the 24- and 36-inch-diameter caissons, 55 feet deep will be no more than approximately ¼ inch under the allowable design axial loads as shown on Table 6.

Horizontal Subgrade Reaction: The constant of horizontal subgrade reaction (η_h) as determined by Terzaghi (1955) or the coefficient of variation of lateral subgrade reaction (f) as determined by NAVFAC is recommended to be 35 pci for embedment into competent fill material. We recommend the value to be reduced to 15 pci, if embedded in inert landfill materials.

3.8 Shallow Foundations and Slabs-on-Grade

Structures and equipment outside the landfill area or that can tolerate the estimated seismic settlement stated in Section 3.5 may be constructed on conventional shallow foundations.

Small Isolated Foundations and Continuous Foundations: A net allowable bearing capacity of 2,000 psf may be assumed for a 12-inch-wide footing embedded 12 inches below lowest adjacent grade. This may be increased by 400 psf for every additional foot of width and by 800 psf for every additional foot of embedment depth up to a maximum of 3,500 psf. The allowable bearing pressure may be increased by one-third for wind and seismic loading. We recommend that strip and isolated footings for larger structures have a minimum embedment depth of 18 inches.

For lateral resistance against sliding, a friction coefficient of 0.38 may be used at the soil-foundation interface.

Interior Slabs-on-grade: For more lightly loaded slabs-on-grade for building interiors, a coefficient of subgrade reaction (k_s) of 150 pci and a modulus of elasticity (E_s) of 2,000 psi may be used for compacted fill with the properties described in Section 3.4.

Structures or equipment requiring mat foundations may be designed with the following parameters. Mat foundations over left-in-place landfill material should be analyzed by the geotechnical consultant to determine potential settlements for specific loading and mat areas that, in turn, should be reviewed and accepted by the designing structural engineer.

Mat Foundations: Net bearing capacity of larger mat foundations should be limited for to a maximum allowable bearing capacity is 3,500 psf. For larger mat foundations (typically 15'x 15' or larger) we recommend a coefficient of subgrade reaction value of 50 pci.

Slabs-on-grade: Slabs-on-grade for occupied interior spaces such as the office / control room building should be a minimum of 4 inches thick. Slabs in office or other occupied spaces should be provided with a vapor retarder below the slab. Suitable retarder material, thickness and permeance should be specified by the project architect depending on the use of the space and sensitivity to moisture of the flooring and other objects in contact with the floor.

Interior slabs-on-grade that will be subject to equipment traffic such as forklifts or other vehicles should be a minimum of 5 inches thick with minimum reinforcement consisting of No. 3 rebar, 18 inches on center, both directions. Ultimately, design of floor slabs with significant static and/or dynamic loads is the purview of the structural engineer.

3.9 Lateral Earth Pressures

There are a significant amount of inert landfill materials within the northeastern areas of the site including the property locating along the northern perimeters of the site. The estimated lateral earth pressures presented in Table 8 are for structures retaining inert landfill materials (built-in-place retaining structures) in drained conditions.

TABLE 8 – LATERAL EARTH PRESSURES FOR INERT LANDFILL MATERIALS

	Equivalent Fluid Pressure (psf/ft.)
Conditions	*Level*
Active (drained)	64
At Rest (drained)	83
Passive (drained)	220 (Maximum of 2,000)
Seismic	+14 (see text below)

For retaining structures backfilled with approved onsite soils with sufficient drainage provisions (drained condition), the lateral earth pressures presented in Table 9 are recommended.

TABLE 9 – LATERAL EARTH PRESSURES FOR COMPACTED FILL/NATIVE MATERIALS

	Equivalent Fluid Pressure (psf/ft.)	
Conditions	*Level*	*2:1 Slope*
Active	40	65
At Rest	60	85
Passive	360 (Max. 6,000)	135 (if sloping in front of wall)
Seismic	+14 (see text below)	--

To design an unrestrained retaining wall, such as a cantilever wall, the active earth pressure may be used. For a restrained retaining wall, such as a vault or at restrained wall corners, the at-rest pressure should be used. Passive pressure is used to compute lateral soils resistance developed against lateral structural movement. Further, for sliding resistance the friction coefficient of 0.38 may be used at the concrete and native/compacted artificial fill material interface. This value may be increased to 0.55 for the keyway below the wall base. The passive resistance is taken into account only if it is ensured that the soil against embedded structure will remain intact with time. The retaining walls may also need to be designed for additional lateral loads if other structures or walls are planned within a 1H:1V projection from the back of the wall footing.

Seismic: The seismic lateral earth pressure given in the table above represents an additional lateral force that should be added to the static active and at-rest pressure. The additional seismic force distribution should have a triangular distribution similar to active and at-rest conditions, with the maximum force toward the bottom of the wall and zero at the top.

Drainage: Where feasible, retaining walls should be provided with drainage. Surface drainage, such as a concrete V-ditch, should be provided along the top of walls. Down drains (outlets) for surface drainage should not be tied into the subdrain system for walls; they should be outlet separately. Recommendations for drainage behind retaining walls are provided in the attached detail (Figure 3, rear of text). If adequate drainage is not feasible, the retaining wall design should consider the additional loads due to hydrostatic pressures.

3.10 Perimeter Free-Standing Wall and Retaining Walls

Portions of the perimeter block wall and the containment area retaining wall will be constructed over left-in-place landfill material that is prone to seismic settlements of up to 3.5 inches. At least 2 inches of this may be differential settlement over a 40-foot span due to the nature of the landfill materials. Unless the walls are designed with deep foundations or ground improvements, impacts to the walls could include leaning, cracking, or compromised containment capabilities of the containment area walls. Pile foundations would address the potential settlements. They should be designed by a structural engineer in collaboration with the geotechnical consultant based on the final wall locations, vertical and lateral loads and the anticipated soil conditions.

Temporary shoring (most likely a cantilever pile or sheet pile wall) will be required along the north and east sides of site to facilitate the 15 foot deep removals of landfill material. If left in place, a pile wall will most likely conflict with the foundation for the 16-foot high screen wall. We recommend that the structural engineer for the screen wall consider designing the excavation shoring such that it can be used as the foundation for the screen wall that will be constructed along the same line.

3.11 Seismic Design Values

The following Tables 10 and 11 summarize the seismic design criteria for horizontal and vertical acceleration, respectively, at the subject site. The site coordinates of 33.859 North and 118.395 West were used.

TABLE 10 – SEISMIC DESIGN PARAMETERS FOR HORIZONTAL ACCELERATION

Selected Seismic Design Parameters for Horizontal Acceleration	*Seismic Design Values*
Nearest seismic source	Palos Verdes Fault
Distance to nearest seismic source	3.13 miles (5.0 km)
Site Class per Table 1613.5.2 of CBC 2010	D
Mapped spectral acceleration for short (0.2 sec) periods (S_S)	1.939g
Mapped spectral acceleration for 1-second periods (S_1)	0.811g
Maximum considered earthquake spectral response acceleration for short periods (S_{MS}) from *site-specific analysis*	1.551g
Maximum considered earthquake spectral response acceleration for 1-second periods (S_{M1}) from *site-specific analysis*	1.136g
Five-percent damped design spectral response acceleration at short periods (S_{DS}) from *site-specific analysis*	1.034g
Five-percent damped design spectral response acceleration at 1-second period (S_{D1}) from *site-specific analysis*	0.757g
Peak ground horizontal acceleration *site-specific analysis*	0.433g
Moment magnitude for the controlling fault, Mw	7.70

TABLE 11 – SEISMIC DESIGN PARAMETERS FOR VERTICAL ACCELERATIONS

Selected Seismic Design Parameters for Vertical Acceleration	*Seismic Design Values*
Nearest seismic source	Palos Verdes Fault
Distance to nearest seismic source	3.13 miles (5.0 km)
Site Class per Table 1613.5.2 of CBC 2010	D
Maximum considered earthquake spectral response acceleration for short periods (S_{MS}) from *site-specific analysis*	1.551g
Maximum considered earthquake spectral response acceleration for 1-second periods (S_{M1}) from *site-specific analysis*	0.974g
Five-percent damped design spectral response acceleration at short periods (S_{DS}) from *site-specific analysis*	1.034g
Five-percent damped design spectral response acceleration at 1-second period (S_{D1}) from *site-specific analysis*	0.649g
Peak ground vertical acceleration *site-specific analysis*	0.560g
Moment magnitude for the controlling fault, Mw	7.70

3.12 Dynamic Soil Properties

Soil properties for dynamic foundation design were evaluated using the shear wave data collected at CPT-1 location. Our findings are summarized in tabular form in Section 2.10.

As previously discussed, we anticipate that the upper 15 feet of soil within the inert land fill area will be removed and, at minimum, 8 feet of compacted fill will be placed. Thus, we anticipate that the structures in this zone will be placed over 8 to 9 feet of fill. The remainder of the site will have 2 to 4 feet of removal and re-compaction. The design parameters provided for fill materials may be used for the foundations and slabs placed on 3 feet of fill.

3.13 Pavements

For preliminary purposes the following pavement sections for various traffic indexes (TI) and a design R-value of 40 are provided. In general, structural pavement sections should be based on R-value testing after the completion of the grading and calculated traffic volumes and loads, including the construction traffic. The pavement section must accommodate the heavier drill rigs which we understand weigh on the order of 100,000 pounds.

TABLE 12 – PRELIMINARY ASPHALT PAVEMENT SECTIONS

Traffic Index	Pavement Sections (ft)
5.5	0.50 AC over Native Subgrade or 0.25 AC / 0.50 AB
6	0.55 AC over Native Subgrade or 0.25 AC / 0.55 AB
6.5	0.60 AC over Native Subgrade or 0.35 AC / 0.50 AB
7	0.65 AC over Native Subgrade or 0.35 AC / 0.55 AB

Where AC = Asphalt Concrete and AB = Aggregate Base

Asphalt pavement should be placed in accordance with the requirements of Section 301 and 302 of the Standard Specifications of Public Works Construction (The Green Book). Prior to construction of pavement sections, the subgrade soils should be scarified to a minimum depth of 6 inches, moisture-conditioned as needed, and recompacted in place to a minimum of 90 percent relative compaction per ASTM D1557. If asphalt concrete is placed directly over the native soil, the subgrade soil should be compacted to a minimum of 95 percent relative compaction. Subgrade for the proposed pavements should be firm and unyielding.

AB materials should be crushed aggregate or crushed miscellaneous base in accordance with The Green Book. The materials should be free of any deleterious materials. AB materials should be placed in 6- to 8-inch loose lifts, moisture-conditioned as necessary, and compacted to a minimum of 95 percent relative compaction per ASTM D1557. AC should also be compacted to a minimum of 95 percent relative compaction.

PCC Pavement: For preliminary budgetary purposes, concrete pavements for light duty vehicles constructed over competent compacted fill of at least 3 feet in thickness should be at least 5 inches thick and reinforced with No. 4 rebar, spaced 24 inches on center, both directions. Heavy duty PCC pavements for trucks and cranes should be a minimum of 7 inches thick, reinforced with No. 4 rebar, 18 inches on center, both directions. Final PCC pavement designs should be based on graded subgrade soil conditions and calculated truck traffic volumes and axle loads.

Subgrade soil or AB directly below PCC pavement should be compacted to a minimum of 95 percent relative compaction, per ASTM D1557. Subgrade soil underlying AB should be compacted to a minimum of 90 percent relative compaction. Concrete should be placed and cured in general conformance to American Concrete Institute recommendations.

We understand that the concrete platform around the well cellars will be a reinforced structural slab designed by a structural engineer to support the large loads generated by the well drilling equipment.

3.14 Trench Excavation and Temporary Shoring

Trench excavations should be stabilized per the latest edition of Cal/OSHA requirements (shoring or laying back of trench walls). Site soils are generally classified as Type "C" per Title 8 California Code of Regulations. Excavations into undisturbed alluvium may encounter zones of friable sands that may be prone to run or cave. Also, the inert fill materials are expected to be loose and prone to caving. For excavations less than 20 feet in depth, the contractor should use the published Cal/OSHA shoring systems and follow their construction requirements. Shoring that deviates from OSHA standards or for excavations greater than 20 feet in depth should be designed by a registered professional engineer.

Shoring for the planned excavations along the northern perimeter of the site must be designed by an experienced structural engineer because of the close proximity to existing buildings that must be protected from potential settlement and lateral movements. Additional loads on the shoring from the adjacent buildings must also be accounted for in the shoring design. Ordinary soil loads are provided below that do not include the effects of the additional loads from buildings or other surcharges.

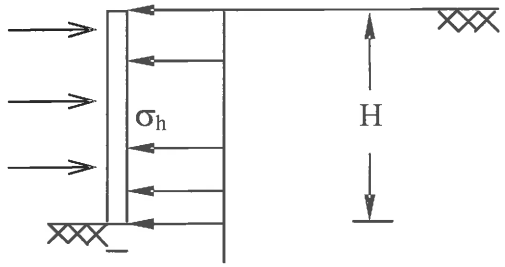
When soldier piles are used for shoring (with no more than one level of tiebacks), triangular stress distributions may be used for the loading from soil with the equivalent fluid pressures provided in Section 3.9 for native/compacted fill and inert landfill materials (psf/ft).

For braced shoring (or more than one level of tiebacks), a uniform pressure may be assumed for the soil loading, as presented in Table 13.

TABLE 13 – LATERAL EARTH PRESSURES FOR BRACED SHORING

Soil Condition	σ_h
Engineered Artificial Fill	26 H
Native Alluvium	26 H
Inert Landfill	42 H

Where "H" is the retained height of the shoring, in feet, and σ_h is the uniform soil pressure in psf, as illustrated below:



For design of wood lagging, the above applied pressures may be reduced by 40 percent. Our recommended lateral earth pressures do not contain an appreciable margin of safety, but are intended to be used for design with appropriate load/resistance factors or a factor of safety.

We recommend that shoring with continuous sheeting or trench shields be used during construction of buried utilities in trenches with vertical sides. Heavy construction loads and stockpiles of excavated soils should be kept away from the edge of trenches, at minimum, a distance equal to the depth of the excavation. Otherwise, these surcharges will need to be considered for the design of the shoring system. Also, the shoring may be needed to protect existing utilities and improvements in-place.

Native soils should be suitable for use as trench backfill. Backfill materials should be compacted to a minimum relative compaction of 90 percent (per ASTM D1557).

3.15 Cement Type

The results of the laboratory testing of onsite soil that may end up at the graded pad surface indicate soluble sulfate exposure levels in the "negligible" range, per Table 4.3.1 of ACI-318 which would allow Type I or II cement. Cement type and mix design for structural concrete with respect to soluble sulfates should conform to the ACI recommendations.

3.16 Soil Corrosivity

Onsite soils are corrosive to metals. Specific recommendations pertaining to corrosion protection are provided in the report prepared by HDR Schiff included in Appendix C.

3.17 Surface Drainage

Inadequate control of surface runoff or heavy irrigation after development of the site may result in nuisance seepage conditions and/or erosion. Maintaining adequate surface drainage, proper disposal of runoff water and control of irrigation will help reduce the potential for future moisture-related problems. Ponding of water on structural pads should not be allowed.

Surface drainage should be carefully taken into consideration during site planning, grading and future structural design and construction. Positive surface drainage should be provided to direct runoff away from slopes and structures and toward roadways or suitable drainage devices. The devices should be maintained and periodically cleaned out, especially immediately before and during the rainy season.

3.18 Future Plan Reviews

The final grading plan for the proposed development should be reviewed and analyzed by the geotechnical consultant prior to grading to determine if additional recommendations are needed or the recommendations herein should be modified.

Each phasing plan should also be reviewed and the appropriate remedial recommendations be provided in consideration of the next phase of work. Geotechnical analyses with recommendations specific to engineered grading plans, proposed structures, and associated site improvements should be issued once construction level plans are available.

Final block wall, retaining wall, temporary shoring, and structural foundation plans should reviewed by the geotechnical consultant to verify conformance to the most current geotechnical recommendations.

3.19 Settlement Mitigation Cost Analysis

For the three options to address settlement that were presented (Tubex piles, CIDH piles, injection grouting), the costs may be better evaluated once structural requirements are further defined. This will allow more precise calculations of the number of piles and the injection grout treatment area which will allow contractors to provide more accurate cost estimates.

3.20 Geotechnical Observation and Testing during Grading and Construction

The findings, conclusions and preliminary recommendations in this report are based upon interpretation of data and data points having limited spatial extent. Verification and refinement of actual geotechnical conditions during grading is critically important, especially when temporary slope stabilization is involved. At minimum, geotechnical observation and testing should be conducted during grading at the following stages:

- During demolition of the existing structures and underground utilities/structures;
- Following clearing and grubbing, prior to site processing or fill placement;
- During and following cutting of temporary slopes for remedial grading;

- During installation of shoring;
- During and after remedial removals;
- During fill placement;
- During and after excavations and backfill for utilities or structures;
- When any unusual or unexpected geotechnical conditions are encountered during grading and construction.

Observation and testing during construction of structures, utilities and pavements should be as follows:

- Following retaining wall foundation excavations;
- During subdrain installation (if any) and retaining wall backfill;
- Following foundation excavations for other structures;
- During and after slab subgrade preparation;
- During and following pavement subgrade preparation;
- During and after placement of aggregate base and asphaltic concrete;
- During backfill of utility trenches; and
- When any unusual geotechnical conditions are encountered.

3.21 Standard Conditions and Project Design Features

Standard Conditions: The California Building Code, the County of Los Angeles and the City of Hermosa Beach have adopted a number of existing codes and policies, which are implemented through the regular development process. The proposed project will be designed and constructing in compliance with these standard conditions related to geology and soils.

- Grading operations and construction will be conducted in conformance with the applicable Los Angeles County Grading and Building Codes and consistent with the recommendations included in geotechnical reports for this project.
- The building and seismic design will be in accordance with the 2010 California Building Code.
- The abandonment of septic tanks, leech field, and seepage pits, if encountered during grading, shall be performed in accordance with the Uniform Plumbing Code requirements.

Project Design Features: The design and construction of the proposed project will incorporate the following design features to address the potential geotechnical constraints and effects of the proposed project, based on the geotechnical conditions that exist at the project site.

1. **Geotechnical Reports:** Detailed geotechnical reports for each grading plan shall be submitted with engineered grading plans to provide a design and/or construction level recommendations for the proposed development. The geotechnical reports shall be prepared

and signed/stamped by a Registered Civil Engineer specializing in geotechnical engineering and a Certified Engineering Geologist. Geotechnical rough grading plan review reports shall be prepared in accordance with the County of Los Angeles Department of Public Works, Geotechnical and Materials Engineering Division, Manual for Preparation of Geotechnical Reports.

2. **Registered Civil Engineer:** Grading and earthwork shall be performed under the observation of a Registered Civil Engineer specializing in Geotechnical Engineering in order to achieve proper sub-grade preparation, selection of satisfactory fill materials, placement and compaction of structural fill, stability and design parameters for retaining and free standing walls and temporary excavations, settlement issues and incorporation of data supplied by the engineering geologist.

3. **Certified Engineering Geologist:** Grading and earthwork shall also be performed under the observation of a Certified Engineering Geologist to provide professional review and written approval of the adequacy of natural ground for receiving fills, the stability of temporary slopes with respect to geological matters, and the evaluation of onsite earth materials (fills verses native soils). The geologist shall geologically map the exposed earth units during grading to verify the anticipated conditions, and if different, provide findings to the geotechnical engineer for possible design modifications.

4. **Temporary Slope Stability:** Prior to the issuance of grading permits, grading level details of the proposed temporary removal excavation slopes shall be evaluated for stability and necessary shoring to protect the adjacent property and improvements. The geotechnical report shall provide design parameters for shoring. The shoring shall be designed by a shoring engineer and then reviewed by the geotechnical engineer and City for approval prior to installation.

5. **Seismic Hazards:** Potential seismic hazards related to seismic shaking, liquefaction and earthquake induced landslides shall be mitigated in accordance with the 2010 California Building Code and the findings stated herein.

6. **Seismic Settlement:** Secondary seismic hazards include local settlement of landfill materials that will be left in place in the northeast portion of the site below a depth of 15 feet below existing ground. Proposed structures that cannot tolerate total settlements of 3.5 inches or significant differential settlement shall be provided with either ground improvement and/or deep foundations as described in the geotechnical report. These remedial measures will be reviewed and approved by the City of Hermosa Beach Building Official prior to implementation.

7. **Retaining Wall and Free Standing Wall Design:** There are a number of proposed retaining structures and a 16 foot high free standing perimeter wall. The geotechnical engineer will provide parameters for design of these walls and the walls will be designed by a structural engineer and/or the civil engineer. The design of these walls will be reviewed by the geotechnical engineer, and will be submitted to and reviewed and approved by the City of Hermosa Beach Building Official prior to implementation.

4.0 LIMITATIONS

This report has been prepared for the exclusive use of our client, E&B Natural Resources, based on the specific scope of services requested by our client for the project described herein. This report or its contents should not be used or relied upon for other projects or by other parties without the consent of NMG and the involvement of a geotechnical professional. The means and methods used by NMG for this study are based in part on local geotechnical standards of practice, care, and requirements of governing agencies. No warranty or guarantee, express or implied is given.

The findings, conclusions, and recommendations are professional opinions based on interpretations and inferences made from geologic and engineering data from specific locations and depths, observed or collected at a given time. By nature, geologic conditions can vary from point to point, can be very different in between points, and can also change over time. Therefore, our conclusions and recommendations are by nature preliminary and are subject to verification and possible modification as plans develop and with more exploration and/or observations during grading and construction when more subsurface data becomes available.

Liquefaction

Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslides

Areas where previous occurance of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

SITE LOCATION AND SEISMIC HAZARDS MAP

BASE: U.S.G.S. SEISMIC HAZARDS MAP,
REDONDO BEACH QUADRANGLE
Dated: March 25, 1999

N

E & B OIL DEVELOPMENT PROJECT
555 6th STREET
HERMOSA BEACH, CALIFORNIA

Project Number: 12053-01

Project Name: E & B / Hermosa Beach

Date: 10-19-12 Figure No. 1

NMG
Geotechnical, Inc.

REGIONAL ACTIVE FAULT MAP

Modified After CDMG, 1994

N

N.T.S.

E & B OIL DEVELOPMENT PROJECT
555 6th STREET
HERMOSA BEACH, CALIFORNIA

Project Number: 12053-01

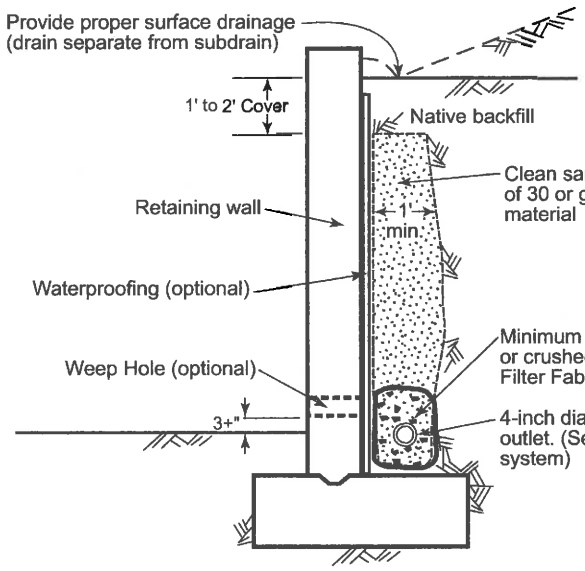
Project Name: E & B / Hermosa Beach

Date: 10/19/12 Figure No. 2

NMG Geotechnical, Inc.

OPTION 1:

AGGREGATE SYSTEM DRAIN



Clean sand vertical drain having sand equivalent of 30 or greater or other free-draining granular material

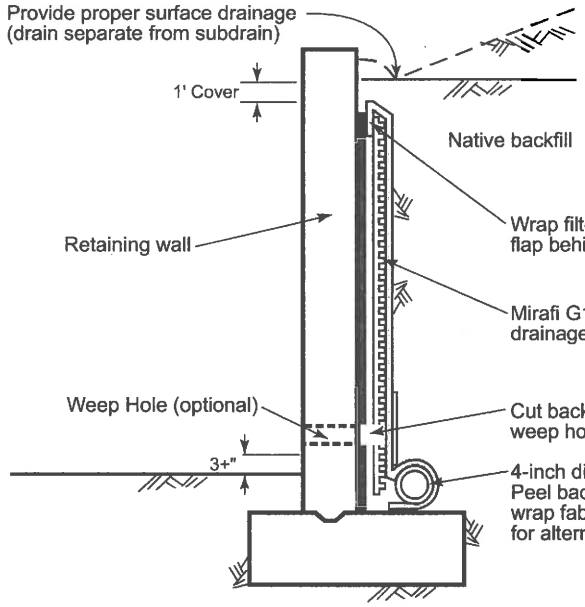
Minimum 1 ft.^{3}/ft. of 1/4 to 1 1/2" size gravel or crushed rock encased in approved Filter Fabric

4-inch diameter perforated pipe with proper outlet. (See Notes below for alternate discharge system)

Alternative: Class 2 permeable filter material (Per Caltrans specifications) may be used for vertical drain and around perforated pipe (without filter fabric)

OPTION 2:

COMPOSITE DRAINAGE SYSTEM



Wrap filter fabric flap behind core

Mirafi G100N, Contech C-Drain 15K, or equivalent drainage composite.

Cut back of core to match size of weep hole. Do not cut fabric.

4-inch diameter perforated pipe with proper outlet. Peel back the bottom fabric flap,place pipe next to core, wrap fabric around pipe and tuck behind core. (See Notes for alternate weep hole discharge system)

NOTES:

1. **PIPE TYPE SHOULD BE PVC OR ABS, SCHEDULE 40 OR SDR35 SATISFYING THE REQUIREMENTS OF ASTM TEST STANDARD D1527, D1785, D2751 , OR D3034.**
2. **FILTER FABRIC SHALL BE APPROVED PERMEABLE NON-WOVEN POLYESTER, NYLON, OR POLYPROPYLENE MATERIAL.**
3. **DRAIN PIPE SHOULD HAVE A GRADIENT OF 1 PERCENT MINIMUM.**
4. **WATERPROOFING MEMBRANE MAY BE REQUIRED FOR A SPECIFIC RETAINING WALL (SUCH AS A STUCCO OR BASEMENT WALL).**
5. **WEEP HOLES MAY BE PROVIDED FOR LOW RETAINING WALLS (LESS THAN 3 FEET IN HEIGHT) IN LIEU OF A VERTICAL DRAIN AND PIPE AND WHERE POTENTIAL WATER FROM BEHIND THE RETAINING WALL WILL NOT CREATE A NUISANCE WATER CONDITION. IF EXPOSURE IS NOT PERMITTED, A PROPER SUBDRAIN OUTLET SYSTEM SHOULD BE PROVIDED.**
6. **IF EXPOSURE IS PERMITTED, WEEP HOLES SHOULD BE 2-INCH MINIMUM DIAMETER AND PROVIDED AT 25-FOOT MAXIMUM SPACING ALONG WALL. WEEP HOLES SHOULD BE LOCATED 3+ INCHES ABOVE FINISHED GRADE.**
7. **SCREENING SUCH AS WITH A FILTER FABRIC SHOULD BE PROVIDED FOR WEEP HOLES/OPEN JOINTS TO PREVENT EARTH MATERIALS FROM ENTERING THE HOLES/JOINTS.**
8. **OPEN VERTICAL MASONRY JOINTS (I.E., OMIT MORTAR FROM JOINTS OF FIRST COURSE ABOVE FINISHED GRADE) AT 32-INCH MAXIMUM INTERVALS MAY BE SUBSTITUTED FOR WEEP HOLES.**
9. **THE GEOTECHNICAL CONSULTANT MAY PROVIDE ADDITIONAL RECOMMENDATIONS FOR RETAINING WALLS DESIGNED FOR SELECT SAND BACKFILL.**

RETAINING WALL DRAINAGE DETAIL

NMG Geotechnical, Inc.

3/05 RETAINING WALL DRAINAGE.ai

FIGURE 3

APPENDIX A

APPENDIX A

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AERIAL PHOTOGRAPHS REVEIWED

Date	*Photos*	*Source*
1928	N/A	Environmental Data Resources, Inc.
1938	N/A	Environmental Data Resources, Inc.
1947	N/A	Environmental Data Resources, Inc.
11/4/1952	4K-132-133	Continental Aerial
1953	N/A	Environmental Data Resources, Inc.
1956	N/A	Environmental Data Resources, Inc.
5/20/1958	CAA-7-43-44	Continental Aerial
1960	N/A	Environmental Data Resources, Inc.
1965	N/A	Environmental Data Resources, Inc.
1/31/1970	61-7-182-183	Continental Aerial
1975	N/A	Environmental Data Resources, Inc.
5/12/79	FCLA-9-89-90	Continental Aerial
1/27/86	F-343-345	Continental Aerial
1986	N/A	Environmental Data Resources, Inc.
7/7/1988	19306-07-08	Continental Aerial
6/12/1990	C84-15-1-2	Continental Aerial
1/24/1992	C85-5-37-38	Continental Aerial
6/9/1993	C93-17-87-88	Continental Aerial
1994	N/A	Environmental Data Resources, Inc.
1/30/1995	C104-33-175-176	Continental Aerial
10/16/1997	C118-33-122-123	Continental Aerial
2/23/1999	C133-33-201-202	Continental Aerial
2005	N/A	Environmental Data Resources, Inc.

APPENDIX B

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	*GRAVEL AND GRAVELLY SOILS* MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	*CLEAN GRAVELS* (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	*CLEAN SANDS* (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND - SILT MIXTURES
			SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	*SILTS AND CLAYS* LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS 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
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Dual symbols are used to indicate gravels or sand with 5-12% fines and soils with fines classifying as CL-ML. Symbols separated by a slash indicate borderline soil classifications.

Sampler and Symbol Descriptions

- Modified California sample (63.5 mm diameter)
- Standard Penetration Test
- Undisturbed pushed tube sample
- Large bulk sample
- Small bulk sample
- Approximate depth of perched water or groundwater

Note: Number of blows required to advance driven sample 300 mm (or length noted) is recorded; blow count recorded for seating interval (initial 150 mm of drive) is indicated by an asterisk.

Laboratory and Field Test Abbreviations

MD	Laboratory compaction test
CN	Laboratory consolidation test
DS	Laboratory direct shear test
AL	Atterberg limits
SE	Sand Equivalent
GS	Grain Size Analysis (Sieve and/or Hydro.)
RV	R-Value
CC	Chemical Testing incl. Soluble Sulfate
EI	Expansion Index
UU	Unconsolidated Shear Strength

GENERAL NOTES

1. Station location is indicated with offset to right (R) or left (L) of centerline (CL).
2. Soil classifications are based on the Unified Soil System and include color, moisture, and relative density or consistency. Field descriptions have been modified to reflect results of laboratory tests where deemed appropriate. Bedrock descriptions are based on visual classification and include rock type, moisture, color, grain size, strength, and weathering.
3. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were made. They are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.

Report: HOLLOW STEM; Project: P:\2012\12053-01\GINT\12053-01.GPJ; Data Template: NMGNOV98.GDT; Printed: 8/21/12

Date(s) Drilled	5/16/12	Logged By	PA
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	Groundwater Not Encountered		
Comments			

H-1

Sheet 1 of 2

Total Depth Drilled (ft)	31.5
Approximate Ground Surface Elevation (ft)	48.0

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0						Surface: 3" AC over 4" AB			
						SM	**Dune Sand (Qds)** Yellowish brown silty SAND.			
	5									
		D	1	20		SP-SM	@ 5' Pale yellowish brown slightly silty SAND, medium dense, massive, friable.	2.7	102.3	
40		D	2	13			@ 7.5' Pale yellowish brown slightly silty SAND, medium dense, massive, friable.	3.2	101.0	
	10									
		D	3	15			@ 10' Pale yellowish brown slightly silty SAND, medium dense, massive, friable.	1.8	96.2	CN, DS
		D	4	19		SM	@ 12.5' Upper: Pale yellowish brown slightly silty SAND, medium dense, massive, friable. Tip: Brown silty SAND, damp to moist, medium dense, massive, slightly micaceous. -Sample Disturbed-	2.4		
	15									
		D	5	29			@ 15' Reddish brown silty SAND, moist to very moist, medium dense, massive.	9.4	129.1	GS
30										
	20									
		D	6	22			@ 20' Yellowish brown silty SAND, damp, medium dense, massive, slightly friable.	4.7	112.3	
	25									
		D	7	47		SP-SM	@ 25' Yellowish brown SAND with few fines, damp, medium dense, massive, slightly friable.	3.8	109.2	
20										
	30									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30		D-8	76		SP	@ 30' Yellowish brown coarse-grained SAND, damp, dense, massive, friable.	4.3	118.6	
							Notes: Total Depth 31.5 Feet. Groundwater Not Encountered. Backfilled with Cuttings. AC Patched.			
-10	35									
	40									
	45									
0										
	50									
	55									
-10										
	60									
	65									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California

PROJECT NO. 12053-01

NMG

Report: HOLLOW STEM; Project: P:\2012\12053-01\GINT\12053-01.GPJ; Data Template: NMGNOV98.GDT; Printed: 8/21/12

Date(s) Drilled	5/17/12	Logged By	PA
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	Groundwater Encountered at 47.8 Feet During Drilling		
Comments			

H-2

Sheet 1 of 2

Total Depth Drilled (ft)	51.5
Approximate Ground Surface Elevation (ft)	52.5

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0						Surface: 2" AC over 2" AB.			
						SM	**Undocumented Artificial Fill (Afu)** Pale yellow silty SAND.			
50						SM	**Dune Sands (Qds)** Pale yellow silty SAND.			
	5	D	D-1	32		SP	@ 5' Pale yellowish brown SAND, damp, medium dense, massive, well-sorted, friable.	2.1	105.3	
		SPT	SPT-1	13			@ 7.5' Pale yellowish brown SAND, damp, medium dense, massive, well-sorted, friable.	2.6		
	10	D	D-2	18			@ 10' Pale yellowish brown SAND, damp, medium dense, massive, well-sorted, friable.	1.7	96.1	CN, DS
40		SPT	SPT-2	7		SP-SM	@ 12.5' Upper: Pale yellowish brown SAND, damp, medium dense, massive, well-sorted, friable. Tip: Brown silty SAND, damp to moist, medium dense.	4.7		
	15	D	D-3	25		SM	@ 15' Brown silty SAND, damp to moist, medium dense, massive.	7.1	126.2	
	20	SPT	SPT-3	14			@ 20' Yellowish brown silty SAND, damp, medium dense, massive, slightly friable.	5.1		
30										
	25	D	D-4	50		SP	@ 25' Yellowish brown SAND, damp, dense, massive, friable.	4.0	109.4	
	30									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

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Elevation (ft)	Depth (ft)	SAMPLES Type Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	SPT-4	27		SP	@ 30' Yellowish brown SAND, damp, dense, massive, friable, scattered pebbles.	3.1		
20									
	35	D-5	77/11"			@ 35' Yellowish brown coarse-grained SAND, damp, very dense, massive, well-sorted, friable. -Sample Disturbed-	2.0		
	40	SPT-5	43			@ 40' Yellowish brown coarse-grained SAND, damp, very dense, massive, well-sorted, friable.	2.3		
10									
	45	D-6	88/11"			@ 45' Yellowish brown coarse-grained SAND, very moist to wet, very dense, massive, well-sorted, friable. -Sample Disturbed-	2.9		
						▼			
	50	SPT-6	46			@ 50' Yellowish brown coarse-grained SAND, saturated, very dense, massive, well-sorted, friable, scattered gravel.	9.4		
0									
	55					Notes: Total Depth 51.5 Feet. Groundwater Encountered at 47.8 Feet. Backfilled with Cuttings. AC Patched.			
	60								
-10									
	65								

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California

PROJECT NO. 12053-01

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Date(s) Drilled	5/16/12	Logged By	PA
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	Groundwater Not Encountered		
Comments			

H-3

Sheet 1 of 2

Total Depth Drilled (ft)	31.5
Approximate Ground Surface Elevation (ft)	53.0

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0						Surface: 4" AC over 9" AB.			
						SP	**Dune Sand (Qds)** Pale gray SAND.			
50			B-1							B-1 @ 0-5 feet MD, GS
	5		D-1	18		SP-SM	@ 5' Pale gray SAND, dry to damp, medium dense, friable, massive.	2.4	100.8	
			D-2	20			@ 7.5' Pale gray SAND, dry to damp, medium dense, friable, massive. -Sample Disturbed-	1.0		
	10		D-3	14			@ 10' Pale gray SAND, dry to damp, medium dense, friable, massive. -Sample Disturbed-	1.2		
40			D-4	20		SM	@ 12.5' Brown silty SAND, damp to moist, medium dense, massive, slightly micaceous.	6.4	122.6	GS
	15		D-5	24			@ 15' Yellowish brown silty SAND, damp to moist, medium dense, massive, slightly micaceous.	6.6	121.5	
	20		D-6	22		SP	@ 20' Yellowish brown SAND, damp, medium dense, massive, well-sorted, micaceous, friable.	3.1	104.2	
30										
	25		D-7	54			@ 25' Yellowish brown SAND, damp, medium dense, massive, well-sorted, micaceous, friable.	2.9	109.6	
	30									

LOG OF BORING

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PROJECT NO. 12053-01

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30		D-8	75		SP-SM	@ 30' Reddish brown coarse-grained SAND, damp, dense, massive, friable.	5.0	118.8	
-20	35						Notes: Total Depth 31.5 Feet. Groundwater Not Encountered. Backfilled with Cuttings. AC Patched.			
	40									
-10	45									
	50									
0	55									
	60									
-10	65									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California

PROJECT NO. 12053-01

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Date(s) Drilled	5/16/12	Logged By	PA
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	Groundwater Not Encountered		
Comments			

H-4

Sheet 1 of 2

Total Depth Drilled (ft)	31.5
Approximate Ground Surface Elevation (ft)	53.0

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SP-SM	Surface: 5" AC **Dune Sands (Qds)** Pale yellow SAND.			
50										
	5		D-1	18			@ 5' Pale gray slightly silty SAND, damp, medium dense, massive, slightly friable.	1.1	100.1	
			B-1							
			D-2	14			@ 7.5' Pale gray slightly silty SAND, damp, medium dense, massive, slightly friable.	0.7	99.1	B-1 @ 5-10 feet RV, CC
	10		D-3	16		SP	@ 10' Pale gray slightly silty SAND, dry, medium dense, massive, slightly friable.	0.6	96.0	GS
40			D-4	25			@ 12.5' Pale gray slightly silty SAND, dry, medium dense, massive, slightly friable.	1.0	96.8	
	15		D-5	12			@ 15' Brown SAND, moist, medium dense, massive, slightly micaceous.	6.8	121.5	
	20		D-6	23			@ 20' Yellowish brown SAND, damp, medium dense, massive, slightly micaceous.	6.6	116.3	
30										
	25		D-7	32		SP-SM	@ 25' Yellowish brown slightly silty SAND, damp, medium dense, massive, slightly micaceous.	3.7	109.5	
	30									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

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Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30		D-8	60		SP	@ 30' Yellowish brown coarse-grained SAND, damp, dense, massive, friable.	3.0	111.4	
-20	35						Notes: Total Depth 31.5 Feet. Groundwater Not Encountered. Backfilled with Cuttings. AC Patched.			
-10	40									
0	45									
	50									
	55									
-10	60									
	65									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California

PROJECT NO. 12053-01

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Date(s) Drilled	5/16/12	Logged By	PA
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	Groundwater Encountered at 49.3 Feet During Drilling		
Comments			

H-5

Sheet 1 of 2

Total Depth Drilled (ft)	51.5
Approximate Ground Surface Elevation (ft)	54.0

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0						Surface: AC			
						SP	**Undocumented Artificial Fill (Afu)** Pale yellowish brown to brown SAND.			
			B-1				@ 1.5' Brown SAND.			B-1 @ 0-5' GS, DS, RV, MD, CC
50										
	5		D-1	13			@ 5' Brown SAND, damp, medium dense, massive, micaceous, friable.	2.6	103.1	CN
			D-2	20			@ 7.5' Pale brown SAND, dry, medium dense, massive, micaceous, friable.	1.6	103.5	GS
	10		D-3	13		SM	**Undocumented Artificial Fill (Afu)/Dune Sand (Qds)** @ 10' Brown silty SAND, damp, medium dense, massive, micaceous, slightly friable.	4.7	115.1	
			D-4	31			@ 12.5' Reddish brown silty SAND, damp, medium dense, massive, micaceous.	6.0	126.8	GS
40										
	15		D-5	21		SP-SM	**Dune Sand (Qds)** @ 15' Yellowish brown slightly silty SAND, damp, medium dense, massive, slightly micaceous, friable.	2.8	106.5	DS
	20		D-6	24			@ 20' Yellowish brown slightly silty SAND, dry, medium dense, massive, slightly micaceous, friable.	3.0	103.7	DS
30										
	25		D-7	52		SP	@ 25' Yellowish brown SAND with few fines, dry, dense, massive, micaceous, friable.	2.1	107.0	
	30									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG

Elevation (ft)	Depth (ft)	Type	Number	Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30	D	8	59		SP-SM	@ 30' Yellowish brown coarse-grained SAND with trace gravel, damp, dense, massive, friable.	2.2		
20										
	35	D	9	45		SP	@ 35' Yellowish brown SAND with few fines, damp, dense, massive, friable.	2.1	106.5	
	40	D	10	80/11"			@ 40' Yellowish brown SAND with few fines, damp, very dense, massive, friable. -Sample Disturbed-	1.3		
10										
	45	D	11	50/4"			@ 45' NO RECOVERY.			
							▼			
	50	D	12	88/11"			@ 50' Pale yellow coarse-grained SAND, saturated, very dense, well-sorted, massive, highly friable, trace cobbles up to 2 inches in diameter. -Sample Disturbed-	9.0		
0							Notes: Total Depth 51.5 Feet. Groundwater Encountered at 49.3 Feet. Backfilled with Cuttings. AC Patched.			
	55									
	60									
-10										
	65									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California

PROJECT NO. 12053-01

NMG

Report: HOLLOW STEM; Project: P:\2012\12053-01\GINT\12053-01.GPJ; Data Template: NMGNOV98.GDT; Printed: 8/21/12

Date(s) Drilled	5/17/12	Logged By	PA
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	Groundwater Not Encountered		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	31.5
Approximate Ground Surface Elevation (ft)	52.5

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
50	0					SM	Surface: 3" AC **Inert Landfill (Afl)** Yellowish brown silty SAND, damp.			
	5		D-1	16		SP	@ 5' Pale brown SAND with few fines, damp, medium dense, massive, friable.	3.6	104.8	
			D-2	6		SM	@ 7.5' Brown silty SAND, moist, loose, debris (glass, metal, pottery), massive.	9.2	103.4	
	10		B-1 D-3	4			@ 10' NO RECOVERY.			B-1 @ 7.5'-12.5' CC
40			D-4	3			@ 12.5' Reddish brown silty SAND, moist, loose, debris (glass, metal, pottery).	7.3	87.2	
	15		D-5	29			@ 15' Black silty SAND, moist, medium dense, debris, strong hydrocarbon odor in tip.	24.6	87.9	
	20		D-6	12			@ 20' Black silty SAND, moist, medium dense, oily, strong hydrocarbon odor, copper wire in tip.	10.3	111.1	CN
30	25		D-7	93/10"		SM	**Dune Sand (Qds)** @ 25' Brown slightly silty SAND, moist, dense, massive, friable, slight hydrocarbon staining.	6.6	113.5	
	30									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30		D-8	80/11"		SM	@ 30' Brown slightly silty SAND, moist, dense, massive, friable, slight hydrocarbon staining.	5.9	111.2	
-20	35						Notes: Total Depth 31.5 Feet. Groundwater Not Encountered. Backfilled with Cuttings. AC Patched.			
	40									
-10	45									
	50									
0	55									
	60									
-10	65									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California

PROJECT NO. 12053-01

NMG

Report: HOLLOW STEM; Project: P:\2012\12053-01\GINT\12053-01.GPJ; Data Template: NMGNOV98.GDT; Printed: 8/21/12

Report: HOLLOW STEM; Project: P:\2012\12053-01\GINT\12053-01.GPJ; Data Template: NMGNOV98.GDT; Printed: 8/21/12

Date(s) Drilled	5/17/12	Logged By	PA
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	Groundwater Encountered at 47.7 Feet During Drilling		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	51.5
Approximate Ground Surface Elevation (ft)	53.0

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0					SM	Surface: 4" AC **Dune Sands (Qds)** Brown slightly silty SAND, dry to damp.			
50		B	B-1							B-1 @ 0-5' RV
	5	SPT	SPT-1	11			@ 5' Brown slightly silty SAND, dry to damp, medium dense, massive, slightly friable.	2.2		
		D	D-1	25			@ 7.5' Brown slightly silty SAND, damp, medium dense, massive, slightly friable, micaceous.	2.5	118.1	CN
	10	SPT	SPT-2	21			@ 10' Yellowish brown silty medium to coarse-grained SAND, damp, medium dense, massive, slightly friable.	4.7		
40		D	D-2	24			@ 12.5' Yellowish brown silty medium to coarse-grained SAND, damp, medium dense, massive, slightly friable.	3.6	111.1	GS, DS
	15	SPT	SPT-3	22			@ 15' Pale yellowish brown slightly silty coarse-grained SAND, damp, medium dense, massive, slightly friable.	2.3		
	20	D	D-3	85/11"		SP	@ 20' Pale yellowish brown SAND with few fines, damp, dense to very dense, massive, slightly friable.	2.7	111.8	
30										
	25	SPT	SPT-4	59			@ 25' Pale yellowish brown SAND with few fines, damp, dense to very dense, massive, slightly friable.	2.3		
	30									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30		D-4	50		SP	@ 30' Pale yellow coarse-grained SAND, damp, dense, friable, massive. -Sample Disturbed-	1.1		
20										
	35		SPT-5	31			@ 35' Pale yellow coarse-grained SAND, damp, dense, friable, massive.	1.9		
	40		D-5	80/10"			@ 40' Pale yellow coarse-grained SAND with little-to-no fines, dry to damp, very dense, highly friable, well-sorted.	2.8	109.9	DS
10										
	45		SPT-6	87/11"		SM	@ 45' Pale yellow slightly silty SAND, damp to moist, very dense, friable, massive. ▼	3.3		
	50		D-6	50/5"			@ 50' NO RECOVERY			
0										
	55						Notes: Total Depth 51.5 Feet. Groundwater Encountered at 47.7 Feet. Backfilled with Cuttings. AC Patched.			
	60									
-10										
	65									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California

PROJECT NO. 12053-01

NMG

Report: HOLLOW STEM; Project: P:\2012\12053-01\GINT\12053-01.GPJ; Data Template: NMGNOV98.GDT; Printed: 8/21/12

Date(s) Drilled	5/17/12	Logged By	PA
Drilling Company	2R Drilling	Drill Bit Size/Type	8"
Drill Rig Type	CME 75	Hammer Data	140 lbs @ 30" Drop
Sampling Method(s)	Modified California, Bulk		
Approximate Groundwater Depth:	Groundwater Encountered at 48 Feet During Drilling		
Comments			

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Sheet 1 of 2

Total Depth Drilled (ft)	51.5
Approximate Ground Surface Elevation (ft)	52.5

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	0						Surface: 1" AC over 5" AB			
						SM	**Inert Landfill (Afl)** Brown silty SAND with debris (glass, brick).			
50			B-1							B-1 @ 0-5'
	5		D-1	6			@ 5' Brown silty SAND, dry, loose, friable, debris (glass, concrete, brick). -Sample Disturbed-	3.4		
			D-2	12			@ 7.5' Brown silty SAND, dry, loose, friable, debris (glass, concrete, brick). -Sample Disturbed-	13.6		
	10		D-3	36			@ 10' NO RECOVERY. -Abundant brick and pottery shards with scattered metal in cuttings.			
40			D-4	50/5"			@ 12.5' NO RECOVERY. -Abundant brick and pottery shards with scattered metal in cuttings.			
	15		D-5	7			@ 15' NO RECOVERY. -Abundant pottery and glass shards in cuttings.			
	20		D-6	24			@ 20' NO RECOVERY. -Abundant pottery and glass shards in cuttings.			
30										
	25		D-7	65			@ 25' NO RECOVERY. -Abundant pottery and glass shards in cuttings.			
	30									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG

Elevation (ft)	Depth (ft)	SAMPLES Type	SAMPLES Number	SAMPLES Blows per foot	Graphic Log	USCS	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	OTHER TESTS and REMARKS
	30		D-8	50/5"		SM	@ 30' NO RECOVERY. -Abundant pottery and glass shards in cuttings.			
20						SM	**Dune Sands (Qds)**			
	35		D-9	86/11"			@ 35' Yellowish brown slightly silty SAND, damp, very dense, massive, highly friable. -Sample Disturbed-	3.2		
	40		D-10	50/5"			@ 40' NO RECOVERY.			
10										
	45		D-11	50/3"			@ 45' NO RECOVERY.			
							▼			
	50		D-12	50/5"		SP	@ 50' Pale yellow SAND, saturated, very dense, massive, highly friable. -Sample Disturbed-	19.6		
0							Notes: Total Depth 51.5 Feet. Groundwater Encountered at 48 Feet. Backfilled with Cuttings. AC Patched.			
	55									
	60									
-10										
	65									

LOG OF BORING

E&B Hermosa Beach
Hermosa Beach, California

PROJECT NO. 12053-01

NMG

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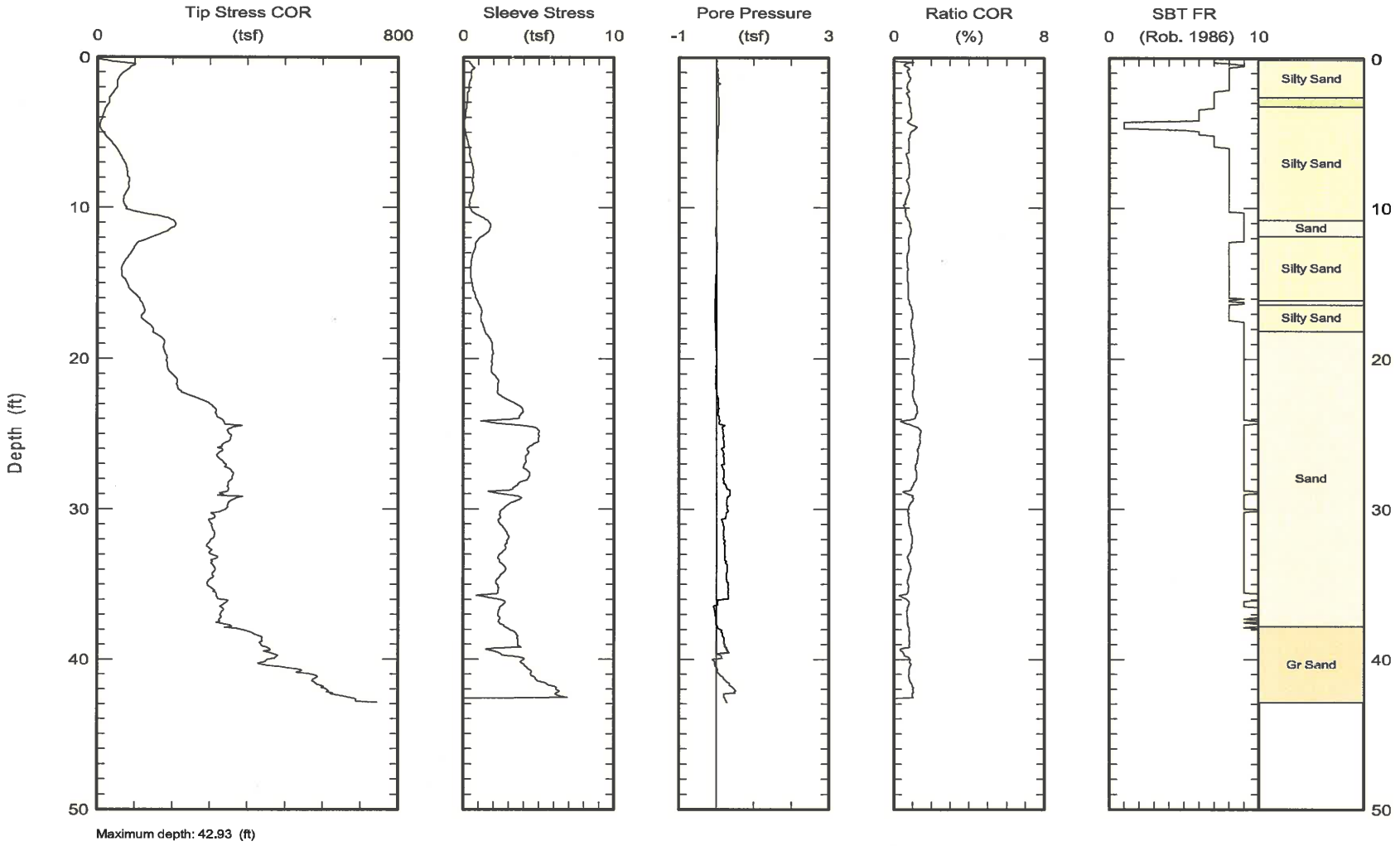
Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 17/May/2012
Test ID: CPT-1
Project: HermosaBeach

Customer: NMG Geotechnical, Inc.
Job Site: 555 6th St



Maximum depth: 42.93 (ft)

Kehoe Testing & Engineering
Office: (714) 901-7270
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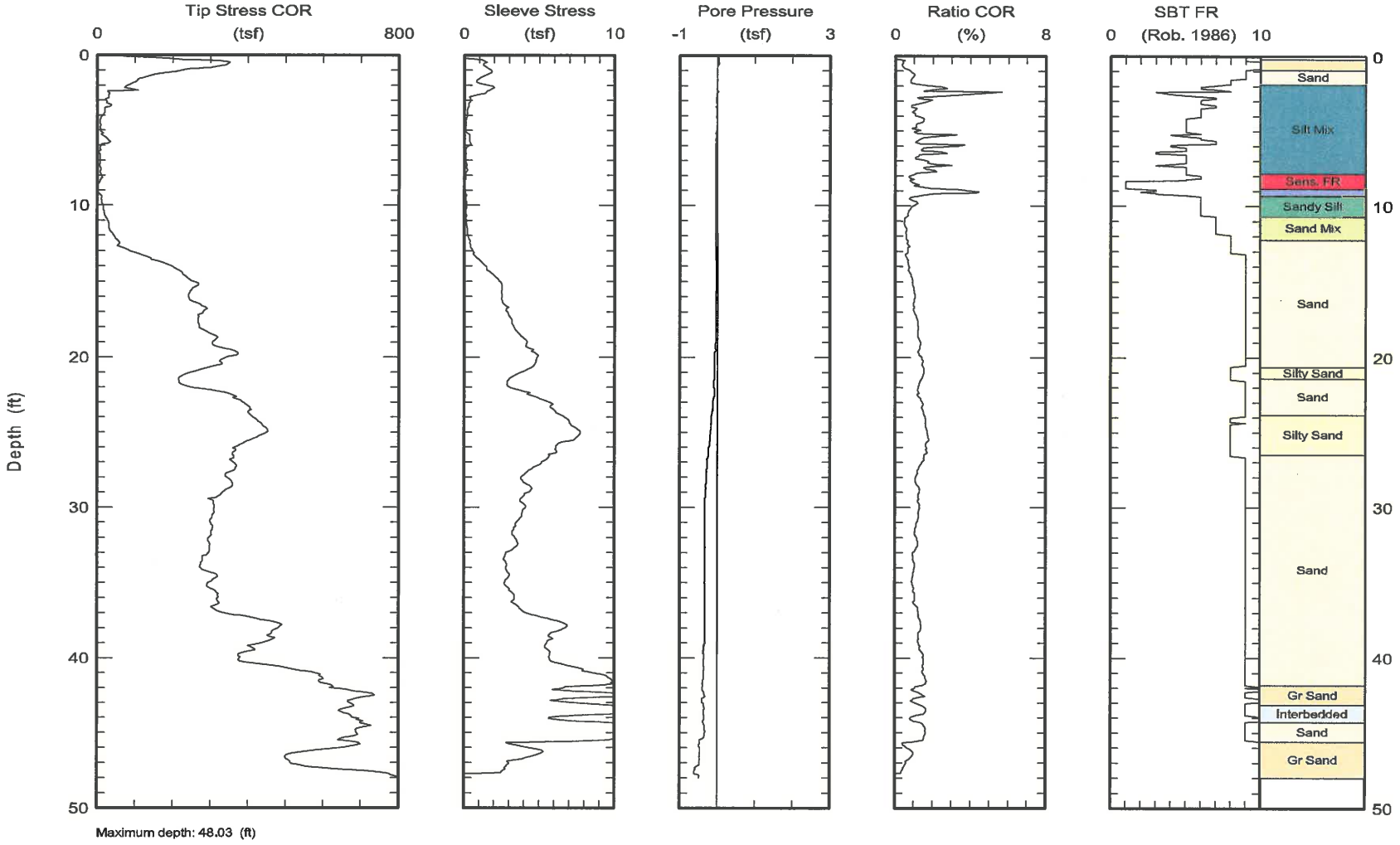
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 17/May/2012
Test ID: CPT-2
Project: HermosaBeach

Customer: NMG Geotechnical, Inc.
Job Site: 555 6th St



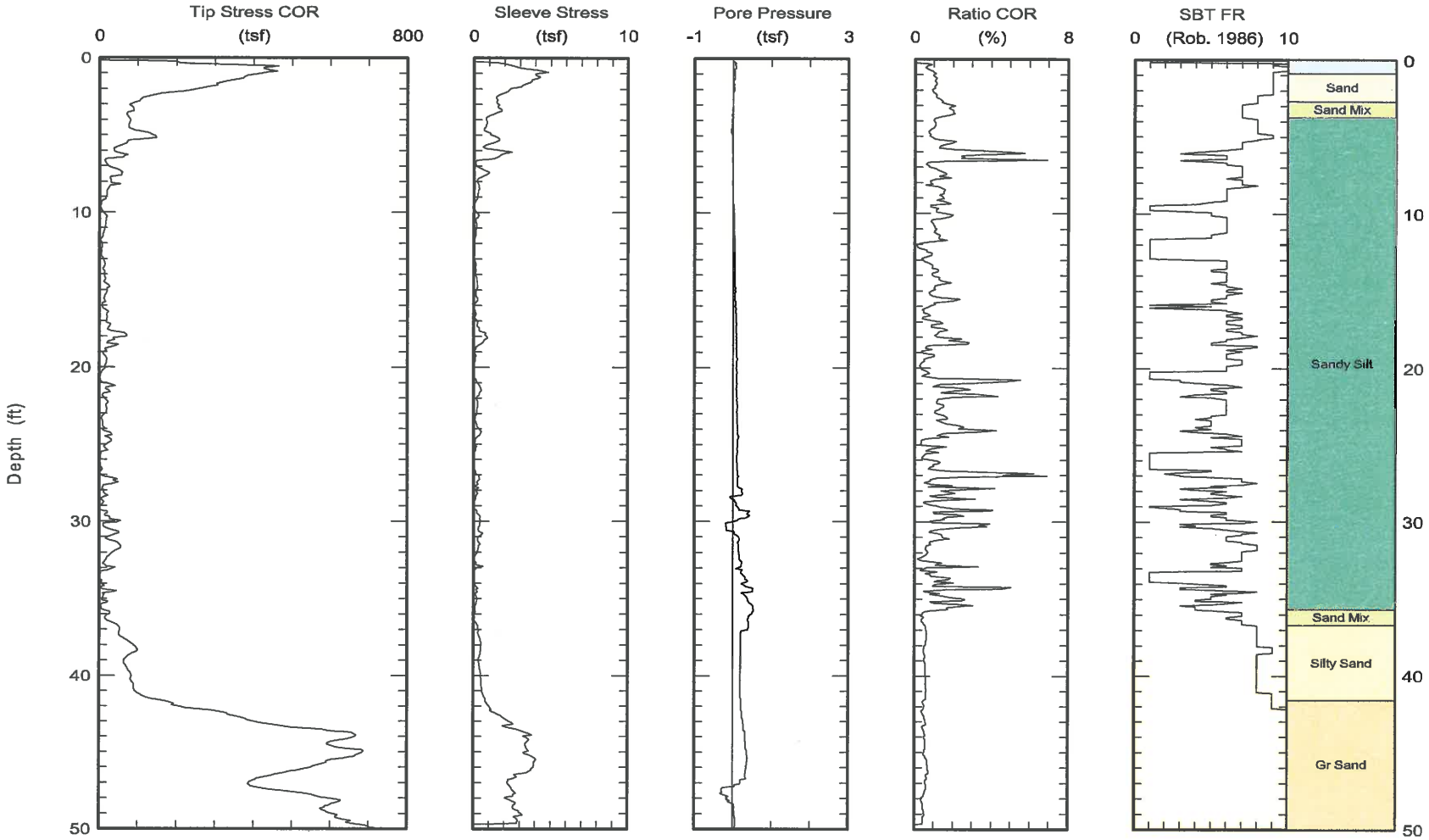
Maximum depth: 48.03 (ft)

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 17/May/2012
Test ID: CPT-3
Project: HermosaBeach

Customer: NMG Geotechnical, Inc.
Job Site: 555 6th St



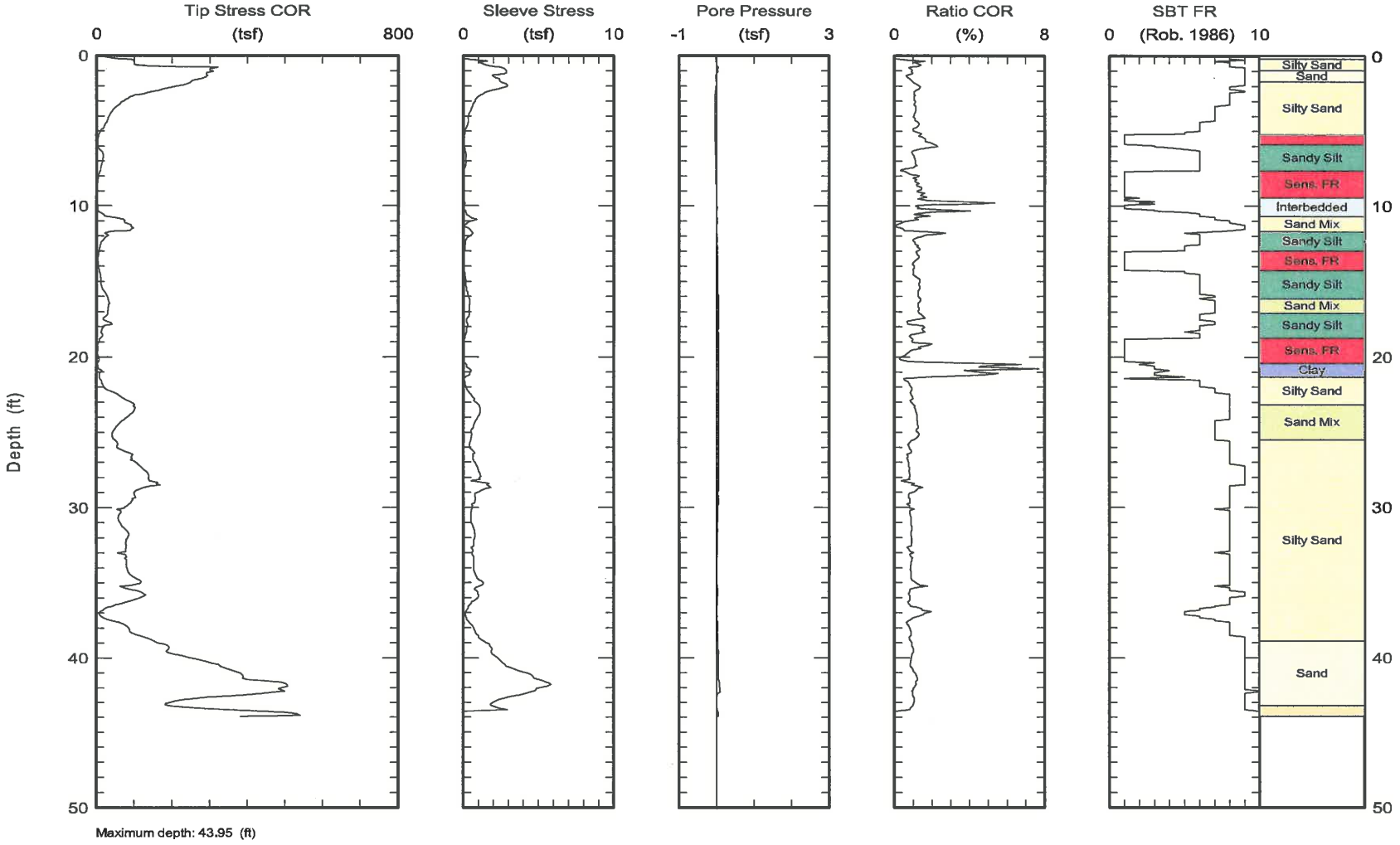
Maximum depth: 50.06 (ft)

Kehoe Testing & Engineering
Office: (714) 901-7270
Fax: (714) 901-7289
rich@kehoetesting.com
www.kehoetesting.com

CPT Data
30 ton rig

Date: 17/May/2012
Test ID: CPT-4
Project: HermosaBeach

Customer: NMG Geotechnical, Inc.
Job Site: 555 6th St



Maximum depth: 43.95 (ft)

555 6th St
Hermosa Beach, CA

CPT-1

CPT Shear Wave Measurements

Depth (ft)	Travel Distance (ft)	S-Wave Arrival (msec)	S-Wave Velocity from Surface (ft/sec)	Interval S-Wave Velocity (ft/sec)
10.11	11.28	15.23	740.57	
20.06	20.67	26.70	774.30	819.09
30.66	31.07	36.24	857.20	1089.23
40.01	40.32	46.24	872.00	925.62
42.94	43.23	49.01	882.07	1050.15

Shear Wave Source Offset = 5 ft

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

Note

Top Previous Next

1. Soil Behavior Type (non-normalized), SBT Robertson (1990)
2. Unit weight, g either constant or based on Non-normalized SBT (Lunne et al., 1997 and table below)
3. Soil Behavior Type (Normalized), SBT_n Robertson (1990), using Q_{tn}
4. SBT_n Index, $I_c = ((3.47 - \log Q_{t1})^2 + (\log Fr + 1.22)^2)^{0.5}$
5. Normalized Cone resistance, Q_{tn} (n varies with I_c)

   $Q_{tn} = ((q_t - s_{vo})/pa) \times (pa/(s'_{vo})^n$ and recalculate I_c, then iterate:

   $$n = 0.381 \times I_c + 0.05 \times \left(\frac{s'_{vo}}{p_a}\right) - 0.15$$

   Iterate until the change in n, $D_n < 0.01$
6. Estimated permeability, k_{SBT} (based on Normalized SBT_n) (Lunne et al., 1997 and table below)
7. Equivalent SPT N60, (blows/ft or blows/30cm) Lunne et al. (1997)

   $$\frac{(q_t/p_a)}{N_{60}} = 8.5 \left(1 - \frac{I_c}{4.6}\right)$$
8. Relative Density, D_r, (%) $D_r^2 = Q_{tn} / C_{Dr}$

   Only SBTn 5, 6, 7 & 8 '0' in zones 1, 2, 3, 4 & 9
9. Friction Angle, f', (degrees)

   $$\varphi = 17.60 + 11 \times \log(Q_t)$$

   Only SBTn 5, 6, 7 & 8 '0' in zones 1, 2, 3, 4 & 9
10. Young's modulus, E_s

    $$E_s = \alpha_E \times (q_t - s_{vo})$$
    $$\alpha_E = 0.015 \times \left[10^{(0.55 I_c + 1.68)}\right]$$

    Only when Ic < 2.60
11. Constrained Modulus, M

    $$M = \alpha_M \times (q_t - s_{vo})$$

    When $I_c > 2.20$ use:

    $\alpha_M = Q_t$ when $Q_t < 14$

    $\alpha_M = 14$ when $Q_t > 14$

    When $I_c < 2.20$ use:

    $$\alpha_M = 0.0188 \times \left[10^{(0.55 I_c + 1.68)}\right]$$
12. Undrained shear strength, $s_u = (q_t - s_{vo}) / N_{kt}$

    Only SBT_n 1, 2, 3, 4 & 9 '0' in zones 5, 6, 7 & 8
13. Over Consolidation ratio, $OCR = k_{ocr} Q_{t1}$

    Only SBT_n 1, 2, 3, 4 & 9 '0' in zones 5, 6, 7 & 8

14. Small strain shear modulus, G_o

$$G_0 = \alpha_M \times (q_t - \sigma_{vo})$$
$$\alpha_M = 0.0188 \times \left[10^{(0.55 I_c + 1.68)}\right]$$

The following updated and simplified SBT descriptions have been used in the software:

SBT Zones		**SBT_n Zones**	
1	sensitive fine grained	1	sensitive fine grained
2	organic soil	2	organic soil
3	clay	3	clay
4	clay & silty clay	4	clay & silty clay
5	clay & silty clay		
6	sandy silt & clayey silt		
7	silty sand & sandy silt	5	silty sand & sandy silt
8	sand & silty sand	6	sand & silty sand
9	sand		
10	sand	7	sand
11	very dense/stiff soil*	8	very dense/stiff soil*
12	very dense/stiff soil*	9	very dense/stiff soil*

* heavily overconsolidated and/or cemented

Estimated Permeability (see Lunne et al., 1997)

SBT_n	**Permeability (ft/sec)**	**(m/sec)**
1	3×10^{-8}	1×10^{-8}
2	3×10^{-7}	1×10^{-7}
3	1×10^{-9}	3×10^{-10}
4	3×10^{-8}	1×10^{-8}
5	3×10^{-6}	1×10^{-6}
6	3×10^{-4}	1×10^{-4}
7	3×10^{-2}	1×10^{-2}
8	3×10^{-6}	1×10^{-6}
9	1×10^{-8}	3×10^{-9}

Estimated Unit Weight (see Lunne et al., 1997)

SBT	**Approximate Unit Weight (kN/m³) (lb/ft³)**	
1	111.4	17.5
2	79.6	12.5
3	111.4	17.5
4	114.6	18.0
5	114.6	18.0
6	114.6	18.0

7	117.8	18.5
8	120.9	19.0
9	124.1	19.5
10	127.3	20.0
11	130.5	20.5
12	120.9	19.0

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SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP1
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/08/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL. N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: ASPHALT PAVING AT SURFACE TOP 4 FT. BELOW IS SAND W/TRASH AND OIL (FILL)
	X	0	4OZ. JAR	GP1-3	SM		
5	X	0	ACETATE	GP1-5	SM		SILTY SAND - DARK BROWN (FILL)
10	X	0	ACETATE	GP1-10	SM		SILTY SAND - DARK BROWN (FILL)
15	X	0	ACETATE	GP1-15	SP		SAND - BROWN
20	X	0	ACETATE	GP1-20	SP		SAND - BROWN
25	X	0	ACETATE	GP1-25	SP		SAND - BROWN
30	X	0	ACETATE	GP1-30	SP		COURSE SAND - BROWN
35	X	0	ACETATE	GP1-35	SP		COURSE SAND - BROWN

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP2
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/09/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: CONC. SLAB AT SURFACE W/2' BASE 3 FT. BELOW THAT IS SILTY SAND W/TRASH (FILL)
5	X	0	ACETATE	GP2-5	SM		SILTY SAND/GRAVEL/TRASH DARK BROWN (FILL)
10	X	0	ACETATE	GP2-10	SM		SILTY SAND/GRAVEL/TRASH DARK BROWN (FILL)
15	X	0	ACETATE	GP2-15	SM		SILTY SAND/GRAVEL/TRASH DARK BROWN (FILL)
20	X	0	ACETATE	GP2-20	SP		SAND - BROWN
25	X	0	ACETATE	GP2-25	SP		SAND - BROWN
30	X	0	ACETATE	GP2-30	SP		COURSE SAND - BROWN
35	X	0	ACETATE	GP2-35	SP		COURSE SAND - BROWN

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP3
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/09/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 43 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: CONC. SLAB AT SURFACE W/2' BASE 3 FT. BELOW THAT IS FINE SAND (FILL)
5	X	0	ACETATE	GP3-5	SP		FINE SAND – GREEN/BROWN (FILL)
10	X	10.7	ACETATE	GP3-10	SM		SILTY SAND W/ASH – GREEN/BROWN (FILL)
15	X	19.5	ACETATE	GP3-15	SM		SILTY SAND/GRAVEL W/ASH – DARK BROWN (FILL)
20	X	0	ACETATE	GP3-20	SM		SILTY SAND W/ASH – DARK BROWN/ BLACK (FILL)
25	X	---	-----	-----	--		NO SAMPLE OBTAINED
30	X	---	-----	-----	--		NO SAMPLE OBTAINED
35	X	300	ACETATE	GP3-35	SM		SILTY SAND/GRAVEL/TRASH DARK BROWN W/OIL SMELL
40	X	300	ACETATE	GP3-40	SM		SILTY SAND – BLACK W/OIL
43	X	418	ACETATE	GP3-43	SM		SILTY SAND/GRAVEL DARK GREEN W/OIL SMELL

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP4
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/09/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 39.5 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: 3" ASPHALT AT SURFACE W/DARK BROWN SAND W/GLASS TO 5 FT.
5	X	0	ACETATE	GP4-5	SM		SILTY SAND W/ASH AND GLASS DARK BROWN (FILL)
10	X	15.9	ACETATE	GP4-10	SM		SILTY SAND W/ASH AND GLASS DARK BROWN (FILL)
15	X	31.4	ACETATE	GP4-15	SM		SILTY SAND W/ASH AND GLASS DARK BROWN/BLACK (FILL)
20	X	78	ACETATE	GP4-20	SM		SILTY SAND W/ASH AND GLASS DARK BROWN/BLACK (FILL)
25	X	191	ACETATE	GP4-25	SM		SILTY SAND/GRAVEL/BRICK - BLACK W/OIL SMELL
30							NOTE: 29'-31' HARD CONC.
32	X	224	ACETATE	GP4-32	SP		SAND/GRAVEL - BLACK W/OIL
35	X	827	ACETATE	GP4-35	SP		SAND/GRAVEL - BLACK W/OIL
39.5	X	370	ACETATE	GP4-39.5	SP		SAND - BLACK W/OIL

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP5
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/08/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: 3" ASPHALT AT SURFACE W/DARK BROWN SILTY SAND TO 5 FT. (FILL)
5	X	0	ACETATE	GP5-5	SM		SILTY SAND - DARK BROWN (FILL)
10	X	0	ACETATE	GP5-10	SM		SILTY SAND - DARK BROWN (FILL)
15	X	0	ACETATE	GP5-15	SM		SILTY SAND/GRAVEL - DARK BROWN (FILL)
20	X	0	ACETATE	GP5-20	SM		SILTY SAND - DARK BROWN (FILL)
25	X	0	ACETATE	GP5-25	SM		SILTY SAND - MED. BROWN (FILL)
30	X	0	ACETATE	GP5-30	SM		SILTY SAND - DARK BROWN (FILL)
35	X	0	ACETATE	GP5-35	SM		SILTY SAND - DARK BROWN (FILL)

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP6
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/08/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: 3" ASPHALT AT SURFACE W/DARK BROWN SILTY SAND W/TRASH TO 5' (FILL)
5	X	0	ACETATE	GP6-5	SM		SILTY SAND W/TRASH – DARK BROWN (FILL)
10	X	0	ACETATE	GP6-10	SP		FINE SAND – LIGHT BROWN
15	X	0	ACETATE	GP6-15	SP		FINE SAND – LIGHT BROWN
20	X	0	ACETATE	GP6-20	SP		FINE SAND – DARK GREEN/BROWN
25	X	0	ACETATE	GP6-25	SP		FINE SAND – BROWN
30	X	0	ACETATE	GP6-30	SP		COURSE SAND – BROWN
35	X	0	ACETATE	GP6-35	SP		COURSE SAND – BROWN

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP7
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/08/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: 3" ASPHALT AT SURFACE
5	X	0	ACETATE	GP7-5	SP		FINE SAND - GRAY/GREEN
10	X	0	ACETATE	GP7-10	SP		FINE SAND - LIGHT BROWN
15	X	0	ACETATE	GP7-15	SM		SILTY SAND - DARK BROWN
20	X	0	ACETATE	GP7-20	SP		SAND - DARK BROWN
25	X	0	ACETATE	GP7-25	SP		SAND - BROWN
30	X	0	ACETATE	GP7-30	SP		SAND - BROWN
35	X	0	ACETATE	GP7-35	SP		COURSE SAND - BROWN

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP8
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/08/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: SURFACE IS ASPHALT W/BASE FINE SAND TO 5 FT. BELOW
5	X	0	ACETATE	GP8-5	SP		FINE SAND – LIGHT BROWN
10	X	0	ACETATE	GP8-10	SP		FINE SAND – LIGHT BROWN
15	X	0	ACETATE	GP8-15	SM		SILTY SAND – DARK BROWN
20	X	0	ACETATE	GP8-20	SM		SILTY SAND – BROWN
25	X	0	ACETATE	GP8-25	SP		SAND – LIGHT BROWN
30	X	0	ACETATE	GP8-30	SP		COURSE SAND – BROWN
35	X	0	ACETATE	GP8-35	SP		COURSE SAND – BROWN

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP3
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/09/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL. N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 43 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: CONC. SLAB AT SURFACE W/2' BASE 3 FT. BELOW THAT IS FINE SAND (FILL)
5	X	0	ACETATE	GP3-5	SP		FINE SAND – GREEN/BROWN (FILL)
10	X	10.7	ACETATE	GP3-10	SM		SILTY SAND W/ASH – GREEN/BROWN (FILL)
15	X	19.5	ACETATE	GP3-15	SM		SILTY SAND/GRAVEL W/ASH – DARK BROWN (FILL)
20	X	0	ACETATE	GP3-20	SM		SILTY SAND W/ASH – DARK BROWN/ BLACK (FILL)
25	X	---	-----	-----	--		NO SAMPLE OBTAINED
30	X	---	-----	-----	--		NO SAMPLE OBTAINED
35	X	300	ACETATE	GP3-35	SM		SILTY SAND/GRAVEL/TRASH DARK BROWN W/OIL SMELL
40	X	300	ACETATE	GP3-40	SM		SILTY SAND – BLACK W/OIL
43	X	418	ACETATE	GP3-43	SM		SILTY SAND/GRAVEL DARK GREEN W/OIL SMELL

BRYCON, LLC
SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP4
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/09/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 39.5 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: 3" ASPHALT AT SURFACE W/DARK BROWN SAND W/GLASS TO 5 FT.
5	⊠	0	ACETATE	GP4-5	SM		SILTY SAND W/ASH AND GLASS DARK BROWN (FILL)
10	⊠	15.9	ACETATE	GP4-10	SM		SILTY SAND W/ASH AND GLASS DARK BROWN (FILL)
15	⊠	31.4	ACETATE	GP4-15	SM		SILTY SAND W/ASH AND GLASS DARK BROWN/BLACK (FILL)
20	⊠	78	ACETATE	GP4-20	SM		SILTY SAND W/ASH AND GLASS DARK BROWN/BLACK (FILL)
25	⊠	191	ACETATE	GP4-25	SM		SILTY SAND/GRAVEL/BRICK - BLACK W/OIL SMELL
30							NOTE: 29'-31' HARD CONC.
32	⊠	224	ACETATE	GP4-32	SP		SAND/GRAVEL - BLACK W/OIL
35	⊠	827	ACETATE	GP4-35	SP		SAND/GRAVEL - BLACK W/OIL
39.5	⊠	370	ACETATE	GP4-39.5	SP		SAND - BLACK W/OIL

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP5
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/08/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: 3" ASPHALT AT SURFACE W/DARK BROWN SILTY SAND TO 5 FT. (FILL)
5	X	0	ACETATE	GP5-5	SM		SILTY SAND – DARK BROWN (FILL)
10	X	0	ACETATE	GP5-10	SM		SILTY SAND – DARK BROWN (FILL)
15	X	0	ACETATE	GP5-15	SM		SILTY SAND/GRAVEL – DARK BROWN (FILL)
20	X	0	ACETATE	GP5-20	SM		SILTY SAND – DARK BROWN (FILL)
25	X	0	ACETATE	GP5-25	SM		SILTY SAND – MED. BROWN (FILL)
30	X	0	ACETATE	GP5-30	SM		SILTY SAND – DARK BROWN (FILL)
35	X	0	ACETATE	GP5-35	SM		SILTY SAND – DARK BROWN (FILL)

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP6
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/08/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: 3" ASPHALT AT SURFACE W/DARK BROWN SILTY SAND W/TRASH TO 5' (FILL)
5	X	0	ACETATE	GP6-5	SM		SILTY SAND W/TRASH – DARK BROWN (FILL)
10	X	0	ACETATE	GP6-10	SP		FINE SAND – LIGHT BROWN
15	X	0	ACETATE	GP6-15	SP		FINE SAND – LIGHT BROWN
20	X	0	ACETATE	GP6-20	SP		FINE SAND – DARK GREEN/BROWN
25	X	0	ACETATE	GP6-25	SP		FINE SAND – BROWN
30	X	0	ACETATE	GP6-30	SP		COURSE SAND – BROWN
35	X	0	ACETATE	GP6-35	SP		COURSE SAND – BROWN

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP7
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/08/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: 3" ASPHALT AT SURFACE
5	X	0	ACETATE	GP7-5	SP		FINE SAND - GRAY/GREEN
10	X	0	ACETATE	GP7-10	SP		FINE SAND - LIGHT BROWN
15	X	0	ACETATE	GP7-15	SM		SILTY SAND - DARK BROWN
20	X	0	ACETATE	GP7-20	SP		SAND - DARK BROWN
25	X	0	ACETATE	GP7-25	SP		SAND - BROWN
30	X	0	ACETATE	GP7-30	SP		SAND - BROWN
35	X	0	ACETATE	GP7-35	SP		COURSE SAND - BROWN

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP8
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 5/08/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL. N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: SURFACE IS ASPHALT W/BASE FINE SAND TO 5 FT. BELOW
5	X	0	ACETATE	GP8-5	SP		FINE SAND - LIGHT BROWN
10	X	0	ACETATE	GP8-10	SP		FINE SAND - LIGHT BROWN
15	X	0	ACETATE	GP8-15	SM		SILTY SAND - DARK BROWN
20	X	0	ACETATE	GP8-20	SM		SILTY SAND - BROWN
25	X	0	ACETATE	GP8-25	SP		SAND - LIGHT BROWN
30	X	0	ACETATE	GP8-30	SP		COURSE SAND - BROWN
35	X	0	ACETATE	GP8-35	SP		COURSE SAND - BROWN

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP9
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 6/06/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL. N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: ASPHALT PAVING AT SURFACE
5	X	–	ACETATE	GP9–5	SM		SILTY SAND – DARK BROWN W/ASH, GLASS (FILL)
10	X	–	ACETATE	GP9–10	SM		SILTY SAND – BLACK W/CONC., GLASS (FILL)
15	X	–	ACETATE	GP9–15	SM		SILTY SAND – BROWN W/ASH (FILL)
20	X	–	ACETATE	GP9–20	SP		SAND – BROWN
25	X	–	ACETATE	GP9–25	SP		SAND – LIGHT BROWN
30	X	–	ACETATE	GP9–30	SP		SAND – LIGHT BROWN
35	X	–	ACETATE	GP9–35	SP		COURSE SAND – BROWN

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP10
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 6/06/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL. N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 44 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: CONC. SLAB AT SURFACE W/2' BASE 3 FT. BELOW THAT IS FINE SAND (FILL)
5	X	–	ACETATE	GP10–5	SP		SILTY SAND – GREEN/BROWN (FILL)
10	X	–	ACETATE	GP10–10	SM		SILTY SAND – DARK BROWN W/ASH TRASH WIRE (FILL)
15	X	–	ACETATE	GP10–15	SM		SILTY SAND – BROWN W/TILE, GLASS (FILL)
20	X	–	ACETATE	GP10–20	SM		SILTY SAND – DARK BROWN/RED W/CONC. (FILL)
25	X	–	ACETATE	GP10–25	SM		SILTY SAND – GRAY/BROWN W/CONC. AND WOOD
30	X	–	ACETATE	GP10–30	SM		SILTY SAND/MUD – BLACK W/OIL AND METAL
35	X	–	ACETATE	GP3–35	SM		SILTY SAND/MUD – BLACK W/CONC., GLASS, OIL SMELL
40	X	–	ACETATE	GP3–40	SM		SILTY SAND – BLACK W/OIL W/METAL AND WIRE
44	X	–	ACETATE	GP3–44	SM		COURSE SAND DARK BROWN/BLK W/OIL SMELL

BRYCON, LLC

SOIL BORING LOG INFORMATION

FACILITY/PROJECT NAME: 555 6th STREET, HERMOSA BCH.		BORING NUMBER: GP11
BORING DRILLED BY: J & H DRILLING CO.	DRILLING METHOD: GEOPROBE	DATE: 6/06/12
LOCATION: SEE FIGURE NO. 2 FOR LOCATION	APPROX. SURFACE EL.: N.A.	BACKFILL METHOD: BENTONITE
	BORING TOTAL DEPTH: 35 FT.	LOGGED BY: M. WILSON

DEPTH	SAMPLE INTERVAL	OVA (ppm)	SAMPLE TYPE	SAMPLE ID	USCS SOIL TYPE	GRAPHICS LOG	DESCRIPTIONS
0							NOTE: CONC. SLAB AT SURFACE W/2' BASE 3 FT. BELOW THAT IS FINE SAND (FILL)
5	X	–	ACETATE	GP11–5	SM		SILTY SAND – DARK BROWN W/GLASS AND BRICK (FILL)
10	X	–	ACETATE	GP11–10	SM		SILTY SAND – DARK BROWN/BLACK W/GLASS (FILL)
15	X	–	ACETATE	GP11–15	SM		SILTY SAND – DARK BROWN/BLACK W/GLASS (FILL)
20	X	–	ACETATE	GP11–20	SP		SAND – BROWN
25	X	–	ACETATE	GP11–25	SP		SAND – BROWN
30	X	–	ACETATE	GP11–30	SP		SAND – BROWN
35	X	–	ACETATE	GP11–35	SP		COURSE SAND – BROWN

E N T R I X

Glendale, California (E-1)

Boring Number: **B 1**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

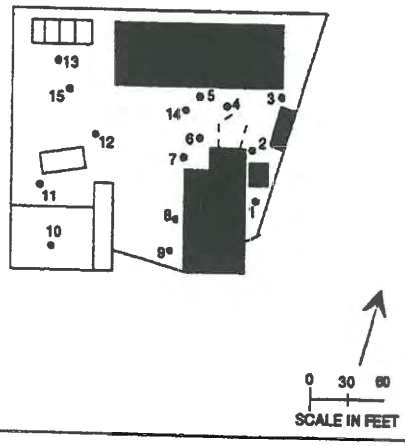
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **100 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/14/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet ASPHALTIC CONCRETE PAVEMENT
2					0.5 - 9.0 feet FINE TO MEDIUM SAND, yellowish brown, very loose, dry
4				9.5 ppm	
6					
8					
10				11.0 ppm	9.0 - 14.0 feet FINE TO MEDIUM SILTY SAND, light brown, very loose, dry
12					
14				17.9 ppm	14.0 - 19.0 feet FINE TO MEDIUM SILTY SAND, light yellowish brown, very loose, dry
16					
18					
				17.0 ppm	19.0 - 24.0 feet see following page

MOC029614

ENTRIX Glendale, California

Boring Number: **B 1 continued**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

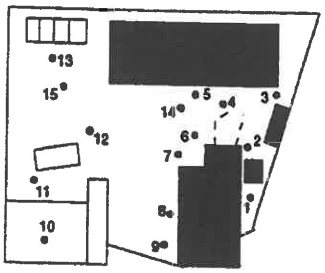
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

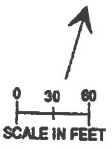
Suface Elev: **100 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/14/95**

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION	
					(continued)	
20				17.0 ppm	19.0 - 24.0 feet	FINE TO MEDIUM SAND, light yellow very loose, dry
22						
24				18.0 ppm	24.0 - 31.0 feet	FINE TO MEDIUM SAND, light yellowish brown, traces of lenses or silt, very loose, dry
26						
28						
30						
32						
34						
36						
38						

ENTRIX Glendale, California (E-2)

Boring Number: **B 2**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

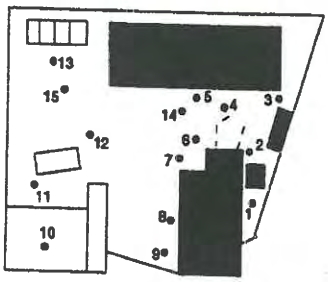
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **99 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/14/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.25 feet ASPHALTIC CONCRETE PAVEMENT
2					0.25 - 8.0 feet FINE TO MEDIUM SILTY SAND, dark gray brown, very loose, dry
4					
6					
8					8.0 - 14.0 feet FINE TO MEDIUM SILTY SAND, light brown, traces of soft clay, loose, moist
10				13.1 ppm	
12					
14				21.0 ppm	14.0 - 19.0 feet FINE TO MEDIUM SAND, very light yellowish orange, traces of silt, very loose, slightly moist
16					
18					
				20.1 ppm	19.0 - 24.0 feet see following page

MOC029616

ENTRIX

Glendale, California

Boring Number: B 2 continued

Project: Hermosa Beach/Macpherson Owner Hermosa Beach

Location: Maintenance Yard Project No: 693302

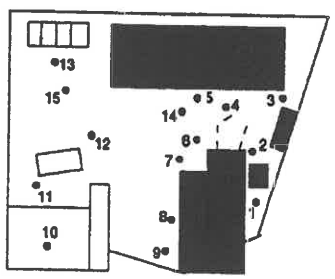
Total Depth: 31 Feet Borehole Dia.: 1.5 Inches

Suface Elev: 99 Feet Water First Encountered: ----

Drilling Company: Vironex Drilling Method: Geoprobe

Driller T. Hanna Geologist C. White Date Drilled: 03/14/95

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20				20.1 ppm	19.0 - 24.0 feet FINE TO MEDIUM SILTY SAND, very light yellow orange, very loose, dry
22					
24				17.2 ppm	24.0 - 31.0 feet FINE TO MEDIUM SAND, light brown, very loose, dry
26					
28					
30					
32					
34					
36					
38					

MOC029617

ENTRIX Glendale, California (E-3)

Boring Number: **B 3**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

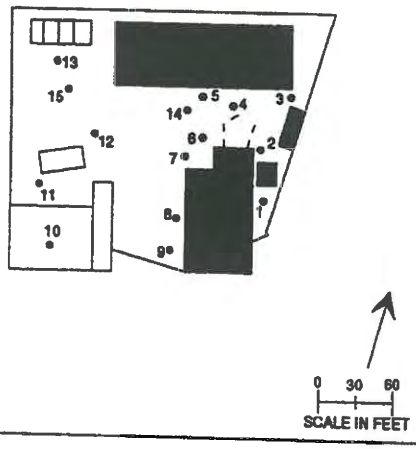
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **99 Feet** Water First Encountered: —

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/14/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet ASPHALTIC CONCRETE PAVEMENT
2					0.5 - 7.0 feet FINE SILTY SAND, dark to medium brown, very loose, dry
4				1.0 ppm	
6					
8					7.0 - 19.0 feet FILL-SILTY FINE TO MEDIUM SAND, dark to medium brown glass ceramic, wood, bick, rusty metal below 14 feet; layers of light yellowish orange, medium to fine grained sand and white chalky debris
10					
12					
14				2.1 ppm	
16					
18					
				2.1 ppm	19.0 - 24.0 feet see following page

MOC029618

ENTRIX

Glendale, California

Boring Number: B 3 continued

Project: Hermosa Beach/Macpherson Owner Hermosa Beach

Location: Maintenance Yard Project No: 693302

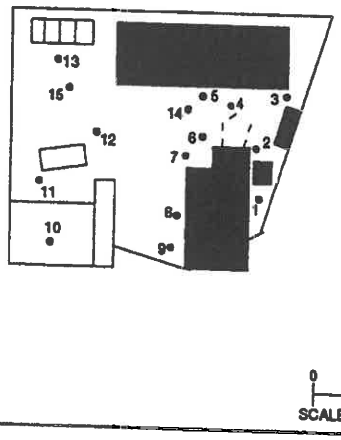
Total Depth: 31 Feet Borehole Dia.: 1.5 Inches

Suface Elev: 99 Feet Water First Encountered: ---

Drilling Company: Vironex Drilling Method: Geoprobe

Driller T. Hanna Geologist C. White Date Drilled: 03/14/95

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20				2.1 ppm	19.0 - 24.0 feet FINE TO MEDIUM SILTY SAND, medium to dark brown, loose, dry
22					
24				1.7 ppm	24.0 - 28.0 feet FINE TO MEDIUM SAND, yellowish orange, very loose, dry
26					
28					28.0 - 31.0 feet FINE TO MEDIUM SILTY SAND, light tan, very loose, dry
30					
32					
34					
36					
38					

E N T R I X

Glendale, California (E-4)

Boring Number: **B 4**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

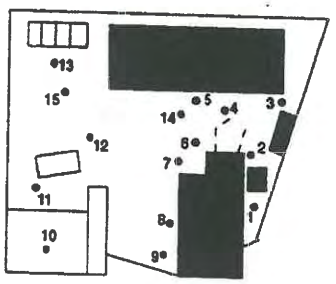
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **99 Feet** Water First Encountered: —

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet ASPHALTIC CONCRETE PAVEMENT
2					0.5 - 6.0 feet FINE SAND, medium brown, very loose, dry, brick at 6.0 feet
4				13.1 ppm	
6					6.0 - 27.0 feet FILL-FINE TO MEDIUM SAND, dark brown, very loose with wood, glass, rusty metal, brick, ceramic, cement block
8					
10				22.6 ppm	
12					
14				9.0 ppm	
16					
18					
				2.4 ppm	

MOC029620

ENTRIX Glendale, California

Boring Number: **B 4 continued**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

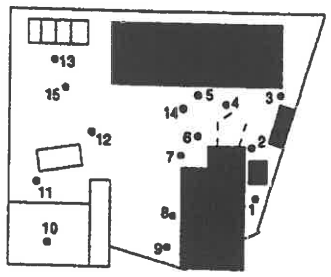
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

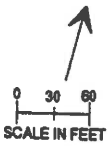
Suface Elev: **99 Feet** Water First Encountered: ----

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20				2.4 ppm	6.0 - 27.0 feet FILL-FINE TO MEDIUM SAND, dark brown, very loose with wood, glass, rusty metal, brick, ceramic, cement block
22					
24					
26					
28					27.0 - 31.0 feet FINE TO MEDIUM SAND, medium brown, very loose, moist
30				4.0 ppm	
32					
34					
36					
38					

ENTRIX Glendale, California (E-5)

Boring Number: **B 5**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

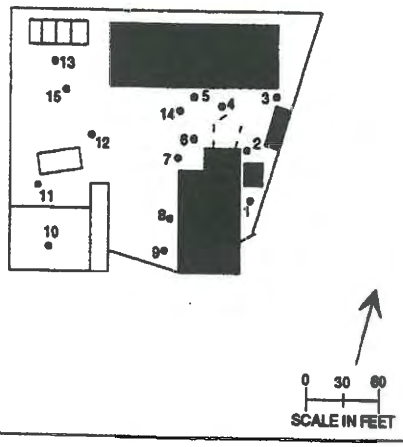
Total Depth: **46 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **99 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/14/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet ASPHALTIC CONCRETE PAVEMENT
2					0.5 - 12.0 feet FINE SAND, olive gray, very loose, moist at 10.0 feet color becomes variable
4				14.0 ppm	
6					
8					
10					
12					12.0 - 22.0 feet FINE TO MEDIUM SILTY SAND, dark gray, loose, moist with, brick, glass, rusty metal, wood
14				5.8 ppm	
16					
18					

MOC029622

ENTRIX Glendale, California

Boring Number: **B 5 continued**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

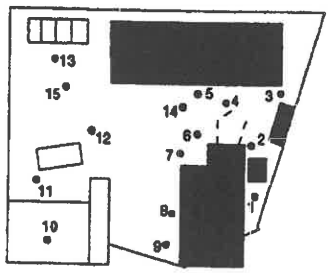
Total Depth: **46 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **99 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/14/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20					12.0 - 22.0 feet FINE TO MEDIUM SILTY SAND, dark gray, loose, moist with, brick, glass, rusty metal, wood
22					22.0 - 38.0 feet MEDIUM TO FINE SAND, black, stained oily and sticky, very moist, strong product odor
24				158.0 ppm	
26					
28					
30				210.0 ppm	
32					
34				56.0 ppm	
36					
38				22.0 ppm	38.0 - 46.0 feet see following page

ENTRIX

Glendale, California

Boring Number: B 5 continued

Project: Hermosa Beach/Macpherson Owner Hermosa Beach

Location: Maintenance Yard Project No: 693302

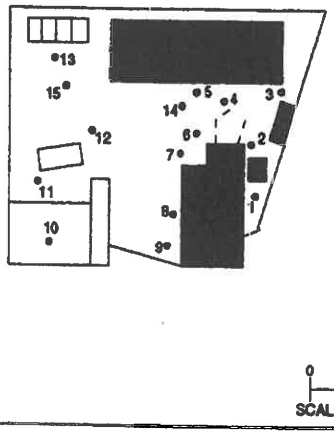
Total Depth: 46 Feet Borehole Dia.: 1.5 Inches

Suface Elev: 99 Feet Water First Encountered: ----

Drilling Company: Vironex Drilling Method: Geoprobe

Driller T. Hanna Geologist C. White Date Drilled: 03/14/95

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
40				22.0 ppm	38.0 - 46.0 feet MEDIUM TO COARSE SAND, light yellowish brown, very loose, moist with lenses of dark brown fine to medium grainded oily sand
42					
44				48.0 ppm	
46					
48					
50					
52					
54					
56					
58					

ENTRIX Glendale, California (E-6)

Boring Number: **B 6**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

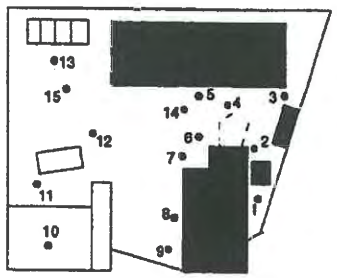
Total Depth: **16 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **100 Feet** Water First Encountered: ----

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet ASPHALTIC CONCRETE PAVEMENT
					0.5 - 16.0 feet FINE SILTY SAND, light brown, very loose, moist
2					
4					
				19.7 ppm	
6					
8					
10					
12					
14					
				16.7 ppm	
16					
18					

MOC029625

ENTRIX Glendale, California (E-7)

Boring Number: **B 7**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

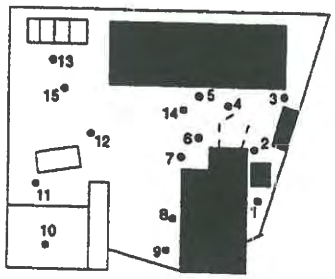
Total Depth: **36 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **100 Feet** Water First Encountered: ----

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet CONCRETE WITH ASPHALT AT SURFACE
					0.5 - 13.0 feet FINE SAND, light brown, very loose, dry, grading to medium brown at 10 feet
4				8.0 ppm	
10				17.2 ppm	
12					
					13.0 - 26.0 feet FINE SILTY SAND, medium brown, loose, dry grading to light yellowish orange at 20 feet
14				20.2 ppm	
18				9.0 ppm	

MOC029626

E N T R I X

Glendale, California

Boring Number: **B 7 continued**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

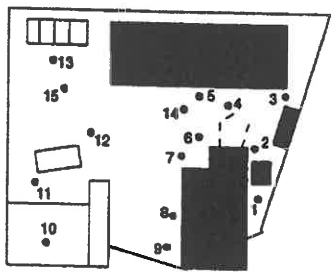
Total Depth: **36 Feet** Borehole Dia.: **1.5 Inches**

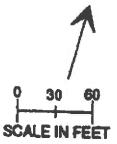
Suface Elev: **100 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION	
					(continued)	
20				9.0 ppm	13.0 - 26.0 feet	FINE SILTY SAND, medium brown, loose, dry grading to light yellowish orange at 20 feet
22						
24				3.2 ppm		
26					26.0 - 31.0 feet	FINE TO MEDIUM SAND, yellowish orange, very loose, dry
28						
30				6.0 ppm		
32						
34						
36						
38						

MOC029627

ENTRIX Glendale, California (E-8)

Boring Number: **B 8**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

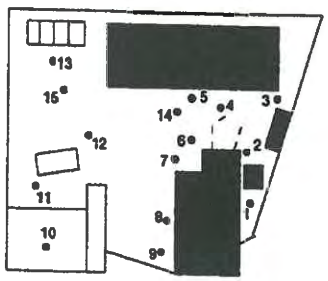
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

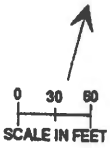
Suface Elev: **100 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet ASPHALTIC CONCRETE PAVEMENT
2					0.5 - 6.0 feet FINE SILTY SAND, dark brown, very loose, moist
4				4.0 ppm	
6					6.0 - 18.0 feet FINE TO MEDIUM SAND, light tan, very loose, moist
8					
10				6.5 ppm	
12					
14					
16					
18					18.0 - 24.0 feet FINE TO MEDIUM SILTY SAND, orangish brown, loose, with plant materials, moist
				2.4 ppm	

MOC029628

ENTRIX

Glendale, California

Boring Number: B 8 continued

Project: Hermosa Beach/Macpherson Owner Hermosa Beach

Location: Maintenance Yard Project No: 693302

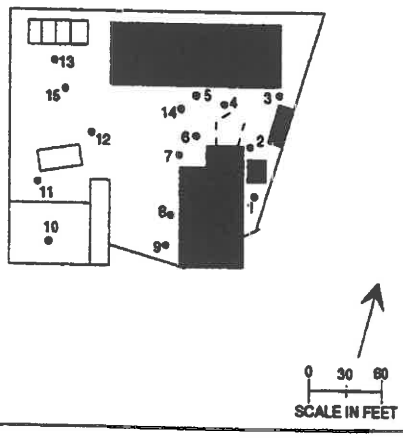
Total Depth: 31 Feet Borehole Dia.: 1.5 Inches

Suface Elev: 100 Feet Water First Encountered: ---

Drilling Company: Vironex Drilling Method: Geoprobe

Driller T. Hanna Geologist C. White Date Drilled: 03/15/95

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20				22.7 ppm	18.0 - 24.0 feet FINE TO MEDIUM SILTY SAND, orangish brown, loose, with plant materials, moist
22					
24					24.0 - 31.0 feet FINE TO MEDIUM SAND, light yellow orange, very loose, dry, becoming more coarse at 28.0 feet
26					
28				22.2 ppm	
30				4.0 ppm	
32					
34					
36					
38					

ENTRIX Glendale, California (E-9)

Boring Number: **B 9**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

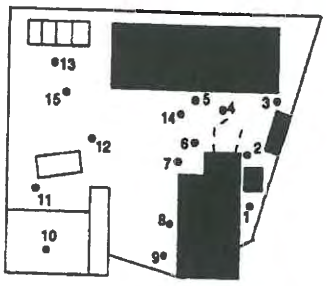
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **100 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet ASPHALTIC CONCRETE PAVEMENT
					0.5 - 13.0 feet FINE SAND, light yellow, very loose, slightly moist
4				20.7 ppm	
10				22.0 ppm	
					13.0 - 18.0 feet FINE SILTY SAND, dark brown, loose, moist, somewhat clayey
14				26.7 ppm	
18				4.6 ppm	18.0 - 31.0 feet FINE TO MEDIUM SAND, moderate yellow brown, very loose, slightly moist

MOC029630

ENTRIX

Glendale, California

Boring Number: B 9 continued

Project: Hermosa Beach/Macpherson Owner Hermosa Beach

Location: Maintenance Yard Project No: 693302

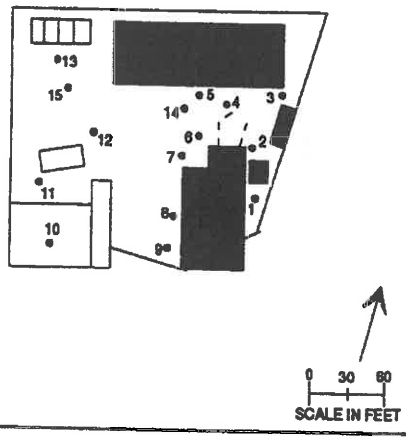
Total Depth: 31 Feet Borehole Dia.: 1.5 Inches

Suface Elev: 100 Feet Water First Encountered: —

Drilling Company: Vironex Drilling Method: Geoprobe

Driller T. Hanna Geologist C. White Date Drilled: 03/15/95

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20				4.6 ppm	18.0 - 31.0 feet FINE TO MEDIUM SAND, moderate yellow brown, very loose, slightly moist
22					
24				25.1 ppm	
26					
28					
30				19.0 ppm	
32					
34					
36					
38					

ENTRIX Glendale, California (E-10)

Boring Number: **B 10**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

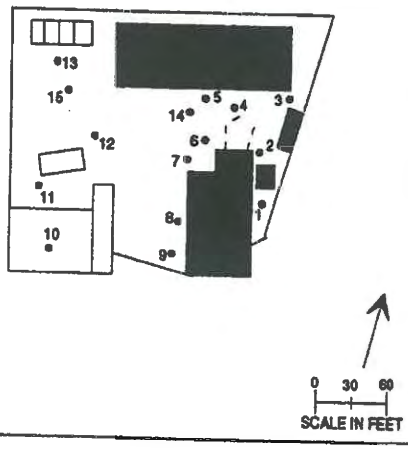
Total Depth: **21 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **95 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet ASPHALTIC CONCRETE PAVEMENT
2					0.5 - 7.0 feet FINE SILTY SAND, medium brown grading to light tan, very loose, dry, with some rusty lenses
4				5.0 ppm	
6					
8					7.0 - 18.0 feet FINE SAND, light yellowish brown, very loose, dry
10				4.2 ppm	
12					
14				2.0 ppm	
16					
18					18.0 - 21.0 feet FINE SILTY SAND, medium brown, loose. moist
				9.0 ppm	

MOC029632

E N T R I X

Glendale, California (E-11)

Boring Number: **B 11**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

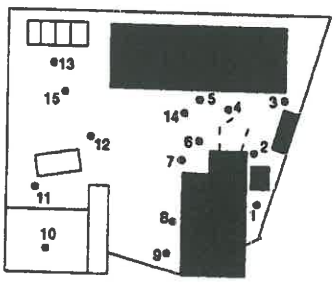
Total Depth: **4 Feet** Borehole Dia.: **3 Inches**

Suface Elev: **98 Feet** Water First Encountered: ----

Drilling Company: _____ Drilling Method: **Hand Auger**

Driller **D. Tormey** Geologist **C. White** Date Drilled: **03/14/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 4.0 feet FINE TO MEDIUM SAND, light brown, very loose, dry
2					
4					
6					
8					
10					
12					
14					
16					
18					

MOC029633

ENTRIX

Glendale, California (E-12)

Boring Number: **B 12**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

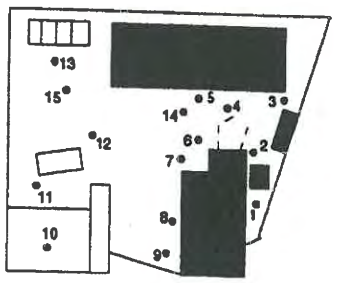
Total Depth: **16 Feet** Borehole Dia.: **1.5 Inches**

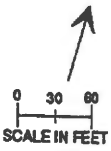
Suface Elev: **103 Feet** Water First Encountered: ----

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (ratio above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
0					0.0 - 12.0 feet FINE SAND, light tan gray, very loose, dry
4				17.4 ppm	
10				18.6 ppm	
12					12.0 - 16.0 feet FINE TO MEDIUM SILTY SAND, light medium brown, loose, moist, with some clayey lenses
14				19.6 ppm	
16					
18					

MOC029634

ENTRIX

Glendale, California (E-13)

Boring Number: **B 13**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

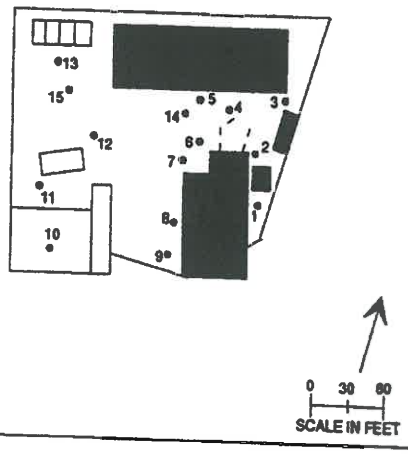
Total Depth: **4 Feet** Borehole Dia.: **3 Inches**

Suface Elev: **98 Feet** Water First Encountered: ----

Drilling Company: Drilling Method: **Hand Auger**

Driller **D. Tormey** Geologist **C. White** Date Drilled: **03/14/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 4.0 feet FINE TO MEDIUM grained, light brown, very loose, dry
2					
4					
6					
8					
10					
12					
14					
16					
18					

MOC029635

ENTRIX Glendale, California (E-14)

Boring Number: **B 14**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

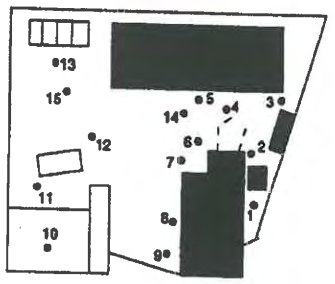
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

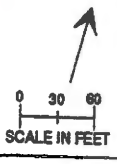
Suface Elev: **99 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet ASPHALTIC CONCRETE PAVEMENT
2					0.5 - 6.0 feet FINE TO MEDIUM SAND, light brown, very loose, moist, some brick material at 6.0 feet
4				20.7 ppm	
6					6.0 - 19.0 feet FILL-FINE SAND, dark brown, very loose, moist with rusty metal, wood, glass, ceramic, some isolated lenses of very sticky, oily material, black
8					
10				62.5 ppm	
12					
14				22.6 ppm	
16					
18					
				176.0 ppm	19.0 - 23.0 feet see following page

ENTRIX Glendale, California

Boring Number: **B 14 continued**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

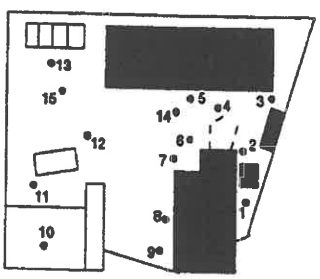
Total Depth: **31 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **99 Feet** Water First Encountered: ----

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION	
					(continued)	
20				176.0 ppm	19.0 - 23.0 feet	FINE TO MEDIUM SAND, black, oil stained sticky, strong product odor
22						
24				17.1 ppm	23.0 - 31.0 feet	FINE TO MEDIUM SAND, medium to dark brown, loose, slightly moist
26						
28						
30						
32						
34						
36						
38						

ENTRIX Glendale, California (E-15)

Boring Number: **B 15**

Project: **Hermosa Beach/Macpherson** Owner **Hermosa Beach**

Location: **Maintenance Yard** Project No: **693302**

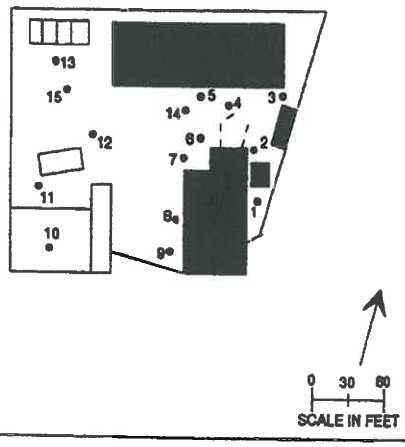
Total Depth: **21 Feet** Borehole Dia.: **1.5 Inches**

Suface Elev: **99 Feet** Water First Encountered: ---

Drilling Company: **Vironex** Drilling Method: **Geoprobe**

Driller **T. Hanna** Geologist **C. White** Date Drilled: **03/15/95**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	NO CORE	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0 - 0.5 feet GRAVEL FILL
2					0.5 - 21.0 feet FINE TO MEDIUM SAND, light brown, very loose, dry, grading to light orange brown sand at 14 to 16 feet
4				32.1 ppm	
6					
8					
10				14.2 ppm	
12					
14				22.8 ppm	
16					
18					
				15.5 ppm	

MOC029638

ENTRIX

Glendale, California

Boring Number: **ASE 1**

Project: **Hermosa Beach/Macpherson** Owner

Location: **Maintenance Yard** Project No: **693302**

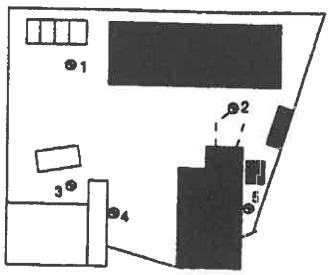
Total Depth: **25 Feet** Borehole Dia.: **8 Inches**

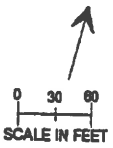
Suface Elev: **101 Feet** Water First Encountered: ----

Drilling Company: **ASE** Drilling Method: **Rotary**

Driller ____ Geologist ____ Date Drilled: **05/17/94**

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION	
0						
					0.0 - 1.0 foot	FILL-FINE TO COARSE SANDY GRAVEL, grey, dry
2					1.0 - 11.0 feet	NATURAL FINE SAND, pale yellow becoming very pale brown to white below 8 feet, dry
4						
6						
8						
10						
12					11.0 - 16.0 feet	SILTY FINE TO MEDIUM SAND, dark yellowish brown with clay binder, damp to moist
14						
16					16.0 - 25.0 feet	FINE TO MEDIUM SAND, brownish yellow, damp
18						

MOC029639

ENTRIX

Glendale, California

Boring Number: ASE 1

Project: Hermosa Beach/Macpherson Owner

Location: Maintenance Yard Project No: 693302

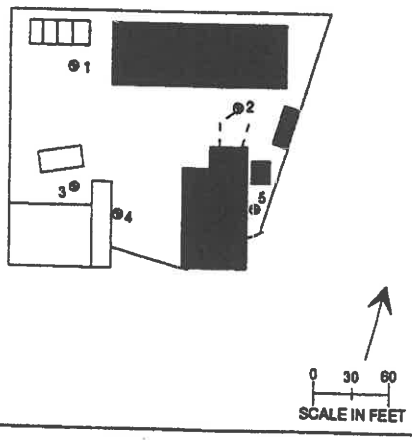
Total Depth: 25 Feet Borehole Dia.: 8 Inches

Suface Elev: 101 Feet Water First Encountered: ---

Drilling Company: ASE Drilling Method: Rotary

Driller Geologist Date Drilled: 05/17/94

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20					16.0 - 25.0 feet FINE TO MEDIUM SAND, brownish yellow, damp
22					
24					
26					
28					
30					
32					
34					
36					
38					

MOC029640

ENTRIX

Glendale, California

Boring Number: **ASE 2**

Project: **Hermosa Beach/Macpherson** Owner

Location: **Maintenance Yard** Project No: **693302**

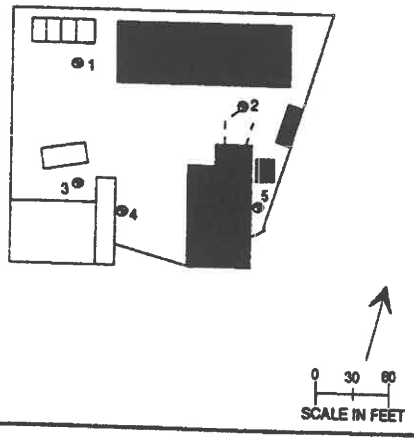
Total Depth: **35 Feet** Borehole Dia.: **8 Inches**

Suface Elev: **98 Feet** Water First Encountered: ----

Drilling Company: **ASE** Drilling Method: **Rotary**

Driller Geologist Date Drilled: **05/17/94**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					0.0-0.54 foot 1.5" ASPHALTIC CONCRETE PAVEMENT, 2" base, 3" ACP
2					0.54 - 2.5 feet FILL-FINE TO COARSE SAND, grey with gravel, dry
4					2.5 - 17.0 feet FILL-SILTY FINE TO MEDIUM SAND, very dark grayish brown with gravel, brick, glass, concrete, wire, wood, charcoal, porlelain pieces, debris content and size increases below 11 feet - damp to moist
6					
8					
10					
12					
14					
16					
18					17.0 - 21.0 feet FILL-FINE TO MEDIUM SAND, brown large quanitites of glass, tile, clay pipe, etc., damp

MOC029641

E N T R I X

Glendale, California

Boring Number: **ASE 2**

Project: **Hermosa Beach/Macpherson** Owner _____

Location: **Maintenance Yard** Project No: **693302**

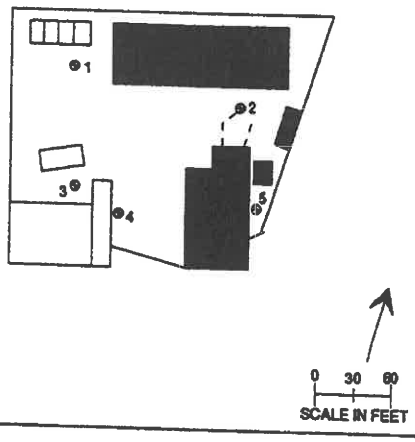
Total Depth: **35 Feet** Borehole Dia.: **8 Inches**

Suface Elev: **98 Feet** Water First Encountered: ----

Drilling Company: **ASE** Drilling Method: **Rotary**

Driller _____ Geologist _____ Date Drilled: **05/17/94**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20					17.0 - 21.0 feet FILL-FINE TO MEDIUM SAND, debris
22					21.0 - 24.0 feet FILL-FINE TO MEDIUM SAND, mottled brown and dark grayish brown, trace silt with brick, glass, clay pipe, etc., damp
24					24.0 - 29.0 feet FILL-FINE TO MEDIUM SAND, brown with gravel, glass, porcelain, etc., damp
26					
28					
30					29.0 - 34.0 feet NATURAL-FINE TO MEDIUM SAND, yellowish brown with, trace silt, dry to damp
32					
34					34.0 - 35.0 feet FINE TO COARSE SAND, brownish yellow, damp
36					
38					

MOC029642

E N T R I X

Glendale, California

Boring Number: **ASE 3**

Project: **Hermosa Beach/Macpherson** Owner

Location: **Maintenance Yard** Project No: **693302**

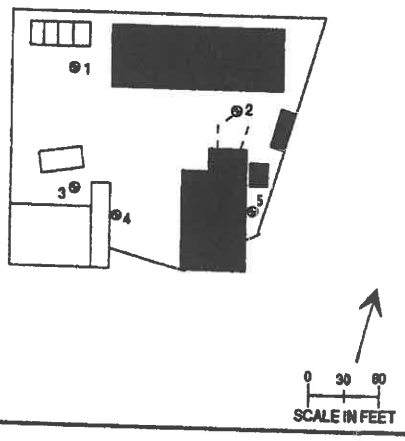
Total Depth: **25 Feet** Borehole Dia.: **8 Inches**

Suface Elev: **101 Feet** Water First Encountered: ----

Drilling Company: **ASE** Drilling Method: **Rotary**

Driller Geologist Date Drilled: **05/17/94**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
2					0.0 - 3.0 feet FILL-FINE TO MEDIUM SAND, dark grayish brown to grayish brown, becoming light brown below 2 feet, trace gravel, damp
4					3.0 - 6.0 feet NATURAL-FINE SAND, light yellowish brown to pale yellow dry to damp
6					6.0 - 18.0 feet FINE SAND, very pale brown to white, dry
8					
10					
12					
14					
16					
18					18.0 - 24.0 feet SILTY-FINE TO MEDIUM SAND, dark brown, trace clay binder below 21 feet, moist

ENTRIX

Glendale, California

Boring Number: ASE 3

Project: Hermosa Beach/Macpherson Owner

Location: Maintenance Yard Project No: 693302

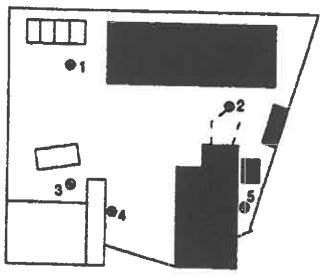
Total Depth: 25 Feet Borehole Dia.: 8 Inches

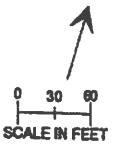
Suface Elev: 101 Feet Water First Encountered: ---

Drilling Company: ASE Drilling Method: Rotary

Driller Geologist Date Drilled: 05/17/94

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20					18.0 - 24.0 feet SILTY-FINE TO MEDIUM SAND, dark brown, trace clay binder below 21 feet, moist
22					
24					24.0 - 25.0 feet FINE TO MEDIUM SAND, yellowish brown, trace silt, damp
26					
28					
30					
32					
34					
36					
38					

MOC029644

E N T R I X

Glendale, California

Boring Number: **ASE 4**

Project: **Hermosa Beach/Macpherson** Owner

Location: **Maintenance Yard** Project No: **693302**

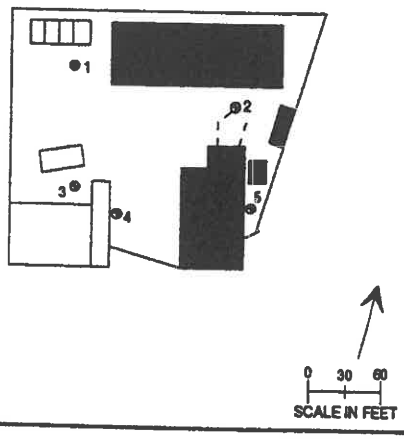
Total Depth: **25 Feet** Borehole Dia.: **8 Inches**

Suface Elev: **100 Feet** Water First Encountered: ---

Drilling Company: **ASE** Drilling Method: **Rotary**

Driller Geologist Date Drilled: **05/17/94**

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
				4.5"	ASPHALTIC CONCRETE PAVEMENT
				0.37 - 1.0 feet	FINE TO MEDIUM SAND, brown with asphalt, damp
2				1.0 - 15.0 feet	NATURAL-FINE SAND, pale brown, trace shell fragments, dry to damp
4					
6					
8					
10					
12					
14					
16				15.0 - 24.0 feet	SILTY FINE TO MEDIUM SAND, dark brown, trace clay binder below 19 feet, moist
18					

MOC029645

ENTRIX

Glendale, California

Boring Number: ASE 4

Project: Hermosa Beach/Macpherson Owner

Location: Maintenance Yard Project No: 693302

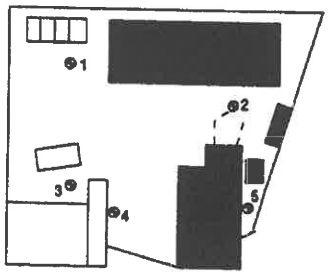
Total Depth: 25 Feet Borehole Dia.: 8 Inches

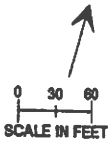
Suface Elev: 100 Feet Water First Encountered: —

Drilling Company: ASE Drilling Method: Rotary

Driller Geologist Date Drilled: 05/17/94

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20					15.0 - 24.0 feet SILTY-FINE TO MEDIUM SAND, dark brown, trace clay binder below 19 feet, moist
22					
24					24.0 - 25.0 feet FINE TO MEDIUM SAND, brownish yellow, damp
26					
28					
30					
32					
34					
36					
38					

MOC029646

ENTRIX

Glendale, California

Boring Number: **ASE 5**

Project: **Hermosa Beach/Macpherson** Owner

Location: **Maintenance Yard** Project No: **693302**

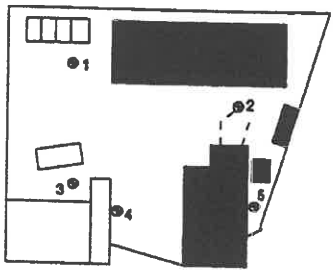
Total Depth: **25 Feet** Borehole Dia.: **8 Inches**

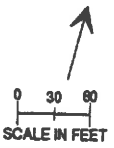
Suface Elev: **100 Feet** Water First Encountered: ----

Drilling Company: **ASE** Drilling Method: **Rotary**

Driller Geologist Date Drilled: **05/17/94**

SKETCH MAP





DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
0					
					4.5" ASPHALTIC CONCRETE PAVEMENT
2					0.37 - 4.0 feet FINE TO MEDIUM SAND, light olive brown, trace silt, dry
4					4.0 - 5.0 feet FINE TO MEDIUM SAND, grayish brown, dry
6					5.0 - 8.0 feet FINE TO MEDIUM SAND, very dark grayish brown, trace silt, dry
8					
10					8.0 - 16.0 feet SILTY FINE TO MEDIUM SAND, brown to yellowish brown, dry to damp
12					
14					
16					16.0 - 25.0 feet FINE TO MEDIUM SAND, very pale brown with lens brown, silty sand at 24 feet, dry
18					

MOC029647

ENTRIX

Glendale, California

Boring Number: ASE 5

Project: Hermosa Beach/Macpherson Owner

Location: Maintenance Yard Project No: 693302

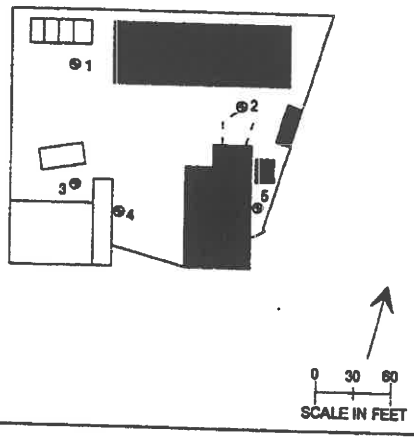
Total Depth: 25 Feet Borehole Dia.: 8 Inches

Suface Elev: 100 Feet Water First Encountered: ----

Drilling Company: ASE Drilling Method: Rotary

Driller Geologist Date Drilled: 05/17/94

SKETCH MAP



DEPTH (feet)	GRAPHIC LOG	CORE	CUTTINGS	OVA READING (units above background)	DESCRIPTION/SOIL CLASSIFICATION
					(continued)
20					16.0 - 25.0 feet FINE TO MEDIUM SAND, very pale brown with lens brown, silty sand at 24 feet, dry
22					
24					
26					
28					
30					
32					
34					
36					
38					

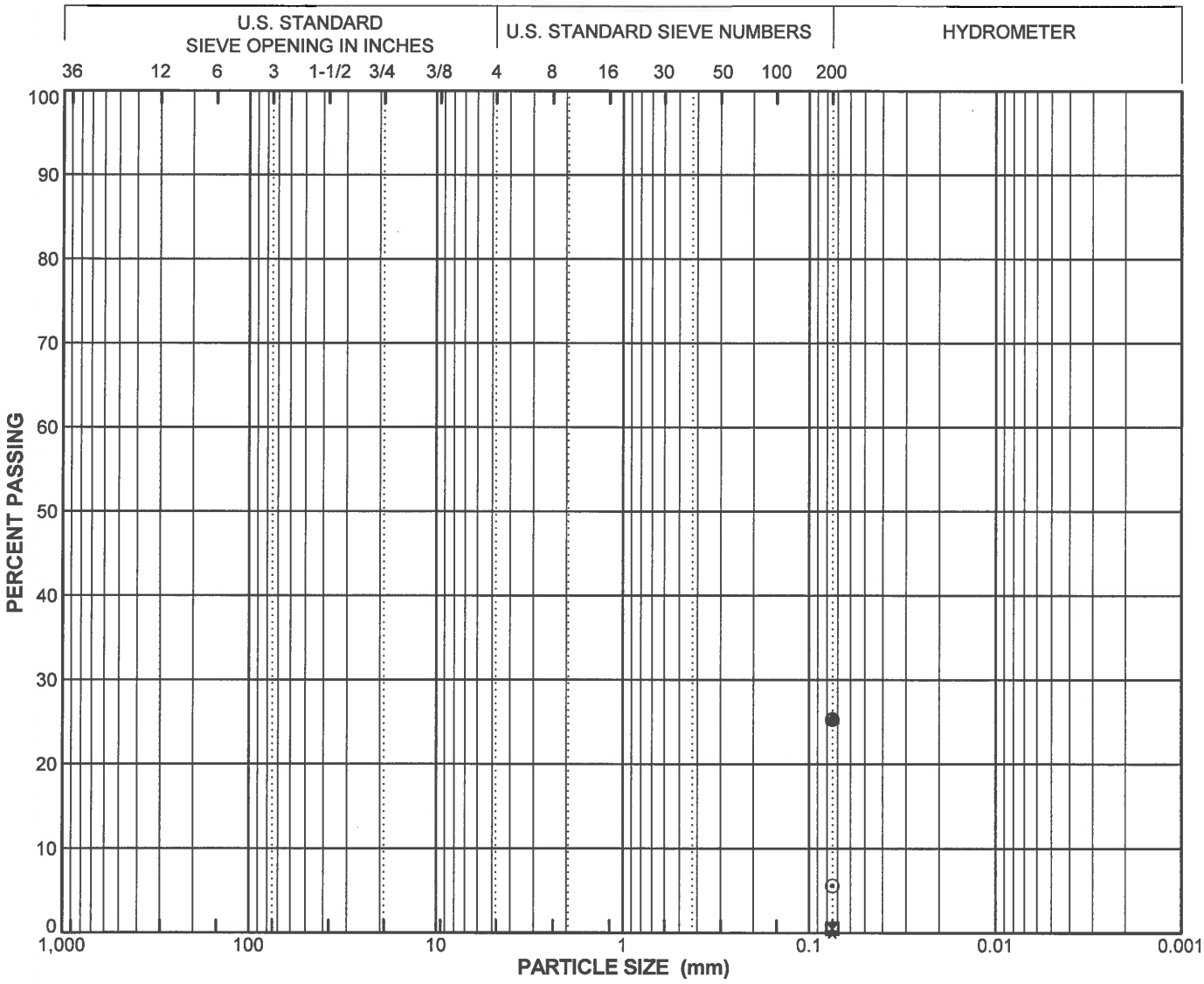
MOC029648

APPENDIX C

SUMMARY OF SOIL LABORATORY DATA

Boring/Sample Information					Field Moisture Content (%)	Field Dry Density (pcf)	Sieve/ Hydrometer		Atterberg Limits		USCS Group Symbol	Direct Shear				Compaction		Expansion Index	R-Value	Soluble Sulfate Content (% by wt)	Remarks / Other Laboratory Tests
												Ultimate		Peak		Maximum Dry Density (pcf)	Optimum Moisture Content (%)				
Boring No.	Sample No.	Depth (feet)	Elevation (feet)	Blow Count (N)			Fines Content (% pass. #200)	Clay Content (% pass. 2μ)	LL (%)	PI (%)		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)						
H-1	D-3	10.0	38.0	15	2	96					SM	30	27	30	32						
H-1	D-5	15.0	33.0	29	9	129	25				SC										
H-2	D-2	10.0	42.5	18	2	96					SP	0	30	0	33						
H-3	B-1	0.0	53.0				1				SP					102.0	12.0				
H-3	D-4	12.5	40.5	20	6	123	26				SM										
H-4	B-1	5.1	48.0								SP								60	0.0016	
H-4	D-3	10.0	43.0	16	1	96	0				SP										
H-5	B-1	0.0	54.0				6				SP	0	30	0	32	108.5	9.5		57	0.0042	
H-5	D-2	7.5	46.5	20	2	104	2				SP										
H-5	D-4	12.5	41.5	31	6	127	23				SM										
H-6	B-1	7.5	45.0								SM									0.0052	
H-6	D-6	20.0	32.5	12	10	111					SM										
H-7	B-1	0.0	53.0								SM								63		
H-7	D-1	7.5	45.5	25	3	118					SM										
H-7	D-2	12.5	40.5	24	4	111	19				SM	0	32	0	33						
H-7	D-5	40.0	13.0	80/10"	3	110					SP	0	35	0	43						

BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	



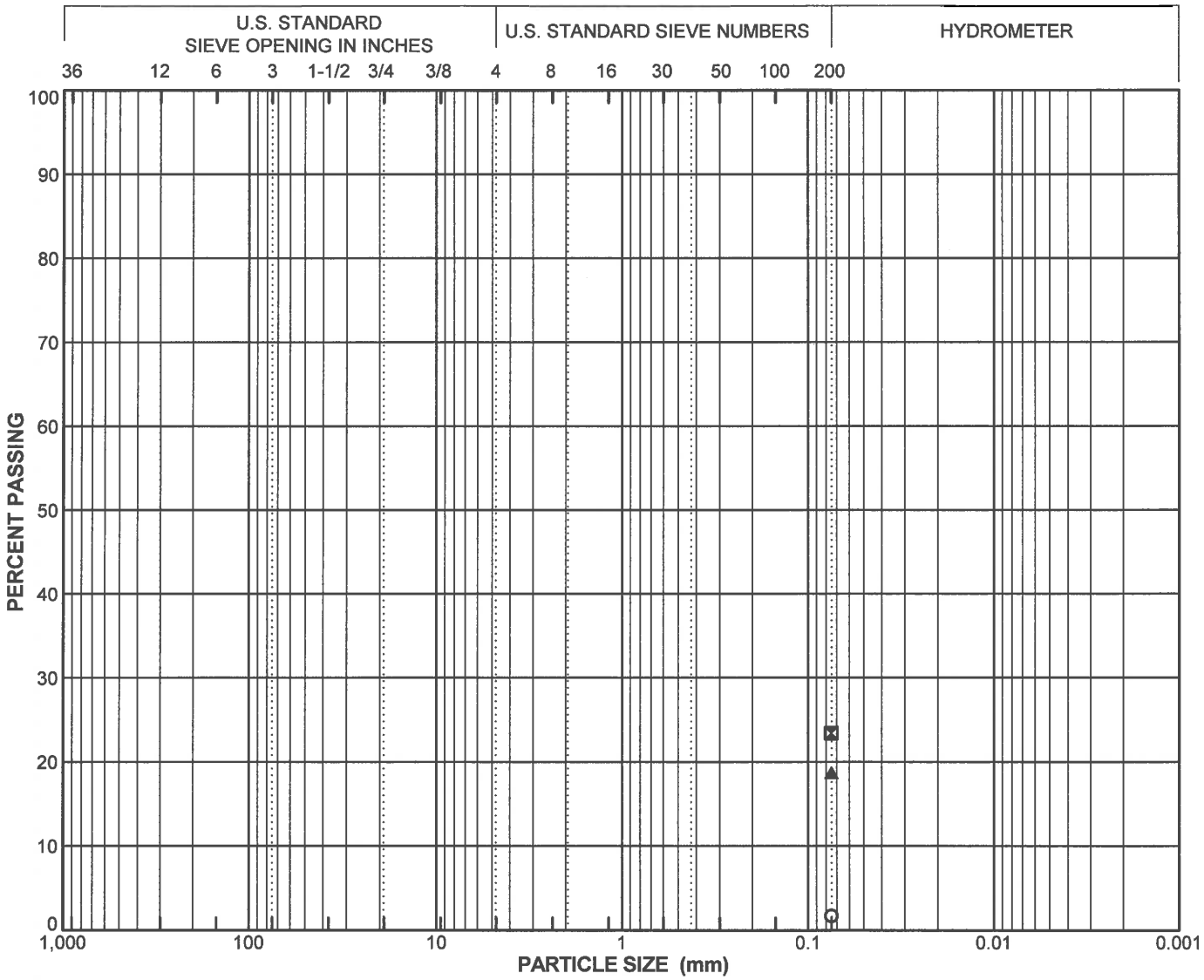
Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
○	H-1	D-5	15.0	9						25		SC
⊠	H-3	B-1	0.0							1		SP
▲	H-3	D-4	12.5	6						26		SM
★	H-4	D-3	10.0	1						0		SP
⊙	H-5	B-1	0.0							6		SP

PARTICLE SIZE DISTRIBUTION

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.

BOULDERS	COBBLES	GRAVEL		SAND			SILT OR CLAY
		coarse	fine	coarse	medium	fine	

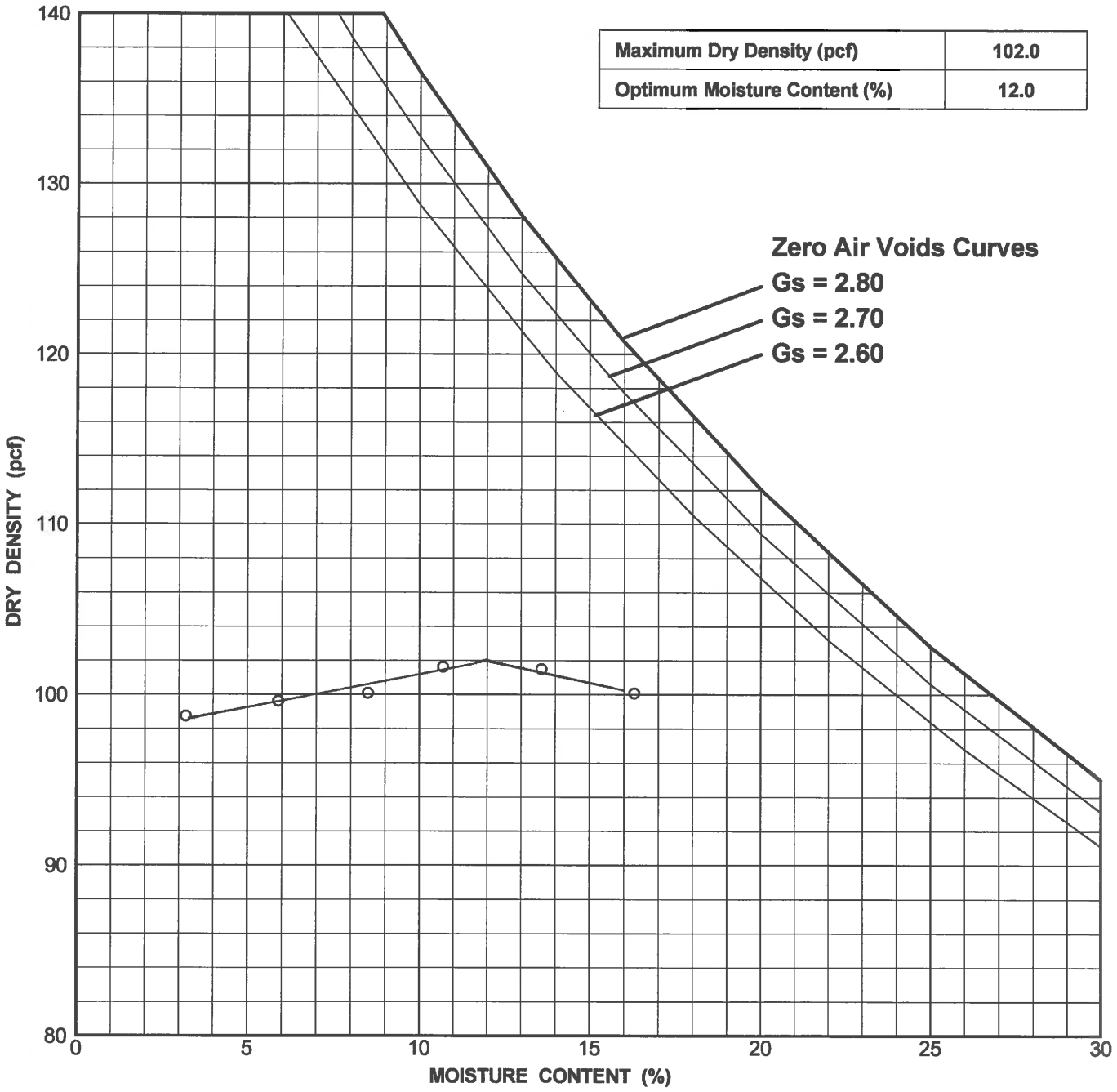


Symbol	Boring Number	Sample Number	Depth (feet)	Field Moisture (%)	LL	PI	Activity PI/-2μ	C_u	C_c	Passing No. 200 Sieve (%)	Passing 2μ (%)	USCS
O	H-5	D-2	7.5	2						2		SP
⊠	H-5	D-4	12.5	6						23		SM
▲	H-7	D-2	12.5	4						19		SM

PARTICLE SIZE DISTRIBUTION

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



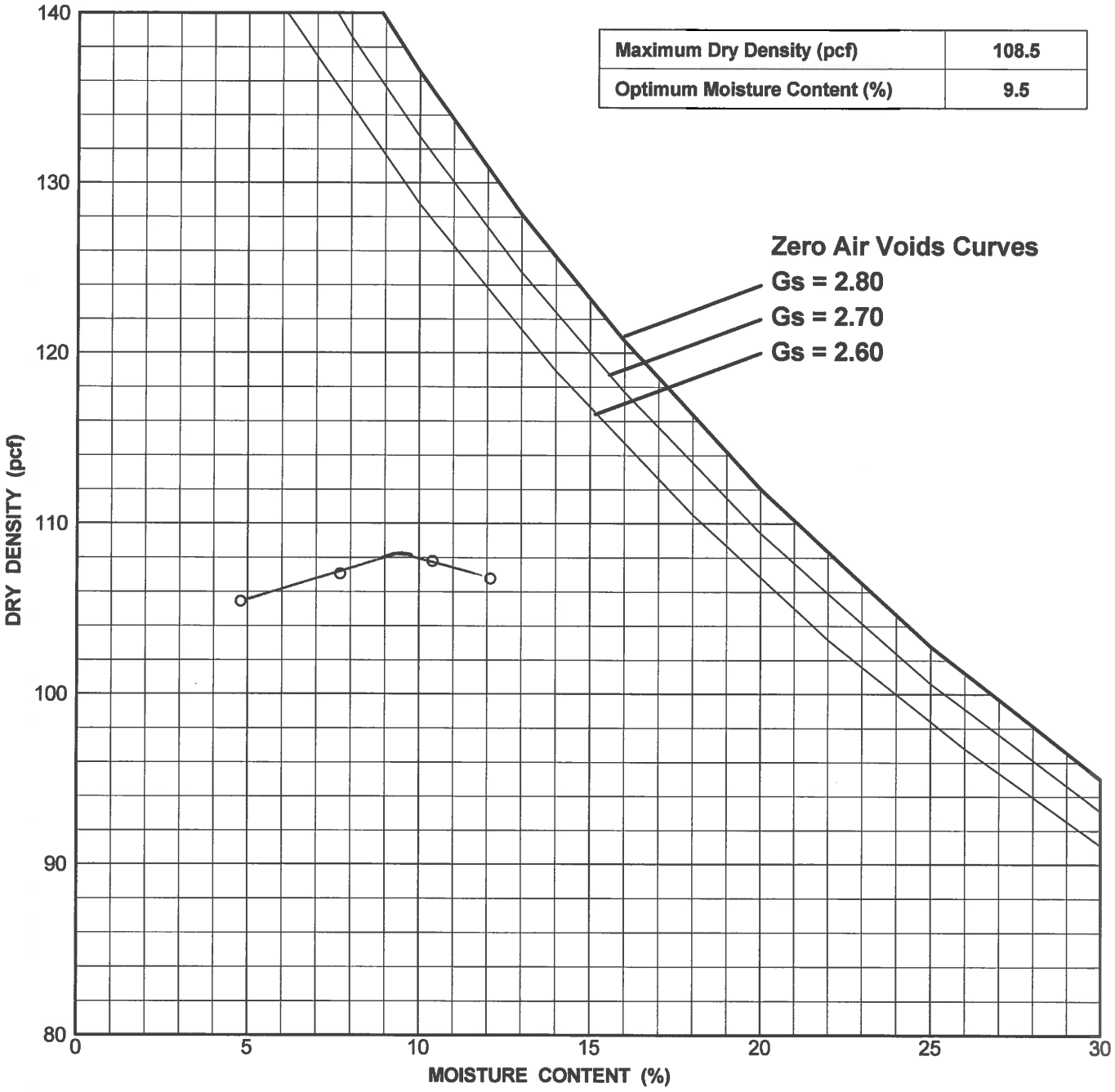
Maximum Dry Density (pcf)	102.0
Optimum Moisture Content (%)	12.0

Boring No. H-3	Sample No. B-1	Depth: 0.0 ft
Sample Description: (Qds) Yellowish brown SAND		
Liquid Limit:	Plasticity Index:	Percent Passing No. 200 Sieve: 1
Comments: 1557A		

COMPACTION TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



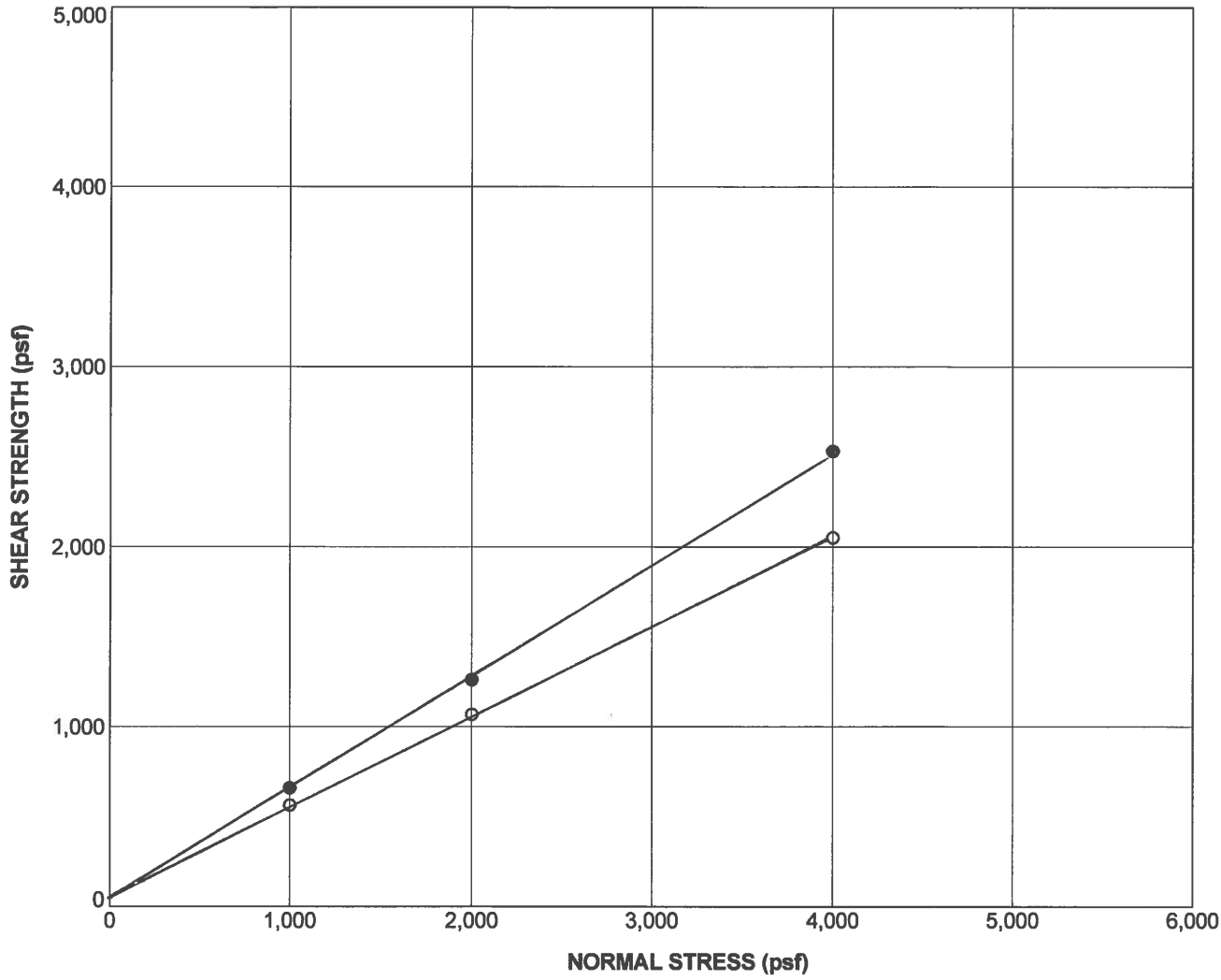
Maximum Dry Density (pcf)	**108.5**
Optimum Moisture Content (%)	**9.5**

Boring No. H-5	**Sample No. B-1**	**Depth: 0.0 ft**
Sample Description: (Afu) Dark olive brown SAND		
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:** 6
Comments: 1557A		

COMPACTION TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



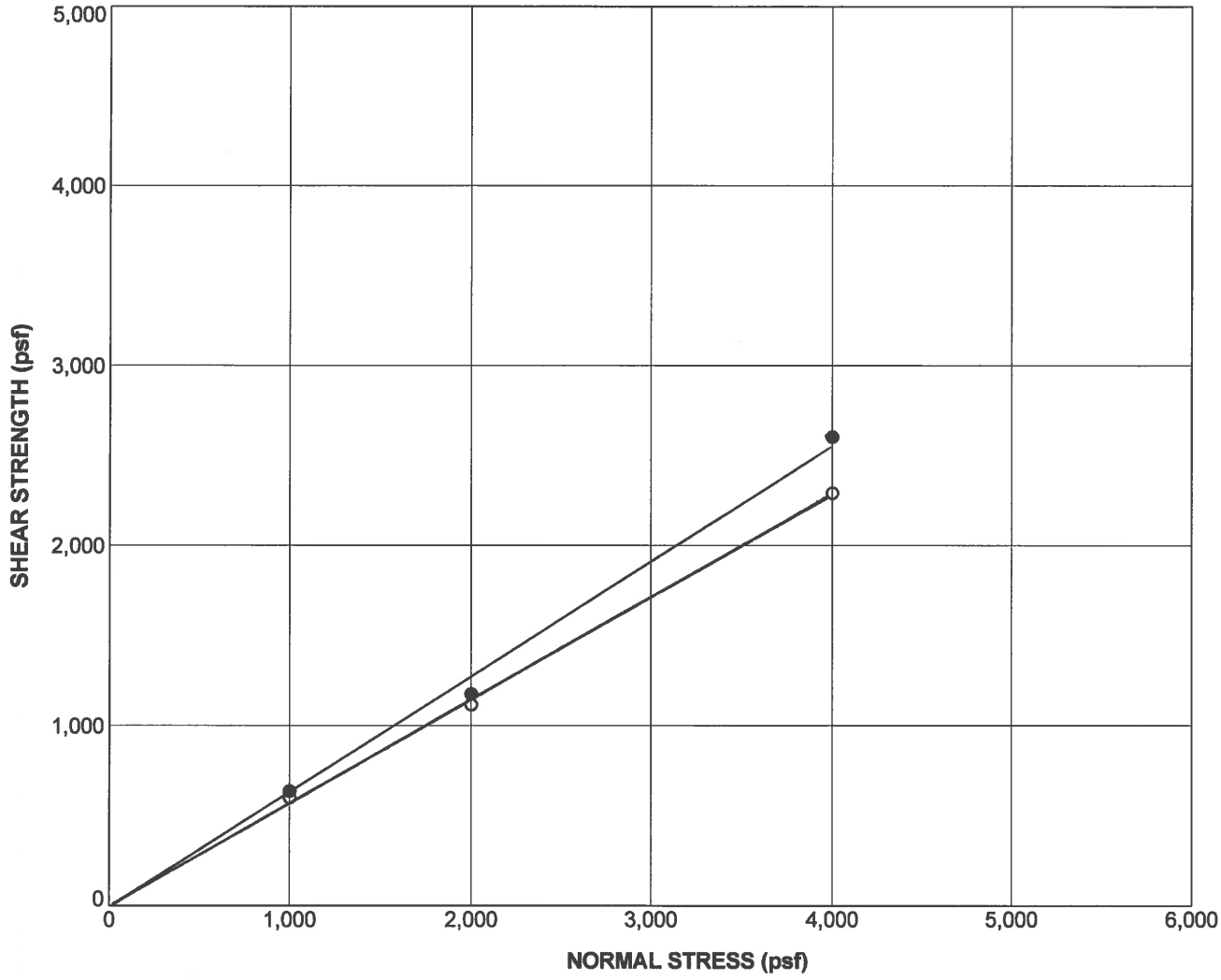
Boring No. H-1	Sample No. D-3	Depth: 10.0 ft
Sample Description:	(Qds) Light gray silty SAND	
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**
Moisture Content (%): 31.1	**Dry Density (pcf):** 90.2	**Degree of Saturation (%):** 99
Sample Type: Undisturbed	**Rate of Shear (in./min.):** 0.05	

SHEAR STRENGTH PARAMETERS		
Parameter	**Peak ●**	**Ultimate ○**
Cohesion (psf)	30	30
Friction Angle (degrees)	32	27.0

DIRECT SHEAR TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



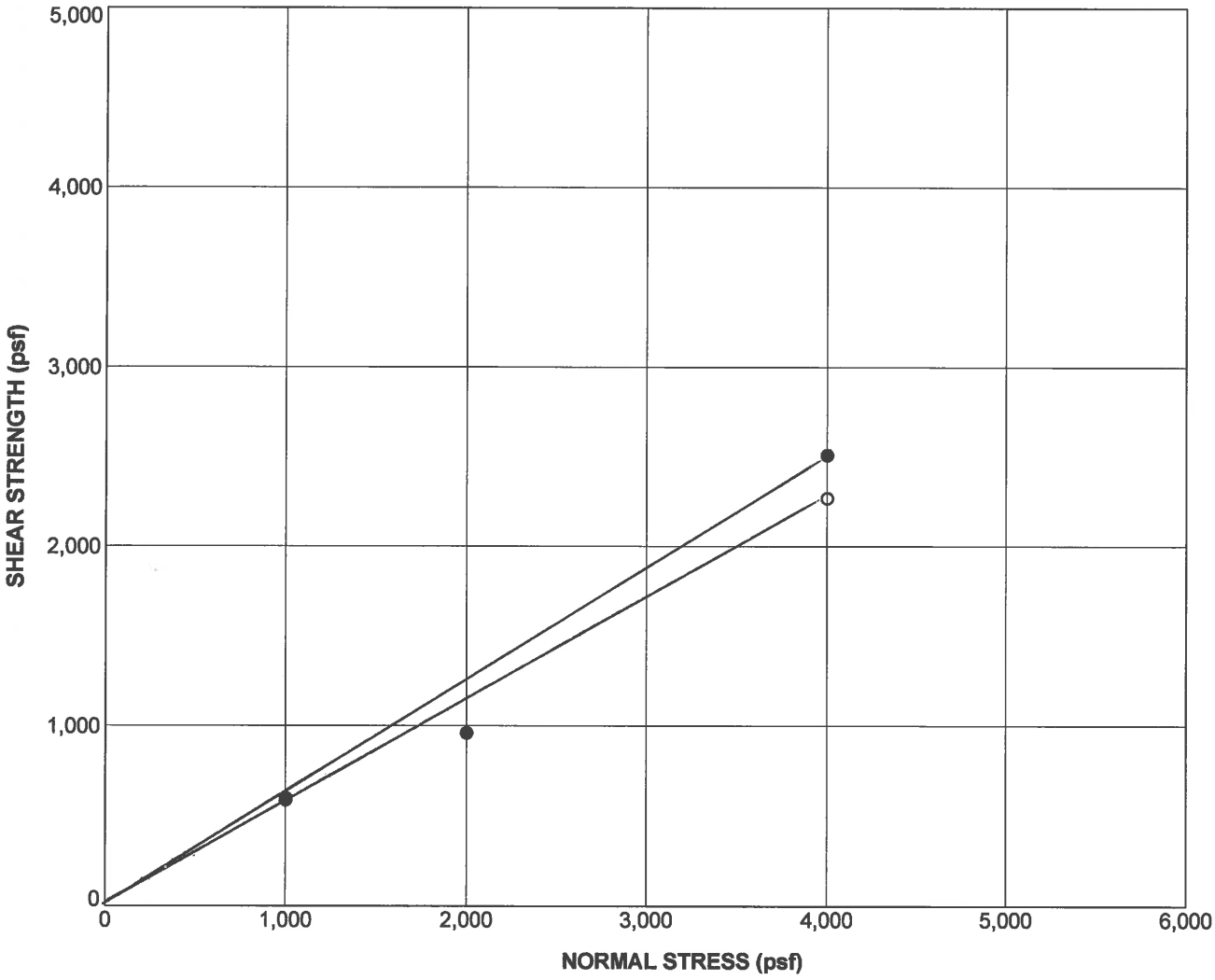
Boring No. H-2	Sample No. D-2	Depth: 10.0 ft
Sample Description: (Qds) Yellowish brown SAND		
Liquid Limit:	Plasticity Index:	Percent Passing No. 200 Sieve:
Moisture Content (%): 27.5	Dry Density (pcf): 90.6	Degree of Saturation (%): 88
Sample Type: Undisturbed	Rate of Shear (in./min.): 0.05	

SHEAR STRENGTH PARAMETERS		
Parameter	Peak ●	Ultimate ○
Cohesion (psf)	0	0
Friction Angle (degrees)	33	30.0

DIRECT SHEAR TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



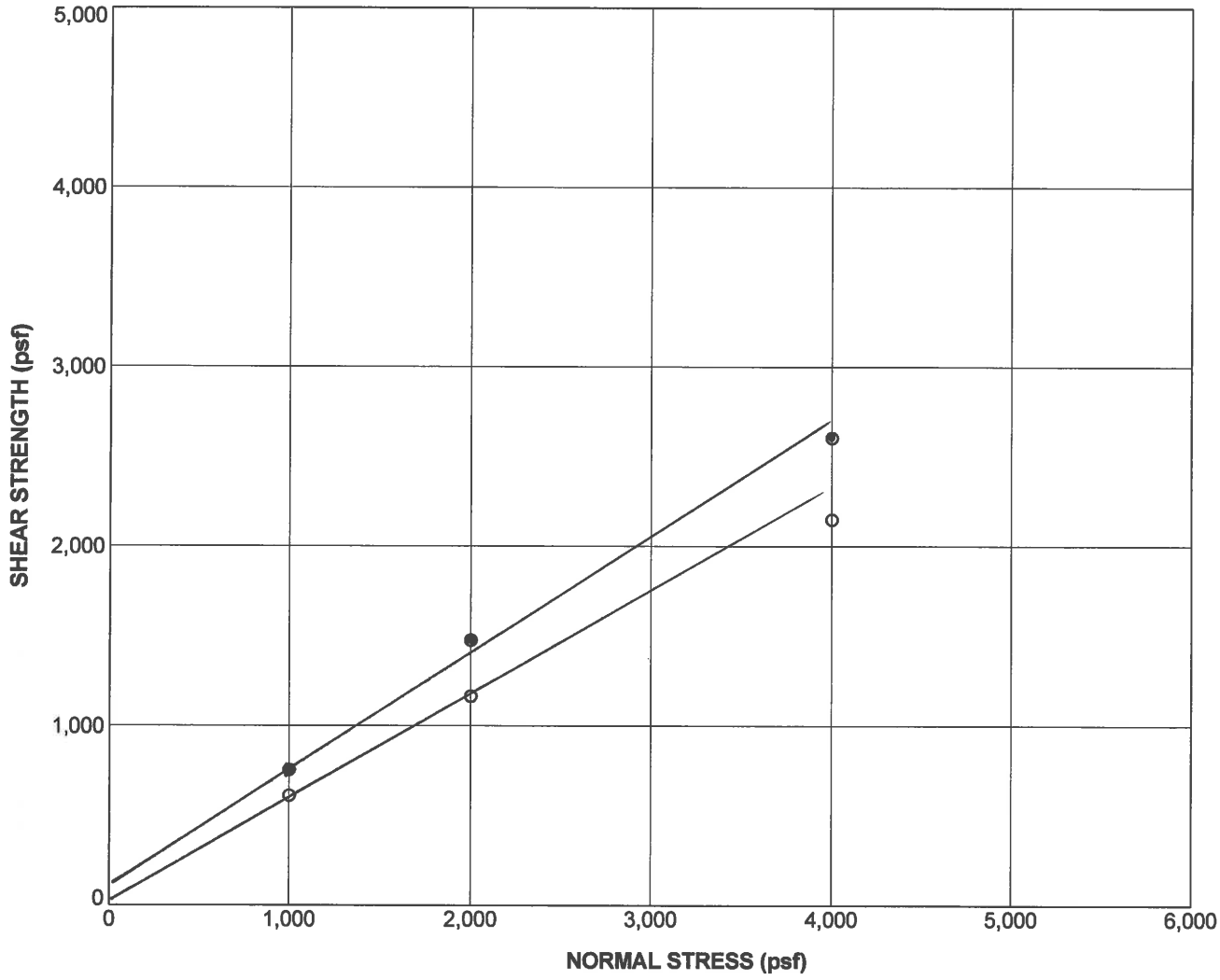
Boring No. H-5		**Sample No. B-1**		**Depth: 0.0 ft**	
Sample Description:	(Afu) Dark olive brown SAND				
Liquid Limit:		**Plasticity Index:**		**Percent Passing No. 200 Sieve:**	6
Moisture Content (%):	23.0	**Dry Density (pcf):**	97.3	**Degree of Saturation (%):**	87
Sample Type:	Remolded to 90% RC	**Rate of Shear (in./min.):**	0.05		

SHEAR STRENGTH PARAMETERS		
Parameter	**Peak ●**	**Ultimate ○**
Cohesion (psf)	0	0
Friction Angle (degrees)	32	30.0

DIRECT SHEAR TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



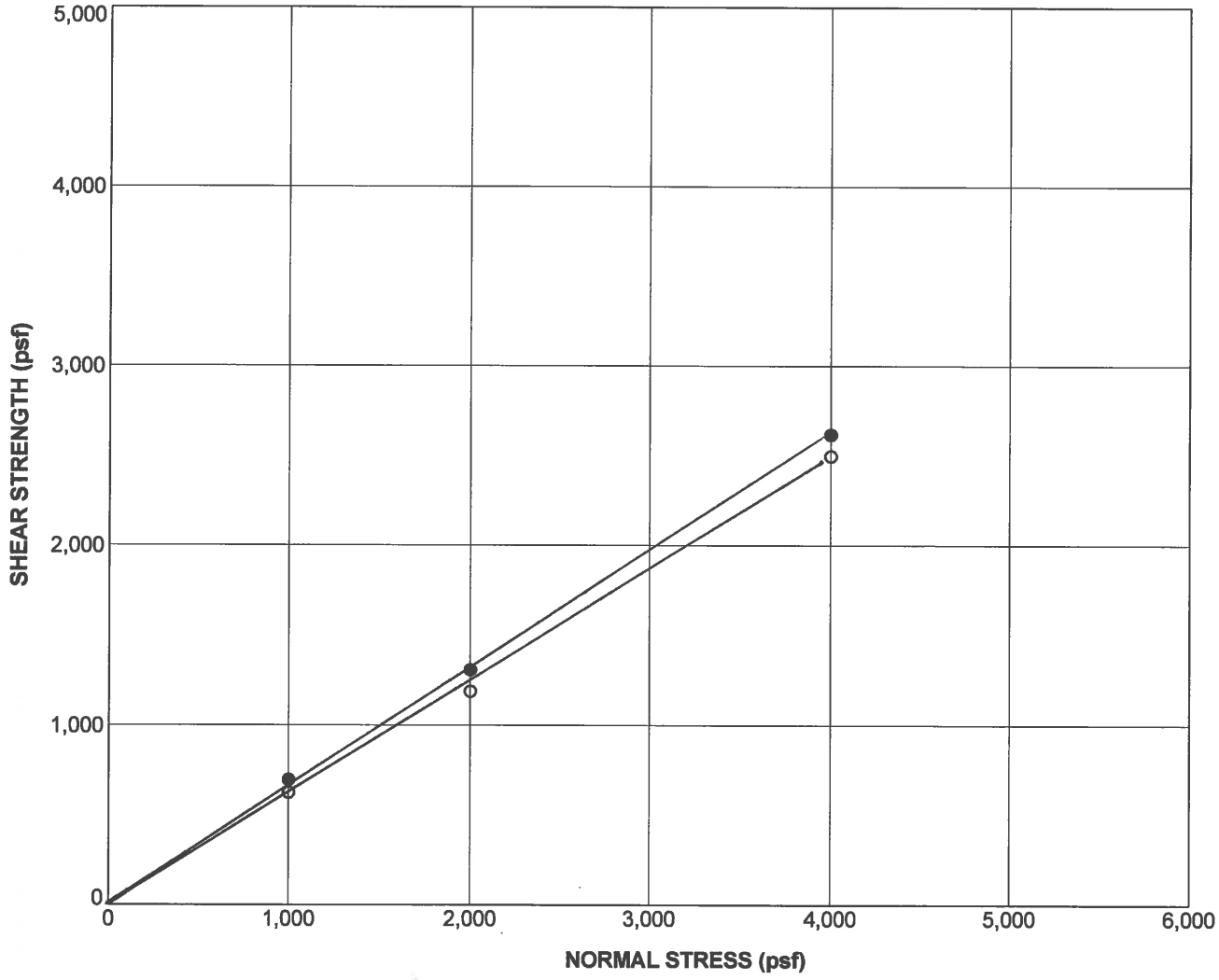
Boring No. H-5	Sample No. D-6	Depth: 20.0 ft
Sample Description:	(Qds) Yellowish brown SAND	
Liquid Limit:	Plasticity Index:	Percent Passing No. 200 Sieve:
Moisture Content (%): 25.5	Dry Density (pcf): 96.5	Degree of Saturation (%): 95
Sample Type: Undisturbed	Rate of Shear (in./min.): 0.05	

SHEAR STRENGTH PARAMETERS		
Parameter	Peak ●	Ultimate ○
Cohesion (psf)	100	20
Friction Angle (degrees)	33	30.0

DIRECT SHEAR TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



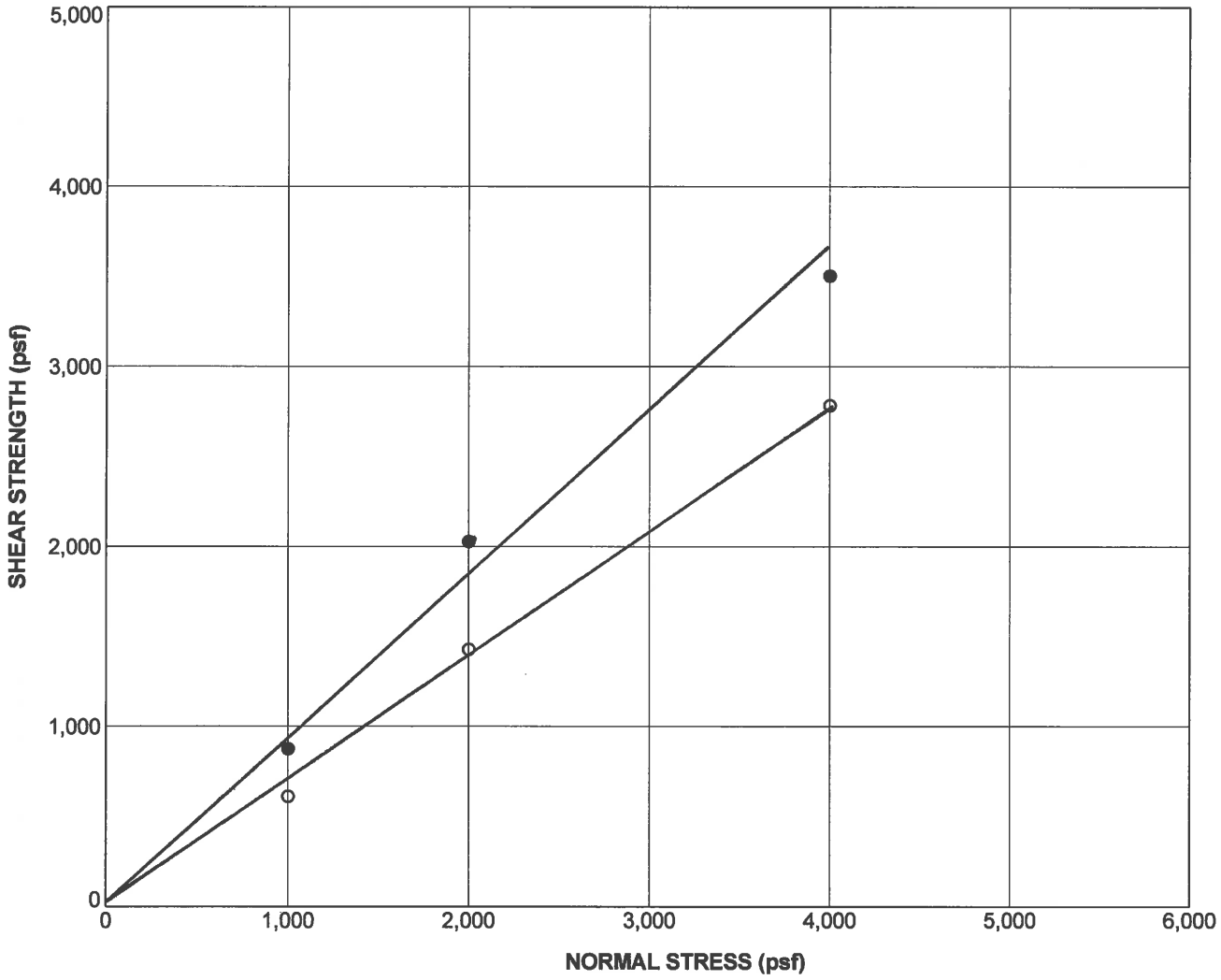
Boring No. H-7		**Sample No. D-2**		**Depth: 12.5 ft**	
Sample Description:	(Qds) Yellowish brown silty SAND				
Liquid Limit:		**Plasticity Index:**		**Percent Passing No. 200 Sieve:**	19
Moisture Content (%):	17.6	**Dry Density (pcf):**	105.1	**Degree of Saturation (%):**	81
Sample Type:	Undisturbed	**Rate of Shear (in./min.):**	0.05		

SHEAR STRENGTH PARAMETERS		
Parameter	**Peak ●**	**Ultimate ○**
Cohesion (psf)	0	0
Friction Angle (degrees)	33	32.0

DIRECT SHEAR TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



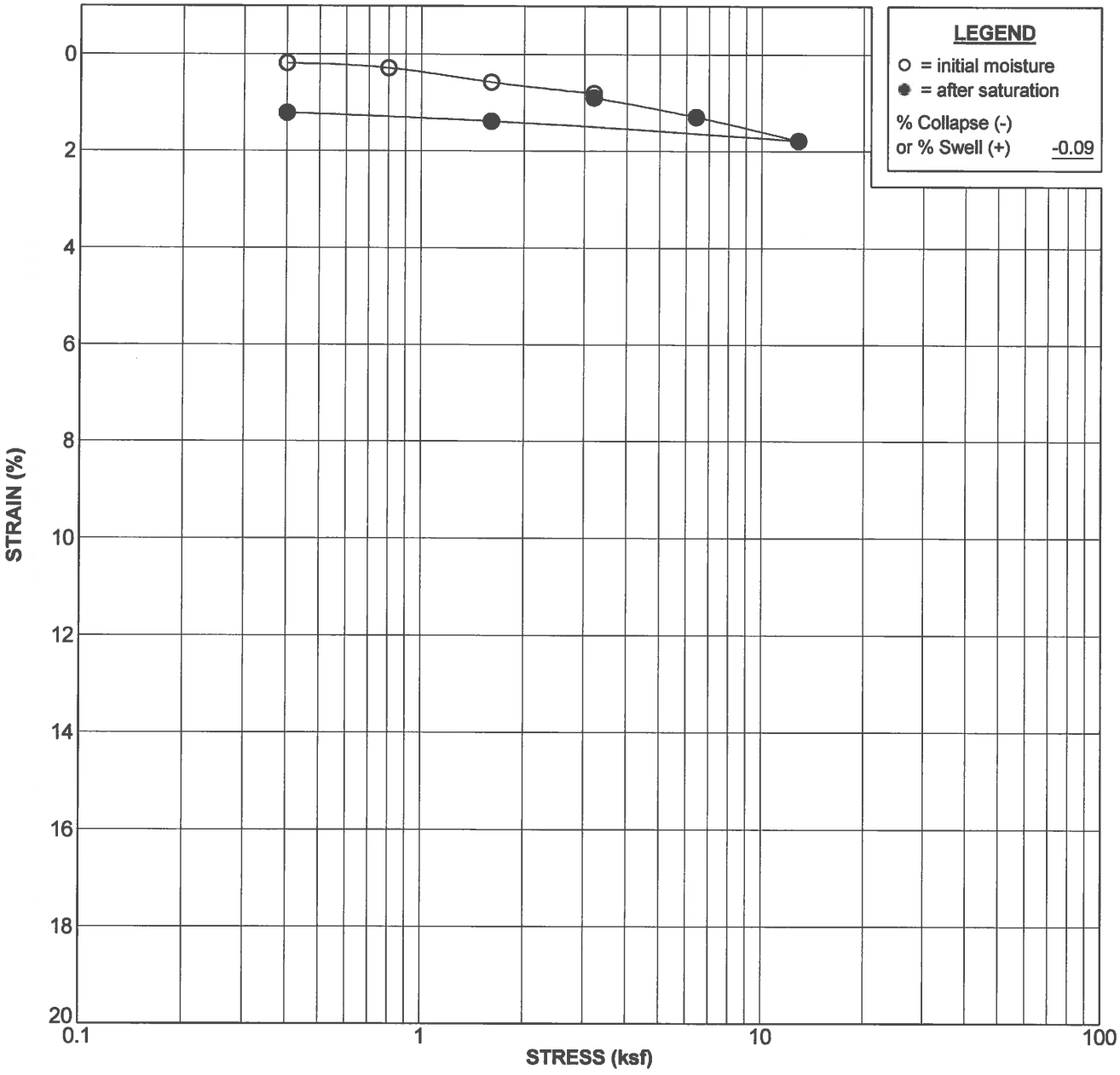
Boring No. H-7	Sample No. D-5	Depth: 40.0 ft
Sample Description:	(Qds) Yellowish brown SAND	
Liquid Limit:	Plasticity Index:	Percent Passing No. 200 Sieve:
Moisture Content (%): 22.5	Dry Density (pcf): 99.5	Degree of Saturation (%): 90
Sample Type: Undisturbed	Rate of Shear (in./min.): 0.05	

SHEAR STRENGTH PARAMETERS		
Parameter	Peak ●	Ultimate ○
Cohesion (psf)	0	0
Friction Angle (degrees)	43	35.0

DIRECT SHEAR TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



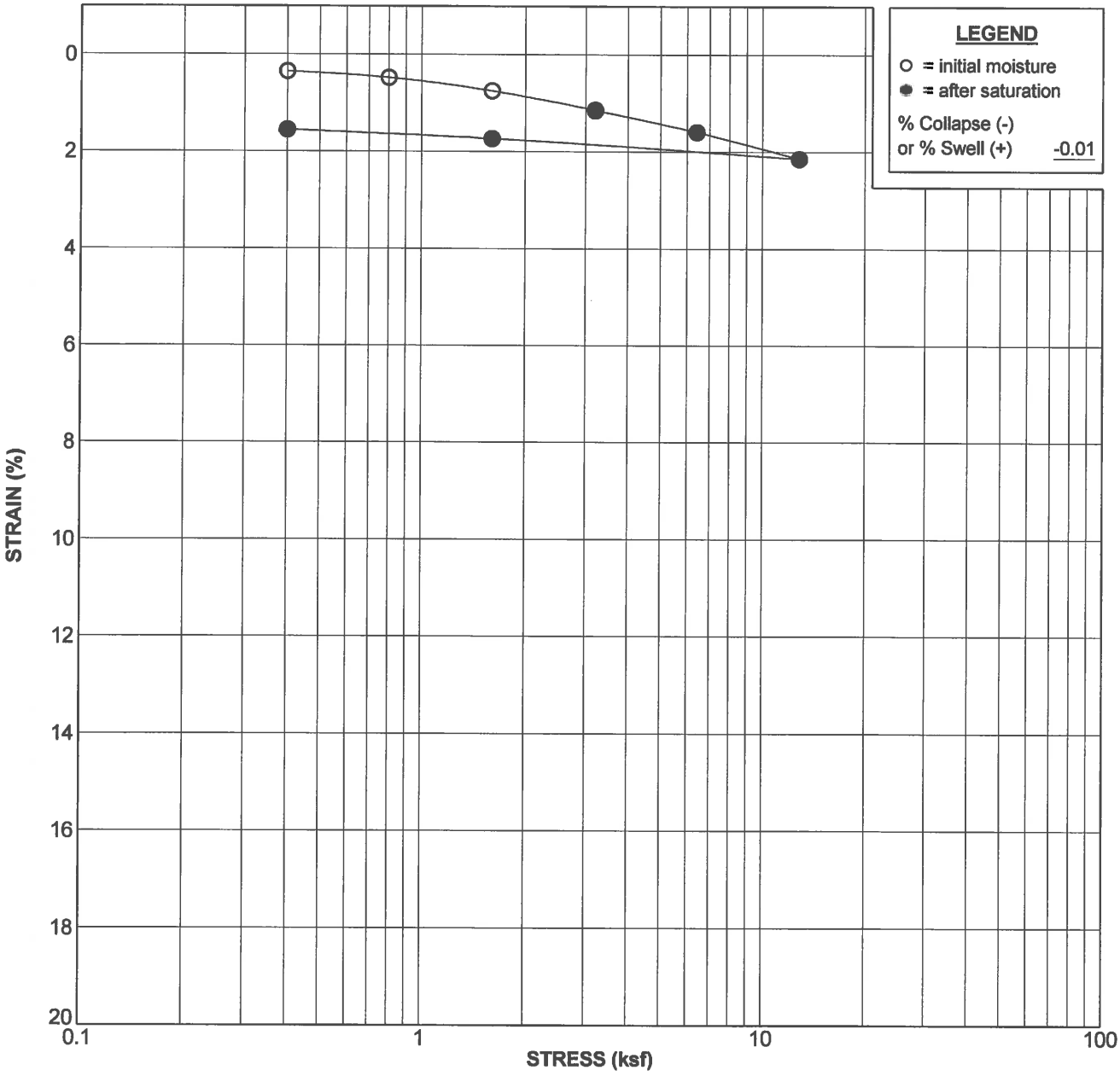
Boring No. H-1	Sample No. D-3	Depth: 10.0 ft
Sample Description:	(Qds) Light gray silty SAND	
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	2.1	94.3	7.4	0.754
Final	24.7	95.4	89.3	0.733

CONSOLIDATION TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



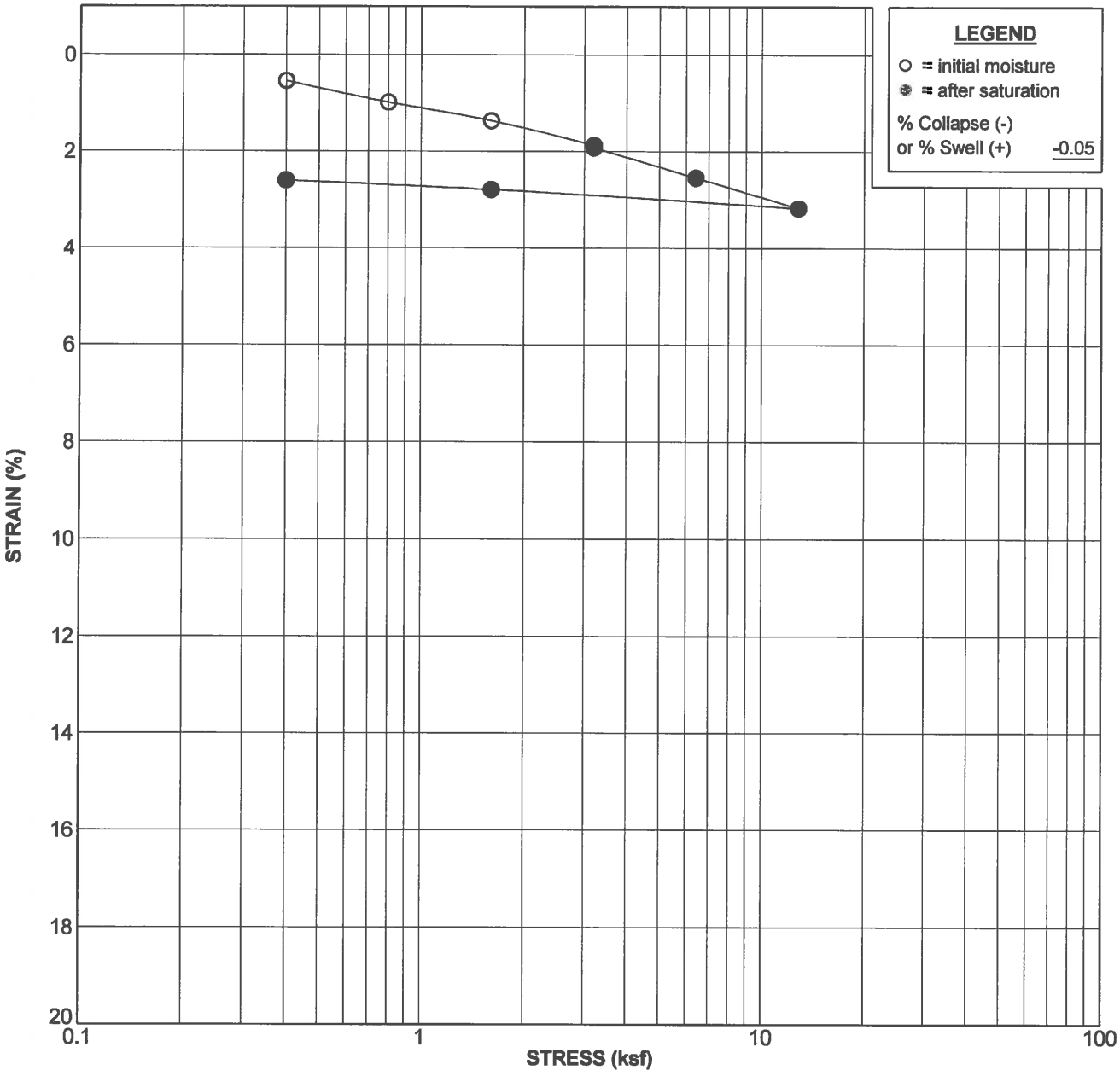
Boring No. H-2	Sample No. D-2	Depth: 10.0 ft
Sample Description:	(Qds) Yellowish brown SAND	
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	2.5	93.8	8.7	0.763
Final	25.6	95.3	92.3	0.735

CONSOLIDATION TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



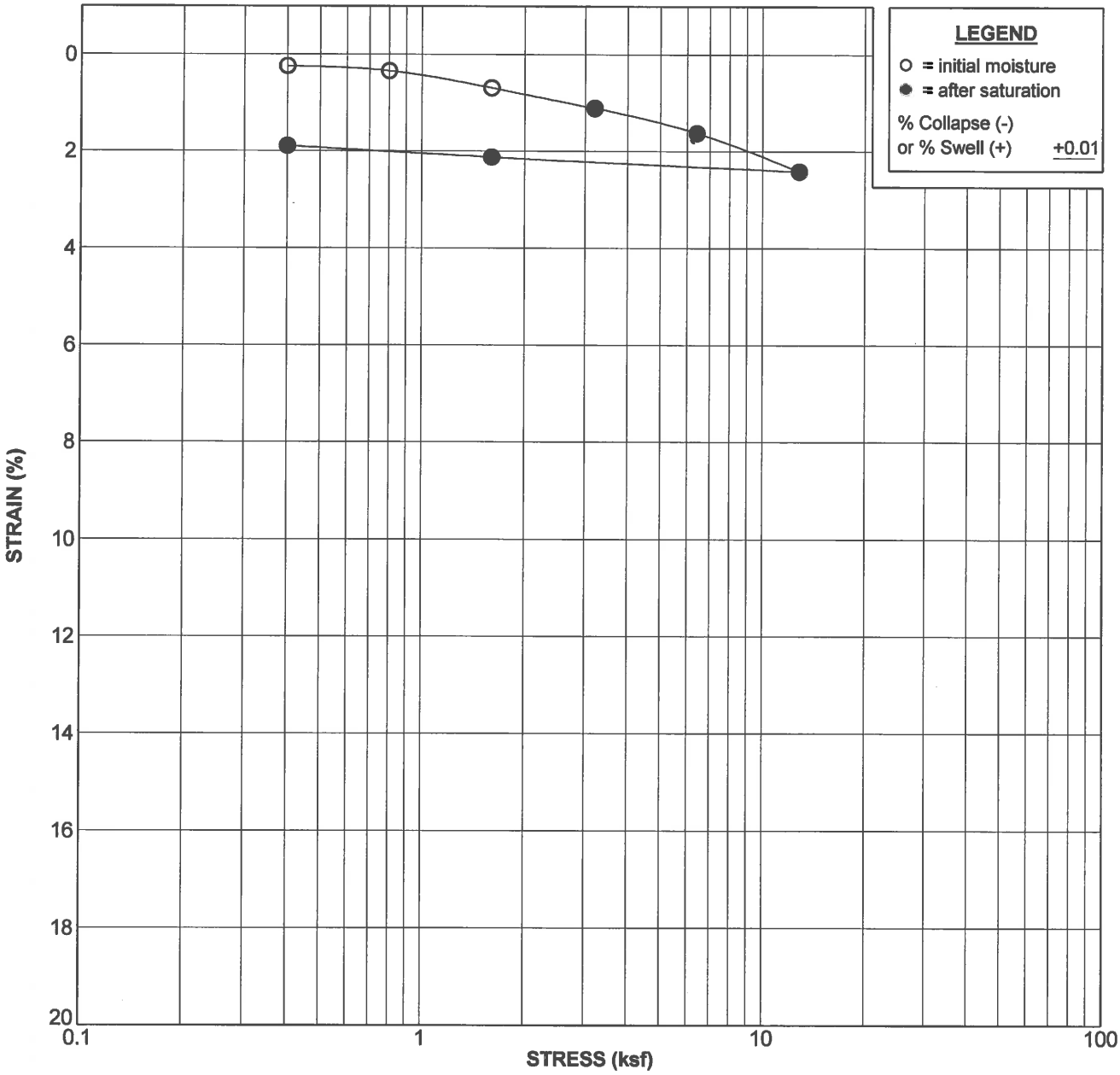
Boring No. H-5	Sample No. D-1	Depth: 5.0 ft
Sample Description:	(Afu) Dark olive brown SAND	
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	3.0	100.6	12.3	0.644
Final	19.9	103.2	87.6	0.602

CONSOLIDATION TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



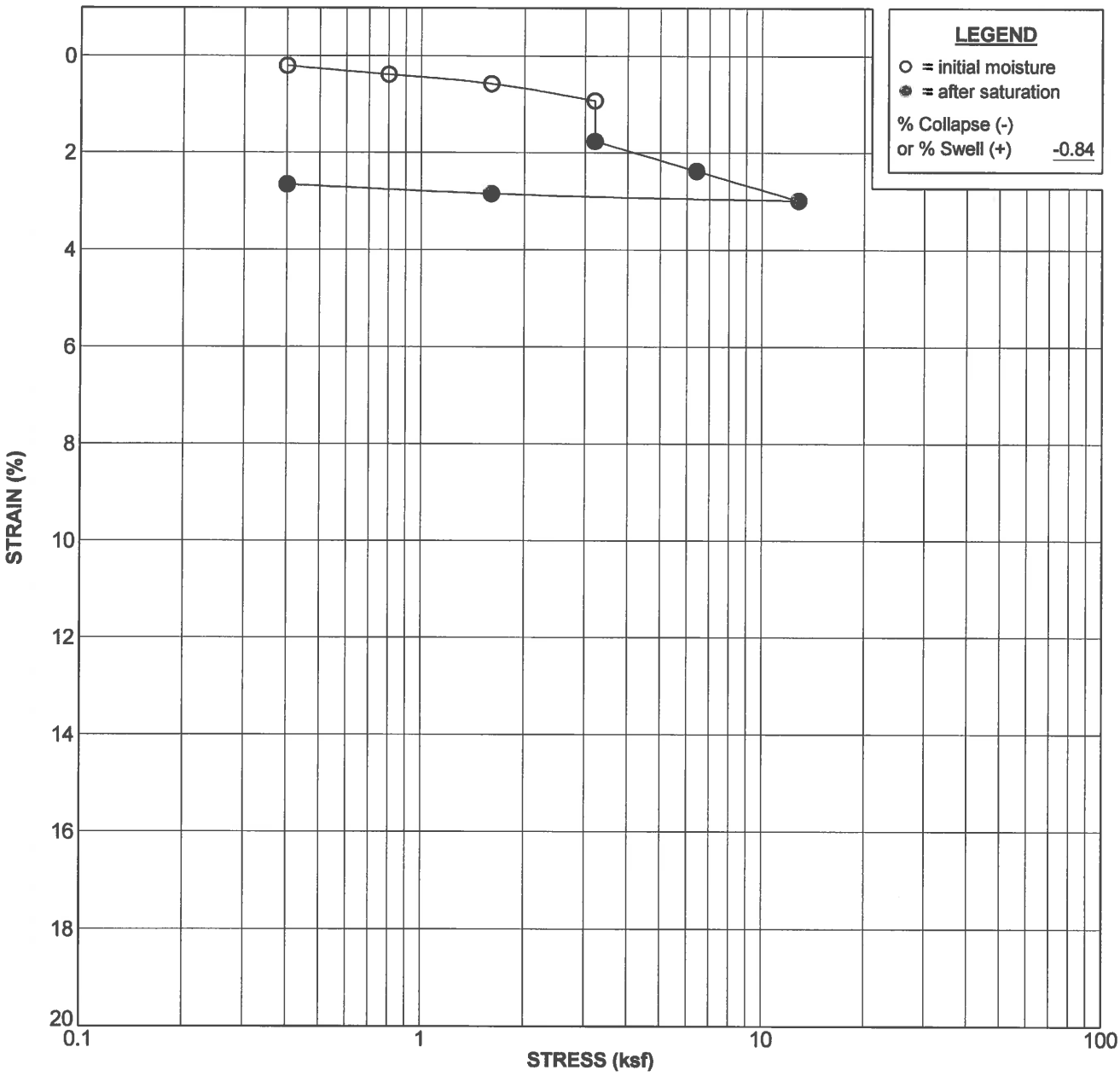
Boring No. H-6	Sample No. D-6	Depth: 20.0 ft
Sample Description:	(Afl) Dark olive brown silty SAND	
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	11.4	104.7	52.1	0.579
Final	15.7	106.7	75.7	0.550

CONSOLIDATION TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.



Boring No. H-7	Sample No. D-1	Depth: 7.5 ft
Sample Description:	(Qds) Dark olive brown silty SAND	
Liquid Limit:	**Plasticity Index:**	**Percent Passing No. 200 Sieve:**

Test Stage	Moisture Content (%)	Dry Density (pcf)	Degree of Saturation (%)	Void Ratio
Initial	2.8	110.9	15.1	0.491
Final	15.5	113.8	90.7	0.453

CONSOLIDATION TEST RESULTS

E&B Hermosa Beach
Hermosa Beach, California
PROJECT NO. 12053-01

NMG Geotechnical, Inc.

R-VALUE TEST DATA CTM 301

Project: E&B Hermosa Beach	Project No: 12053-01	Date: 5/31/2012
Boring Trench No: H-7	Sample No: B-1	Sample Depth: 0-5'
Field Description: SM		
Lab Description: Dark olive brown silty Sand, SM		

Specimen Number	1	2	3	4
Mold Number	1	2	3	
Water Adjustment (g)	+90	+100	+110	
Compactor Pressure (psi)	250	230	210	
Exudation Pressure (psi)	628	349	108	
Gross Weight (g)	3166.4	3150.7	3146.4	
Mold Tare (g)	2132.5	2119.3	2130.3	
Wet Weight (g)	1033.9	1031.4	1016.1	0
Sample Height (in)	2.5	2.5	2.46	
Initial Dial Reading	0.0723	0.0358	0.04	
Final Dial Reading	0.0723	0.0358	0.04	
Expansion (in $x10^{-4}$)	0	0	0	0
Stability(psi) at 2,000 lbs (160 psi)	22 | 36	22 | 38	26 | 46	|
Turns Displacement	3.48	4.06	3.58	
R-Value Uncorrected	71	66	63	#DIV/0!
R-Value Corrected	71	66	63	
Moisture Content (%)	9.5	10.5	11.2	#DIV/0!
Dry Density (pcf)	114.4	113.2	112.5	#DIV/0!
Assumed Traffic Index	4.0	4.0	4.0	4.0
G.E. by Stability	0.30	0.35	0.38	1.02
G.E. by Expansion	0.00	0.00	0.00	0.00
Gf	1.25			

Moisture Content				
Dish No.	Z	C	GG	
Weight of Moist Soil and Dish (g)	310	321.4	353.8	
Weight of Dry Soil and Dish (g)	287.4	295.7	323.1	
Water Loss (g)	22.6	25.7	30.7	0
Weight of Dish (g)	49.8	50.3	49.8	
Dry Soil (g)	237.6	245.4	273.3	0
Moisture Content (%)	9.5	10.5	11.2	#DIV/0!

R-Value by Exudation = 63

R-Value by Expansion = 70

R-Value at Equilibrium = 63 by Exudation

The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301

Remarks:

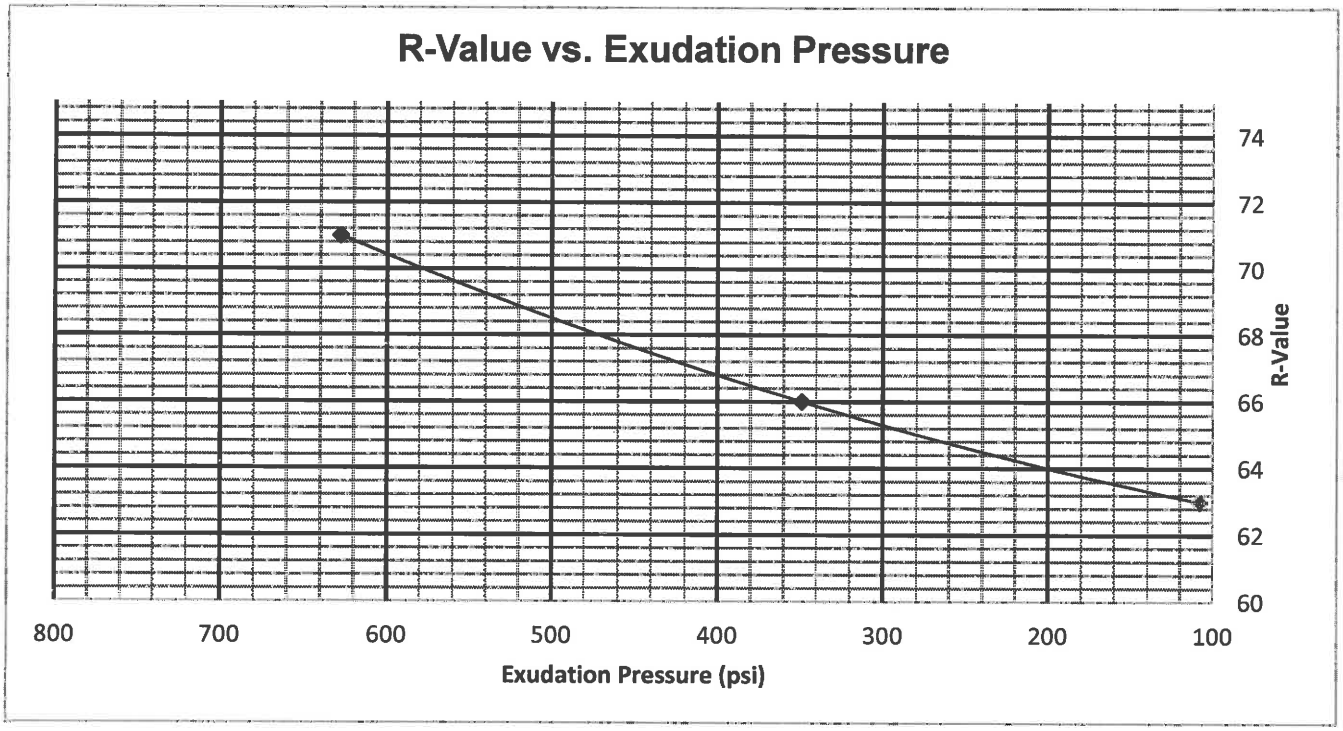
Set up by: Run by: GEH

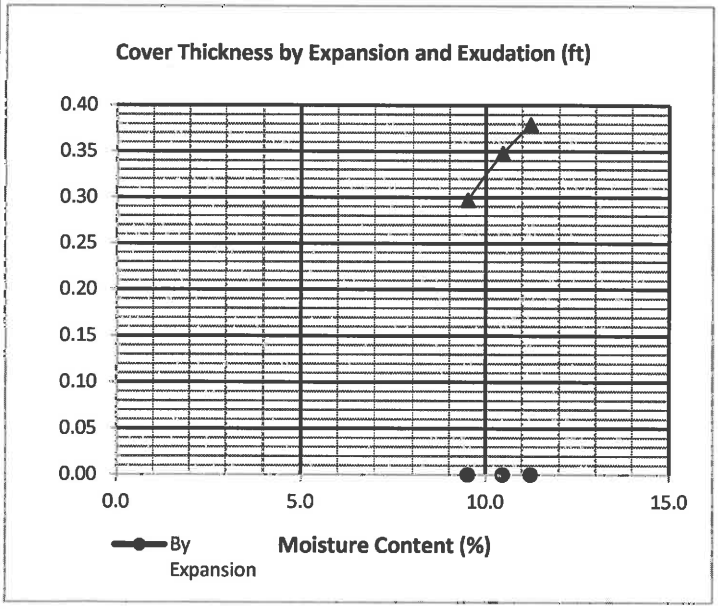
Calculated by: Checked by: Date Completed: 6/1/2012

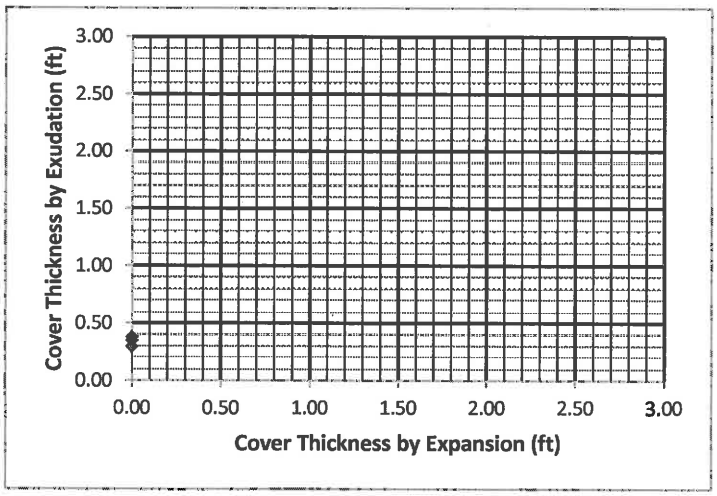
NMG Geotechnical, Inc.

R-VALUE GRAPHICAL PRESENTATION

Project:	E&B Hermosa Beach	Project No:	12053-01	Date:	5/31/2012
Boring Trench No:	H-7	Sample No:	B-1	Sample Depth:	0-5'
Field Description: SM					
Lab Description:	Dark olive brown silty Sand, SM				







Cover Thickness (ft)	=	0.32

The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301

Remarks:				
Set up by:	Run by: GEH			
Calculated by:	Checked by:	Date Completed:	6/1/2012	

NMG Geotechnical, Inc.

R-VALUE TEST DATA CTM 301

Project: E&B Hermosa Beach	Project No: 12053-01	Date: 5/31/2012
Boring Trench No: H-4	Sample No: B-1	Sample Depth: 5'-10'
Field Description: SM		
Lab Description: Yellowish brown Sand, SP		

Specimen Number	1	2	3	4
Mold Number	4	5	6	
Water Adjustment (g)	+115	+125	+130	
Compactor Pressure (psi)	350	325	300	
Exudation Pressure (psi)	562	387	279	
Gross Weight (g)	3110.7	3097.8	3080.8	
Mold Tare (g)	2115.7	2121.3	2116.9	
Wet Weight (g)	995	976.5	963.9	0
Sample Height (in)	2.69	2.6	2.59	
Initial Dial Reading	0.0601	0.0602	0.0954	
Final Dial Reading	0.0601	0.0602	0.0954	
Expansion (in $x10^{-4}$)	0	0	0	0
Stability(psi) at 2,000 lbs (160 psi)	22 40	22 40	21 42	
Turns Displacement	4.27	4.61	4.88	
R-Value Uncorrected	64	62	59	#DIV/0!
R-Value Corrected	67	63	60	
Moisture Content (%)	10.6	11.6	11.9	#DIV/0!
Dry Density (pcf)	101.3	102.0	100.8	#DIV/0!
Assumed Traffic Index	4.0	4.0	4.0	4.0
G.E. by Stability	0.34	0.38	0.41	1.02
G.E. by Expansion	0.00	0.00	0.00	0.00
Gf	1.25			

Moisture Content				
Dish No.	BBB	LL	Y	
Weight of Moist Soil and Dish (g)	339.4	357.8	319.6	
Weight of Dry Soil and Dish (g)	311.6	325.8	291	
Water Loss (g)	27.8	32	28.6	0
Weight of Dish (g)	49.9	50.3	49.8	
Dry Soil (g)	261.7	275.5	241.2	0
Moisture Content (%)	10.6	11.6	11.9	#DIV/0!

R-Value by Exudation = 60

R-Value by Expansion = 68

R-Value at Equilibrium = 60 by Exudation

The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301

Remarks:

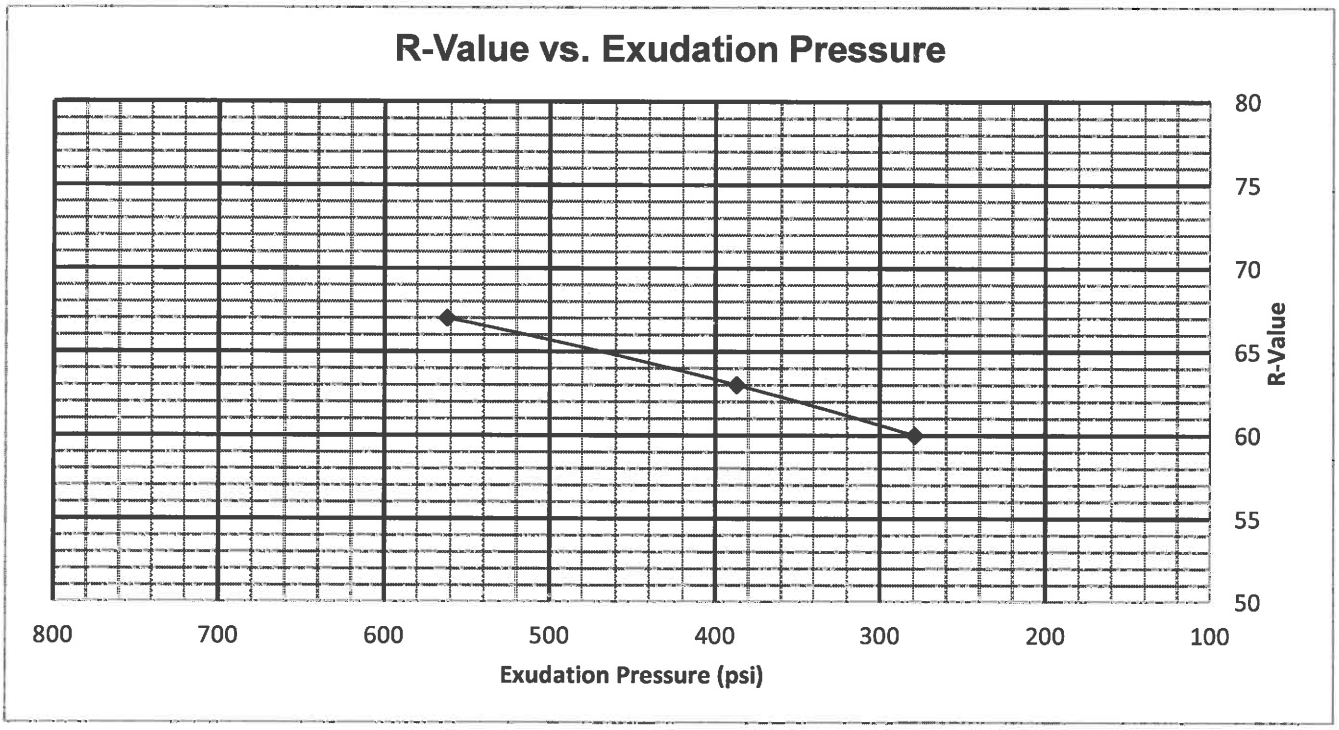
Set up by: Run by: GEH

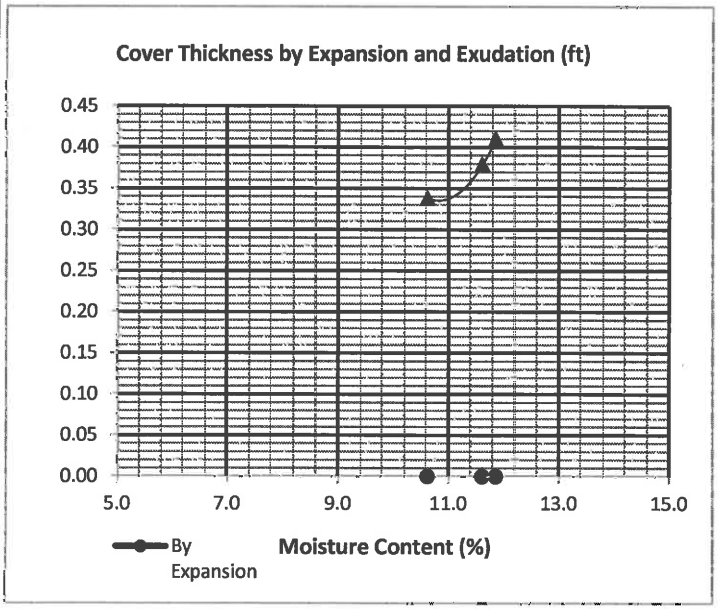
Calculated by: Checked by: Date Completed: 6/1/2012

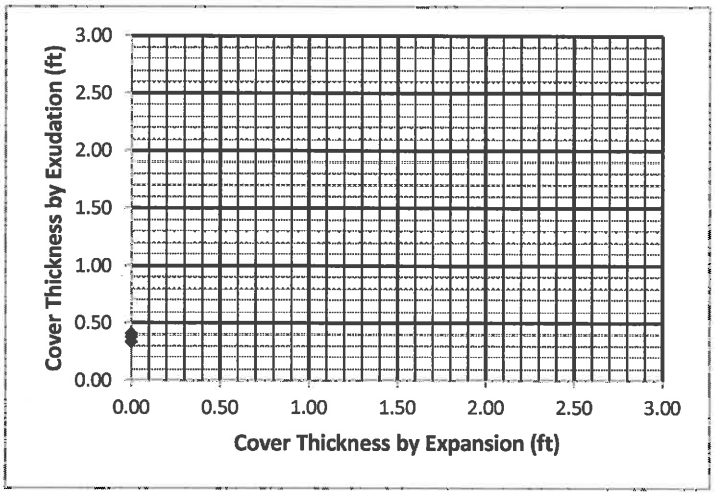
NMG Geotechnical, Inc.

R-VALUE GRAPHICAL PRESENTATION

Project:	E&B Hermosa Beach	Project No:	12053-01	Date:	5/31/2012
Boring Trench No:	H-4	Sample No:	B-1	Sample Depth:	5'-10'
Field Description: SM					
Lab Description:	Yellowish brown Sand, SP				







Cover Thickness (ft)	=	0.34

The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301

Remarks:			
Set up by:	Run by: GEH		
Calculated by:	Checked by:	Date Completed:	6/1/2012

NMG Geotechnical, Inc.

R-VALUE TEST DATA CTM 301

Project:	E&B Hermosa Beach	Project No:	12053-01	Date:	5/31/2012
Boring Trench No:	H-5	Sample No:	B-1	Sample Depth:	0-5'
Field Description: SM					
Lab Description:	Dark olive brown Sand, SP				

Specimen Number	1	2	3	4
Mold Number	7	8	9	
Water Adjustment (g)	+70	+85	+100	
Compactor Pressure (psi)	350	325	300	
Exudation Pressure (psi)	767	538	274	
Gross Weight (g)	3131	3122.2	3095.3	
Mold Tare (g)	2116.4	2128.4	2113.5	
Wet Weight (g)	1014.6	993.8	981.8	0
Sample Height (in)	2.55	2.52	2.42	
Initial Dial Reading	0.0615	0.0994	0.0428	
Final Dial Reading	0.0615	0.0994	0.0428	
Expansion (in $x10^{-4}$)	0	0	0	0
Stability(psi) at 2,000 lbs (160 psi)	20 38	24 44	22 50	
Turns Displacement	4.3	4.41	4.02	
R-Value Uncorrected	65	60	58	#DIV/0!
R-Value Corrected	65	60	57	
Moisture Content (%)	7.6	8.9	10.3	#DIV/0!
Dry Density (pcf)	112.1	109.7	111.4	#DIV/0!
Assumed Traffic Index	4.0	4.0	4.0	4.0
G.E. by Stability	0.36	0.41	0.44	1.02
G.E. by Expansion	0.00	0.00	0.00	0.00
Gf	1.25			

Moisture Content				
Dish No.	VV	AA	WW	
Weight of Moist Soil and Dish (g)	315.4	325	381.1	
Weight of Dry Soil and Dish (g)	296.7	302.5	350	
Water Loss (g)	18.7	22.5	31.1	0
Weight of Dish (g)	50.3	50.3	49.4	
Dry Soil (g)	246.4	252.2	300.6	0
Moisture Content (%)	7.6	8.9	10.3	#DIV/0!

R-Value by Exudation = 57

R-Value by Expansion = 61

R-Value at Equilibrium = 57 by Exudation

The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301

Remarks:

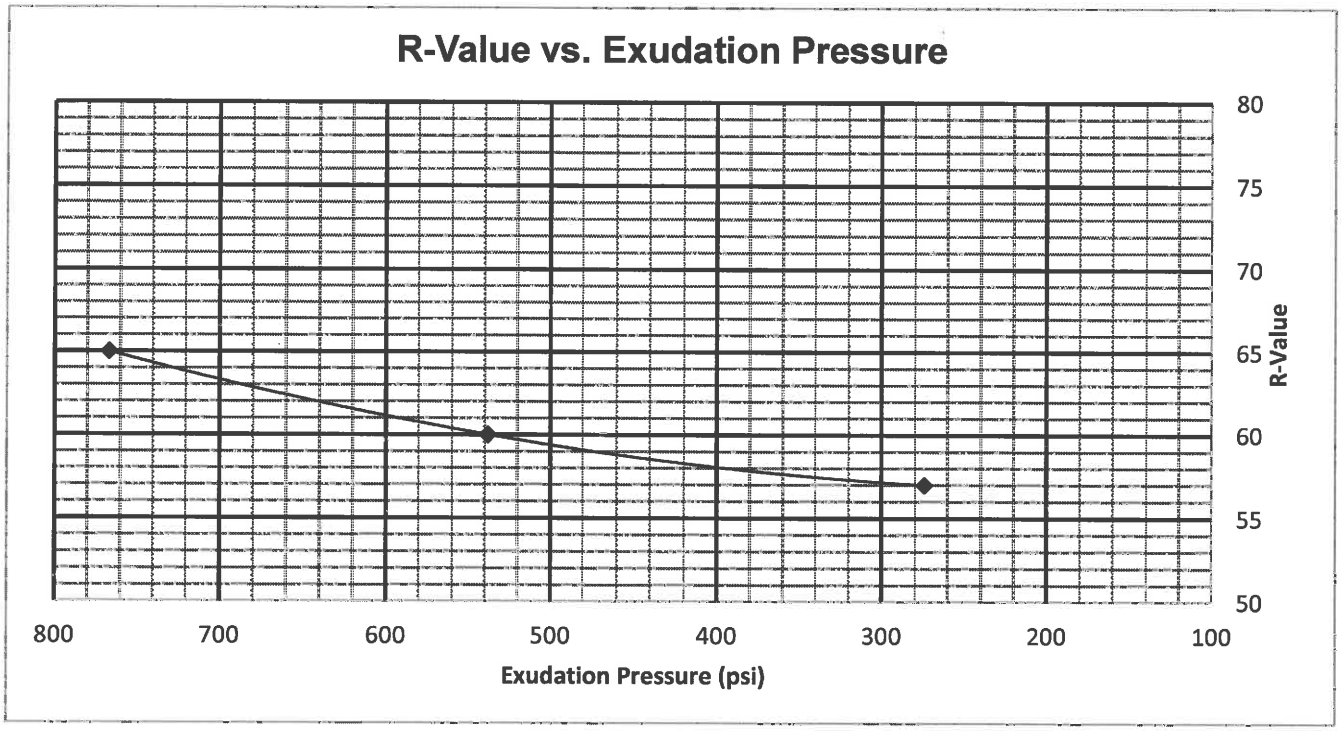
Set up by: Run by: GEH

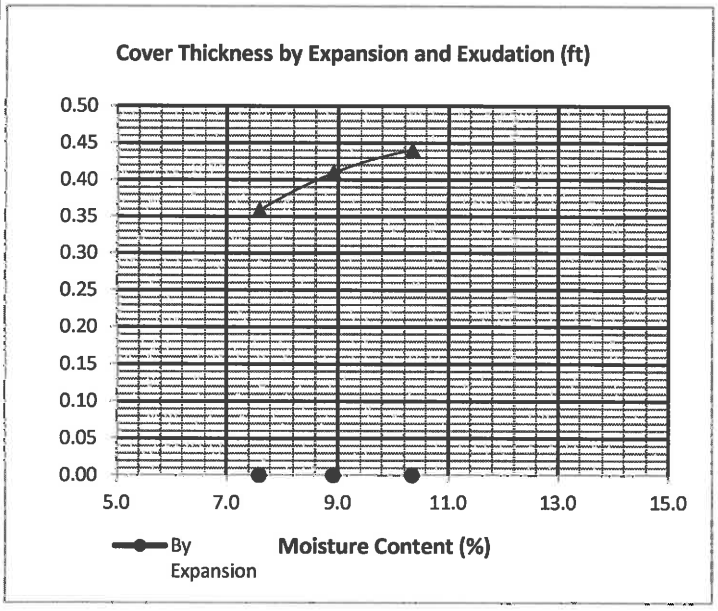
Calculated by: Checked by: Date Completed: 6/1/2012

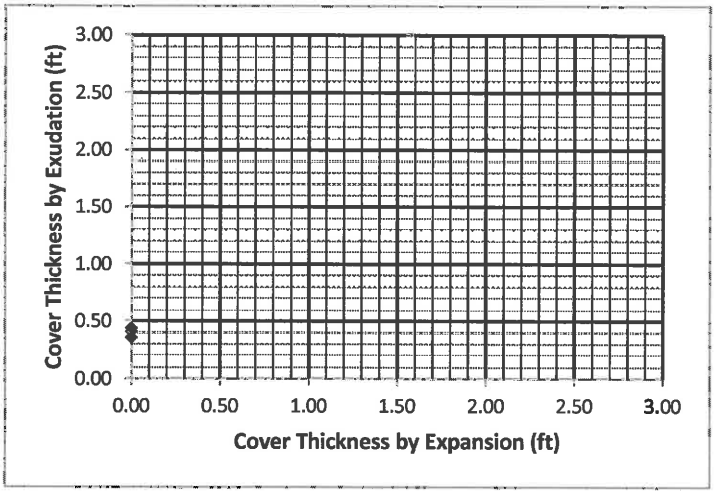
NMG Geotechnical, Inc.

R-VALUE GRAPHICAL PRESENTATION

Project:	E&B Hermosa Beach	Project No:	12053-01	Date:	5/31/2012
Boring Trench No:	H-5	Sample No:	B-1	Sample Depth:	0-5'
Field Description: SM					
Lab Description:	Dark olive brown Sand, SP				







Cover Thickness (ft)	=	0.41

The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301

Remarks:				
Set up by:	Run by:	GEH		
Calculated by:	Checked by:	Date Completed:	6/1/2012	

NMG Geotechnical, Inc.

HDR | SCHIFF

www.hdrinc.com/schiff
Corrosion Control and Condition Assessment (C3A) Department

June 15, 2012 via email: tmiyake@nmggeotech.com

NMG GEOTECHNICAL, INC.
17991 Fitch
Irvine, CA 92714

Attention: Mr. Ted Miyake

RECEIVED
JUN 25 2012
NMG

Re: Soil Corrosivity Study
E&B Hermosa Beach
Hermosa Beach, California
HDR|Schiff #12-0455SCS, HDR #186030
NMG #12053-01

INTRODUCTION

Laboratory tests have been completed on three soil samples provided for the E&B Hermosa Beach project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR|Schiff) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed construction consists of an oil production facility located at 555 Sixth Street in Hermosa Beach, California. The water table is reportedly 30 to 45 feet deep.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. Our recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR|Schiff will be happy to work with them as a separate phase of this project.

LABORATORY SOIL CORROSIVITY TESTS

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per CTM 643. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327 and D6919. Test results are shown in Table 1.

SOIL CORROSIVITY

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:[1]

Soil Resistivity in ohm-centimeters	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,000 to 10,000	Moderately Corrosive
1,000 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

Electrical resistivities were in the mildly corrosive category with as-received moisture. When saturated, the resistivities were in the mildly to moderately corrosive categories. The resistivities dropped considerably with added moisture because the samples were dry as-received.

Soil pH values varied from 7.5 to 8.1. This range is mildly to moderately alkaline.[2] These values do not particularly increase soil corrosivity.

The soluble salt content of the samples was low.

Ammonium was detected in low concentrations. The nitrate concentration was high enough to be aggressive to copper.

Tests were not made for sulfide and negative oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

This soil is classified as moderately corrosive to ferrous metals and aggressive to copper.

---

[1] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.*

[2] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

CORROSION CONTROL RECOMMENDATIONS

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

Steel Pipe

Implement *all* the following measures:

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and possible future cathodic protection.
2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of possible future cathodic protection:
    a. At each end of the pipeline.
    b. At each end of all casings.
    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
3. To prevent dissimilar metal corrosion cells and to facilitate the application of possible future cathodic protection, electrically isolate each buried steel pipeline per NACE Standard SP0286 from:
    a. Dissimilar metals.
    b. Dissimilarly coated piping (cement-mortar vs. dielectric).
    c. Above ground steel pipe.
    d. All existing piping.
4. Choose one of the following corrosion control options:

    OPTION 1

    a. Apply a suitable dielectric coating intended for underground use such as:
        i. Polyurethane per AWWA C222 *or*
        ii. Extruded polyethylene per AWWA C215 *or*
        iii. A tape coating system per AWWA C214 *or*
        iv. Hot applied coal tar enamel per AWWA C203 *or*
        v. Fusion bonded epoxy per AWWA C213.

    b. Although it is customary to cathodically protect bonded dielectrically coated structures, cathodic protection is not recommended at this time due to moderately

corrosive soils. Joint bonds, test stations, and insulated joints should still be installed and will facilitate the application of cathodic protection in the future if needed to control leaks.

OPTION 2

a. As an alternative to dielectric coating and possible future cathodic protection, apply a ¾-inch cement mortar coating per AWWA C205 or encase in concrete 3 inches thick, using any type of cement. Joint bonds, test stations, and insulated joints are still required for these alternatives.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Iron Pipe

Implement *all* the following measures:

1. Electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE Standard SP0286.
2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and possible future cathodic protection.
3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of possible future cathodic protection:
   a. At each end of the pipeline.
   b. At each end of any casings.
   c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
4. Choose one of the following corrosion control options:

OPTION 1

a. Apply a suitable coating intended for underground use such as:
   i. Polyethylene encasement per AWWA C105; *or*
   ii. Epoxy coating; *or*
   iii. Polyurethane; *or*
   iv. Wax tape.

   NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Although it is customary to cathodically protect coated structures, cathodic protection is not recommended at this time due to moderately corrosive soils. Joint bonds, test stations, and insulated joints should still be installed and will facilitate the application of cathodic protection in the future if needed to control leaks.

OPTION 2

As an alternative to coating systems described in Option 1 and possible future cathodic protection, concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of cement.

Copper Tubing

Protect buried copper tubing by *one* of the following measures:

1. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.
2. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kamco's Aqua Shield™, Mueller's Streamline Protec™, or equal. The coating must be continuous with no cuts or defects.
3. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE Standard SP0169.

Plastic and Vitrified Clay Pipe

1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.
2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.
2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete

1. From a corrosion standpoint, any type of cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.1 percent.[3,4,5]

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[3] *2009 International Building Code (IBC) which refers to American Concrete Institute (ACI-318) Table 4.3.1*

[4] *2009 International Residential Code (IRC) which refers to American Concrete Institute (ACI-318) Table 4.3.1*

2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration[6] found onsite.

CLOSURE

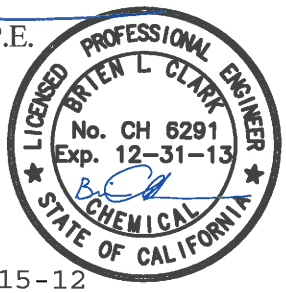
Our services have been performed with the usual thoroughness and competence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

Leobardo Solis

Brien L. Clark, P.E.



6-15-12

Enc: Table 1 - Laboratory Tests on Soil Samples

186030_SCS_Rpt_IB-rev00_LS

[5] *2010 California Building Code (CBC) which refers to American Concrete Institute (ACI-318) Table 4.3.1*
[6] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

Table 1 - Laboratory Tests on Soil Samples

NMG Geotechnical, Inc.
E&B Hermosa Beach
Your #12053-01, HDR|Schiff #12-0455SCS
22-May-12

Sample ID			H-4 B-1 @ 5-10' SM/SP	H-5 B-1 @ 0-5' SM/SP	H-6 B-1 @ 7.5-10' SP
Resistivity		**Units**			
as-received		ohm-cm	120,000	27,200	30,000
saturated		ohm-cm	10,800	2,640	6,000
pH			8.1	7.5	7.9
Electrical Conductivity		mS/cm	0.05	0.10	0.10
Chemical Analyses					
Cations					
calcium	Ca^{2+}	mg/kg	46	58	80
magnesium	Mg^{2+}	mg/kg	4.4	11	6.9
sodium	Na^{1+}	mg/kg	8.9	28	17
potassium	K^{1+}	mg/kg	3.8	5.8	16
Anions					
carbonate	CO_3^{2-}	mg/kg	18	ND	9.0
bicarbonate	HCO_3^{1-}	mg/kg	66	61	146
fluoride	F^{1-}	mg/kg	0.5	0.7	1.3
chloride	Cl^{1-}	mg/kg	4.0	8.5	5.1
sulfate	SO_4^{2-}	mg/kg	16	42	52
phosphate	PO_4^{3-}	mg/kg	1.5	10	3.2
Other Tests					
ammonium	NH_4^{1+}	mg/kg	ND	0.8	0.8
nitrate	NO_3^{1-}	mg/kg	ND	117	15
sulfide	S^{2-}	qual	na	na	na
Redox		mV	na	na	na

Electrical conductivity in millisiemens/cm and chemical analysis were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

PROJECT 94-4796

CONSOLIDATION TEST RESULTS

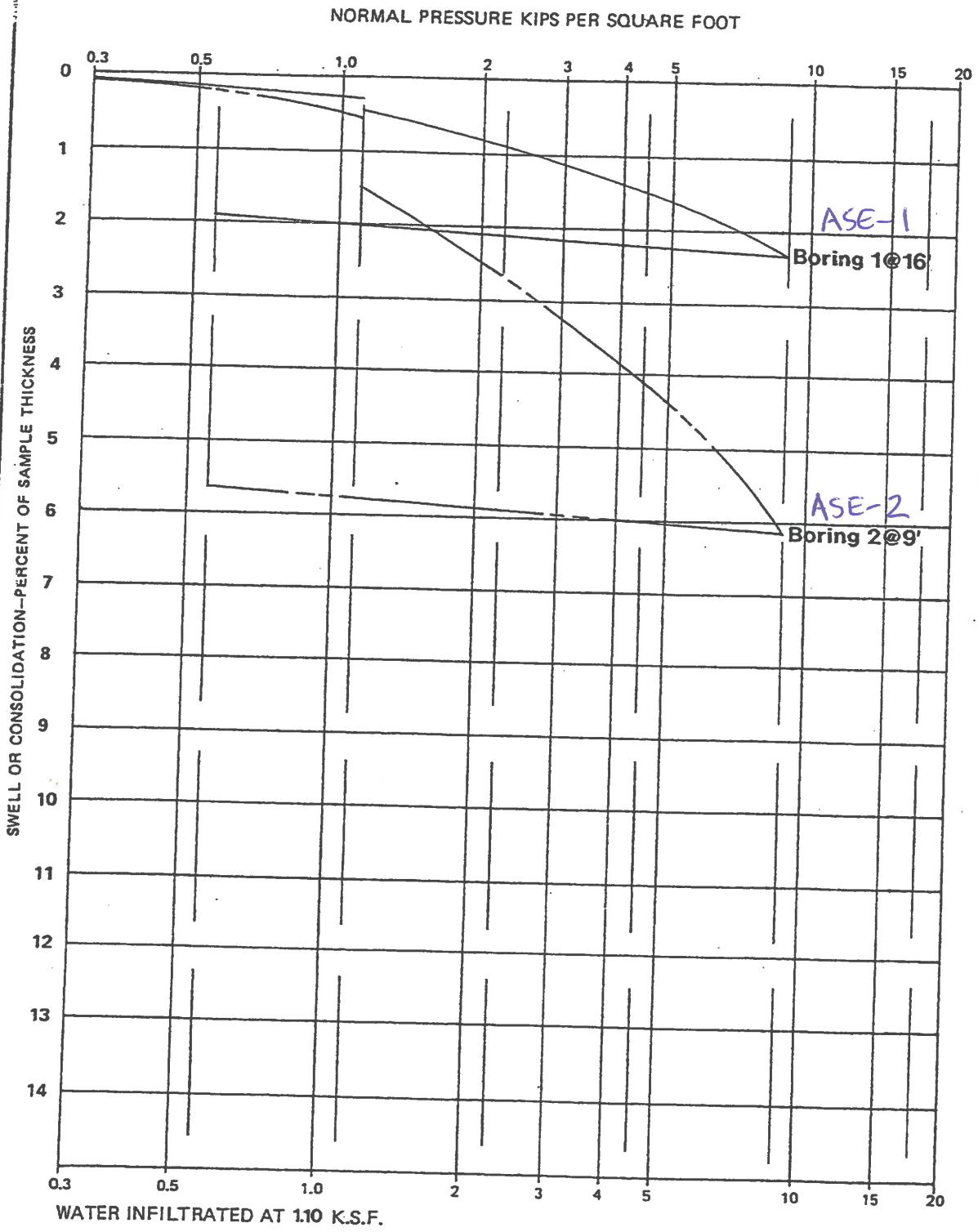


PLATE C-1

FORM ASE-100

CH 001295

PROJECT 94-4796

CONSOLIDATION TEST RESULTS

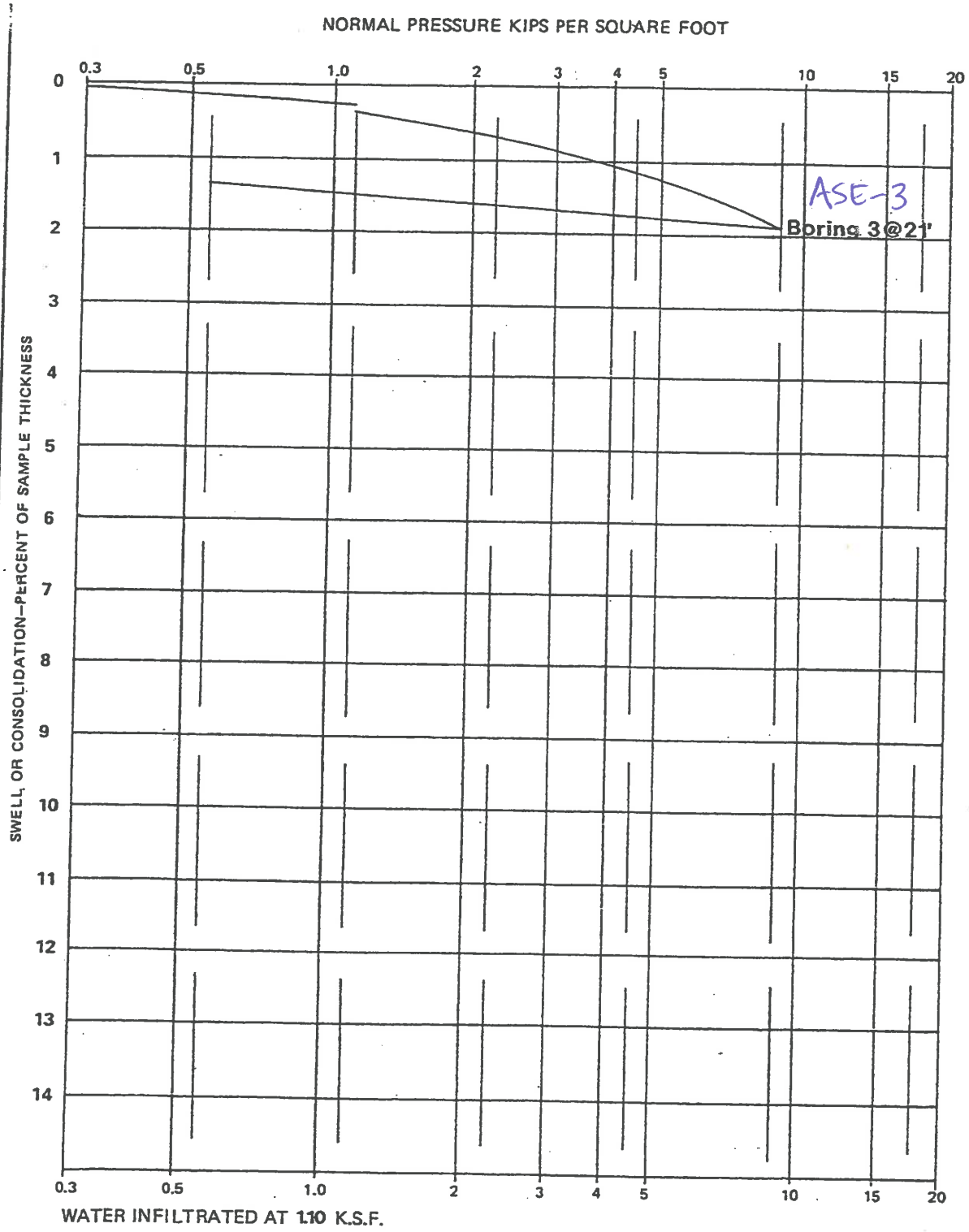


PLATE C-2

SOILS ENGINEERING, INC.

ASSOCIATES

FORM ASE-100

CH 001296

PROJECT 94-4796

CONSOLIDATION TEST RESULTS

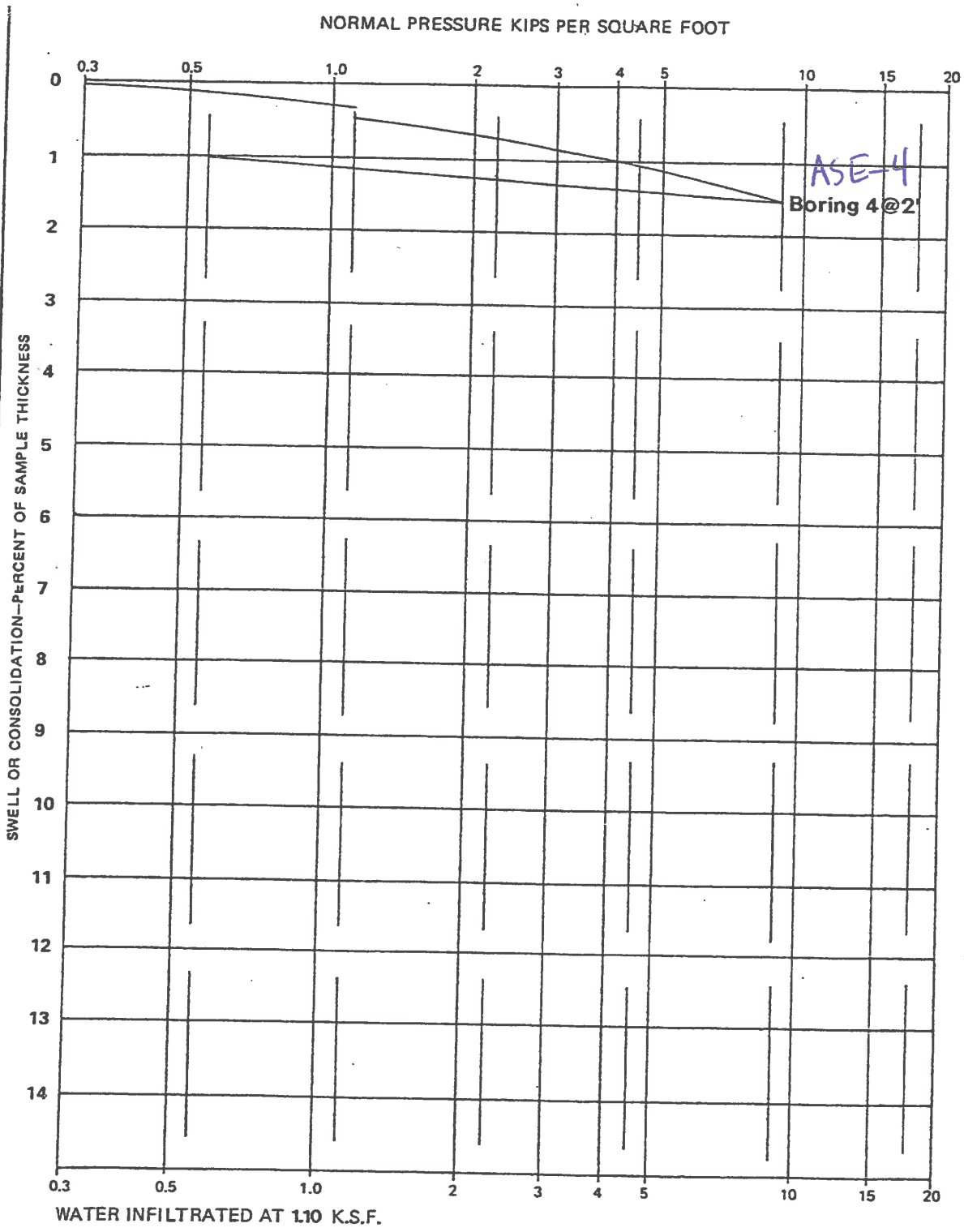


PLATE C-3

SOILS ENGINEERING, INC.
ASSOCIAT

FORM ASE-100

CH 001297

PROJECT 94-4796

CONSOLIDATION TEST RESULTS

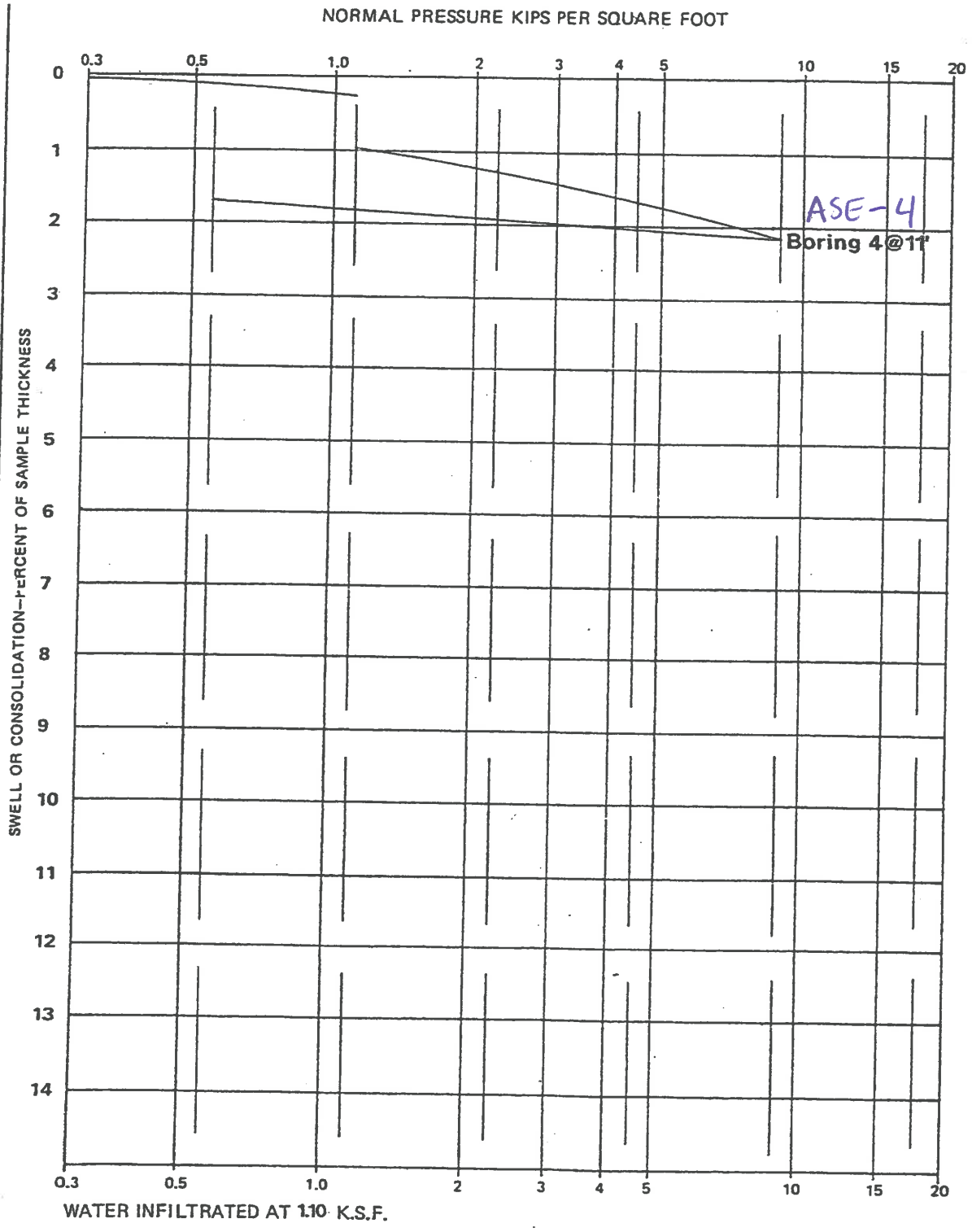


PLATE C-4

SOILS ENGINEERING, INC.
ASSOCIA

FORM ASE-106

CH 001298

PROJECT 94-4796

CONSOLIDATION TEST RESULTS

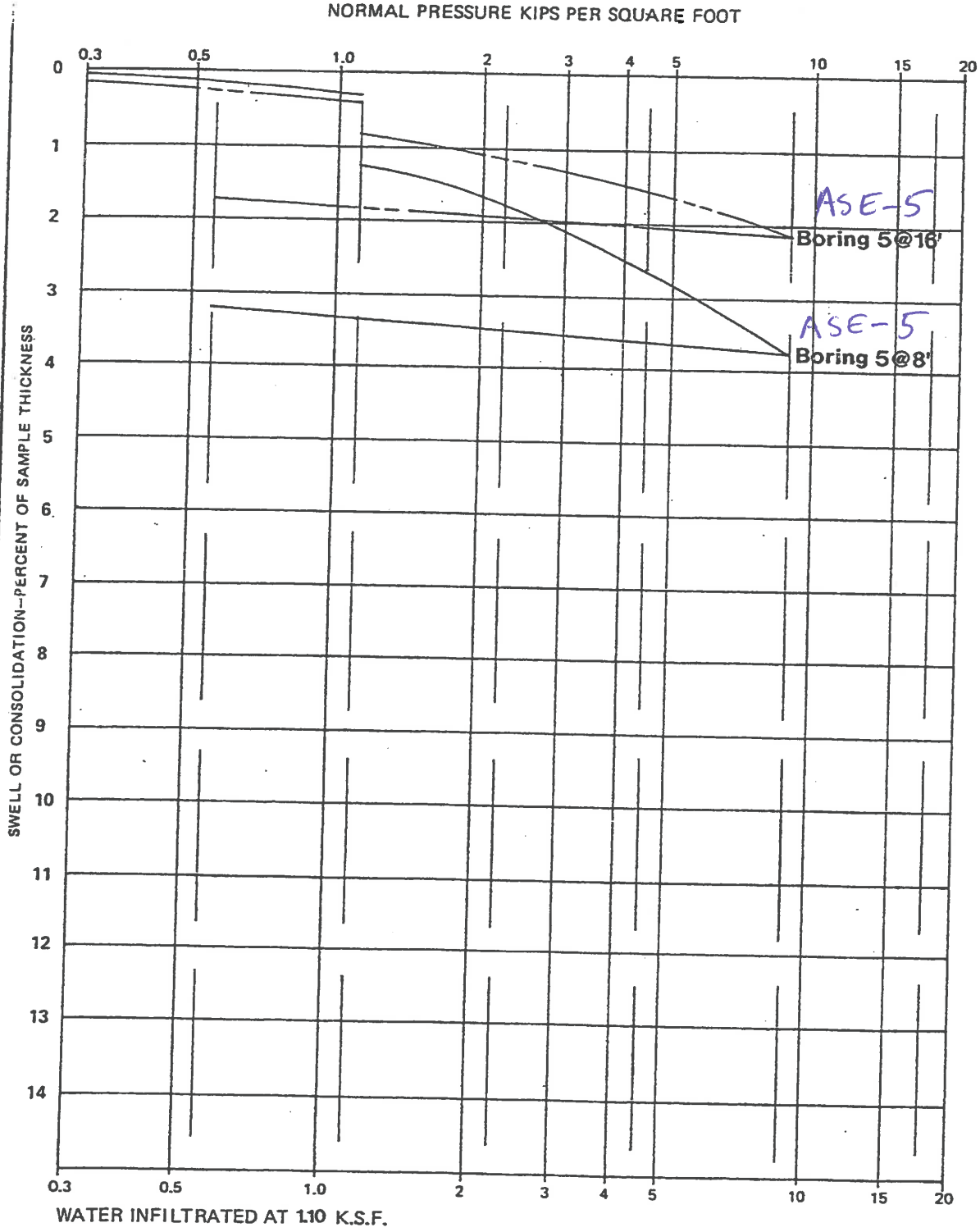


PLATE C-5

SOILS ENGINEERING, INC.

ASSOCIATES

FORM ASE-100

CH 001299

PROJECT 94-4796

DIRECT SHEAR TEST

SPECIMENS SUBMERGED PRIOR TO SHEARING (24 HRS. MIN.)

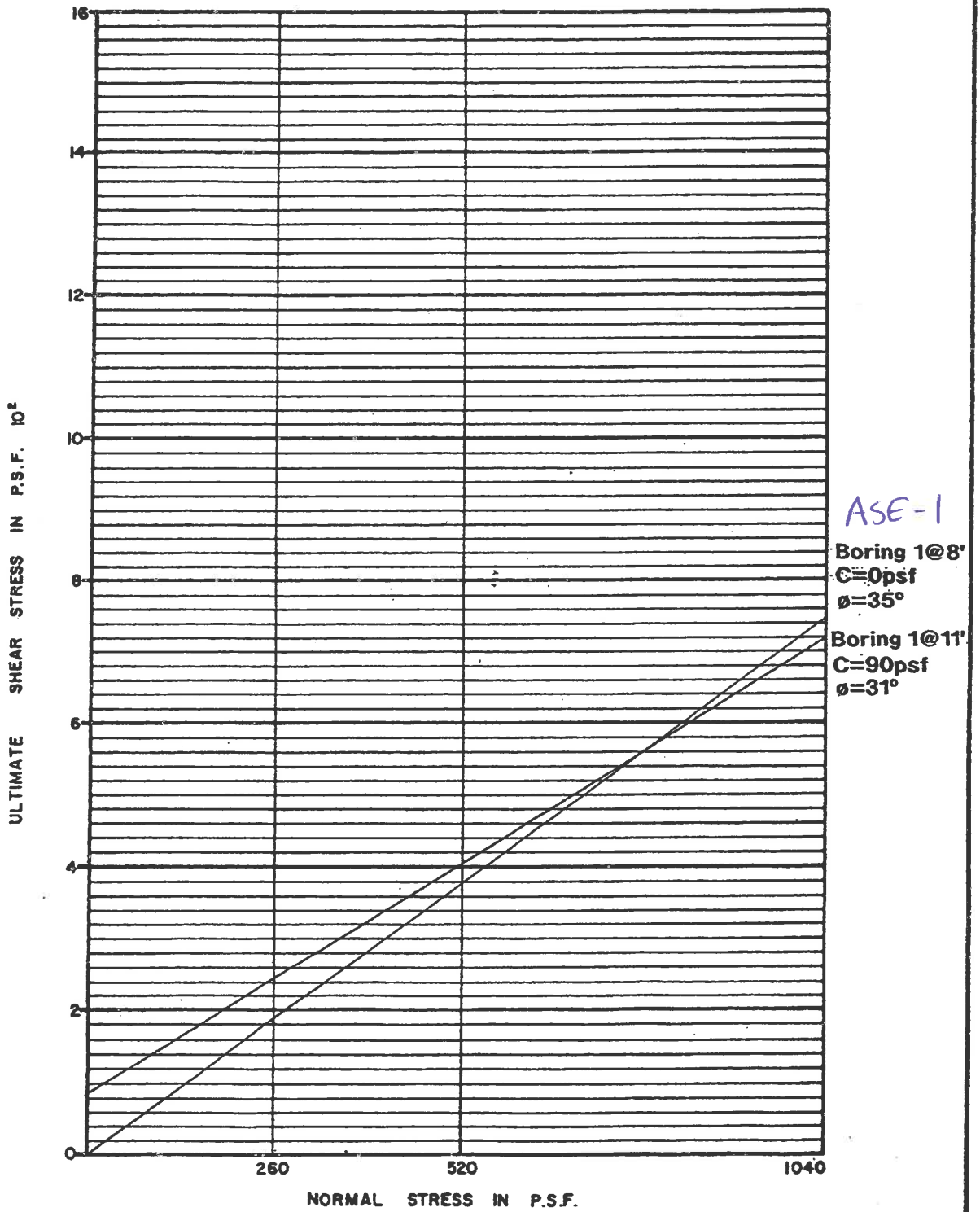


PLATE D-1

AE 31

CH 001300

PROJECT 94-4796

DIRECT SHEAR TEST

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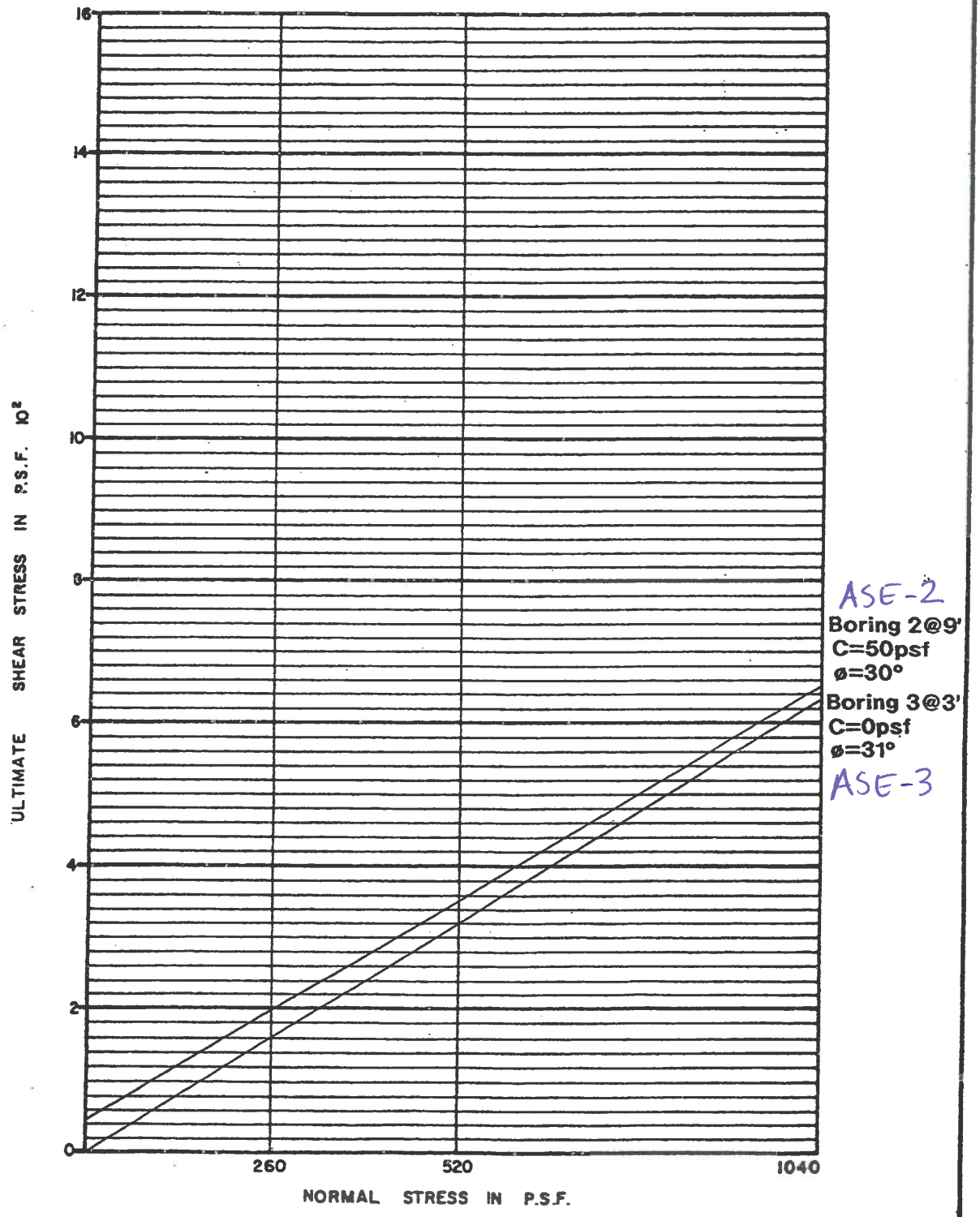

PLATE D-2

AE 31

CH 001301

PROJECT 94-4796

DIRECT SHEAR TEST

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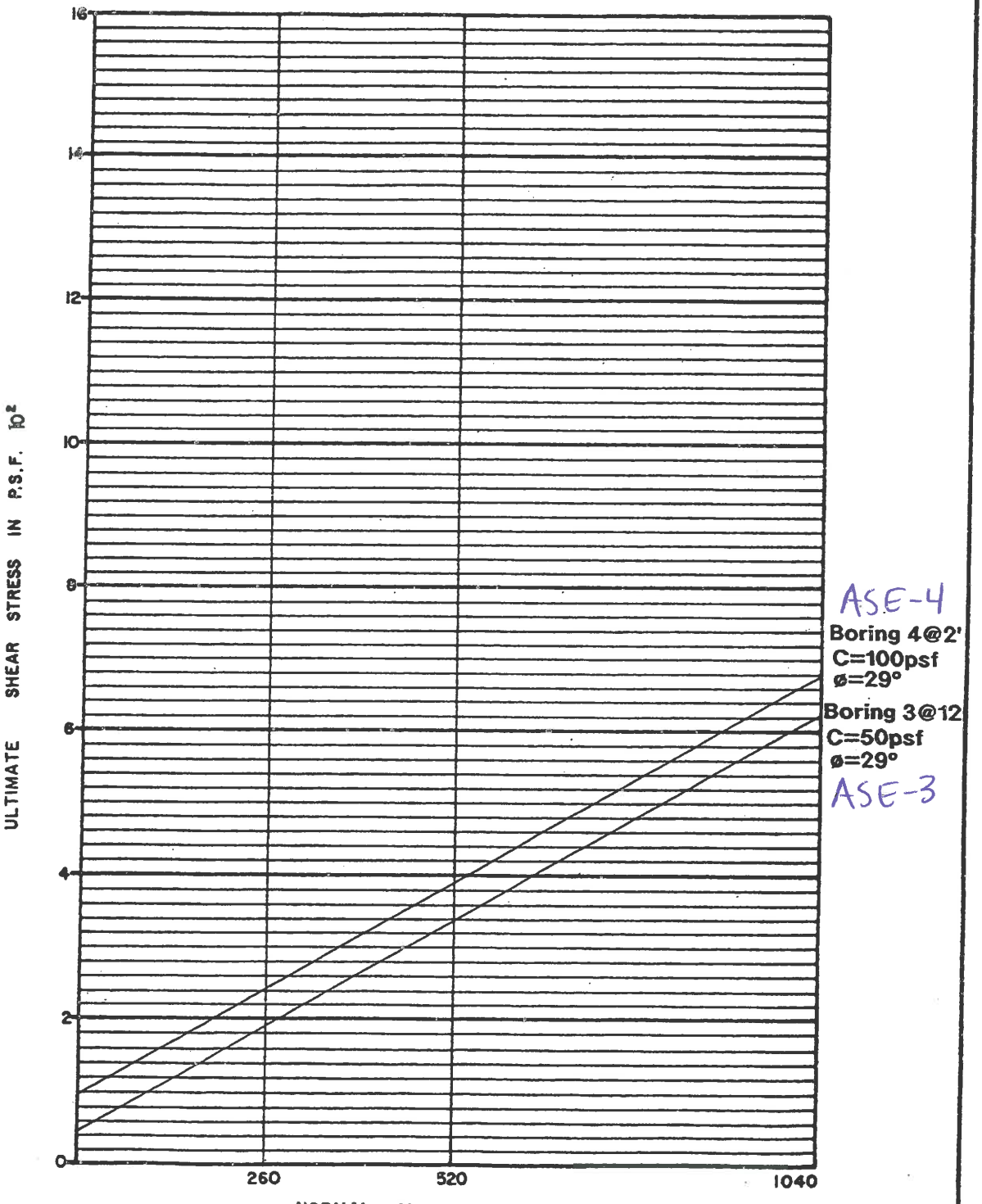

PLATE D-3

AE 31

CH 001302

PROJECT 94-4796

DIRECT SHEAR TEST

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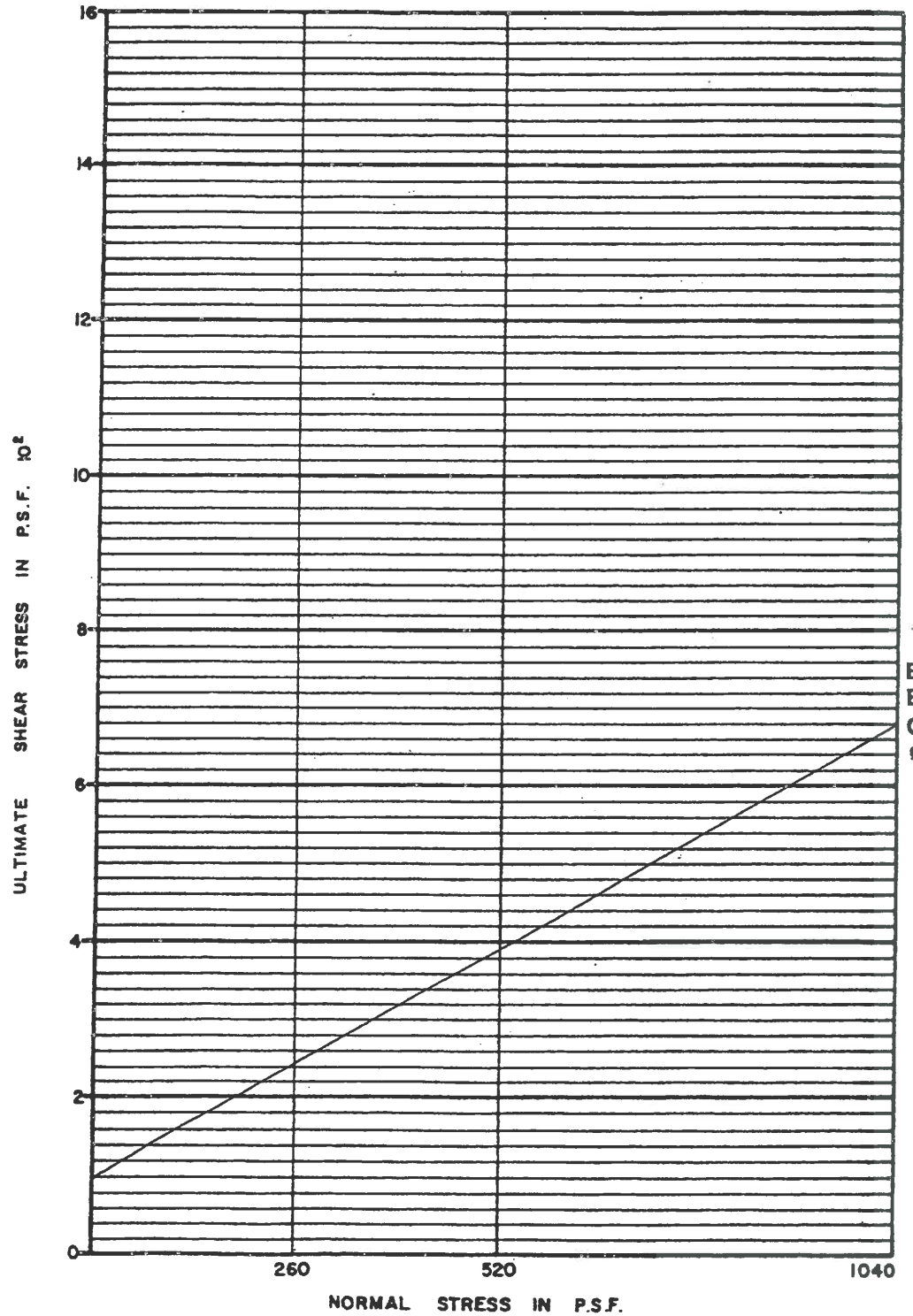


ASE-5
Boring 5@2' &
Boring 5@8'
C=100psf
ø=29°

PLATE D-4

AE 31

CH 001303

APPENDIX D

Site-Specific Seismic Response Spectra (Vertical)
555 Sixth Street, Hermosa Beach, California

12053-01
May 21, 2012

Site Class	D	
T_0	0.13	sec
T_S	0.63	sec
T_L	8.0	sec

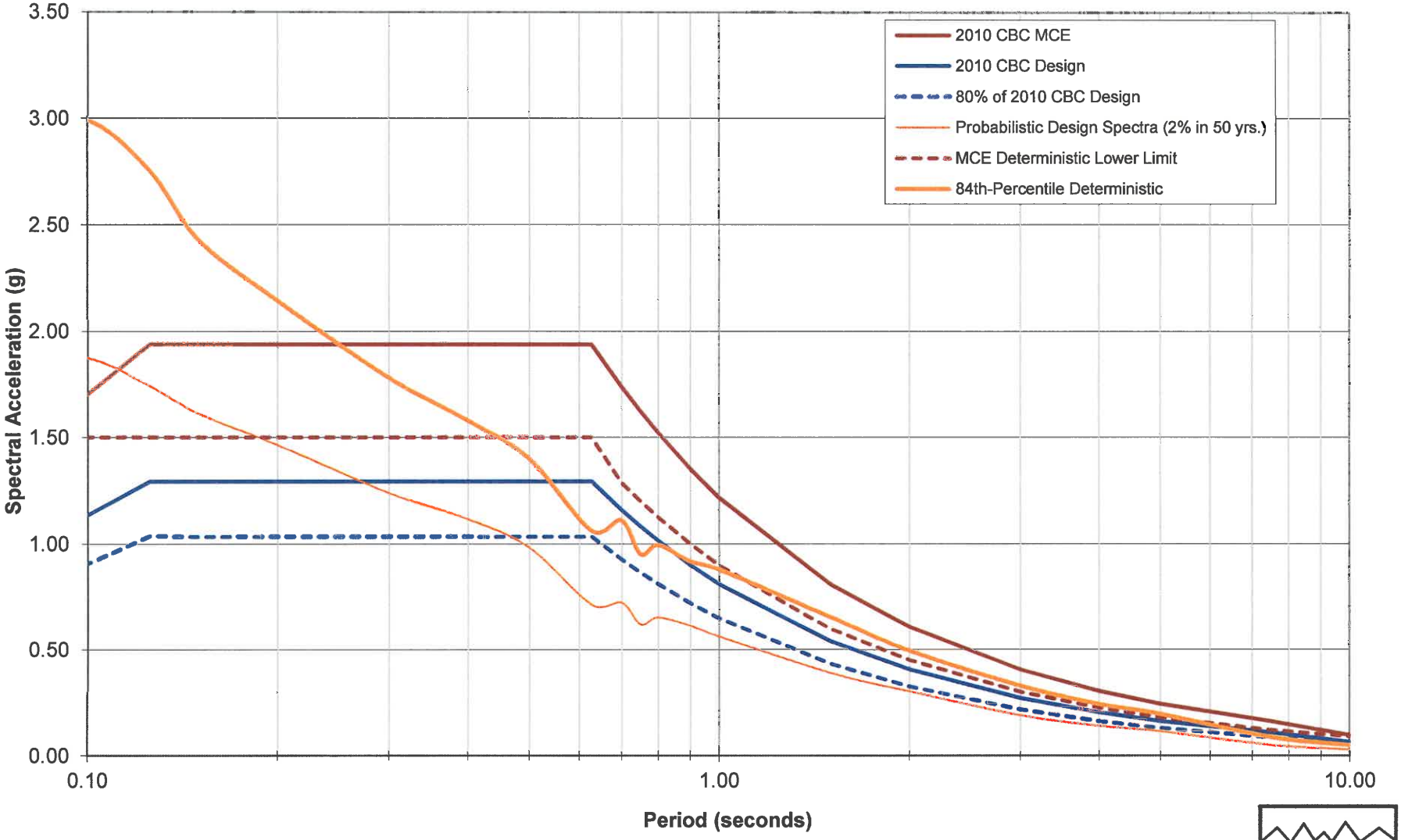
Parameter	2010 CBC Value	Site-Specific Design Acceleration Parameters
S_S	1.939	
S_1	0.811	
F_a	1.0	
F_v	1.5	
S_{MS}	1.939	**1.551**
S_{M1}	1.217	**0.974**
S_{DS}	1.293	**1.034**
S_{D1}	0.811	**0.649**

A	B	C	D	E	F	G	I	J	K	L
Period (sec)	2010 CBC MCE Spectrum	2010 CBC Design Spectrum	80% of 2010 CBC Design Spectrum	MCE Deterministic Lower Limit Spectrum	Probabilistic Design Spectra (2% in 50 yrs.)	84th-Percentile Deterministic Spectrum	Site Specific MCE Spectrum	*2/3 of Site Specific MCE Spectrum*	*80% of 2010 CBCDesign Spectrum*	**Design Response Spectra**
0.00	0.776	0.517	0.414	0.600	0.840	1.035	0.840	0.560	0.414	**0.560**
0.05	1.239	0.826	0.661	0.958	1.693	2.693	1.693	1.129	0.661	**1.129**
0.075	1.471	0.980	0.784	1.138	1.874	2.994	1.874	1.249	0.784	**1.249**
0.10	1.702	1.135	0.908	1.500	1.873	2.992	1.873	1.249	0.908	**1.249**
0.13	1.939	1.293	1.034	1.500	1.740	2.753	1.740	1.160	1.034	**1.160**
0.15	1.939	1.293	1.034	1.500	1.611	2.429	1.611	1.074	1.034	**1.074**
0.20	1.939	1.293	1.034	1.500	1.464	2.144	1.464	0.976	1.034	**1.034**
0.30	1.939	1.293	1.034	1.500	1.239	1.780	1.239	0.826	1.034	**1.034**
0.40	1.939	1.293	1.034	1.500	1.116	1.578	1.116	0.744	1.034	**1.034**
0.50	1.939	1.293	1.034	1.500	0.983	1.399	0.983	0.655	1.034	**1.034**
0.63	1.939	1.293	1.034	1.500	0.715	1.062	0.715	0.477	1.034	**1.034**
0.70	1.739	1.159	0.927	1.286	0.725	1.111	0.725	0.483	0.927	**0.927**
0.75	1.623	1.082	0.865	1.200	0.621	0.953	0.621	0.414	0.865	**0.865**
0.80	1.521	1.014	0.811	1.125	0.654	0.994	0.654	0.436	0.811	**0.811**
0.90	1.352	0.901	0.721	1.000	0.614	0.918	0.614	0.409	0.721	**0.721**
1.00	1.217	0.811	0.649	0.900	0.563	0.880	0.563	0.375	0.649	**0.649**
1.50	0.811	0.541	0.433	0.600	0.390	0.656	0.390	0.260	0.433	**0.433**
2.00	0.609	0.406	0.325	0.450	0.303	0.496	0.303	0.202	0.325	**0.325**
3.00	0.406	0.270	0.216	0.300	0.190	0.329	0.190	0.127	0.216	**0.216**
4.00	0.304	0.203	0.162	0.225	0.141	0.243	0.141	0.094	0.162	**0.162**
5.00	0.243	0.162	0.130	0.180	0.114	0.196	0.114	0.076	0.130	**0.130**
7.50	0.162	0.108	0.087	0.120	0.051	0.087	0.051	0.034	0.087	**0.087**
10.00	0.097	0.065	0.052	0.090	0.028	0.049	0.028	0.019	0.052	**0.052**

Column Descriptions:
(B) USGS, 2011, Java Calculator (MCE Spectrum)
(C) 2/3 of Column B
(E) From ASCE 7-05 Chapter 21.2.2
(F) Risk 2012, EZ-FRISK
(G) Risk 2012, EZ-FRISK for Palos Verdes (i.e. controlling fault)
(I) Lesser of Column F and Greater of Columns E and G
(L) Greater of Columns J and K

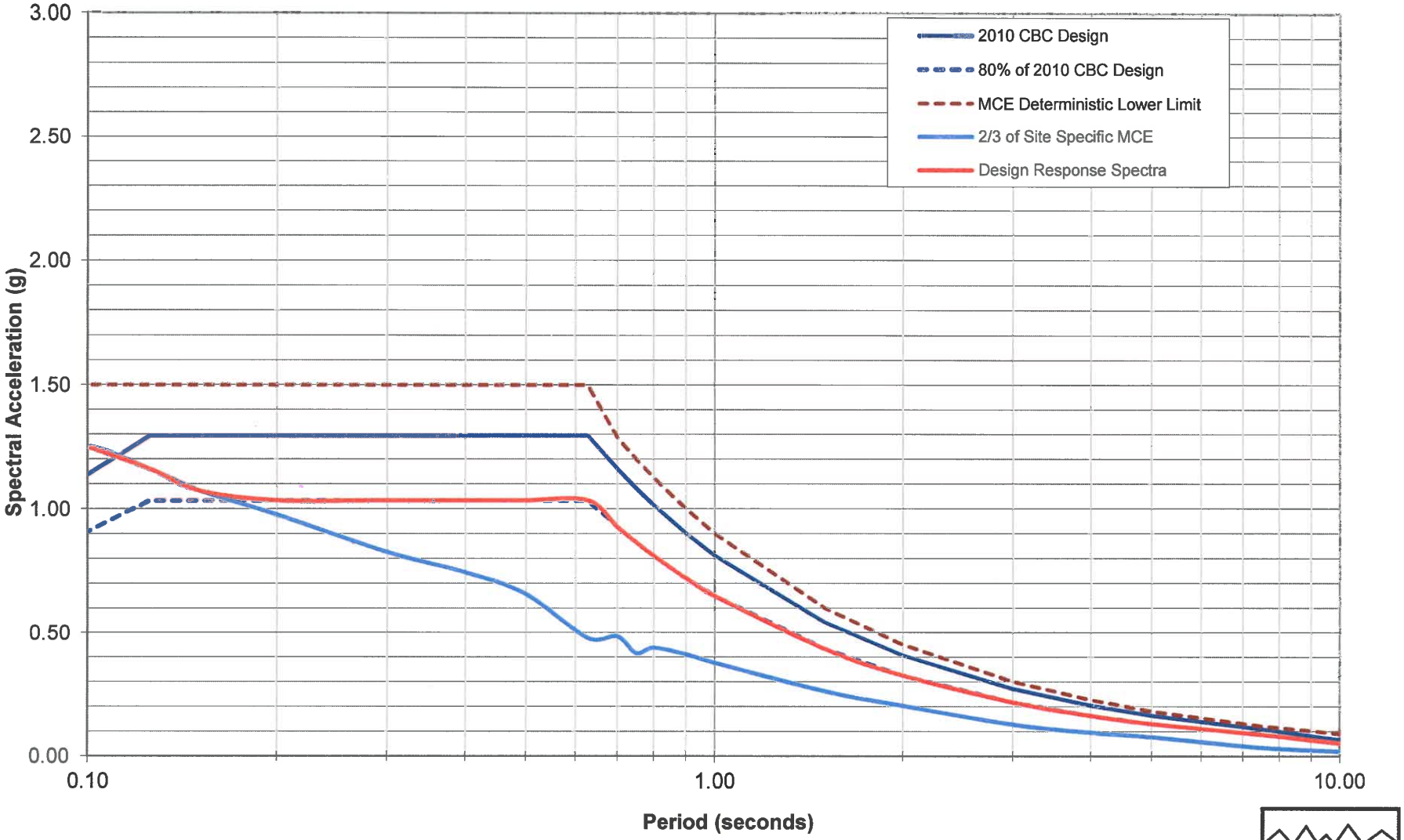
NMG

Site-Specific MCE Response Spectra (Vertical)



NMG

Site-Specific Design Response Spectra (Vertical)



NMG

Probabilistic Spectra results for EZ-FRISK 7.62 Build 001

ANNUAL FREQUENCY OF EXCEEDANCE: 4.041e-004
RETURN PERIOD: 2474.9
PROBABILITY OF EXCEEDENCE: 2.0% IN 50.0 YEARS
  Column 1: Spectral Period
  Column 2: Acceleration (g) for: Mean
  Column 3: Acceleration (g) for: Abra.-Silva (1997) Deep Soil - Vertical
  Column 4: Acceleration (g) for: Campbell-Bozorgnia (2003) Cor.-Vertical
  Column 5: Acceleration (g) for: Somerville (2001) Nonrift Vertical
  Column 6: Acceleration (g) for: Ambraseys et al (2005) Vertical

1	2	3	4	5	6
PGA	8.396e-001	8.108e-001	6.911e-001	1.049e+000	7.529e-001
0.05	1.693e+000	1.667e+000	1.128e+000	2.052e+000	1.815e+000
0.075	1.874e+000	1.975e+000	1.519e+000	2.046e+000	1.954e+000
0.1	1.873e+000	1.894e+000	1.603e+000	2.042e+000	1.943e+000
0.126	1.740e+000	1.696e+000	1.427e+000	2.075e+000	1.676e+000
0.15	1.611e+000	1.534e+000	1.324e+000	2.100e+000	1.331e+000
0.2	1.464e+000	1.250e+000	1.112e+000	2.144e+000	1.093e+000
0.3	1.239e+000	9.332e-001	7.831e-001	2.006e+000	8.688e-001
0.4	1.116e+000	7.608e-001	6.403e-001	1.909e+000	7.013e-001
0.5	9.382e-001	6.331e-001	5.519e-001	1.492e+000	8.016e-001
0.628	7.151e-001	5.477e-001	4.737e-001	1.174e+000	5.018e-001
0.7	7.245e-001	5.123e-001	4.394e-001	1.053e+000	7.790e-001
0.75	6.214e-001	4.907e-001	4.197e-001	9.826e-001	5.202e-001
0.8	6.538e-001	4.612e-001	4.102e-001	9.161e-001	7.401e-001
0.9	6.142e-001	4.176e-001	3.933e-001	8.080e-001	7.455e-001
1	5.629e-001	3.858e-001	3.786e-001	7.242e-001	6.999e-001
1.5	3.904e-001	2.692e-001	3.130e-001	4.433e-001	5.154e-001
2	3.027e-001	2.092e-001	2.407e-001	3.154e-001	4.177e-001
3	1.901e-001	1.405e-001	1.487e-001	2.022e-001	2.587e-001
4	1.411e-001	1.082e-001	1.116e-001	1.474e-001	1.943e-001
5	1.142e-001	9.114e-002	9.069e-002	1.183e-001	1.543e-001
7.5	5.103e-002	4.015e-002	3.884e-002	5.301e-002	6.916e-002
10	2.824e-002	2.245e-002	2.214e-002	2.920e-002	3.844e-002

ANNUAL FREQUENCY OF EXCEEDANCE: 1.026e-003
RETURN PERIOD: 974.8
PROBABILITY OF EXCEEDENCE: 5.0% IN 50.0 YEARS

Column 1: Spectral Period
Column 2: Acceleration (g) for: Mean
Column 3: Acceleration (g) for: Abra.-Silva (1997) Deep Soil - Vertical
Column 4: Acceleration (g) for: Campbell-Bozorgnia (2003) Cor.-Vertical
Column 5: Acceleration (g) for: Somerville (2001) Nonrift Vertical
Column 6: Acceleration (g) for: Ambraseys et al (2005) Vertical

1	2	3	4	5	6
PGA	5.678e-001	5.122e-001	4.879e-001	7.305e-001	4.559e-001
0.05	1.110e+000	1.042e+000	7.901e-001	1.408e+000	1.030e+000
0.075	1.214e+000	1.182e+000	1.079e+000	1.404e+000	1.108e+000
0.1	1.223e+000	1.147e+000	1.134e+000	1.400e+000	1.131e+000
0.126	1.168e+000	1.075e+000	1.055e+000	1.423e+000	1.021e+000
0.15	1.115e+000	1.009e+000	1.007e+000	1.441e+000	8.798e-001
0.2	1.034e+000	8.304e-001	8.306e-001	1.471e+000	7.502e-001
0.3	8.519e-001	6.253e-001	5.860e-001	1.344e+000	5.947e-001
0.4	7.534e-001	5.131e-001	4.950e-001	1.264e+000	4.842e-001
0.5	6.294e-001	4.284e-001	4.230e-001	9.981e-001	5.477e-001
0.628	4.849e-001	3.742e-001	3.590e-001	7.763e-001	3.634e-001
0.7	4.885e-001	3.506e-001	3.326e-001	6.905e-001	5.346e-001
0.75	4.230e-001	3.366e-001	3.175e-001	6.396e-001	3.693e-001
0.8	4.441e-001	3.169e-001	3.095e-001	5.958e-001	5.164e-001
0.9	4.196e-001	2.872e-001	2.952e-001	5.243e-001	5.245e-001
1	3.819e-001	2.653e-001	2.823e-001	4.674e-001	4.812e-001
1.5	2.609e-001	1.841e-001	2.269e-001	2.875e-001	3.358e-001
2	2.024e-001	1.416e-001	1.725e-001	2.049e-001	2.731e-001
3	1.251e-001	9.529e-002	1.091e-001	1.312e-001	1.633e-001
4	9.445e-002	7.258e-002	8.149e-002	9.846e-002	1.225e-001
5	7.601e-002	6.066e-002	6.546e-002	7.855e-002	9.853e-002
7.5	3.314e-002	2.675e-002	2.769e-002	3.419e-002	4.350e-002
10	1.899e-002	1.514e-002	1.605e-002	1.968e-002	2.441e-002

ANNUAL FREQUENCY OF EXCEEDANCE: 2.107e-003
RETURN PERIOD: 474.6
PROBABILITY OF EXCEEDENCE: 10.0% IN 50.0 YEARS
Column 1: Spectral Period
Column 2: Acceleration (g) for: Mean
Column 3: Acceleration (g) for: Abra.-Silva (1997) Deep Soil - Vertical
Column 4: Acceleration (g) for: Campbell-Bozorgnia (2003) Cor.-Vertical
Column 5: Acceleration (g) for: Somerville (2001) Nonrift Vertical

Column 6: Acceleration (g) for: Ambraseys et al (2005) Vertical

1	2	3	4	5	6
PGA	4.024e-001	3.294e-001	3.453e-001	5.394e-001	2.940e-001
0.05	7.730e-001	6.484e-001	5.472e-001	1.050e+000	6.207e-001
0.075	8.475e-001	7.491e-001	7.641e-001	1.046e+000	6.845e-001
0.1	8.611e-001	7.264e-001	8.218e-001	1.044e+000	7.223e-001
0.126	8.345e-001	6.994e-001	7.775e-001	1.060e+000	6.609e-001
0.15	8.081e-001	6.672e-001	7.512e-001	1.072e+000	5.773e-001
0.2	7.517e-001	5.651e-001	6.315e-001	1.092e+000	5.132e-001
0.3	6.177e-001	4.459e-001	4.531e-001	9.850e-001	4.232e-001
0.4	5.435e-001	3.691e-001	3.916e-001	9.127e-001	3.495e-001
0.5	4.551e-001	3.107e-001	3.317e-001	7.114e-001	3.994e-001
0.628	3.529e-001	2.746e-001	2.809e-001	5.502e-001	2.788e-001
0.7	3.533e-001	2.589e-001	2.587e-001	4.877e-001	3.896e-001
0.75	3.089e-001	2.496e-001	2.459e-001	4.512e-001	2.781e-001
0.8	3.228e-001	2.350e-001	2.387e-001	4.199e-001	3.803e-001
0.9	3.052e-001	2.128e-001	2.266e-001	3.677e-001	3.883e-001
1	2.762e-001	1.968e-001	2.168e-001	3.269e-001	3.504e-001
1.5	1.867e-001	1.361e-001	1.699e-001	2.015e-001	2.355e-001
2	1.422e-001	1.042e-001	1.272e-001	1.417e-001	1.922e-001
3	8.949e-002	6.921e-002	8.178e-002	9.310e-002	1.128e-001
4	6.699e-002	5.270e-002	6.058e-002	6.923e-002	8.482e-002
5	5.394e-002	4.370e-002	4.851e-002	5.524e-002	6.796e-002
7.5	2.370e-002	1.952e-002	2.132e-002	2.419e-002	2.978e-002
10	1.335e-002	1.098e-002	1.193e-002	1.364e-002	1.688e-002

ANNUAL FREQUENCY OF EXCEEDANCE: 1.386e-002
RETURN PERIOD: 72.1
PROBABILITY OF EXCEEDENCE: 50.0% IN 50.0 YEARS
Column 1: Spectral Period
Column 2: Acceleration (g) for: Mean
Column 3: Acceleration (g) for: Abra.-Silva (1997) Deep Soil - Vertical
Column 4: Acceleration (g) for: Campbell-Bozorgnia (2003) Cor.-Vertical
Column 5: Acceleration (g) for: Somerville (2001) Nonrift Vertical
Column 6: Acceleration (g) for: Ambraseys et al (2005) Vertical

1	2	3	4	5	6
PGA	1.350e-001	1.057e-001	1.186e-001	2.128e-001	9.907e-002
0.05	2.461e-001	1.862e-001	1.636e-001	4.157e-001	1.753e-001

0.075	2.735e-001	2.158e-001	2.302e-001	4.139e-001	2.043e-001
0.1	2.840e-001	2.092e-001	2.622e-001	4.127e-001	2.261e-001
0.126	2.868e-001	2.203e-001	2.722e-001	4.182e-001	2.170e-001
0.15	2.853e-001	2.243e-001	2.809e-001	4.225e-001	2.024e-001
0.2	2.712e-001	2.064e-001	2.507e-001	4.297e-001	1.955e-001
0.3	2.275e-001	1.801e-001	1.892e-001	3.736e-001	1.722e-001
0.4	2.021e-001	1.526e-001	1.759e-001	3.386e-001	1.442e-001
0.5	1.690e-001	1.316e-001	1.445e-001	2.580e-001	1.484e-001
0.628	1.368e-001	1.195e-001	1.208e-001	1.974e-001	1.225e-001
0.7	1.320e-001	1.141e-001	1.115e-001	1.708e-001	1.402e-001
0.75	1.214e-001	1.109e-001	1.063e-001	1.565e-001	1.185e-001
0.8	1.213e-001	1.050e-001	1.029e-001	1.447e-001	1.397e-001
0.9	1.135e-001	9.524e-002	9.645e-002	1.260e-001	1.418e-001
1	1.035e-001	8.784e-002	9.073e-002	1.119e-001	1.258e-001
1.5	6.848e-002	6.046e-002	6.825e-002	6.798e-002	7.956e-002
2	5.148e-002	4.572e-002	4.963e-002	4.721e-002	6.449e-002
3	3.079e-002	2.846e-002	3.000e-002	2.954e-002	3.573e-002
4	2.323e-002	2.168e-002	2.263e-002	2.213e-002	2.687e-002
5	1.889e-002	1.749e-002	1.824e-002	1.776e-002	2.193e-002
7.5	7.742e-003	6.791e-003	7.307e-003	7.338e-003	9.810e-003
10	3.750e-003	3.331e-003	3.498e-003	3.658e-003	4.515e-003

Deterministic Spectra Results using EZ-FRISK 7.62 Build 001

Largest Amplitudes of Ground Motions Considering All Sources Calculated using Weighted Mean of Attenuation Equations

Amplitude Units: Acceleration (g)

Fractile: 0.84

Period	Amplitude	Magnitude	Closest Distance(km)	Region	Controlling Source
PGA	1.305e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.05	2.693e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.075	2.994e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.1	2.992e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.126	2.753e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.15	2.429e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.2	2.144e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.3	1.780e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.4	1.578e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.5	1.399e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.628	1.062e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.7	1.111e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.75	9.528e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.8	9.942e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.9	9.180e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1	8.802e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1.5	6.559e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
2	4.955e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
3	3.294e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
4	2.430e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
5	1.962e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
7.5	8.721e-002	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
10	4.906e-002	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected

Largest Amplitudes of Ground Motions Considering Sources Calculated with Abra.-Silva (1997) Deep Soil - Vertical

Amplitude Units: Acceleration (g)

Fractile: 0.84

Period	Amplitude	Magnitude	Closest Distance(km)	Region	Controlling Source

PGA	1.211e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.05	2.571e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.075	2.960e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.1	2.858e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.126	2.579e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.15	2.332e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.2	1.898e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.3	1.347e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.4	1.103e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.5	9.194e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.628	7.940e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.7	7.384e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.75	7.051e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.8	6.647e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.9	6.029e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1	5.579e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1.5	4.011e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
2	3.173e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
3	2.265e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
4	1.759e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
5	1.481e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
7.5	6.584e-002	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
10	3.704e-002	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected

Largest Amplitudes of Ground Motions Considering Sources Calculated with Campbell-Bozorgnia (2003) Cor.-Vertical

Amplitude Units: Acceleration (g)

Fractile: 0.84

Period	Amplitude	Magnitude	Closest Distance(km)	Region	Controlling Source
PGA	8.955e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.05	1.412e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.075	1.948e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.1	2.088e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.126	1.876e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.15	1.731e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.2	1.433e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.3	1.008e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.4	7.656e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded

0.5	6.672e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.628	5.890e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.7	5.550e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.75	5.345e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.8	5.181e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.9	4.896e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
1	4.654e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
1.5	3.714e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
2	2.982e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
3	1.889e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
4	1.407e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
5	1.126e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
7.5	5.003e-002	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
10	2.814e-002	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected

Largest Amplitudes of Ground Motions Considering Sources Calculated with Somerville (2001) Nonrift Vertical
Amplitude Units: Acceleration (g)

Fractile: 0.84

Period	Amplitude	Magnitude	Closest Distance(km)	Region	Controlling Source
PGA	1.868e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.05	3.639e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.075	3.624e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.1	3.614e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.126	3.667e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.15	3.708e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.2	3.776e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.3	3.632e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.4	3.534e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.5	2.804e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.628	2.214e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.7	1.978e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.75	1.841e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.8	1.722e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.9	1.524e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1	1.366e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1.5	7.949e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
2	5.412e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
3	3.161e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected

4	2.159e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
5	1.727e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
7.5	7.676e-002	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
10	4.318e-002	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected

Largest Amplitudes of Ground Motions Considering Sources Calculated with Ambraseys et al (2005) Vertical
Amplitude Units: Acceleration (g)

Fractile: 0.84

Period	Amplitude	Magnitude	Closest Distance(km)	Region	Controlling Source
PGA	1.300e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.05	3.149e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.075	3.498e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.1	3.532e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.126	3.064e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.15	2.152e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.2	1.643e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.3	1.287e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.4	1.036e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.5	1.306e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.628	7.460e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.7	1.265e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.75	8.235e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.8	1.153e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.9	1.117e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1	1.176e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1.5	1.056e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
2	8.252e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
3	5.858e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
4	4.394e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
5	3.515e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
7.5	1.562e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
10	8.787e-002	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected

Site-Specific Seismic Response Spectra (Horizontal)
555 Sixth Street, Hermosa Beach, California

12053-01
May 21, 2012

Site Class	D	
T_0	0.13	sec
T_S	0.63	sec
T_L	8.0	sec

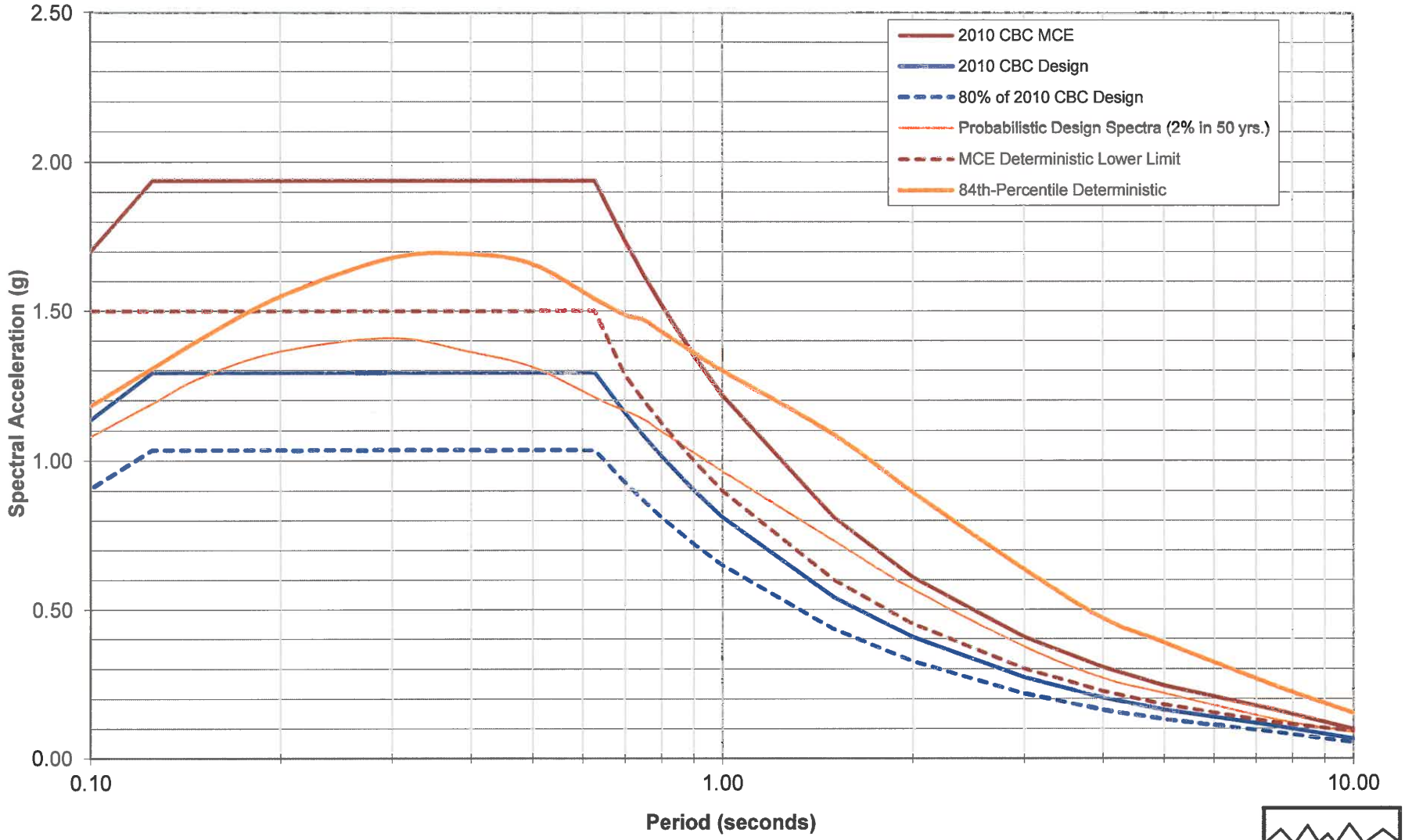
Parameter	2010 CBC Value	Site-Specific Design Acceleration Parameters
S_S	1.939	
S_1	0.811	
F_a	1.0	
F_v	1.5	
S_{MS}	1.939	**1.551**
S_{M1}	1.217	**1.136**
S_{DS}	1.293	**1.034**
S_{D1}	0.811	**0.757**

A	B	C	D	E	F	G	I	J	K	L
Period (sec)	2010 CBC MCE Spectrum	2010 CBC Design Spectrum	80% of 2010 CBC Design Spectrum	MCE Deterministic Lower Limit Spectrum	Probabilistic Design Spectra (2% in 50 yrs.)	84th-Percentile Deterministic Spectrum	Site Specific MCE Spectrum	*2/3 of Site Specific MCE Spectrum*	*80% of 2010 CBCDesign Spectrum*	**Design Response Spectra**
0.00	0.776	0.517	0.414	0.600	0.649	0.760	0.649	0.433	0.414	**0.433**
0.05	1.239	0.826	0.661	0.958	0.784	0.903	0.784	0.522	0.661	**0.661**
0.075	1.471	0.980	0.784	1.138	0.937	1.033	0.937	0.624	0.784	**0.784**
0.10	1.702	1.135	0.908	1.500	1.080	1.182	1.080	0.720	0.908	**0.908**
0.13	1.939	1.293	1.034	1.500	1.190	1.307	1.190	0.793	1.034	**1.034**
0.15	1.939	1.293	1.034	1.500	1.277	1.407	1.277	0.851	1.034	**1.034**
0.20	1.939	1.293	1.034	1.500	1.364	1.550	1.364	0.909	1.034	**1.034**
0.30	1.939	1.293	1.034	1.500	1.409	1.680	1.409	0.939	1.034	**1.034**
0.40	1.939	1.293	1.034	1.500	1.362	1.693	1.362	0.908	1.034	**1.034**
0.50	1.939	1.293	1.034	1.500	1.312	1.659	1.312	0.875	1.034	**1.034**
0.63	1.939	1.293	1.034	1.500	1.210	1.542	1.210	0.807	1.034	**1.034**
0.70	1.739	1.159	0.927	1.286	1.166	1.488	1.166	0.777	0.927	**0.927**
0.75	1.623	1.082	0.865	1.200	1.138	1.471	1.138	0.759	0.865	**0.865**
0.80	1.521	1.014	0.811	1.125	1.097	1.431	1.097	0.731	0.811	**0.811**
0.90	1.352	0.901	0.721	1.000	1.027	1.360	1.027	0.685	0.721	**0.721**
1.00	1.217	0.811	0.649	0.900	0.964	1.299	0.964	0.643	0.649	**0.649**
1.50	0.811	0.541	0.433	0.600	0.732	1.087	0.732	0.488	0.433	**0.488**
2.00	0.609	0.406	0.325	0.450	0.568	0.896	0.568	0.379	0.325	**0.379**
3.00	0.406	0.270	0.216	0.300	0.374	0.635	0.374	0.249	0.216	**0.249**
4.00	0.304	0.203	0.162	0.225	0.268	0.469	0.268	0.179	0.162	**0.179**
5.00	0.243	0.162	0.130	0.180	0.218	0.387	0.218	0.145	0.130	**0.145**
7.50	0.162	0.108	0.087	0.120	0.131	0.243	0.131	0.087	0.087	**0.087**
10.00	0.097	0.065	0.052	0.090	0.086	0.151	0.086	0.057	0.052	**0.057**

Column Descriptions:
(B) USGS, 2011, Java Calculator (MCE Spectrum)
(C) 2/3 of Column B
(E) From ASCE 7-05 Chapter 21.2.2
(F) Risk 2012, EZ-FRISK
(G) Risk 2012, EZ-FRISK for Palos Verdes (i.e. controlling fault)
(I) Lesser of Column F and Greater of Columns E and G
(L) Greater of Columns J and K

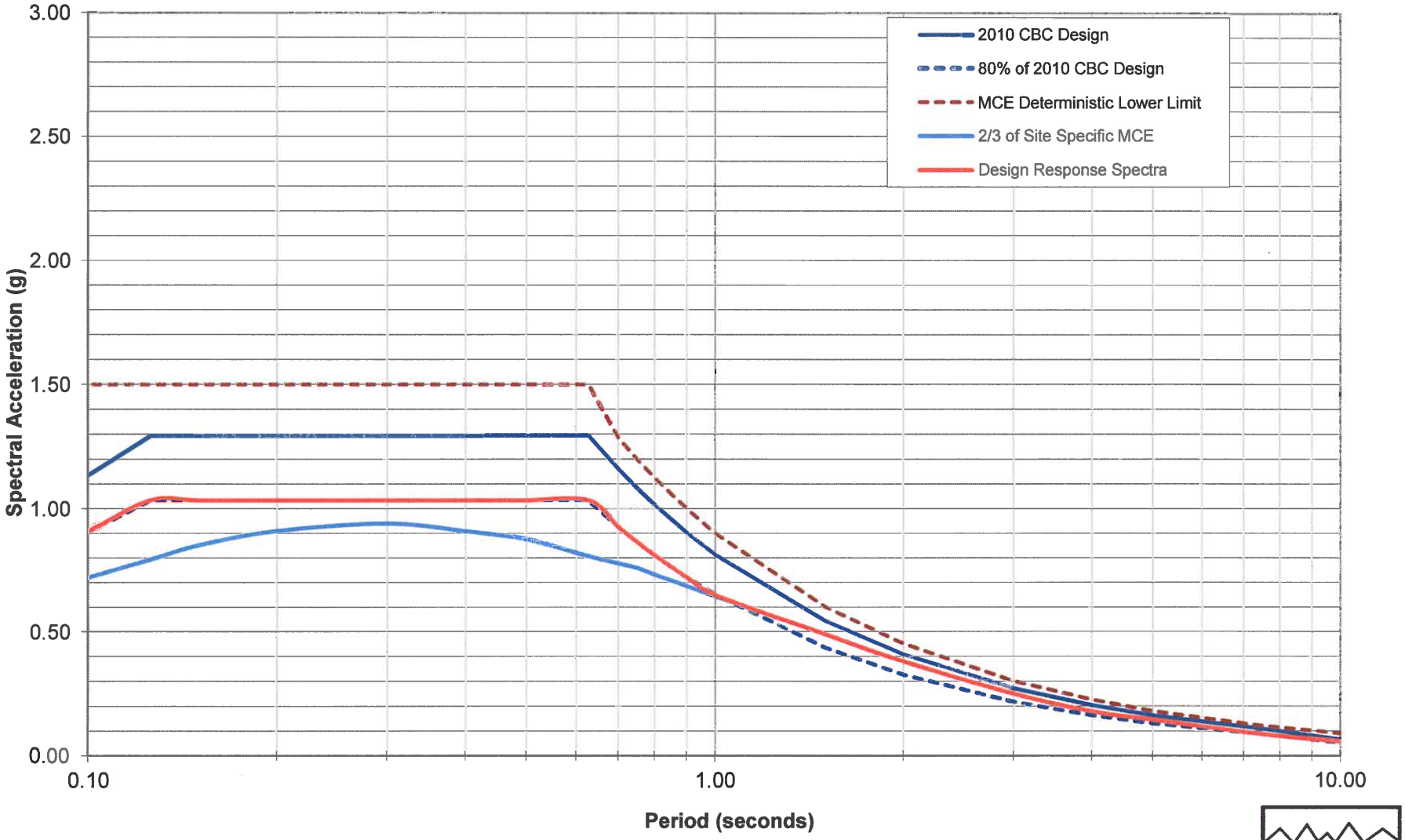
NMG

Site-Specific MCE Response Spectra (Horizontal)



NMG

Site-Specific Design Response Spectra (Horizontal)



NMG

Deterministic Spectra Results using EZ-FRISK 7.62 Build 001

Largest Amplitudes of Ground Motions Considering All Sources Calculated using Weighted Mean of Attenuation Equations

Amplitude Units: Acceleration (g)

Fractile: 0.84

Period	Amplitude	Magnitude	Closest Distance(km)	Region	Controlling Source
PGA	7.595e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.05	9.026e-001	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.075	1.033e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.1	1.182e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.126	1.307e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.15	1.407e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.2	1.550e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.3	1.680e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.4	1.693e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.5	1.659e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.628	1.542e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.7	1.488e+000	7.00 Mw	5.00	USGS 2008 California	California Gridded
0.75	1.471e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.8	1.431e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
0.9	1.360e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1	1.299e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
1.5	1.087e+000	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
2	8.955e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
3	6.354e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
4	4.691e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
5	3.869e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
7.5	2.426e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected
10	1.514e-001	7.70 Mw	3.02	USGS 2008 California	Palos Verdes Connected

Probabilistic Spectra results for EZ-FRISK 7.62 Build 001

ANNUAL FREQUENCY OF EXCEEDANCE: 4.041e-004
RETURN PERIOD: 2474.9
PROBABILITY OF EXCEEDENCE: 2.0% IN 50.0 YEARS
Column 1: Spectral Period
Column 2: Acceleration (g) for: Mean
Column 3: Acceleration (g) for: Boore-Atkinson (2008) NGA USGS 2008
Column 4: Acceleration (g) for: Campbell-Bozorgnia (2008) NGA USGS 2008
Column 5: Acceleration (g) for: Chiou-Youngs (2007) NGA USGS 2008

1	2	3	4	5
PGA	6.490e-001	6.680e-001	5.734e-001	7.015e-001
0.05	7.836e-001	8.087e-001	7.007e-001	8.384e-001
0.075	9.366e-001	1.003e+000	8.403e-001	9.641e-001
0.1	1.080e+000	1.174e+000	9.887e-001	1.079e+000
0.126	1.190e+000	1.311e+000	1.070e+000	1.182e+000
0.15	1.277e+000	1.430e+000	1.137e+000	1.254e+000
0.2	1.364e+000	1.539e+000	1.194e+000	1.340e+000
0.3	1.409e+000	1.598e+000	1.219e+000	1.387e+000
0.4	1.362e+000	1.515e+000	1.213e+000	1.344e+000
0.5	1.312e+000	1.424e+000	1.227e+000	1.276e+000
0.628	1.210e+000	1.284e+000	1.150e+000	1.191e+000
0.7	1.166e+000	1.224e+000	1.118e+000	1.152e+000
0.75	1.138e+000	1.188e+000	1.098e+000	1.126e+000
0.8	1.097e+000	1.124e+000	1.066e+000	1.100e+000
0.9	1.027e+000	1.019e+000	1.011e+000	1.052e+000
1	9.643e-001	9.307e-001	9.591e-001	1.007e+000
1.5	7.318e-001	6.925e-001	7.521e-001	7.544e-001
2	5.680e-001	5.238e-001	6.050e-001	5.810e-001
3	3.740e-001	3.489e-001	4.018e-001	3.745e-001
4	2.684e-001	2.482e-001	2.985e-001	2.589e-001
5	2.178e-001	2.032e-001	2.578e-001	1.866e-001
7.5	1.305e-001	1.284e-001	1.653e-001	8.545e-002
10	8.609e-002	6.642e-002	1.283e-001	4.338e-002

ANNUAL FREQUENCY OF EXCEEDANCE: 1.026e-003
RETURN PERIOD: 974.8
PROBABILITY OF EXCEEDENCE: 5.0% IN 50.0 YEARS
Column 1: Spectral Period
Column 2: Acceleration (g) for: Mean
Column 3: Acceleration (g) for: Boore-Atkinson (2008) NGA USGS 2008
Column 4: Acceleration (g) for: Campbell-Bozorgnia (2008) NGA USGS 2008
Column 5: Acceleration (g) for: Chiou-Youngs (2007) NGA USGS 2008

1	2	3	4	5
PGA	4.901e-001	5.122e-001	4.387e-001	5.132e-001
0.05	5.887e-001	6.103e-001	5.339e-001	6.219e-001
0.075	7.118e-001	7.490e-001	6.550e-001	7.257e-001
0.1	8.267e-001	8.834e-001	7.685e-001	8.301e-001
0.126	9.238e-001	9.922e-001	8.485e-001	9.322e-001
0.15	1.001e+000	1.075e+000	9.189e-001	1.000e+000
0.2	1.058e+000	1.152e+000	9.691e-001	1.052e+000
0.3	1.075e+000	1.188e+000	9.691e-001	1.062e+000
0.4	1.023e+000	1.111e+000	9.325e-001	1.012e+000
0.5	9.713e-001	1.045e+000	9.153e-001	9.363e-001

0.628	8.754e-001	9.360e-001	8.324e-001	8.455e-001
0.7	8.344e-001	8.887e-001	7.979e-001	8.040e-001
0.75	8.094e-001	8.605e-001	7.774e-001	7.775e-001
0.8	7.741e-001	8.128e-001	7.476e-001	7.523e-001
0.9	7.138e-001	7.339e-001	6.972e-001	7.055e-001
1	6.624e-001	6.697e-001	6.544e-001	6.612e-001
1.5	4.856e-001	4.865e-001	4.931e-001	4.756e-001
2	3.693e-001	3.653e-001	3.853e-001	3.558e-001
3	2.384e-001	2.382e-001	2.510e-001	2.234e-001
4	1.705e-001	1.675e-001	1.866e-001	1.545e-001
5	1.383e-001	1.356e-001	1.621e-001	1.109e-001
7.5	8.391e-002	8.605e-002	1.049e-001	5.104e-002
10	5.430e-002	4.598e-002	8.107e-002	2.590e-002

ANNUAL FREQUENCY OF EXCEEDANCE: 2.107e-003
RETURN PERIOD: 474.6
PROBABILITY OF EXCEEDENCE: 10.0% IN 50.0 YEARS
Column 1: Spectral Period
Column 2: Acceleration (g) for: Mean
Column 3: Acceleration (g) for: Boore-Atkinson (2008) NGA USGS 2008
Column 4: Acceleration (g) for: Campbell-Bozorgnia (2008) NGA USGS 2008
Column 5: Acceleration (g) for: Chiou-Youngs (2007) NGA USGS 2008

1	2	3	4	5
PGA	3.826e-001	4.100e-001	3.442e-001	3.870e-001
0.05	4.610e-001	4.841e-001	4.230e-001	4.748e-001
0.075	5.568e-001	5.874e-001	5.232e-001	5.593e-001
0.1	6.548e-001	6.941e-001	6.178e-001	6.520e-001
0.126	7.324e-001	7.739e-001	6.910e-001	7.336e-001
0.15	7.891e-001	8.422e-001	7.450e-001	7.820e-001
0.2	8.395e-001	9.095e-001	7.794e-001	8.288e-001
0.3	8.468e-001	9.365e-001	7.723e-001	8.248e-001
0.4	7.892e-001	8.625e-001	7.307e-001	7.664e-001
0.5	7.415e-001	8.076e-001	7.047e-001	6.993e-001
0.628	6.622e-001	7.214e-001	6.305e-001	6.196e-001
0.7	6.274e-001	6.841e-001	6.000e-001	5.838e-001
0.75	6.064e-001	6.610e-001	5.819e-001	5.611e-001
0.8	5.780e-001	6.235e-001	5.571e-001	5.397e-001
0.9	5.297e-001	5.623e-001	5.154e-001	5.006e-001
1	4.897e-001	5.139e-001	4.811e-001	4.659e-001
1.5	3.504e-001	3.666e-001	3.522e-001	3.255e-001
2	2.625e-001	2.732e-001	2.694e-001	2.393e-001
3	1.667e-001	1.743e-001	1.731e-001	1.490e-001
4	1.190e-001	1.223e-001	1.287e-001	1.022e-001
5	9.675e-002	9.916e-002	1.120e-001	7.372e-002
7.5	5.787e-002	6.171e-002	7.182e-002	3.382e-002
10	3.640e-002	3.337e-002	5.455e-002	1.727e-002

ANNUAL FREQUENCY OF EXCEEDANCE: 1.386e-002
RETURN PERIOD: 72.1
PROBABILITY OF EXCEEDENCE: 50.0% IN 50.0 YEARS
Column 1: Spectral Period
Column 2: Acceleration (g) for: Mean
Column 3: Acceleration (g) for: Boore-Atkinson (2008) NGA USGS 2008
Column 4: Acceleration (g) for: Campbell-Bozorgnia (2008) NGA USGS 2008

Column 5: Acceleration (g) for: Chiou-Youngs (2007) NGA USGS 2008

1	2	3	4	5
PGA	1.737e-001	2.028e-001	1.587e-001	1.577e-001
0.05	2.098e-001	2.303e-001	1.985e-001	1.972e-001
0.075	2.544e-001	2.766e-001	2.451e-001	2.396e-001
0.1	3.036e-001	3.240e-001	2.955e-001	2.872e-001
0.126	3.412e-001	3.629e-001	3.312e-001	3.284e-001
0.15	3.715e-001	3.973e-001	3.620e-001	3.541e-001
0.2	3.985e-001	4.307e-001	3.828e-001	3.765e-001
0.3	3.967e-001	4.412e-001	3.756e-001	3.663e-001
0.4	3.582e-001	4.016e-001	3.402e-001	3.311e-001
0.5	3.295e-001	3.718e-001	3.185e-001	2.944e-001
0.628	2.880e-001	3.267e-001	2.781e-001	2.527e-001
0.7	2.692e-001	3.084e-001	2.609e-001	2.351e-001
0.75	2.582e-001	2.973e-001	2.509e-001	2.244e-001
0.8	2.448e-001	2.792e-001	2.384e-001	2.146e-001
0.9	2.229e-001	2.505e-001	2.178e-001	1.967e-001
1	2.053e-001	2.286e-001	2.016e-001	1.791e-001
1.5	1.371e-001	1.537e-001	1.362e-001	1.198e-001
2	1.012e-001	1.128e-001	1.015e-001	8.554e-002
3	6.119e-002	6.934e-002	6.258e-002	5.128e-002
4	4.198e-002	4.745e-002	4.523e-002	3.337e-002
5	3.254e-002	3.606e-002	3.747e-002	2.405e-002
7.5	1.822e-002	2.159e-002	2.190e-002	1.089e-002
10	1.120e-002	1.286e-002	1.496e-002	4.430e-003

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*                    *
*    E Q F A U L T   *
*                    *
*    Version 3.00    *
*                    *
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DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 12053-01

DATE: 08-23-2012

JOB NAME: Hermosa Beach

CALCULATION NAME: Test Run Analysis

FAULT-DATA-FILE NAME: CGSFLTE.DAT

SITE COORDINATES:
SITE LATITUDE: 33.8590
SITE LONGITUDE: 118.3950

SEARCH RADIUS: 60 mi

ATTENUATION RELATION: 3) Boore et al. (1997) Horiz. - NEHRP D (250)
UNCERTAINTY (M=Median, S=Sigma): M Number of Sigmas: 0.0
DISTANCE MEASURE: cd_2drp
SCOND: 0
Basement Depth: 5.00 km Campbell SSR: Campbell SHR:
COMPUTE PEAK HORIZONTAL ACCELERATION

FAULT-DATA FILE USED: CGSFLTE.DAT

MINIMUM DEPTH VALUE (km): 0.0

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	ESTIMATED MAX. EARTHQUAKE EVENT: PEAK SITE ACCEL. g	ESTIMATED MAX. EARTHQUAKE EVENT: EST. SITE INTENSITY MOD.MERC.
PALOS VERDES	1.5(2.4)	7.3	0.676	XI
NEWPORT-INGLEWOOD (L.A.Basin)	7.3(11.8)	7.1	0.335	IX
SANTA MONICA	13.1(21.1)	6.6	0.210	VIII
MALIBU COAST	14.2(22.9)	6.7	0.208	VIII
PUENTE HILLS BLIND THRUST	14.2(22.9)	7.1	0.257	IX
HOLLYWOOD	15.5(25.0)	6.4	0.167	VIII
UPPER ELYSIAN PARK BLIND THRUST	17.1(27.5)	6.4	0.155	VIII
ANACAPA-DUME	19.3(31.0)	7.5	0.253	IX
NORTHRIDGE (E. Oak Ridge)	20.5(33.0)	7.0	0.186	VIII
RAYMOND	20.6(33.2)	6.5	0.142	VIII
VERDUGO	22.6(36.3)	6.9	0.164	VIII
WHITTIER	23.4(37.6)	6.8	0.124	VII
SIERRA MADRE	27.0(43.5)	7.2	0.167	VIII
SAN JOAQUIN HILLS	28.8(46.4)	6.6	0.116	VII
SIERRA MADRE (San Fernando)	29.0(46.7)	6.7	0.122	VII
CLAMSHELL-SAWPIT	31.6(50.9)	6.5	0.103	VII
SANTA SUSANA	31.7(51.0)	6.7	0.114	VII
SAN JOSE	31.9(51.3)	6.4	0.097	VII
SAN GABRIEL	32.4(52.1)	7.2	0.120	VII
NEWPORT-INGLEWOOD (Offshore)	33.2(53.4)	7.1	0.111	VII
CHINO-CENTRAL AVE. (Elsinore)	35.0(56.4)	6.7	0.105	VII
SIMI-SANTA ROSA	35.2(56.7)	7.0	0.123	VII
HOLSER	36.5(58.8)	6.5	0.092	VII
OAK RIDGE (Onshore)	38.5(62.0)	7.0	0.115	VII
CUCAMONGA	42.4(68.3)	6.9	0.101	VII
ELSINORE (GLEN IVY)	43.5(70.0)	6.8	0.077	VII
SAN CAYETANO	45.1(72.6)	7.0	0.101	VII
OAK RIDGE(Blind Thrust Offshore)	48.8(78.5)	7.1	0.101	VII
CORONADO BANK	48.8(78.6)	7.6	0.108	VII
SAN ANDREAS - 1857 Rupture M-2a	50.1(80.6)	7.8	0.117	VII
SAN ANDREAS - Cho-Moj M-1b-1	50.1(80.6)	7.8	0.117	VII
SAN ANDREAS - Whole M-1a	50.1(80.6)	8.0	0.130	VIII
SAN ANDREAS - Mojave M-1c-3	50.1(80.6)	7.4	0.095	VII
CHANNEL IS. THRUST (Eastern)	50.6(81.5)	7.5	0.121	VII
VENTURA - PITAS POINT	54.4(87.6)	6.9	0.083	VII
SANTA YNEZ (East)	56.8(91.4)	7.1	0.074	VII
OAK RIDGE MID-CHANNEL STRUCTURE	57.4(92.3)	6.6	0.068	VI
SAN JACINTO-SAN BERNARDINO	57.5(92.5)	6.7	0.059	VI
SAN ANDREAS - Carrizo M-1c-2	58.3(93.9)	7.4	0.084	VII
SAN ANDREAS - SB-Coach. M-1b-2	59.4(95.6)	7.7	0.097	VII

DETERMINISTIC SITE PARAMETERS

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	ESTIMATED MAX. EARTHQUAKE EVENT: PEAK SITE ACCEL. g	ESTIMATED MAX. EARTHQUAKE EVENT: EST. SITE INTENSITY MOD.MERC.
SAN ANDREAS - San Bernardino M-1	59.4(95.6)	7.5	0.088	VII
SAN ANDREAS - SB-Coach. M-2b	59.4(95.6)	7.7	0.097	VII

-END OF SEARCH- 42 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE PALOS VERDES FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 1.5 MILES (2.4 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.6756 g

USGS, 2008

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*** Deaggregation of Seismic Hazard at One Period of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2008 version ***
PSHA Deaggregation. %contributions. site: Hermosa_Beach long: 118.395 W., lat: 33.859 N.
Vs30(m/s)= 760.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 2475 yrs. Exceedance PGA =0.6058 g. Weight * Computed_Rate_Ex 0.401E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00285
#This deaggregation corresponds to Mean Hazard w/all GMPEs

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
7.5	5.05	0.774	0.608	0.166	0.000	0.000	0.000	0.000
11.8	5.05	0.069	0.069	0.000	0.000	0.000	0.000	0.000
7.6	5.20	1.753	1.243	0.509	0.000	0.000	0.000	0.000
11.9	5.21	0.200	0.200	0.000	0.000	0.000	0.000	0.000
7.7	5.40	1.992	1.120	0.872	0.000	0.000	0.000	0.000
12.0	5.40	0.304	0.304	0.000	0.000	0.000	0.000	0.000
7.7	5.60	2.037	0.891	1.135	0.011	0.000	0.000	0.000
12.3	5.60	0.399	0.399	0.000	0.000	0.000	0.000	0.000
7.8	5.80	1.892	0.681	1.126	0.084	0.000	0.000	0.000
12.6	5.80	0.458	0.438	0.020	0.000	0.000	0.000	0.000
7.3	6.02	2.743	0.777	1.789	0.178	0.000	0.000	0.000
14.0	5.99	0.427	0.397	0.030	0.000	0.000	0.000	0.000
7.0	6.20	3.755	0.766	2.574	0.415	0.000	0.000	0.000
14.9	6.20	0.569	0.523	0.046	0.000	0.000	0.000	0.000
7.0	6.40	3.701	0.532	2.406	0.763	0.000	0.000	0.000
14.1	6.40	0.870	0.642	0.228	0.000	0.000	0.000	0.000
24.2	6.43	0.177	0.177	0.000	0.000	0.000	0.000	0.000
4.3	6.60	6.073	0.742	3.614	1.714	0.003	0.000	0.000
13.7	6.61	0.808	0.598	0.209	0.000	0.000	0.000	0.000
24.1	6.59	0.283	0.283	0.000	0.000	0.000	0.000	0.000
4.2	6.80	5.850	0.646	3.285	1.915	0.005	0.000	0.000
13.6	6.80	1.132	0.737	0.395	0.000	0.000	0.000	0.000
23.7	6.78	0.354	0.354	0.001	0.000	0.000	0.000	0.000
3.4	7.03	10.695	1.000	5.171	4.335	0.189	0.000	0.000
12.8	7.02	2.013	1.011	1.000	0.002	0.000	0.000	0.000
23.1	7.03	0.608	0.478	0.131	0.000	0.000	0.000	0.000
33.6	7.02	0.083	0.083	0.000	0.000	0.000	0.000	0.000
3.2	7.19	14.639	1.257	6.554	6.413	0.415	0.000	0.000
11.9	7.19	1.200	0.455	0.714	0.030	0.000	0.000	0.000
22.1	7.21	1.036	0.716	0.320	0.000	0.000	0.000	0.000
32.3	7.19	0.073	0.073	0.000	0.000	0.000	0.000	0.000
3.0	7.36	14.963	1.192	6.406	6.860	0.506	0.000	0.000
11.4	7.39	1.287	0.463	0.765	0.059	0.000	0.000	0.000
20.8	7.36	0.805	0.574	0.231	0.000	0.000	0.000	0.000
3.1	7.66	9.713	0.666	3.825	4.780	0.441	0.000	0.000
11.4	7.55	1.332	0.290	0.888	0.154	0.000	0.000	0.000
20.5	7.53	0.206	0.119	0.087	0.000	0.000	0.000	0.000
3.0	7.80	3.305	0.301	1.461	1.399	0.143	0.000	0.000
11.3	7.71	0.181	0.043	0.115	0.023	0.000	0.000	0.000
3.0	7.91	1.009	0.072	0.397	0.489	0.053	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 100.0
Mean src-site R= 5.9 km; M= 6.92; eps0= 0.79. Mean calculated for all sources.
Modal src-site R= 3.0 km; M= 7.36; eps0= 0.38 from peak (R,M) bin
MODE R*= 3.0km; M*= 7.36; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 6.860

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California B-faults Char	50.46	5.1	7.37	0.56
California B-faults GR	24.74	5.2	6.93	0.77
CA Compr. crustal gridded	24.68	8.3	5.98	1.27

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
Palos Verdes Char	28.44	3.0	7.24	0.40	-125.0
Palos Verdes Connected Char	14.31	3.0	7.70	0.31	-125.1
Palos Verdes GR	17.81	4.2	6.89	0.67	-137.5
Palos Verdes Connected GR	4.53	4.2	7.06	0.62	-138.5

#*********End of deaggregation corresponding to Mean Hazard w/all GMPEs *********#

PSHA Deaggregation. %contributions. site: Hermosa_Beach long: 118.395 W., lat: 33.859 N.
Vs30(m/s)= 760.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 2475 yrs. Exceedance PGA =0.6058 g. Weight * Computed_Rate_Ex 0.999E-04
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00110
#This deaggregation corresponds to Boore-Atkinson 2008

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
7.0	5.21	0.041	0.041	0.000	0.000	0.000	0.000	0.000
7.2	5.41	0.075	0.075	0.000	0.000	0.000	0.000	0.000
7.3	5.60	0.114	0.114	0.000	0.000	0.000	0.000	0.000
7.5	5.80	0.152	0.147	0.005	0.000	0.000	0.000	0.000
6.8	6.02	0.340	0.281	0.059	0.000	0.000	0.000	0.000
13.5	5.99	0.018	0.018	0.000	0.000	0.000	0.000	0.000
6.6	6.20	0.548	0.410	0.138	0.000	0.000	0.000	0.000
14.8	6.21	0.046	0.046	0.000	0.000	0.000	0.000	0.000
6.7	6.40	0.573	0.379	0.194	0.000	0.000	0.000	0.000
14.3	6.40	0.102	0.102	0.000	0.000	0.000	0.000	0.000
23.9	6.44	0.047	0.047	0.000	0.000	0.000	0.000	0.000
4.3	6.60	1.446	0.293	0.984	0.169	0.000	0.000	0.000
13.7	6.61	0.161	0.154	0.007	0.000	0.000	0.000	0.000
23.4	6.59	0.120	0.120	0.000	0.000	0.000	0.000	0.000
4.1	6.80	1.538	0.254	0.970	0.315	0.000	0.000	0.000
13.6	6.81	0.329	0.261	0.068	0.000	0.000	0.000	0.000
23.4	6.78	0.179	0.179	0.000	0.000	0.000	0.000	0.000
34.2	6.78	0.020	0.020	0.000	0.000	0.000	0.000	0.000
3.4	7.03	2.985	0.346	1.636	1.003	0.000	0.000	0.000
12.5	7.03	0.674	0.349	0.325	0.000	0.000	0.000	0.000
23.1	6.98	0.144	0.135	0.009	0.000	0.000	0.000	0.000
33.6	7.03	0.077	0.077	0.000	0.000	0.000	0.000	0.000
42.8	7.02	0.014	0.014	0.000	0.000	0.000	0.000	0.000
3.2	7.19	4.221	0.422	2.137	1.663	0.000	0.000	0.000
12.2	7.20	0.416	0.159	0.257	0.001	0.000	0.000	0.000
22.1	7.20	0.464	0.308	0.155	0.000	0.000	0.000	0.000
32.6	7.19	0.056	0.056	0.000	0.000	0.000	0.000	0.000
43.4	7.22	0.017	0.017	0.000	0.000	0.000	0.000	0.000
3.0	7.36	4.365	0.397	2.095	1.870	0.003	0.000	0.000
11.5	7.40	0.451	0.152	0.288	0.010	0.000	0.000	0.000
20.8	7.37	0.272	0.209	0.063	0.000	0.000	0.000	0.000
31.9	7.35	0.023	0.022	0.000	0.000	0.000	0.000	0.000
3.1	7.66	2.903	0.222	1.267	1.369	0.046	0.000	0.000
11.4	7.55	0.424	0.102	0.279	0.043	0.000	0.000	0.000
20.6	7.53	0.073	0.045	0.028	0.000	0.000	0.000	0.000
3.0	7.80	0.998	0.100	0.466	0.409	0.022	0.000	0.000
11.3	7.71	0.062	0.015	0.040	0.007	0.000	0.000	0.000
35.7	7.76	0.017	0.016	0.001	0.000	0.000	0.000	0.000
3.0	7.91	0.308	0.024	0.130	0.145	0.009	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 24.9
Mean src-site R= 5.9 km; M= 7.14; eps0= 0.87. Mean calculated for all sources.
Modal src-site R= 3.0 km; M= 7.36; eps0= 0.51 from peak (R,M) bin
MODE R*= 3.2km; M*= 7.19; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 2.137

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California B-faults Char	15.27	5.6	7.37	0.72
California B-faults GR	7.00	5.5	6.94	0.94

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
Palos Verdes Char	8.23	3.0	7.25	0.54	-125.0
Palos Verdes Connected Char	4.29	3.0	7.70	0.43	-125.1
Palos Verdes GR	4.94	4.3	6.91	0.83	-137.5
Palos Verdes Connected GR	1.29	4.5	7.08	0.78	-138.5

#*********End of deaggregation corresponding to Boore-Atkinson 2008 *********#

PSHA Deaggregation. %contributions. site: Hermosa_Beach long: 118.395 W., lat: 33.859 N.
Vs30(m/s)= 760.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 2475 yrs. Exceedance PGA =0.6058 g. Weight * Computed_Rate_Ex 0.123E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00341
#This deaggregation corresponds to Campbell-Bozorgnia 2008

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
7.4	5.05	0.154	0.154	0.000	0.000	0.000	0.000	0.000
7.5	5.21	0.445	0.425	0.019	0.000	0.000	0.000	0.000
11.8	5.22	0.016	0.016	0.000	0.000	0.000	0.000	0.000
7.6	5.40	0.660	0.542	0.118	0.000	0.000	0.000	0.000
11.9	5.41	0.064	0.064	0.000	0.000	0.000	0.000	0.000
7.7	5.60	0.733	0.549	0.184	0.000	0.000	0.000	0.000
12.0	5.60	0.111	0.111	0.000	0.000	0.000	0.000	0.000
7.8	5.80	0.652	0.467	0.185	0.000	0.000	0.000	0.000
12.3	5.80	0.127	0.127	0.000	0.000	0.000	0.000	0.000
7.3	6.02	0.887	0.574	0.313	0.000	0.000	0.000	0.000
13.7	5.99	0.114	0.114	0.000	0.000	0.000	0.000	0.000
7.0	6.20	1.257	0.676	0.581	0.000	0.000	0.000	0.000
14.8	6.20	0.157	0.157	0.000	0.000	0.000	0.000	0.000
7.0	6.40	1.328	0.517	0.810	0.000	0.000	0.000	0.000
14.1	6.40	0.257	0.251	0.006	0.000	0.000	0.000	0.000
24.9	6.43	0.068	0.068	0.000	0.000	0.000	0.000	0.000
4.3	6.60	2.068	0.309	1.321	0.438	0.000	0.000	0.000
14.2	6.61	0.270	0.245	0.025	0.000	0.000	0.000	0.000
24.8	6.57	0.092	0.092	0.000	0.000	0.000	0.000	0.000
4.2	6.80	1.881	0.262	1.159	0.460	0.000	0.000	0.000
14.1	6.80	0.330	0.274	0.056	0.000	0.000	0.000	0.000
24.5	6.79	0.108	0.108	0.000	0.000	0.000	0.000	0.000
3.4	7.03	3.440	0.351	1.730	1.316	0.043	0.000	0.000
13.1	7.02	0.594	0.352	0.242	0.000	0.000	0.000	0.000
23.1	7.04	0.186	0.137	0.049	0.000	0.000	0.000	0.000
3.2	7.19	4.603	0.419	2.134	1.961	0.089	0.000	0.000
11.9	7.19	0.270	0.133	0.137	0.000	0.000	0.000	0.000
22.1	7.21	0.283	0.207	0.076	0.000	0.000	0.000	0.000
3.0	7.36	4.569	0.397	2.075	1.995	0.102	0.000	0.000
11.4	7.36	0.237	0.101	0.137	0.000	0.000	0.000	0.000
20.8	7.37	0.165	0.125	0.040	0.000	0.000	0.000	0.000
3.1	7.66	2.935	0.252	1.319	1.289	0.075	0.000	0.000
11.3	7.54	0.341	0.131	0.210	0.000	0.000	0.000	0.000
20.4	7.53	0.045	0.028	0.016	0.000	0.000	0.000	0.000
3.0	7.82	0.826	0.070	0.368	0.366	0.023	0.000	0.000
11.3	7.71	0.037	0.013	0.024	0.000	0.000	0.000	0.000
3.0	7.91	0.283	0.024	0.125	0.126	0.008	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 30.6
Mean src-site R= 5.7 km; M= 6.90; eps0= 0.83. Mean calculated for all sources.
Modal src-site R= 3.2 km; M= 7.19; eps0= 0.47 from peak (R,M) bin
MODE R*= 3.2km; M*= 7.19; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 2.134

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California B-faults Char	14.97	4.8	7.36	0.62
California B-faults GR	7.57	4.9	6.92	0.80
CA Compr. crustal gridded	8.07	8.0	6.04	1.26

Individual fault hazard details if its contribution to mean hazard > 2%:

Fault ID	% contr.	Rcd(km)	M	epsilon0	Site-to-src azimuth(d)
Palos Verdes Char	8.87	3.0	7.24	0.45	-125.0
Palos Verdes Connected Char	4.13	3.0	7.70	0.43	-125.1
Palos Verdes GR	5.56	4.0	6.89	0.70	-137.5
Palos Verdes Connected GR	1.38	4.0	7.05	0.66	-138.5

#*********End of deaggregation corresponding to Campbell-Bozorgnia 2008 *********#

PSHA Deaggregation. %contributions. site: Hermosa_Beach long: 118.395 W., lat: 33.859 N.
Vs30(m/s)= 760.0 (some WUS atten. models use Site Class not Vs30).
NSHMP 2007-08 See USGS OFR 2008-1128. dM=0.2 below
Return period: 2475 yrs. Exceedance PGA =0.6058 g. Weight * Computed_Rate_Ex 0.179E-03
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00407
#This deaggregation corresponds to Chiou-Youngs 2008

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
7.6	5.05	0.609	0.548	0.061	0.000	0.000	0.000	0.000
11.8	5.05	0.068	0.068	0.000	0.000	0.000	0.000	0.000
7.7	5.20	1.267	1.067	0.200	0.000	0.000	0.000	0.000
11.9	5.20	0.185	0.185	0.000	0.000	0.000	0.000	0.000
7.7	5.40	1.257	0.978	0.279	0.000	0.000	0.000	0.000
12.1	5.40	0.240	0.240	0.000	0.000	0.000	0.000	0.000
7.8	5.60	1.191	0.804	0.387	0.000	0.000	0.000	0.000
12.4	5.60	0.286	0.286	0.000	0.000	0.000	0.000	0.000
7.8	5.80	1.088	0.626	0.461	0.000	0.000	0.000	0.000
12.8	5.80	0.322	0.322	0.000	0.000	0.000	0.000	0.000
7.5	6.02	1.517	0.734	0.784	0.000	0.000	0.000	0.000
14.2	5.99	0.296	0.296	0.000	0.000	0.000	0.000	0.000
7.2	6.20	1.950	0.754	1.196	0.000	0.000	0.000	0.000
14.9	6.20	0.367	0.361	0.006	0.000	0.000	0.000	0.000
7.1	6.40	1.799	0.532	1.265	0.002	0.000	0.000	0.000
14.2	6.40	0.511	0.472	0.039	0.000	0.000	0.000	0.000
23.6	6.42	0.062	0.062	0.000	0.000	0.000	0.000	0.000
4.4	6.60	2.560	0.310	1.432	0.817	0.000	0.000	0.000
13.1	6.60	0.369	0.265	0.104	0.000	0.000	0.000	0.000
23.8	6.58	0.056	0.056	0.000	0.000	0.000	0.000	0.000
4.2	6.80	2.431	0.263	1.284	0.884	0.000	0.000	0.000
13.3	6.80	0.480	0.316	0.165	0.000	0.000	0.000	0.000
23.7	6.79	0.095	0.094	0.001	0.000	0.000	0.000	0.000
3.4	7.03	4.262	0.352	1.859	1.908	0.143	0.000	0.000
12.8	7.02	0.749	0.368	0.379	0.002	0.000	0.000	0.000
23.0	7.02	0.192	0.152	0.040	0.000	0.000	0.000	0.000
3.2	7.19	5.823	0.420	2.288	2.789	0.326	0.000	0.000
11.8	7.18	0.533	0.164	0.340	0.029	0.000	0.000	0.000
22.3	7.20	0.364	0.243	0.121	0.000	0.000	0.000	0.000
3.0	7.36	6.029	0.398	2.236	2.994	0.401	0.000	0.000
11.4	7.36	0.456	0.126	0.280	0.049	0.000	0.000	0.000
20.8	7.36	0.375	0.247	0.128	0.000	0.000	0.000	0.000
3.1	7.66	3.968	0.222	1.303	2.123	0.320	0.000	0.000
11.4	7.54	0.688	0.138	0.440	0.110	0.000	0.000	0.000
20.4	7.53	0.082	0.039	0.043	0.000	0.000	0.000	0.000
3.0	7.80	1.387	0.100	0.564	0.624	0.099	0.000	0.000
11.3	7.71	0.082	0.015	0.052	0.015	0.000	0.000	0.000
3.0	7.91	0.419	0.024	0.141	0.219	0.035	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Contribution from this GMPE(%): 44.5
Mean src-site R= 6.1 km; M= 6.81; eps0= 0.72. Mean calculated for all sources.
Modal src-site R= 3.0 km; M= 7.36; eps0= 0.23 from peak (R,M) bin
MODE R*= 3.0km; M*= 7.36; EPS.INTERVAL: 0 to 1 sigma % CONTRIB.= 2.994

Principal sources (faults, subduction, random seismicity having > 3% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values).
California B-faults Char	20.21	4.9	7.38	0.41
California B-faults GR	10.16	5.2	6.92	0.64

```
CA Compr. crustal gridded          14.11     8.5   5.90    1.22
Individual fault hazard details if its contribution to mean hazard > 2%:
Fault ID                        % contr.   Rcd(km)  M   epsilon0 Site-to-src azimuth(d)
Palos Verdes Char                 11.34      3.0   7.25     0.26     -125.0
Palos Verdes Connected Char        5.88      3.0   7.70     0.14     -125.1
Palos Verdes GR                    7.31      4.2   6.89     0.54     -137.5
Palos Verdes Connected GR          1.87      4.3   7.06     0.48     -138.5
#**********End of deaggregation corresponding to Chiou-Youngs 2008        *********#

******************** Southern California ***************************************
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USGS, 2002

>

*** Deaggregation of Seismic Hazard for PGA & 2 Periods of Spectral Accel. ***
*** Data from U.S.G.S. National Seismic Hazards Mapping Project, 2002 version ***
PSHA Deaggregation. %contributions. site: Hermosa_Beach long: 118.359 W., lat: 33.859 N.
USGS 2002-03 update files and programs. dM=0.2. Site descr:ROCK
Return period: 2475 yrs. Exceedance PGA =0.7801 g.
#Pr[at least one eq with median motion>=PGA in 50 yrs]=0.00000

DIST(KM)	MAG(MW)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
8.4	5.05	0.419	0.419	0.000	0.000	0.000	0.000	0.000
8.4	5.20	0.900	0.900	0.000	0.000	0.000	0.000	0.000
8.4	5.40	0.988	0.956	0.033	0.000	0.000	0.000	0.000
8.5	5.60	1.080	0.934	0.145	0.000	0.000	0.000	0.000
8.5	5.80	1.159	0.800	0.359	0.000	0.000	0.000	0.000
7.8	6.01	1.440	0.709	0.731	0.000	0.000	0.000	0.000
12.6	6.04	0.179	0.172	0.007	0.000	0.000	0.000	0.000
7.6	6.20	1.862	0.711	1.151	0.000	0.000	0.000	0.000
12.0	6.21	0.324	0.280	0.043	0.000	0.000	0.000	0.000
7.7	6.41	2.159	0.702	1.431	0.026	0.000	0.000	0.000
12.6	6.37	0.273	0.205	0.068	0.000	0.000	0.000	0.000
5.4	6.64	14.990	2.791	8.979	3.220	0.000	0.000	0.000
13.2	6.61	0.305	0.288	0.017	0.000	0.000	0.000	0.000
5.6	6.86	9.378	1.876	5.521	1.981	0.000	0.000	0.000
11.8	6.80	0.480	0.365	0.115	0.000	0.000	0.000	0.000
5.7	6.99	14.360	3.237	7.937	3.186	0.000	0.000	0.000
13.0	6.97	0.156	0.143	0.012	0.000	0.000	0.000	0.000
4.7	7.21	44.329	5.567	24.913	13.849	0.000	0.000	0.000
11.5	7.15	0.076	0.055	0.021	0.000	0.000	0.000	0.000
4.6	7.49	4.725	0.459	2.597	1.669	0.000	0.000	0.000
4.6	7.65	0.271	0.023	0.142	0.105	0.000	0.000	0.000

Summary statistics for above PSHA PGA deaggregation, R=distance, e=epsilon:
Mean src-site R= 5.5 km; M= 6.93; eps0= 0.98. Mean calculated for all sources.
Modal src-site R= 4.7 km; M= 7.21; eps0= 0.76 from peak (R,M) bin
Gridded source distance metrics: Rseis Rrup and Rjb
MODE R*= 4.8km; M*= 7.21; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 24.913

Principal sources (faults, subduction, random seismicity having >10% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values)
California shallow gridded	15.16	8.3	6.15	1.67
Calif b, SS or Thrust	84.75	5.0	7.07	0.85
Individual fault hazard details if contrib.>1%:				
2 Newport-Inglewood	3.75	9.4	7.01	1.67
2 Newport-Inglewood GR M-distri	2.43	9.6	6.77	1.75
2 Palos Verdes	50.85	4.6	7.21	0.73
2 Palos Verdes GR M-distrib	27.72	4.9	6.85	0.88

********** Southern California **********
PSHA Deaggregation. %contributions. ROCK site: Hermosa_Beach long: 118.359 d W., lat: 33.859 N.
USGS 2002-2003 update files and programs. Analysis on DaMoYr:25/09/2012
Return period: 2475 yrs. 1.00 s. PSA =0.7335 g.
#Pr[at least one eq with median motion>=PSA in 50 yrs]=0.00000

DIST(km)	MAG(Mw)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
8.2	5.62	0.062	0.062	0.000	0.000	0.000	0.000	0.000
8.5	5.81	0.161	0.161	0.000	0.000	0.000	0.000	0.000
7.8	6.01	0.318	0.309	0.009	0.000	0.000	0.000	0.000
7.6	6.20	0.587	0.491	0.096	0.000	0.000	0.000	0.000
12.5	6.21	0.135	0.135	0.000	0.000	0.000	0.000	0.000
7.7	6.41	0.954	0.597	0.357	0.000	0.000	0.000	0.000
14.2	6.38	0.188	0.188	0.000	0.000	0.000	0.000	0.000
5.4	6.62	7.302	2.184	4.835	0.283	0.000	0.000	0.000
14.3	6.59	0.321	0.312	0.009	0.000	0.000	0.000	0.000
22.6	6.59	0.127	0.127	0.000	0.000	0.000	0.000	0.000
6.4	6.81	10.406	3.249	7.157	0.000	0.000	0.000	0.000
13.3	6.77	0.701	0.587	0.114	0.000	0.000	0.000	0.000
22.3	6.78	0.240	0.240	0.000	0.000	0.000	0.000	0.000
5.4	7.00	17.279	2.999	12.996	1.284	0.000	0.000	0.000
13.3	6.98	0.692	0.500	0.192	0.000	0.000	0.000	0.000
21.9	6.95	0.160	0.160	0.000	0.000	0.000	0.000	0.000
4.9	7.21	47.612	5.182	28.620	13.811	0.000	0.000	0.000

11.8	7.23	0.094	0.040	0.054	0.000	0.000	0.000	0.000
21.3	7.14	0.183	0.180	0.003	0.000	0.000	0.000	0.000
4.5	7.44	10.663	0.747	4.730	5.185	0.000	0.000	0.000
34.4	7.38	0.265	0.265	0.000	0.000	0.000	0.000	0.000
4.6	7.65	0.380	0.023	0.149	0.207	0.000	0.000	0.000
34.4	7.58	0.673	0.673	0.000	0.000	0.000	0.000	0.000
34.3	7.81	0.063	0.052	0.011	0.000	0.000	0.000	0.000
79.1	7.89	0.073	0.073	0.000	0.000	0.000	0.000	0.000
79.1	8.02	0.165	0.165	0.000	0.000	0.000	0.000	0.000
79.1	8.24	0.072	0.072	0.000	0.000	0.000	0.000	0.000

Summary statistics for above 1.0s PSA deaggregation, R=distance, e=epsilon:
Mean src-site R= 6.0 km; M= 7.09; eps0= 0.98. Mean calculated for all sources.
Modal src-site R= 4.9 km; M= 7.21; eps0= 0.77 from peak (R,M) bin
Gridded source distance metrics: Rseis Rrup and Rjb
MODE R*= 4.9km; M*= 7.20; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 28.620

Principal sources (faults, subduction, random seismicity having >10% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values)
Calif b, SS or Thrust	93.14	5.5	7.12	0.92
Individual fault hazard details if contrib.>1%:				
2 Newport-Inglewood	5.44	9.4	7.04	1.52
2 Newport-Inglewood GR M-distri	2.78	9.8	6.81	1.74
2 Palos Verdes	58.94	4.6	7.23	0.72
2 Palos Verdes GR M-distrib	24.78	5.1	6.90	1.07

********** Southern California **********
PSHA Deaggregation. %contributions. ROCK site: Hermosa_Beach long: 118.359 d W., lat: 33.859 N.
USGS 2002-2003 update files and programs. Analysis on DaMoYr:25/09/2012
Return period: 2475 yrs. 0.20 s. PSA =1.8452 g.
#Pr[at least one eq with median motion>=PSA in 50 yrs]=0.00000

DIST(km)	MAG(Mw)	ALL_EPS	EPSILON>2	1<EPS<2	0<EPS<1	-1<EPS<0	-2<EPS<-1	EPS<-2
8.4	5.05	0.488	0.488	0.000	0.000	0.000	0.000	0.000
8.4	5.20	1.062	1.062	0.000	0.000	0.000	0.000	0.000
8.5	5.40	1.161	1.117	0.045	0.000	0.000	0.000	0.000
8.5	5.60	1.249	1.077	0.172	0.000	0.000	0.000	0.000
8.5	5.80	1.317	0.899	0.418	0.000	0.000	0.000	0.000
15.7	5.81	0.083	0.083	0.000	0.000	0.000	0.000	0.000
7.9	6.01	1.589	0.773	0.816	0.000	0.000	0.000	0.000
13.2	6.03	0.272	0.257	0.015	0.000	0.000	0.000	0.000
7.6	6.20	2.023	0.768	1.256	0.000	0.000	0.000	0.000
12.6	6.21	0.462	0.376	0.085	0.000	0.000	0.000	0.000
7.7	6.41	2.336	0.750	1.551	0.035	0.000	0.000	0.000
13.4	6.37	0.401	0.301	0.100	0.000	0.000	0.000	0.000
5.5	6.64	15.810	3.162	9.261	3.386	0.000	0.000	0.000
13.0	6.62	0.576	0.459	0.117	0.000	0.000	0.000	0.000
23.1	6.59	0.067	0.067	0.000	0.000	0.000	0.000	0.000
5.8	6.87	9.867	2.050	5.644	2.173	0.000	0.000	0.000
13.0	6.81	0.643	0.508	0.135	0.000	0.000	0.000	0.000
21.3	6.80	0.075	0.075	0.000	0.000	0.000	0.000	0.000
5.7	7.00	13.633	2.674	7.498	3.461	0.000	0.000	0.000
12.8	6.99	0.328	0.239	0.088	0.000	0.000	0.000	0.000
21.4	6.97	0.093	0.093	0.000	0.000	0.000	0.000	0.000
4.8	7.21	41.817	5.600	21.354	14.862	0.000	0.000	0.000
21.4	7.18	0.066	0.066	0.000	0.000	0.000	0.000	0.000
4.5	7.49	4.163	0.446	1.962	1.755	0.000	0.000	0.000
4.5	7.65	0.229	0.023	0.103	0.103	0.000	0.000	0.000

Summary statistics for above 0.2s PSA deaggregation, R=distance, e=epsilon:
Mean src-site R= 5.8 km; M= 6.90; eps0= 0.98. Mean calculated for all sources.
Modal src-site R= 4.8 km; M= 7.21; eps0= 0.73 from peak (R,M) bin
Gridded source distance metrics: Rseis Rrup and Rjb
MODE R*= 4.8km; M*= 7.21; EPS.INTERVAL: 1 to 2 sigma % CONTRIB.= 21.354

Principal sources (faults, subduction, random seismicity having >10% contribution)

Source Category:	% contr.	R(km)	M	epsilon0 (mean values)
California shallow gridded	17.29	8.5	6.14	1.68
Calif b, SS or Thrust	82.41	5.1	7.06	0.83
Individual fault hazard details if contrib.>1%:				
2 Newport-Inglewood	4.60	9.4	7.01	1.56
2 Newport-Inglewood GR M-distri	3.10	9.7	6.77	1.66

```
2   Palos Verdes                  47.32     4.5   7.21    0.68
2   Palos Verdes GR M-distrib     27.34     4.9   6.85    0.86
****************** Southern California ****************************************
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APPENDIX E

Seismic Settlement Analysis

(Existing Conditions)

GeoLogismiki
Geotechnical Engineers
P.O. Box 33539
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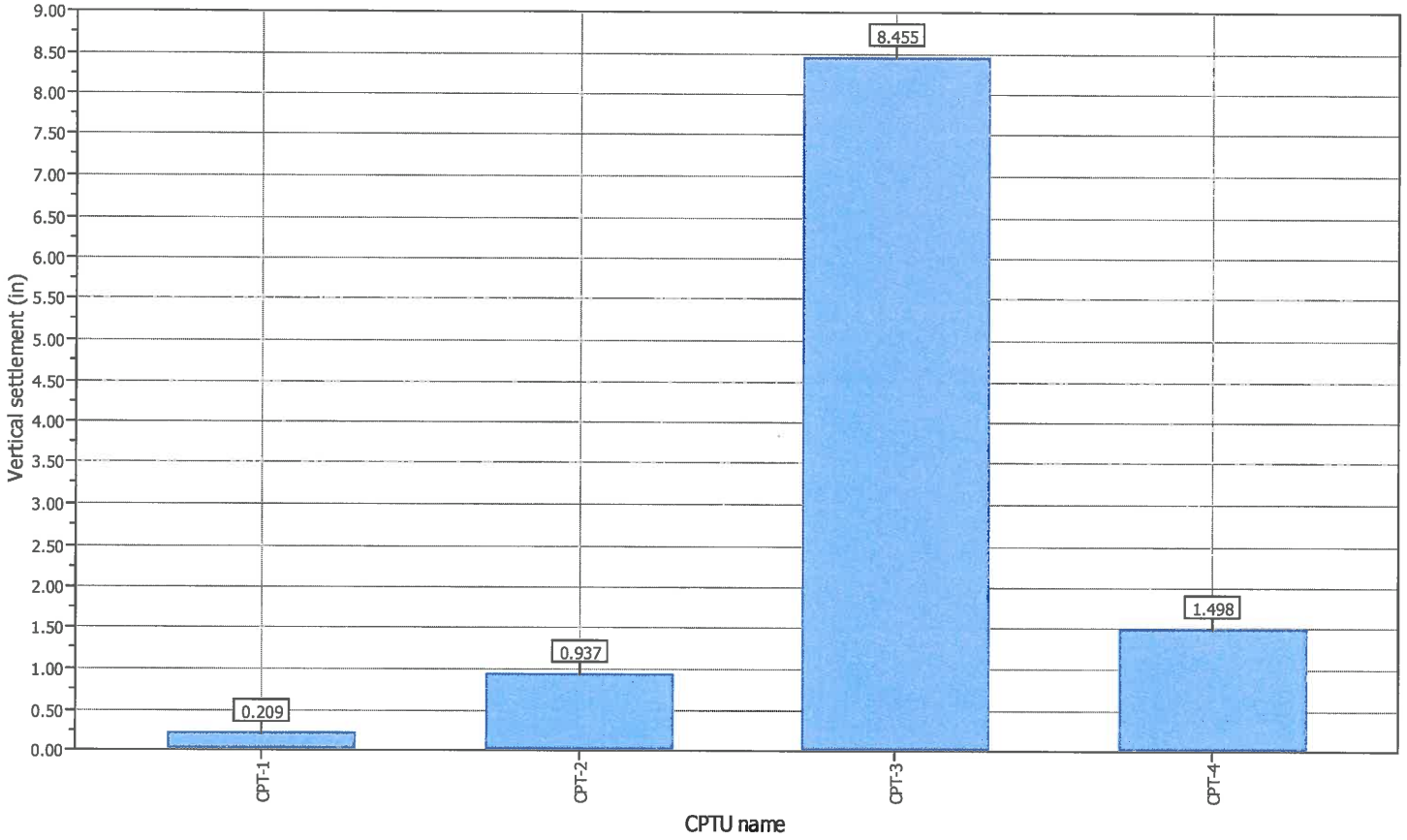
Overall vertical settlements report



GeoLogismiki
Geotechnical Engineers
P.O. Box 33539
621 25 - Serrai - GREECE

LIQUEFACTION ANALYSIS REPORT

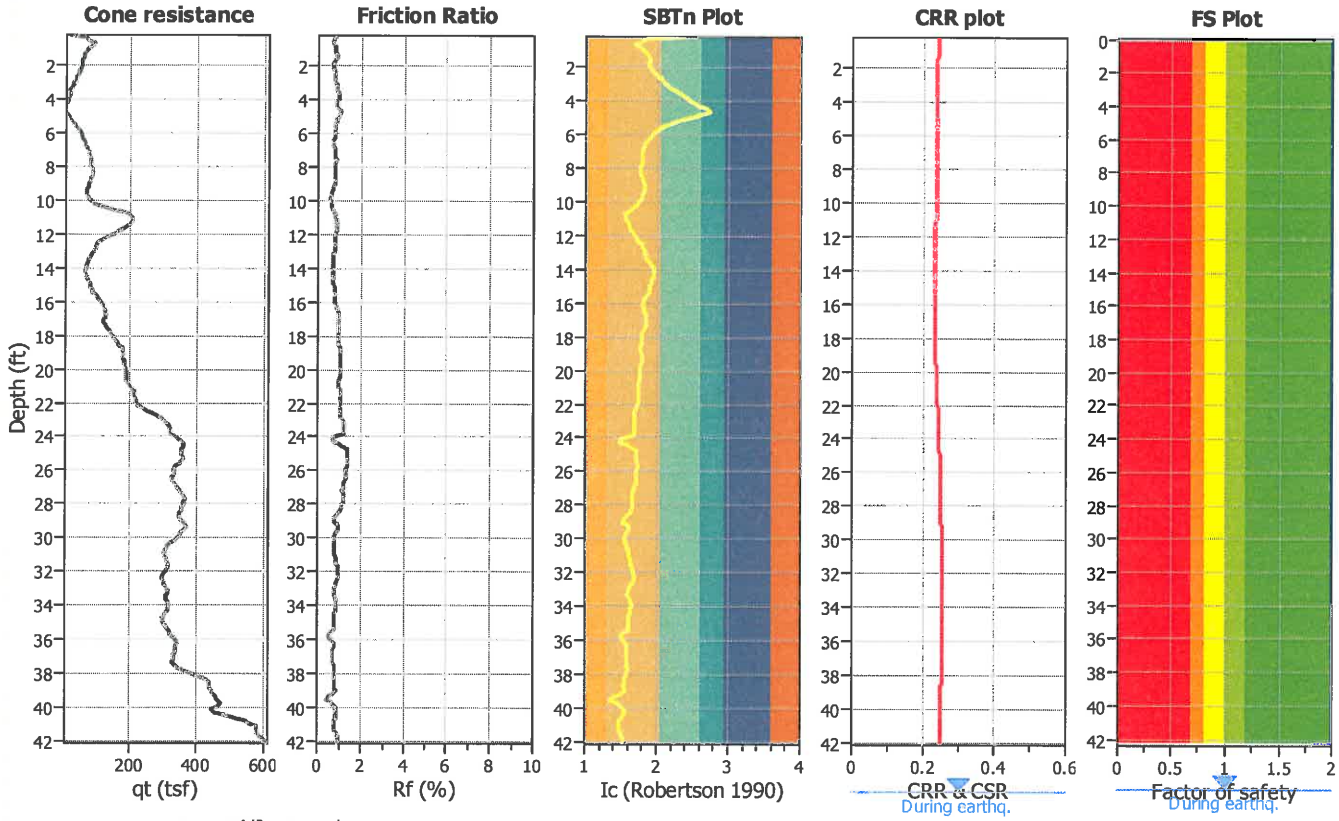
Project title : E&B Hermosa Beach

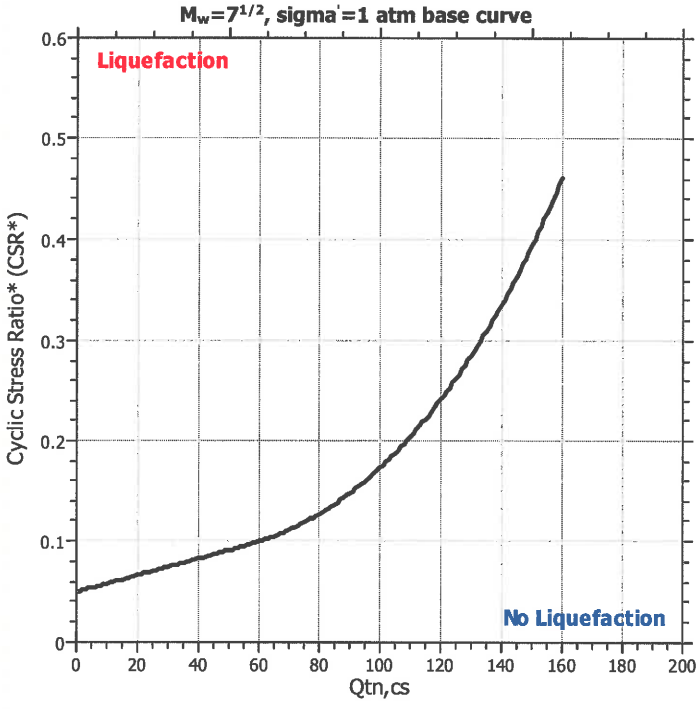
Location : 555 Sixth Street, Hermosa Beach, California

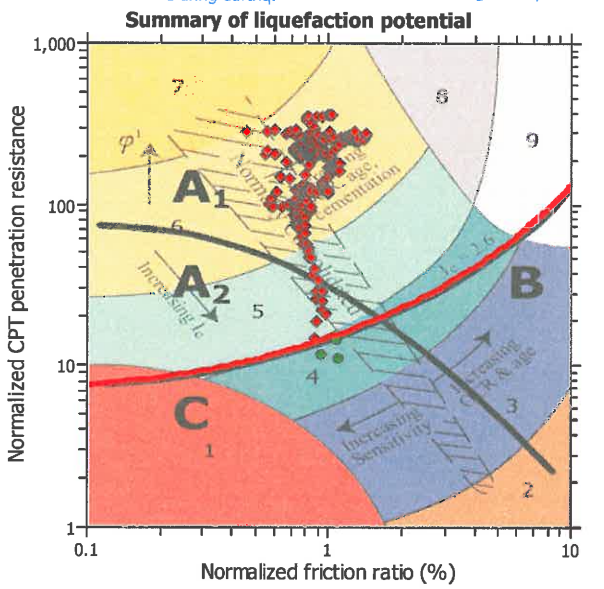
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	45.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	45.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

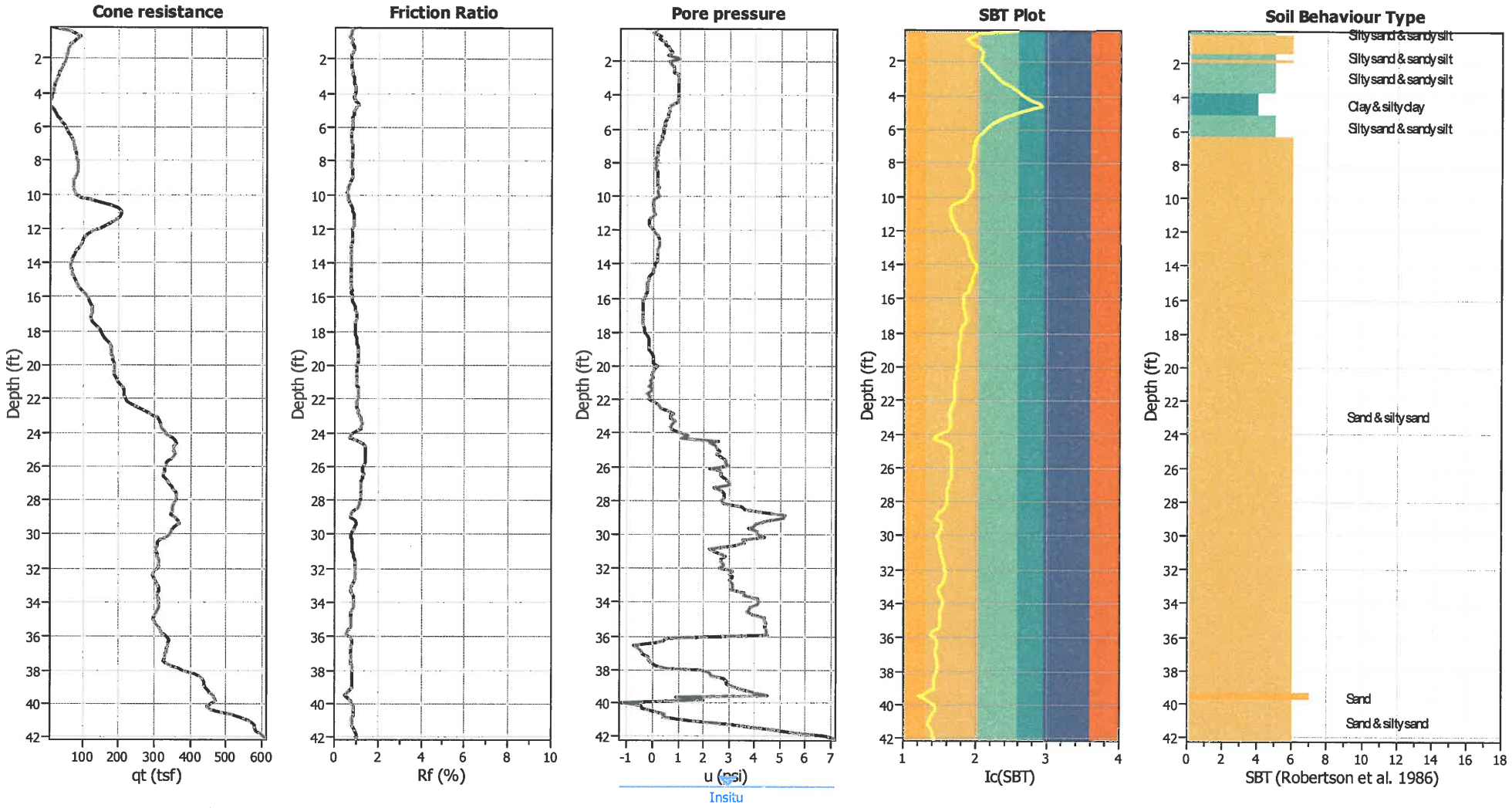






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



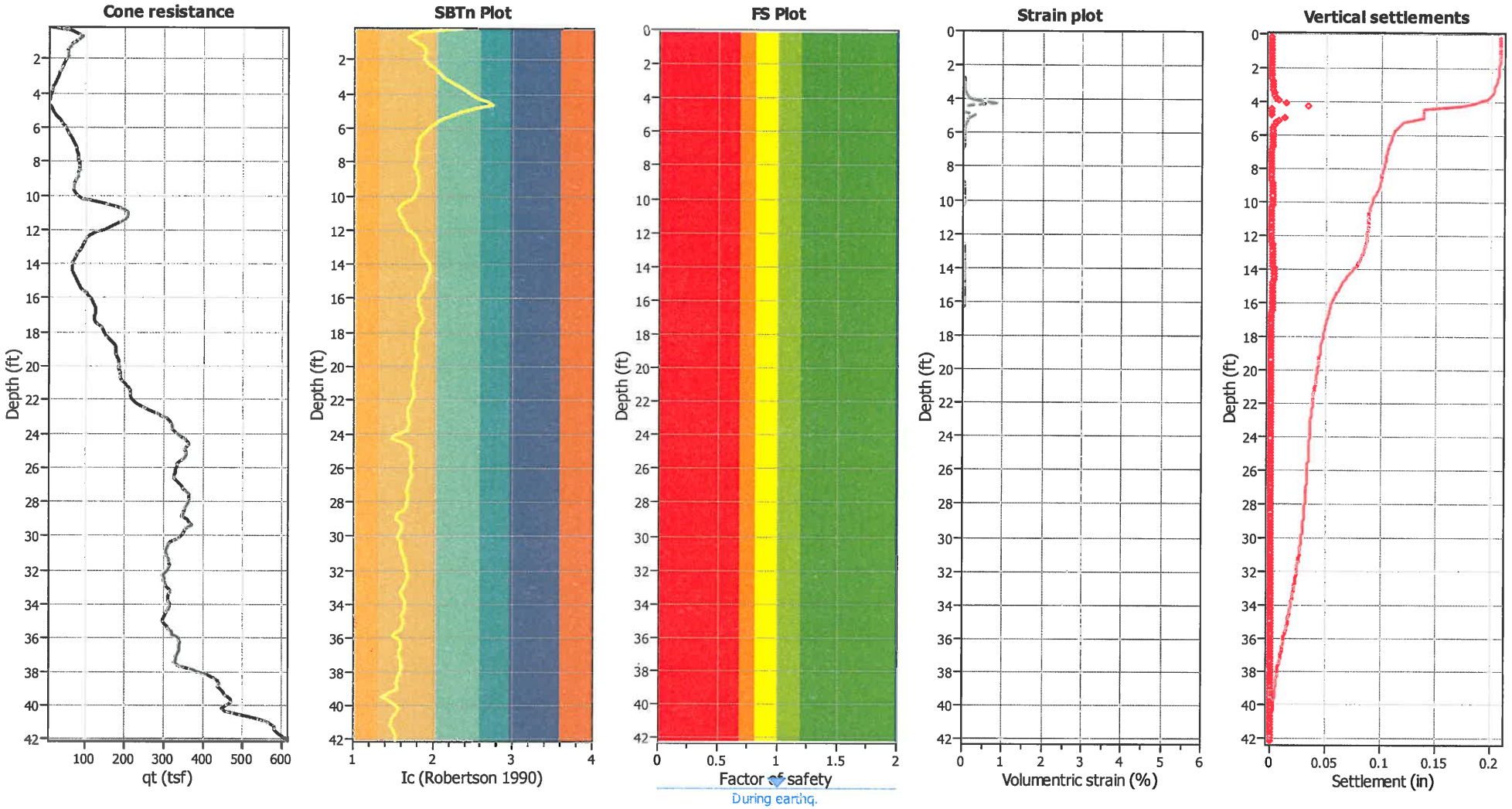
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	45.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	45.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

GeoLogismiki
Geotechnical Engineers
P.O. Box 33539
621 25 - Serrai - GREECE

LIQUEFACTION ANALYSIS REPORT

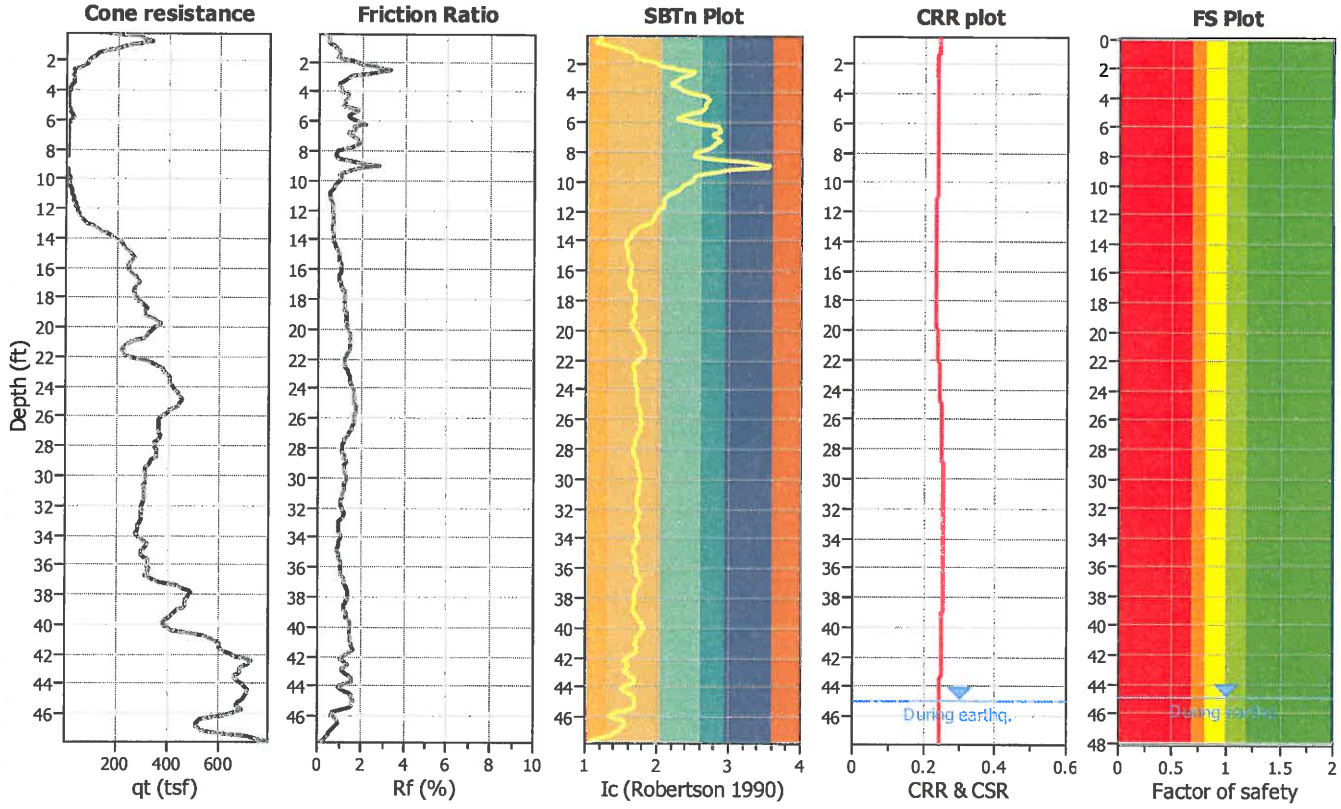
Project title : E&B Hermosa Beach

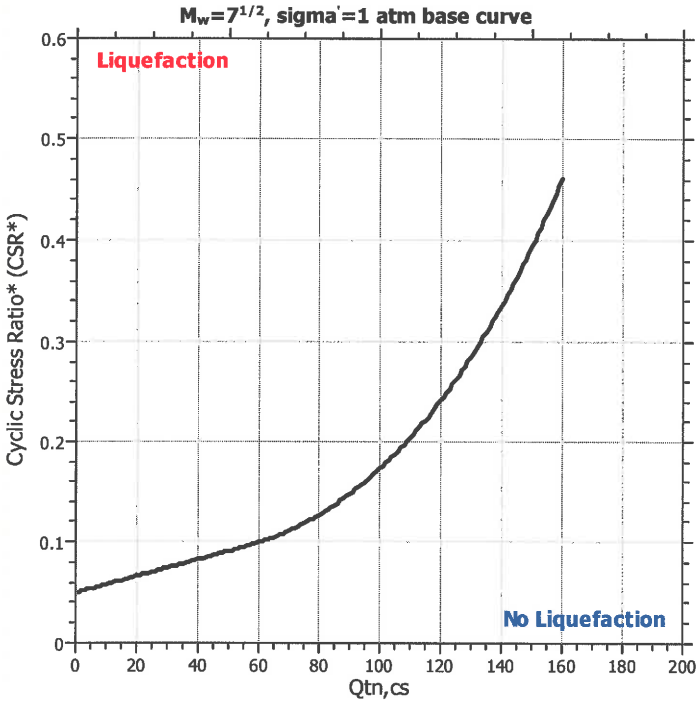
Location : 555 Sixth Street, Hermosa Beach, California

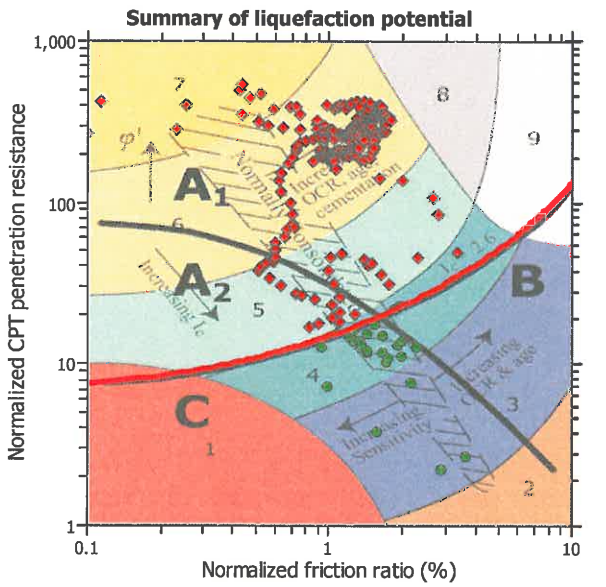
CPT file : CPT-2

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	45.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	45.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

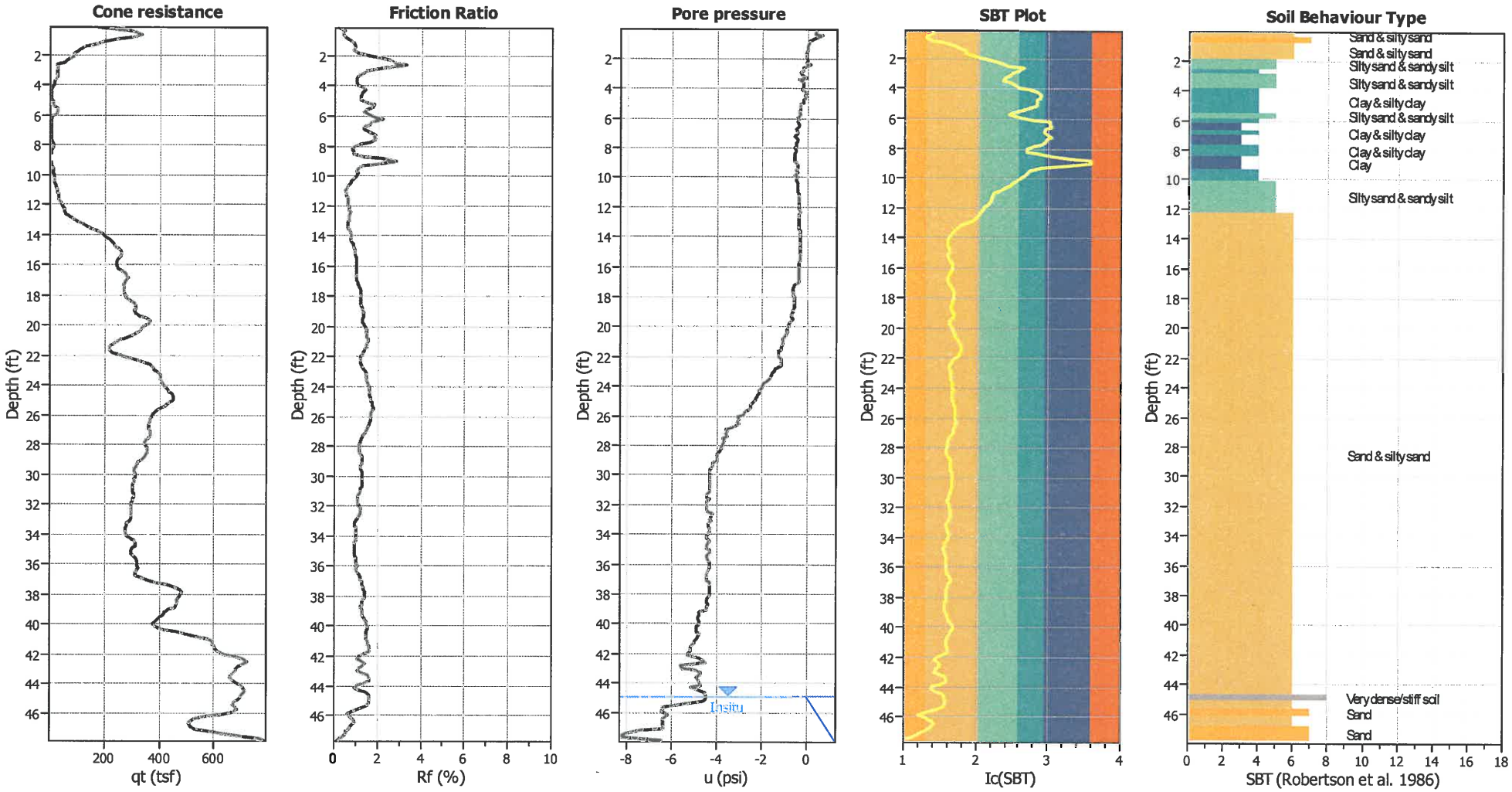






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



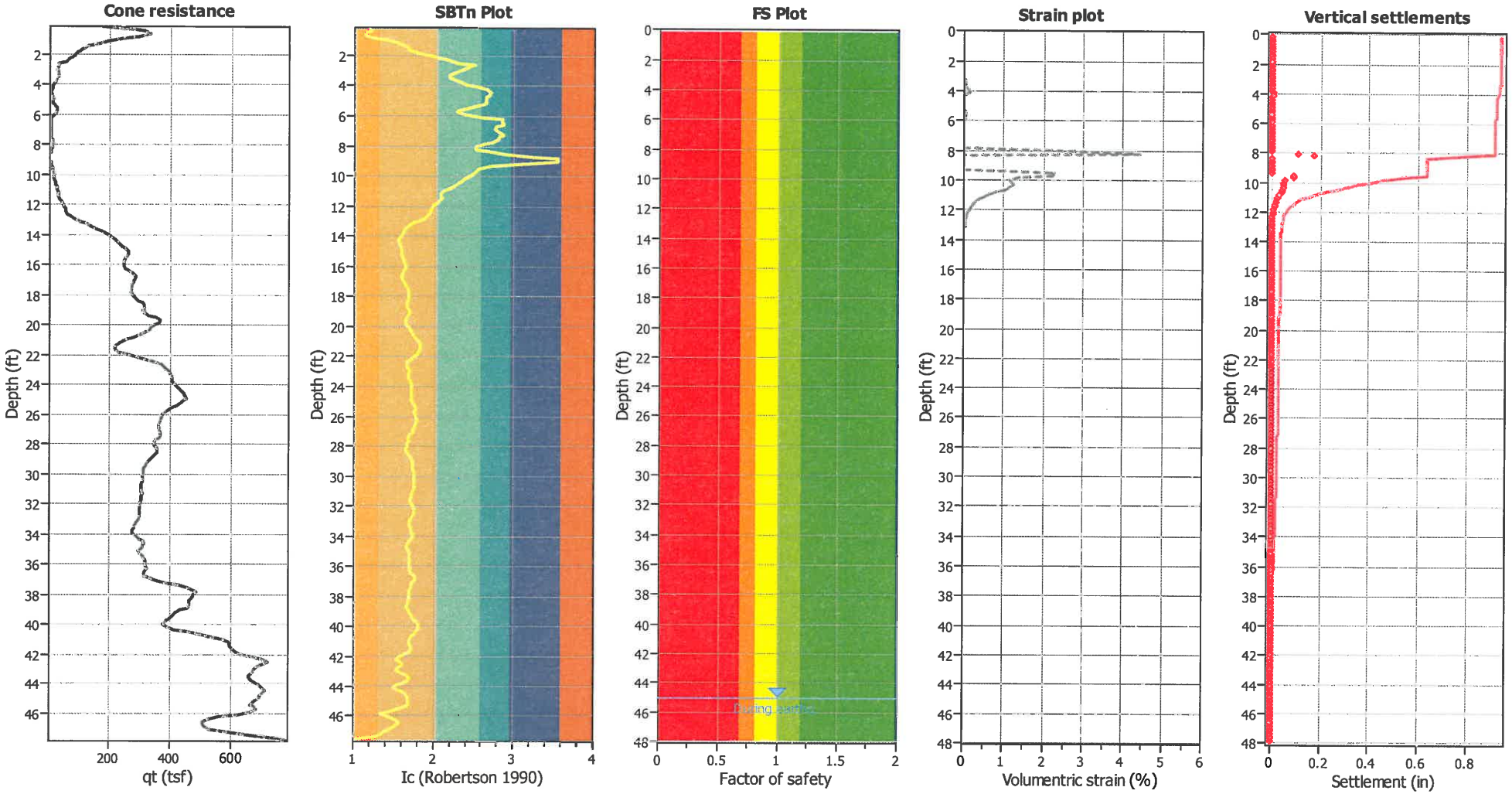
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	45.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	45.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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LIQUEFACTION ANALYSIS REPORT

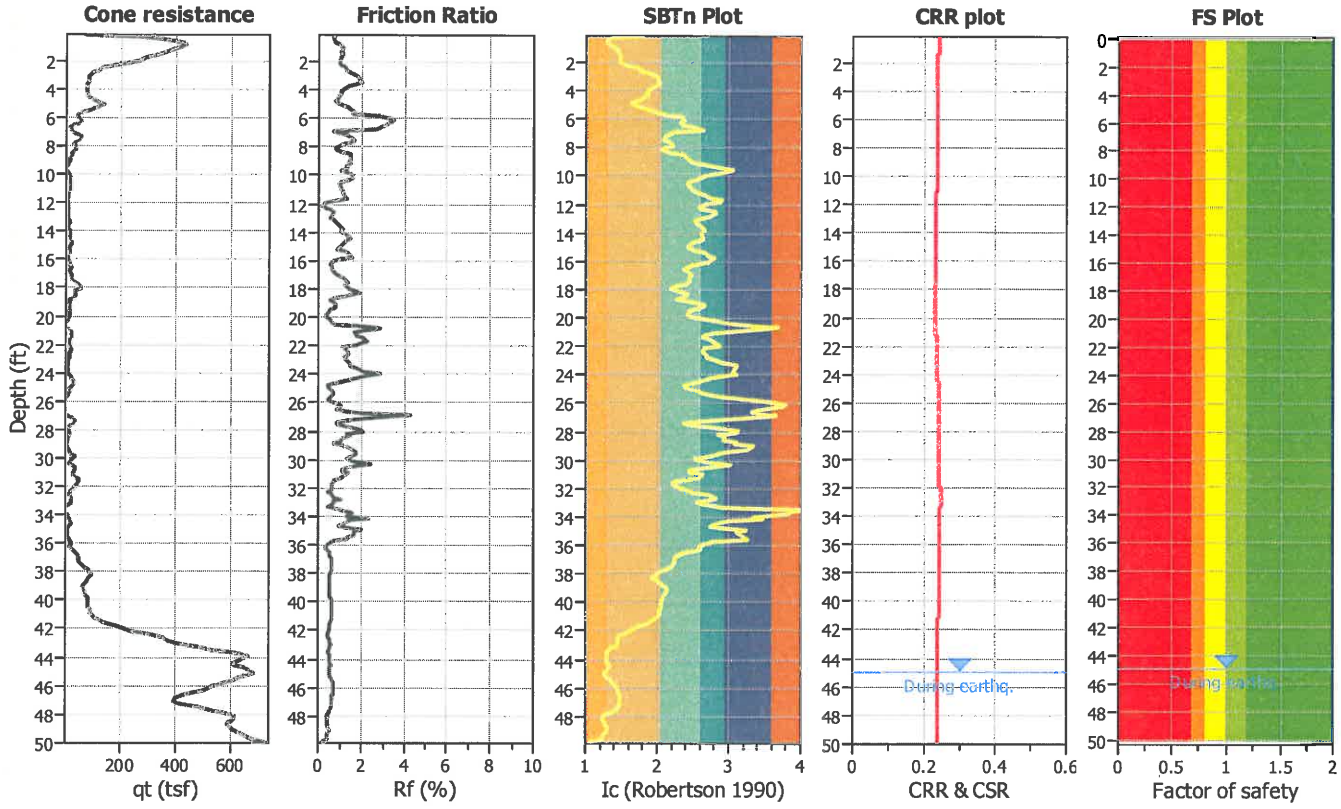
Project title : E&B Hermosa Beach

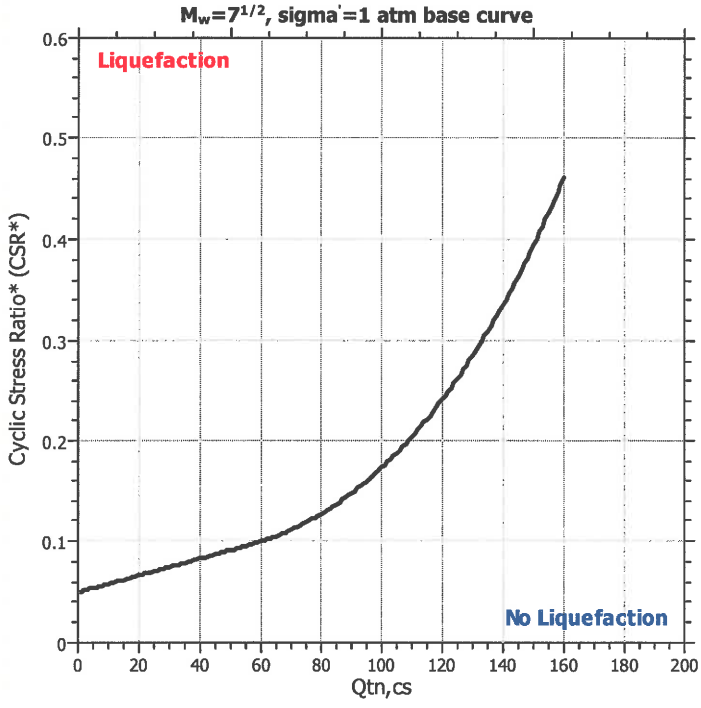
Location : 555 Sixth Street, Hermosa Beach, California

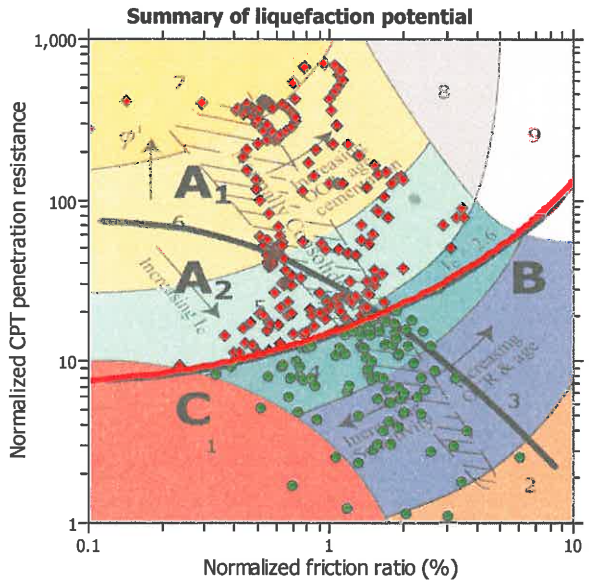
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	45.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	45.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

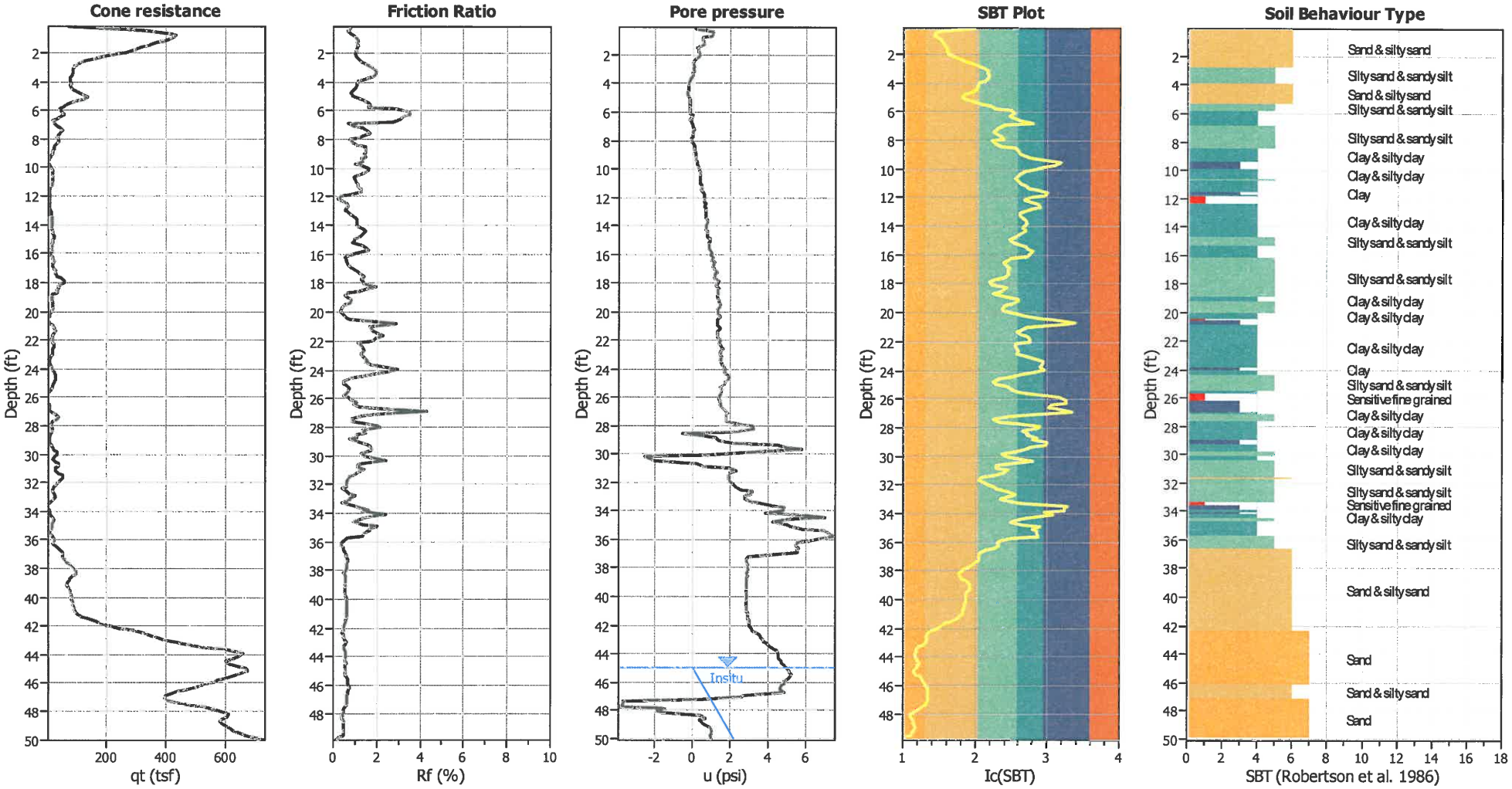






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



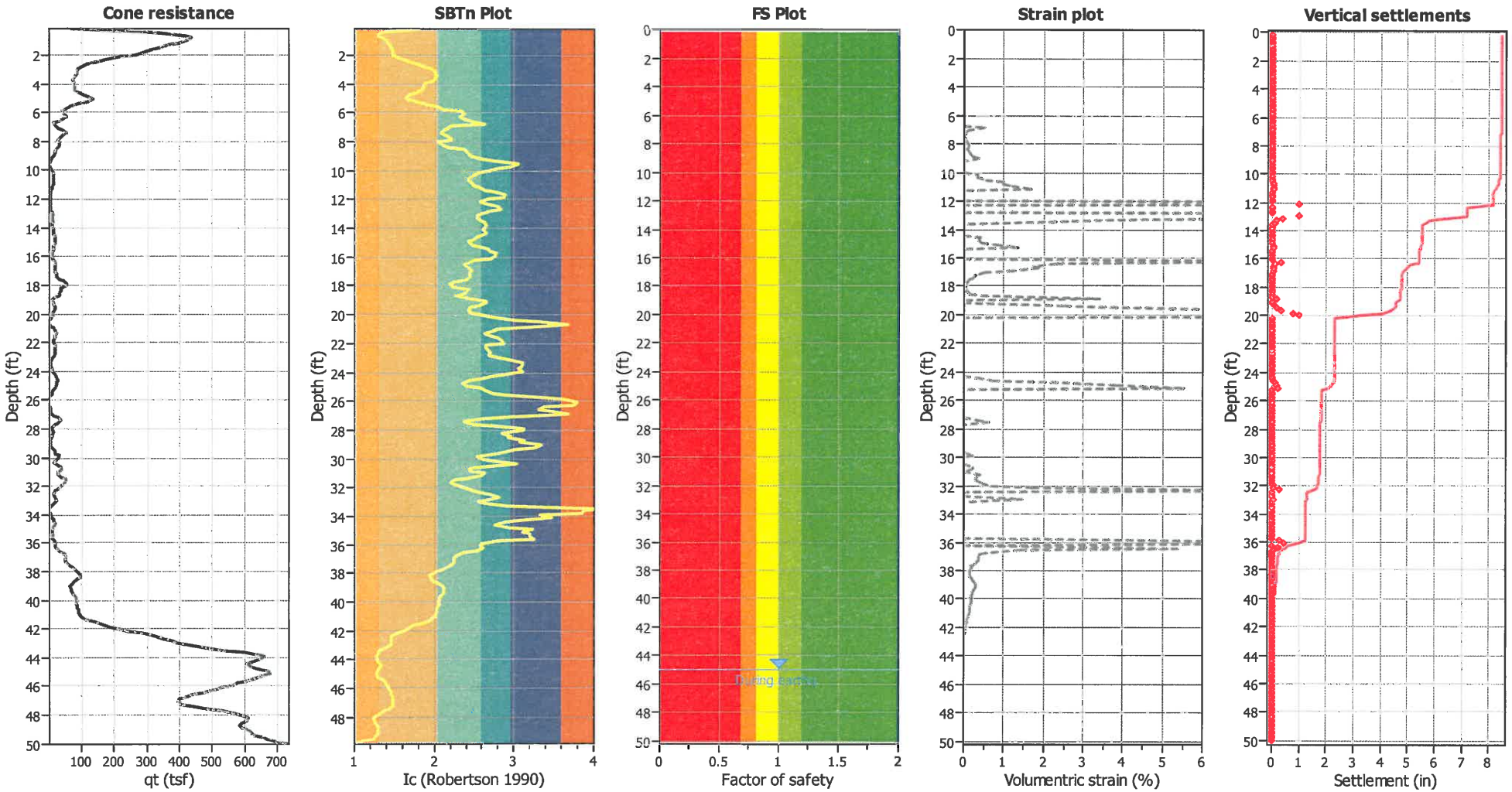
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	45.00 ft	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	45.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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LIQUEFACTION ANALYSIS REPORT

Project title : E&B Hermosa Beach

Location : 555 Sixth Street, Hermosa Beach, California

CPT file : CPT-4

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	45.00 ft	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	45.00 ft	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No		
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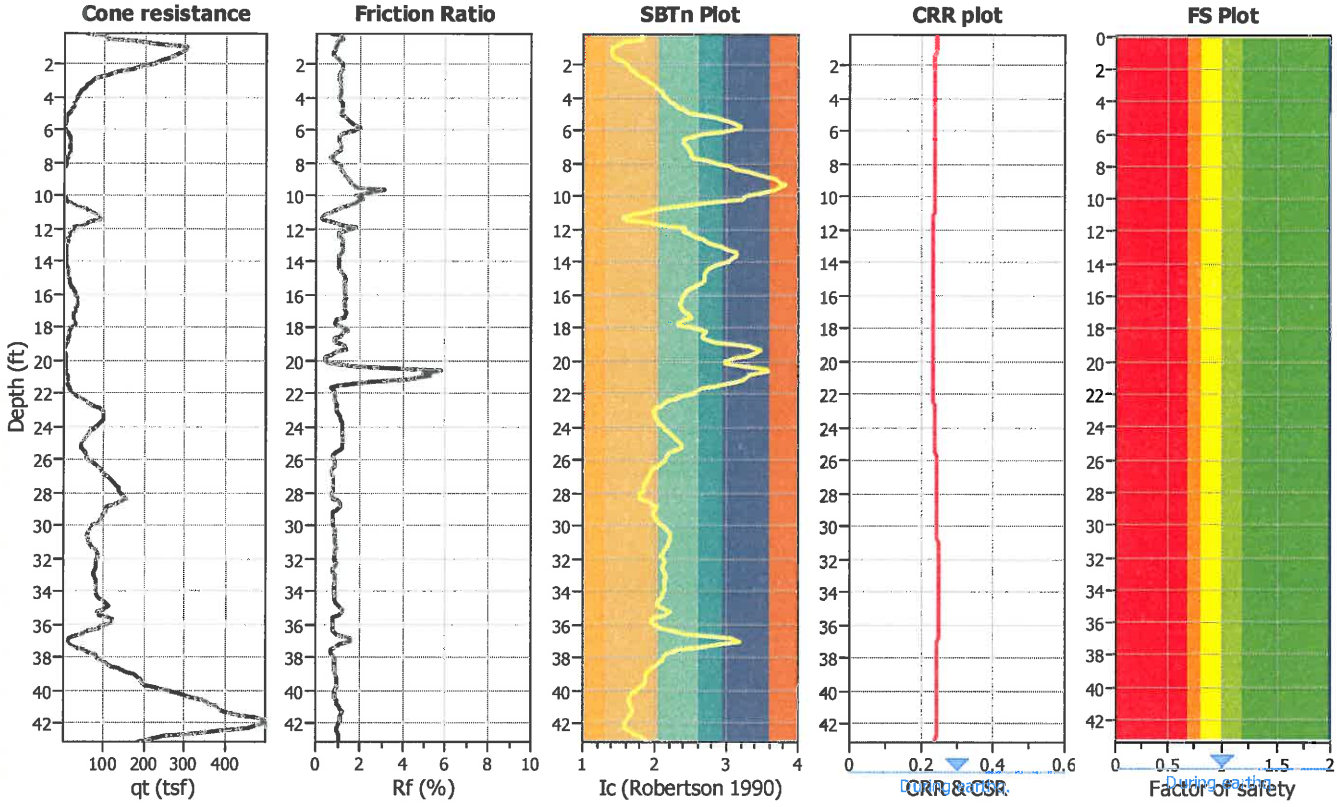

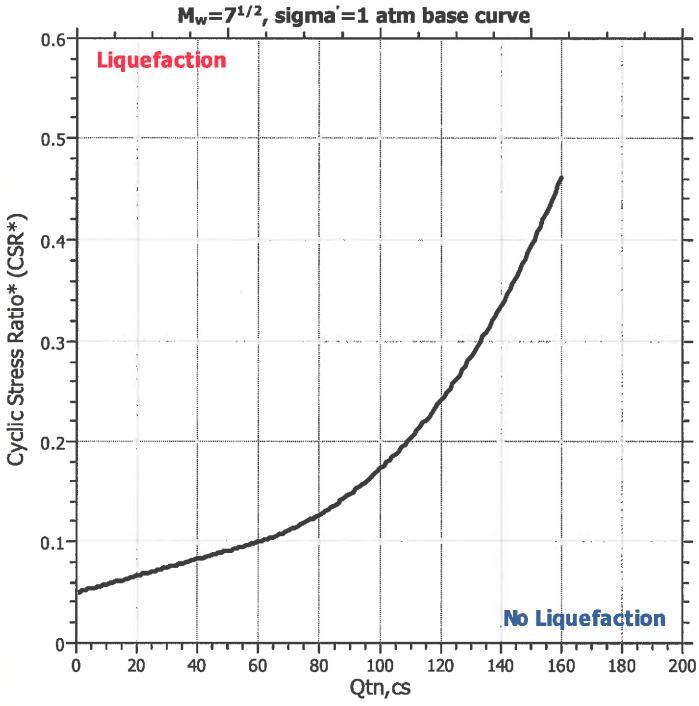

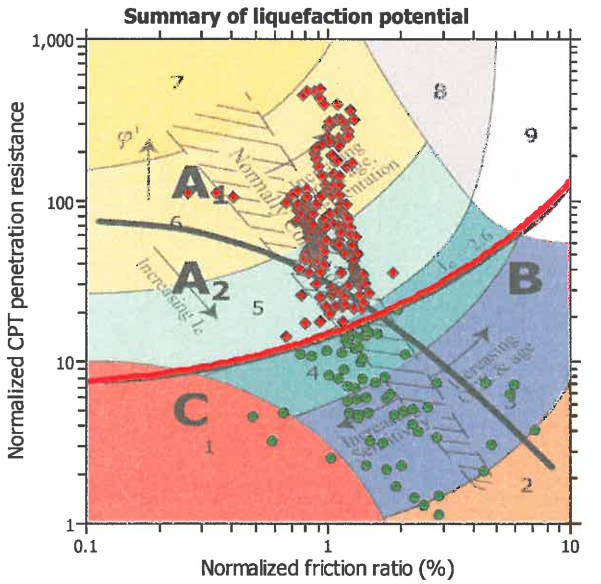

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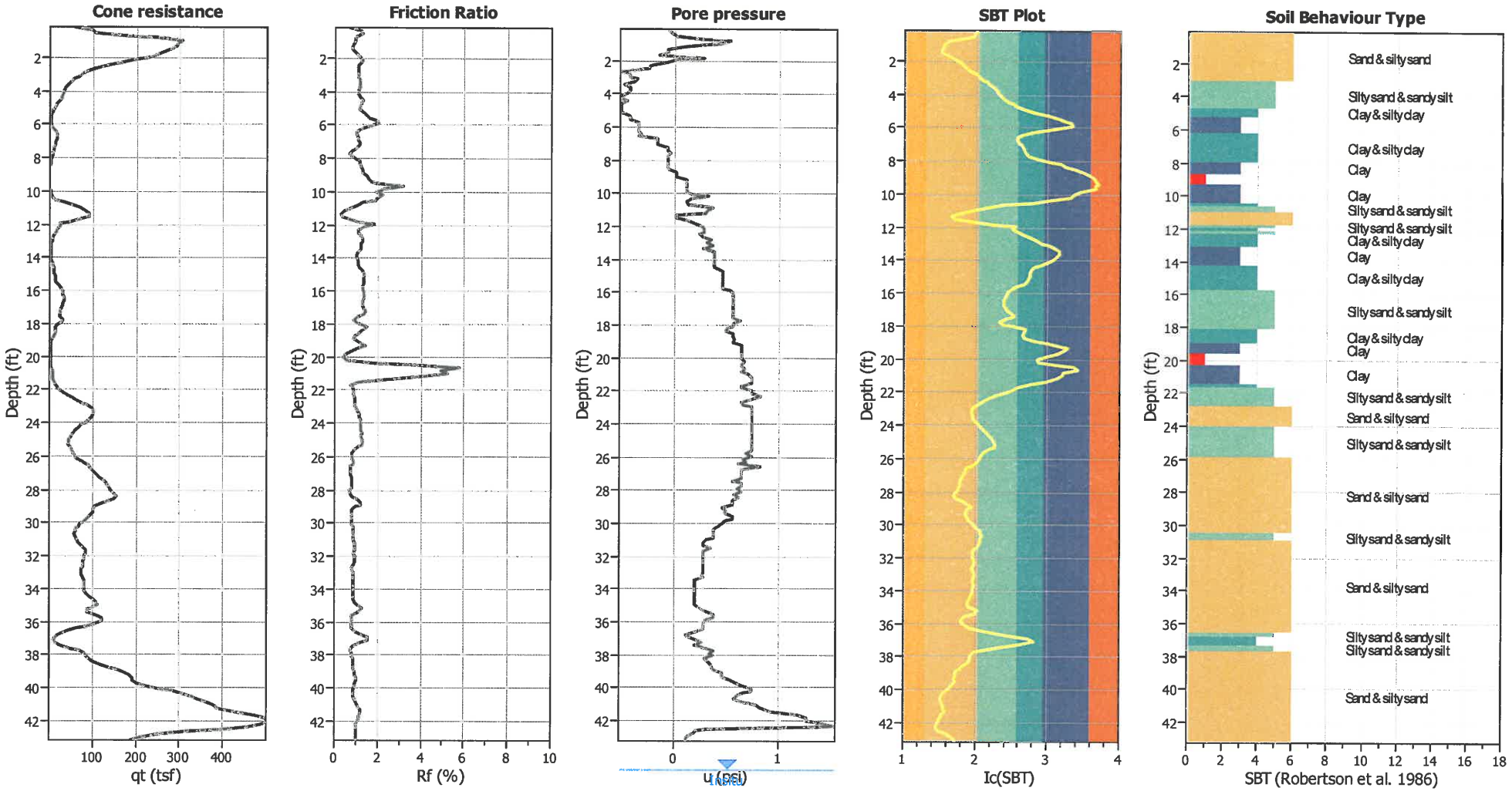
CPT basic interpretation plots



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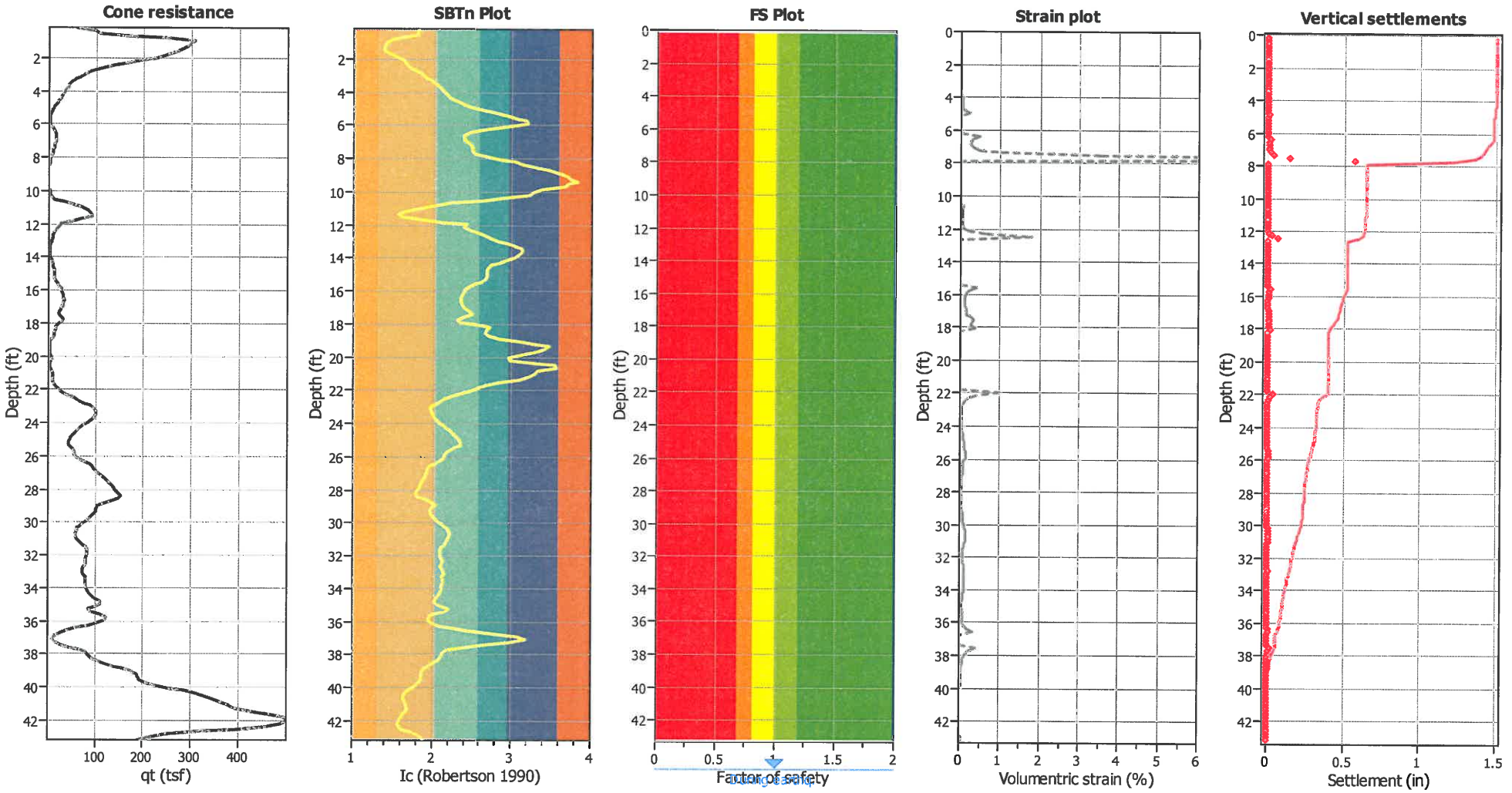
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	45.00 ft	Fill height:	N/A	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
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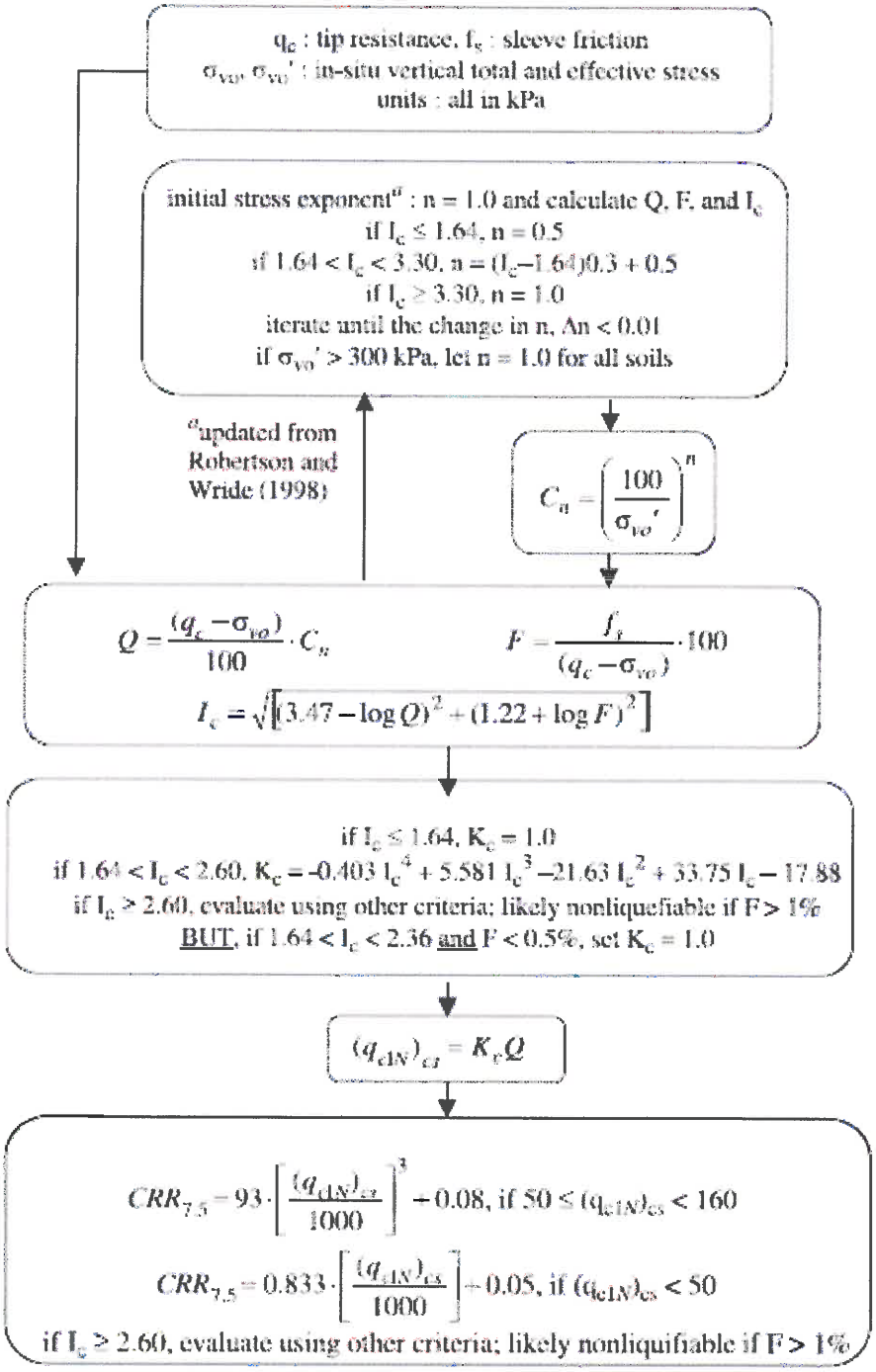
Volumentric strain:	Post-liquefaction volumentric strain

Procedure for the evaluation of soil liquefaction resistance (sandy soils)

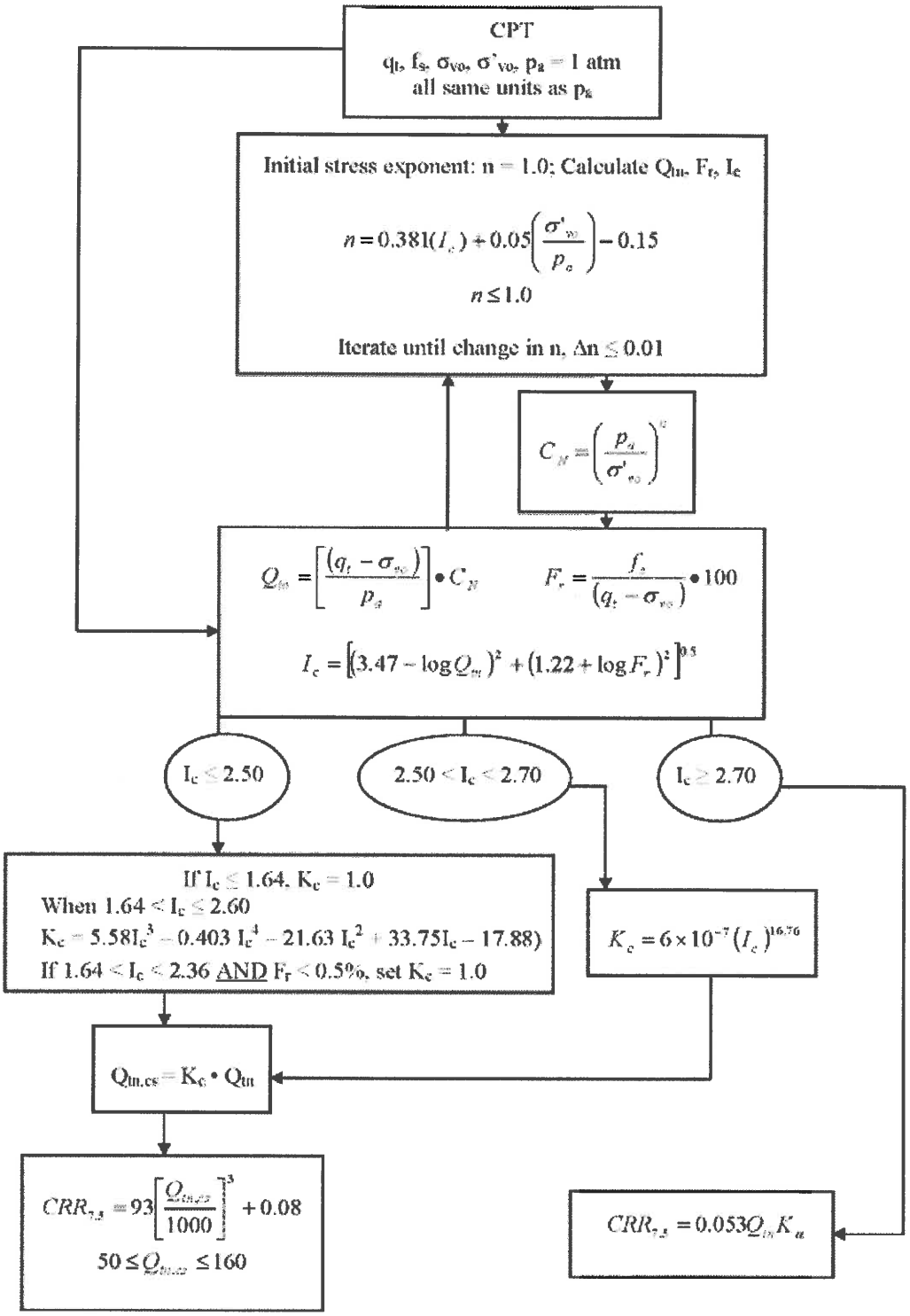
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

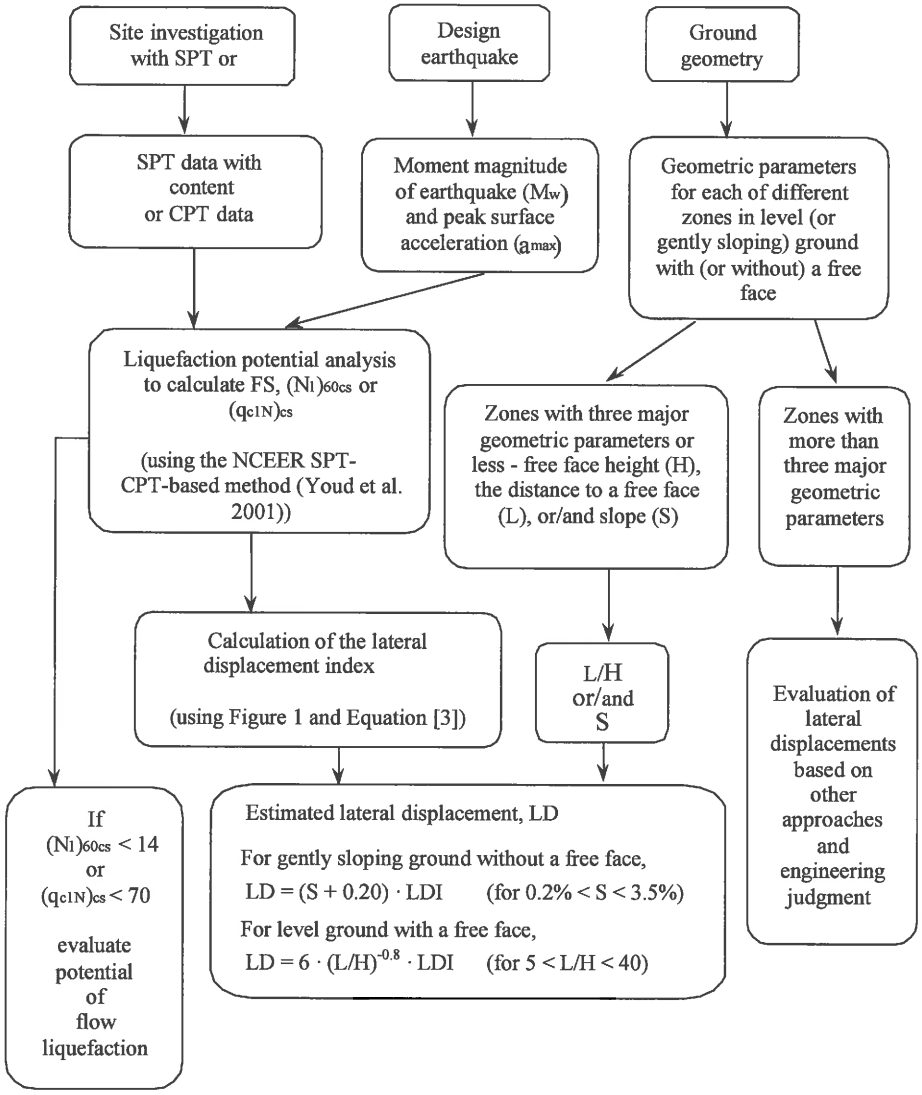
Procedure for the evaluation of soil liquefaction resistance (all soils)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

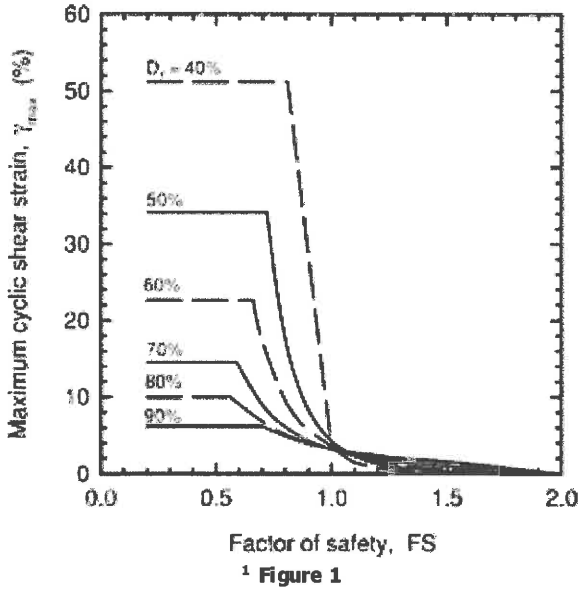


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



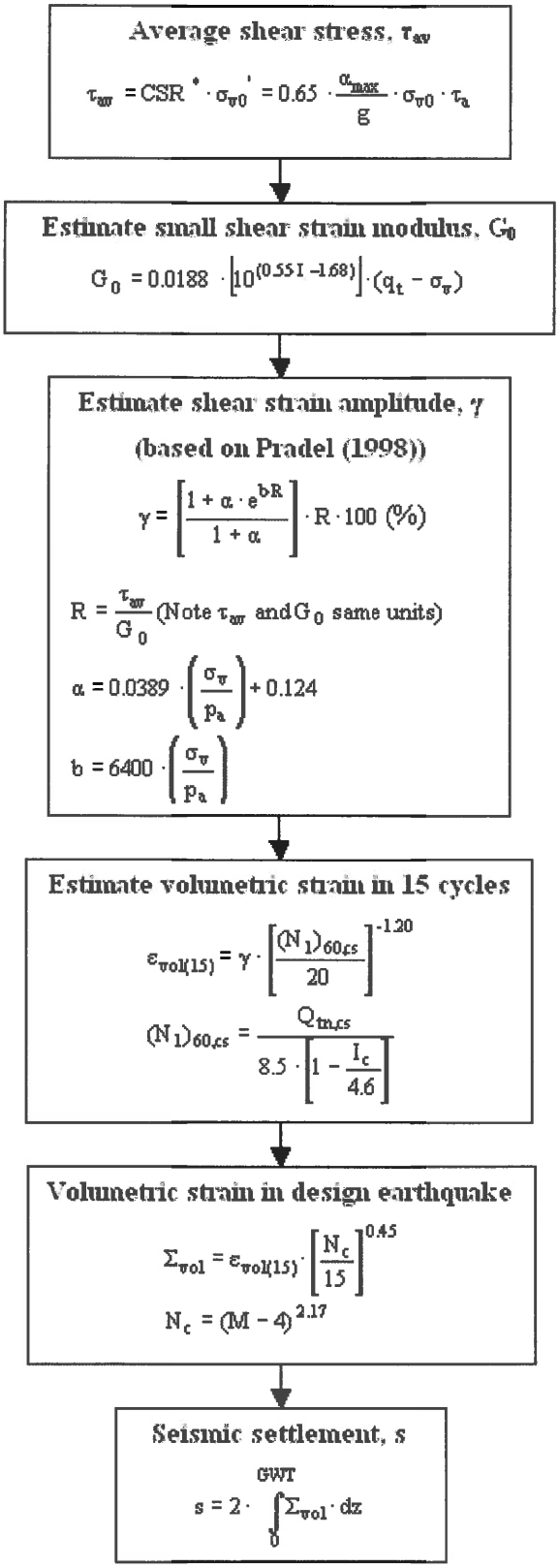
[1] **Figure 1**

$$LDI = \int_0^{z_{max}} \gamma_{max} dz$$

[1] **Equation [3]**

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands



Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

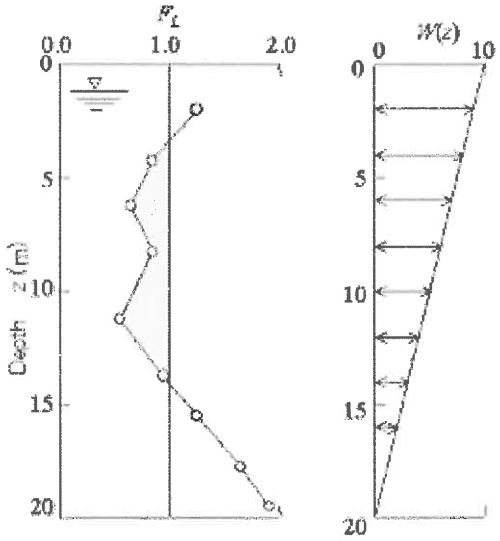
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\mathbf{LPI} = \int_0^{20} (10 - 0{,}5_z) \times F_L \times d_z$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

References

- Lunne, T., Robertson, P.K., and Powell, J.J.M 1997. Cone penetration testing in geotechnical practice, E & FN Spon Routledge, 352 p, ISBN 0-7514-0393-8.
- Boulanger, R.W. and Idriss, I. M., 2007. Evaluation of Cyclic Softening in Silts and Clays. ASCE Journal of Geotechnical and Geoenvironmental Engineering June, Vol. 133, No. 6 pp 641-652
- Robertson, P.K. and Cabal, K.L., 2007. Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/
- Robertson, P.K. 1990. Soil classification using the cone penetration test. Canadian Geotechnical Journal, 27 (1), 151-8.
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- Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J., Liao, S., Marcuson III, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R., and Stokoe, K.H., Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshop on Evaluation of Liquefaction Resistance of Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 127, October, pp 817-833
- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180
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- Iwasaki, T., 1986, Soil liquefaction studies in Japan: state-of-the-art, Soil Dynamics and Earthquake Engineering, Vol. 5, No. 1, 2-70
- P.K. Robertson, 2009, Interpretation of Cone Penetration Tests - a unified approach., Canadian Geotechnical Journal, Vol. 46, No. 11, pp 1337-1355
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Seismic Settlement Analysis

(15 feet of Removal)

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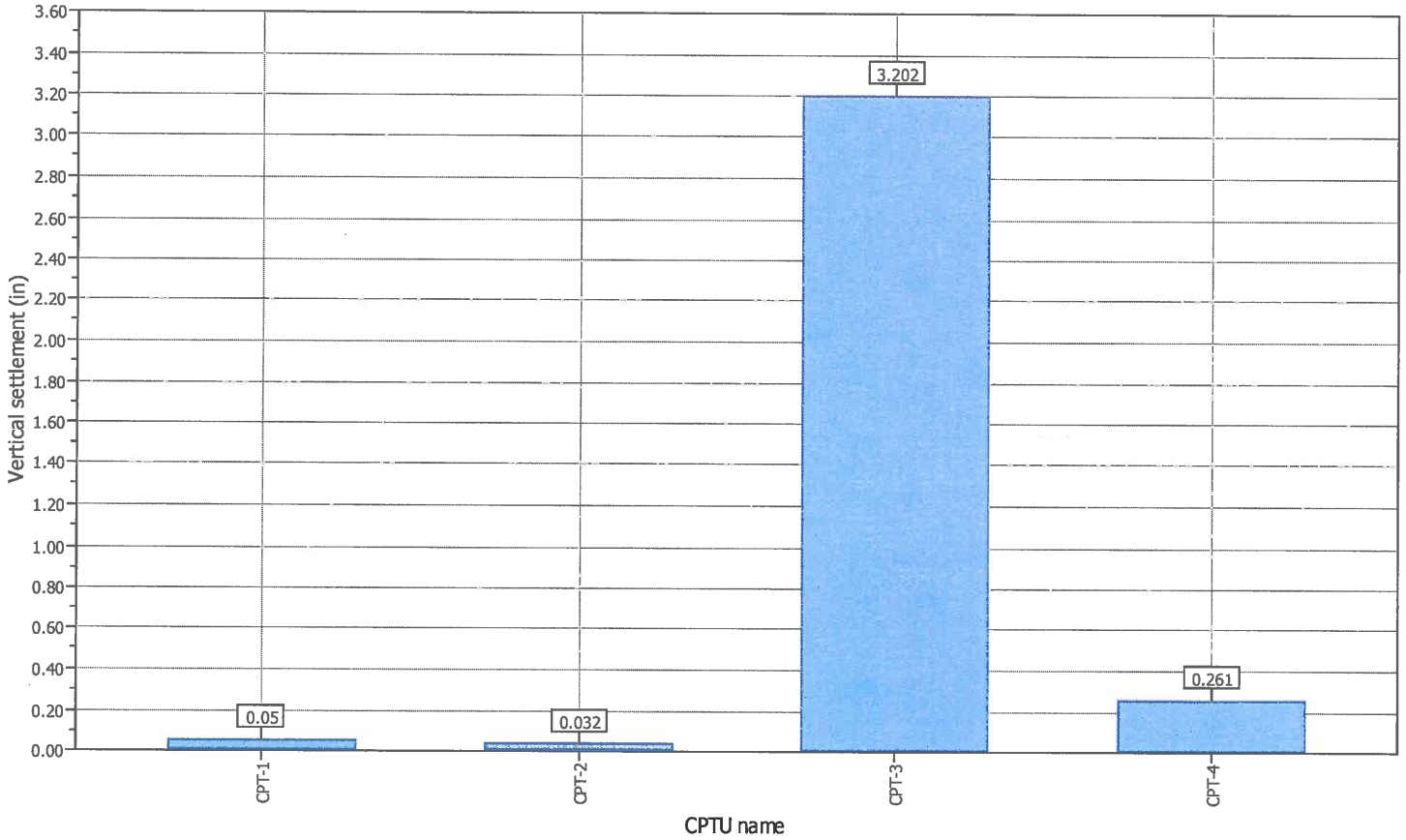
Overall vertical settlements report



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LIQUEFACTION ANALYSIS REPORT

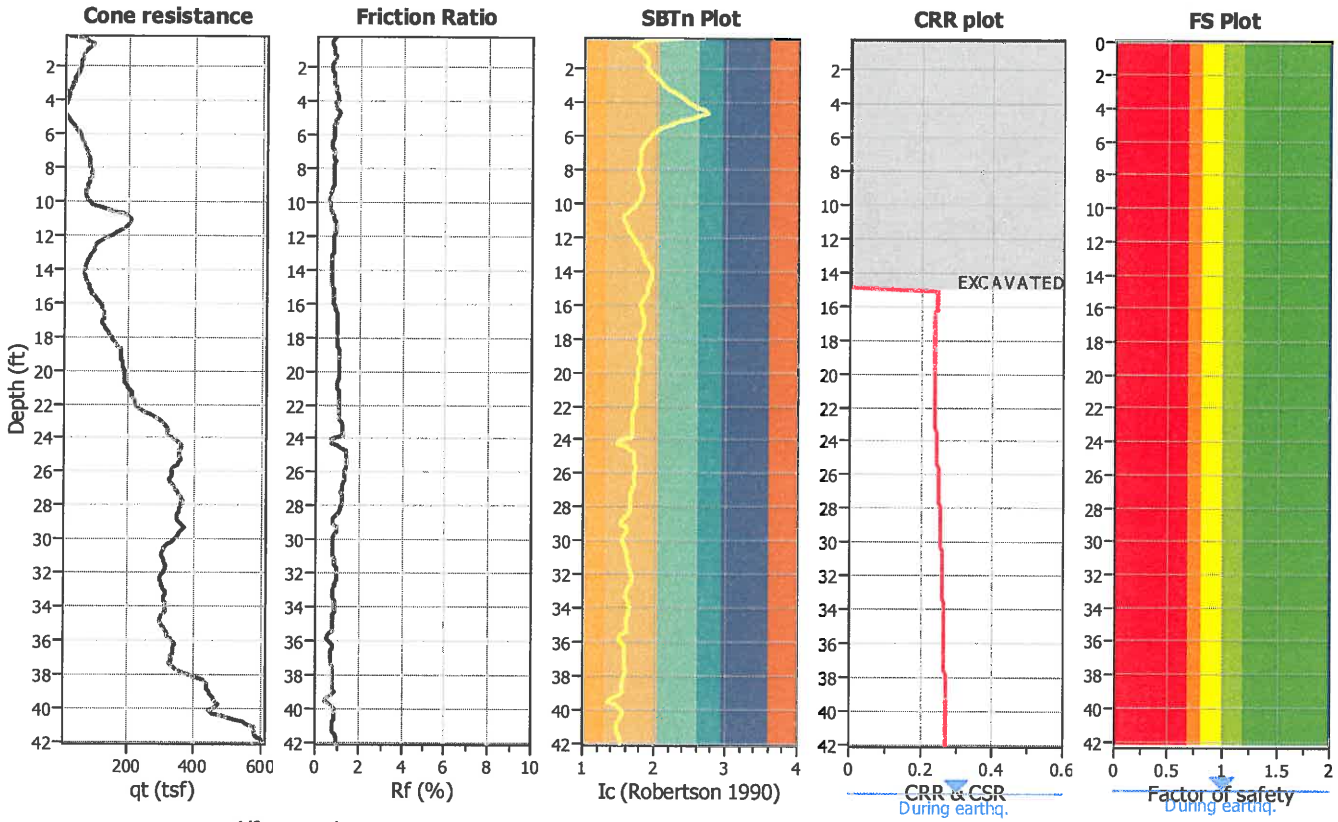
Project title : E&B Hermosa Beach

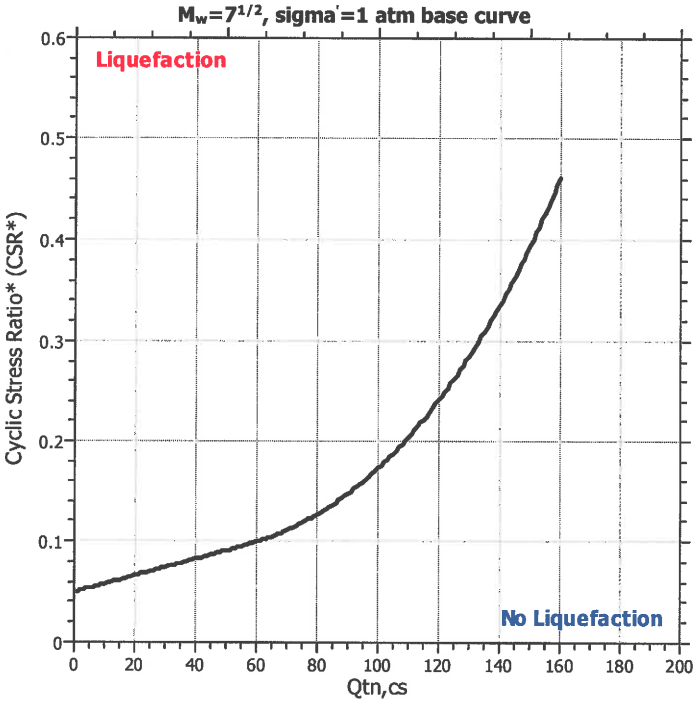
Location : 555 Sixth Street, Hermosa Beach, California

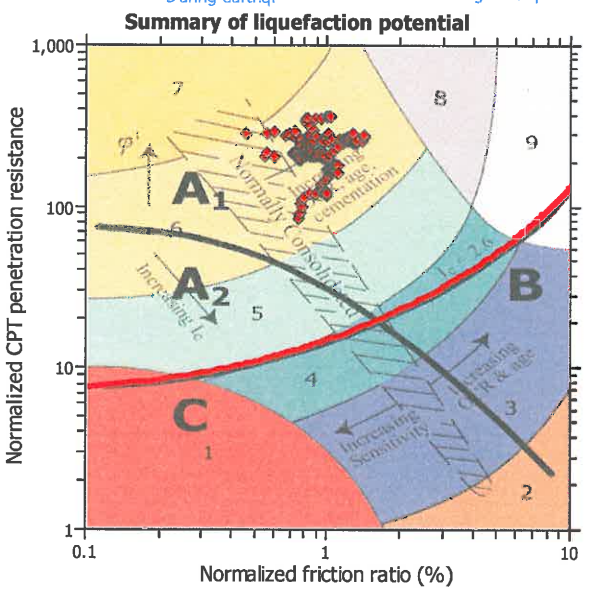
CPT file : CPT-1

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	45.00 ft	Excavation:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	45.00 ft	Excavation depth:	15.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	0.60 tsf	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		







Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
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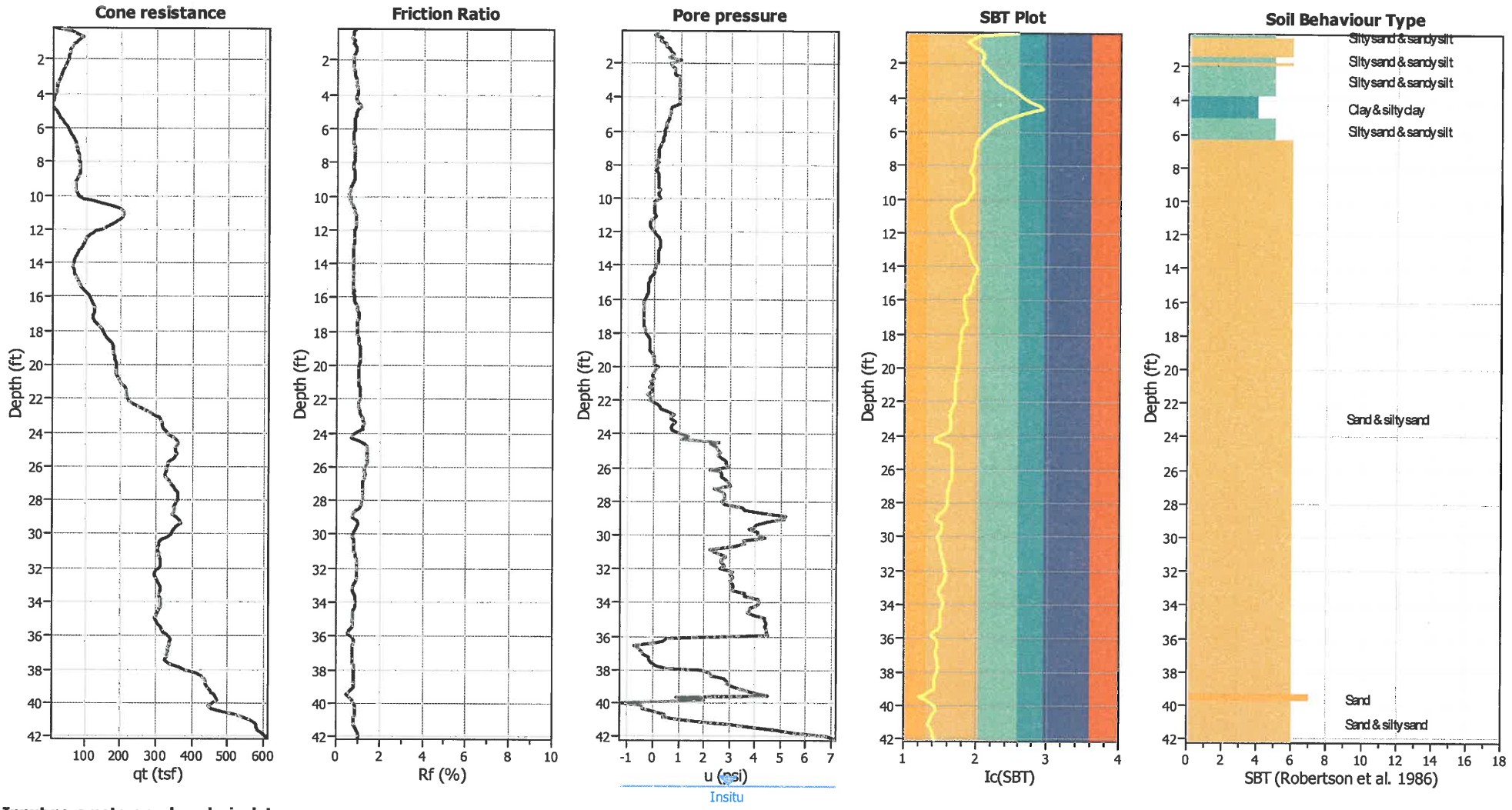
CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	45.00 ft	Footing load:	0.60 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Excavation:	Yes	Limit depth applied:	No
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SBT legend

1. Sensitive fine grained
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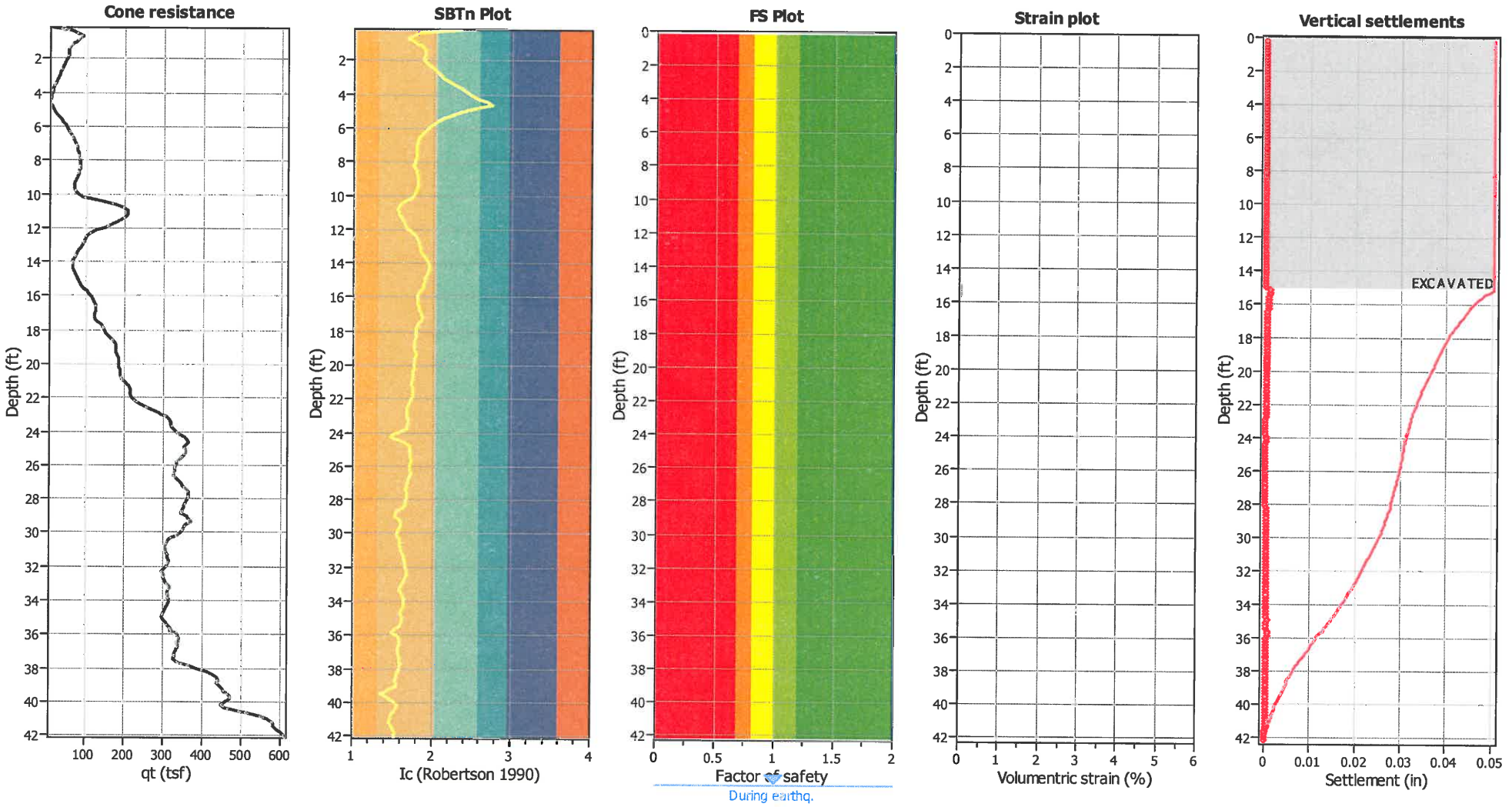
Estimation of post-earthquake settlements



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LIQUEFACTION ANALYSIS REPORT

Project title : E&B Hermosa Beach

Location : 555 Sixth Street, Hermosa Beach, California

CPT file : CPT-2

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	45.00 ft	Excavation:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	45.00 ft	Excavation depth:	15.00 ft	Limit depth applied:	No
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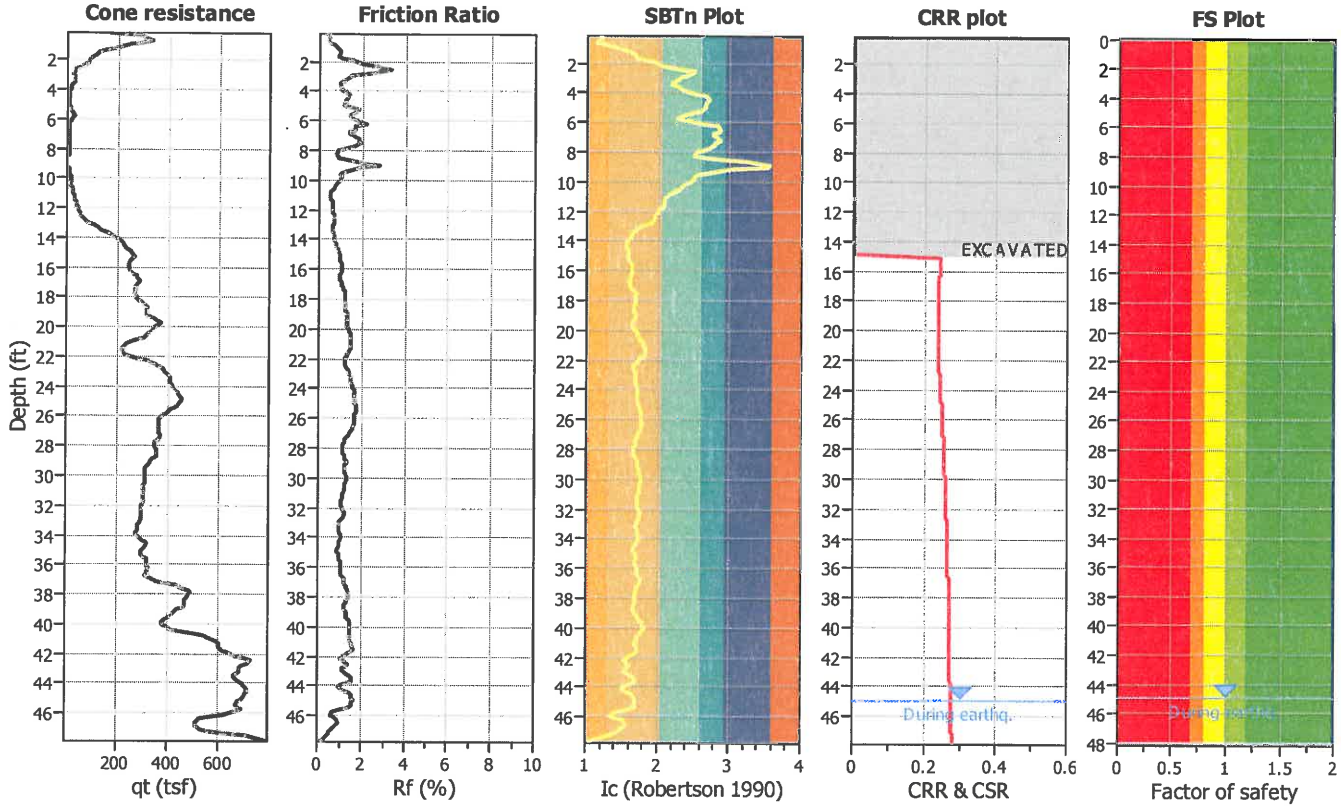

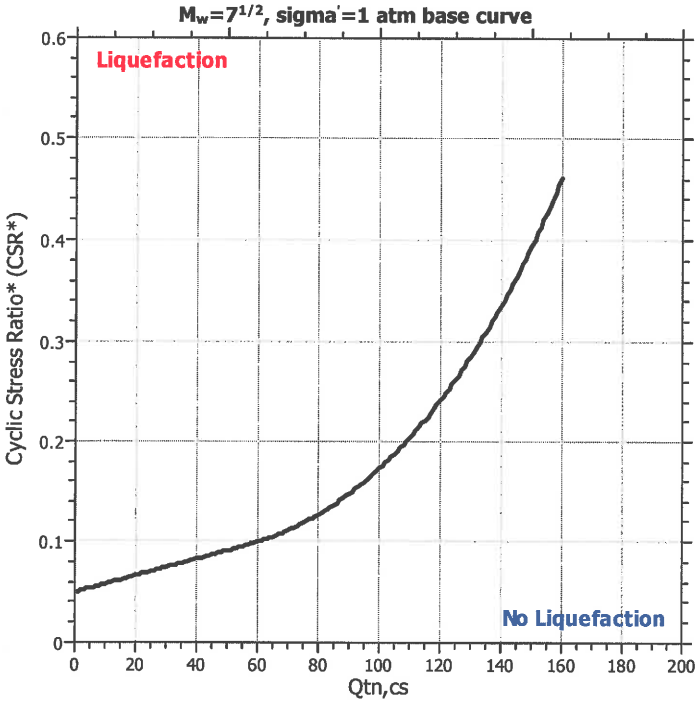

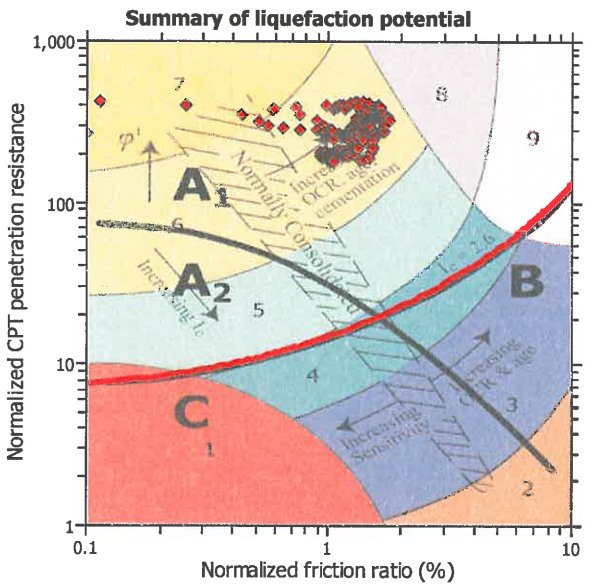

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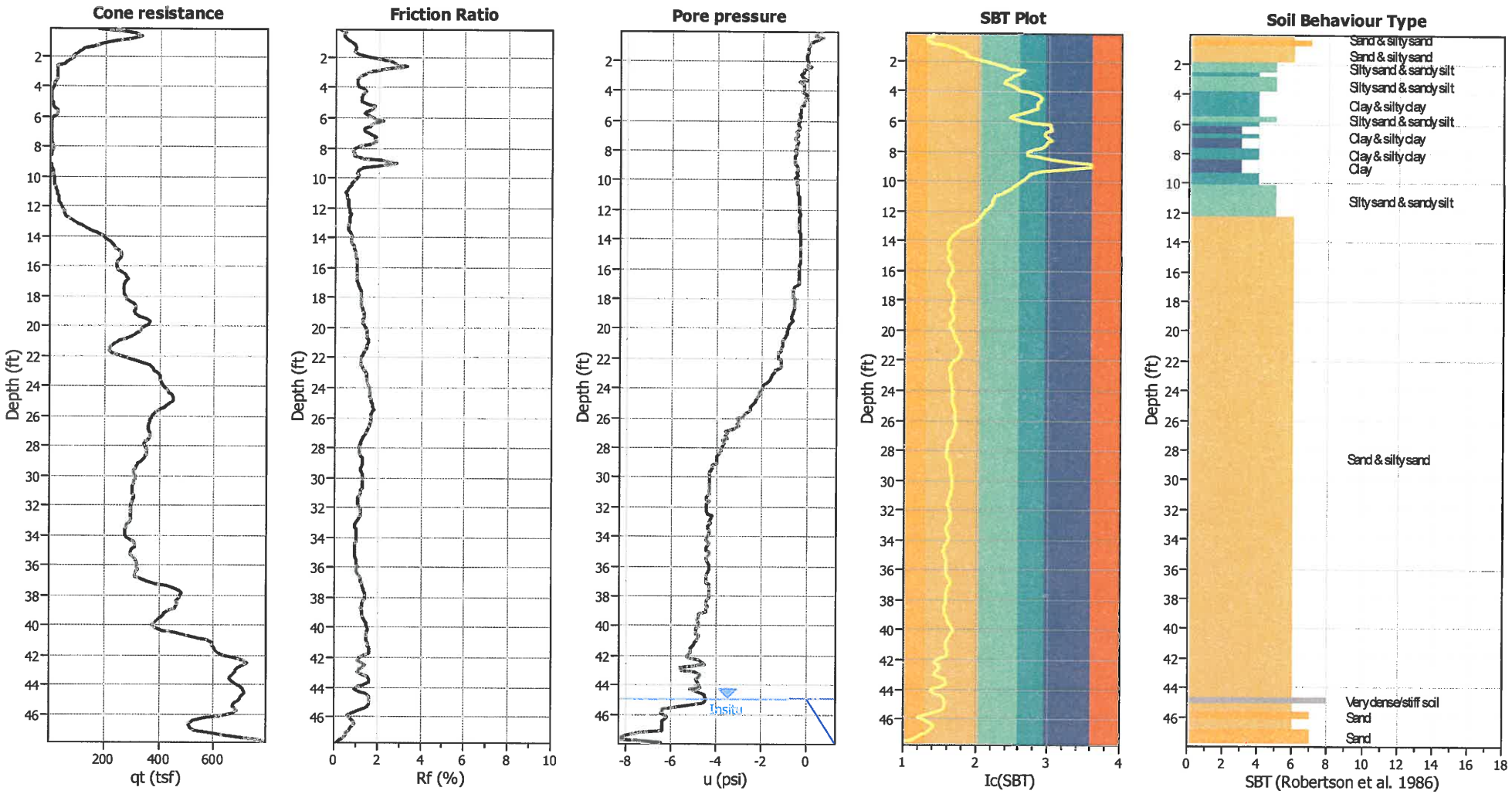
CPT basic interpretation plots



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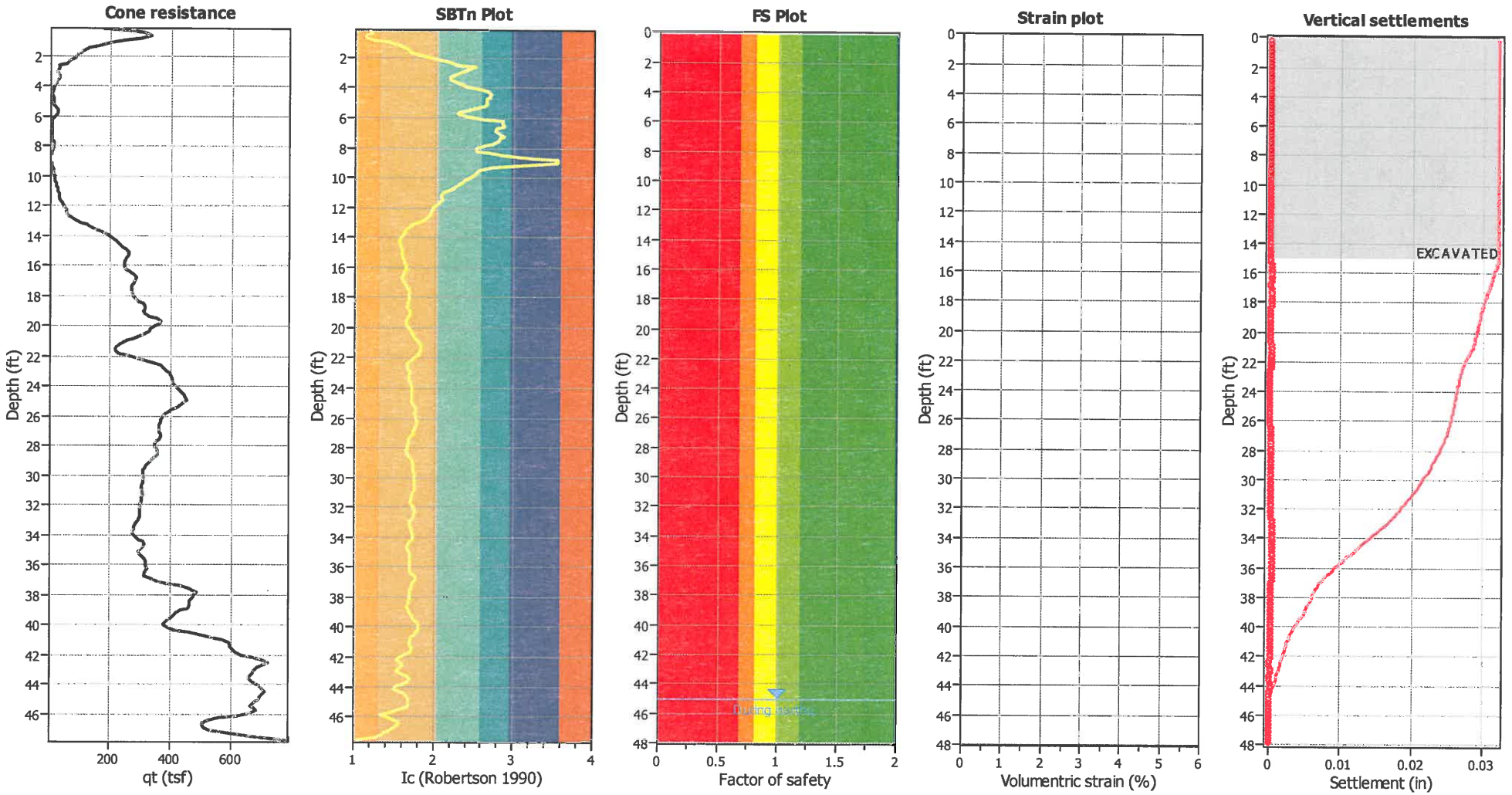
Estimation of post-earthquake settlements



Abbreviations

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I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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621 25 - Serrai - GREECE

LIQUEFACTION ANALYSIS REPORT

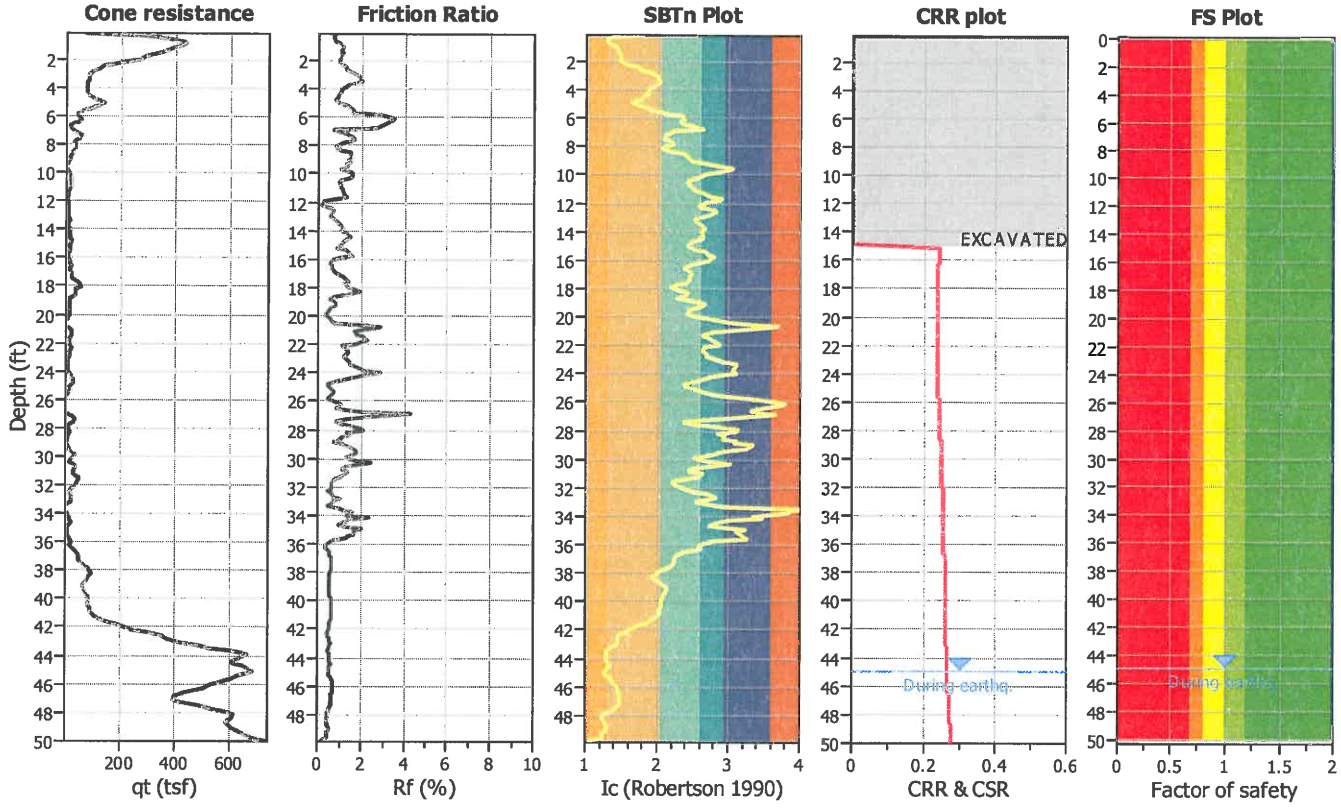
Project title : E&B Hermosa Beach

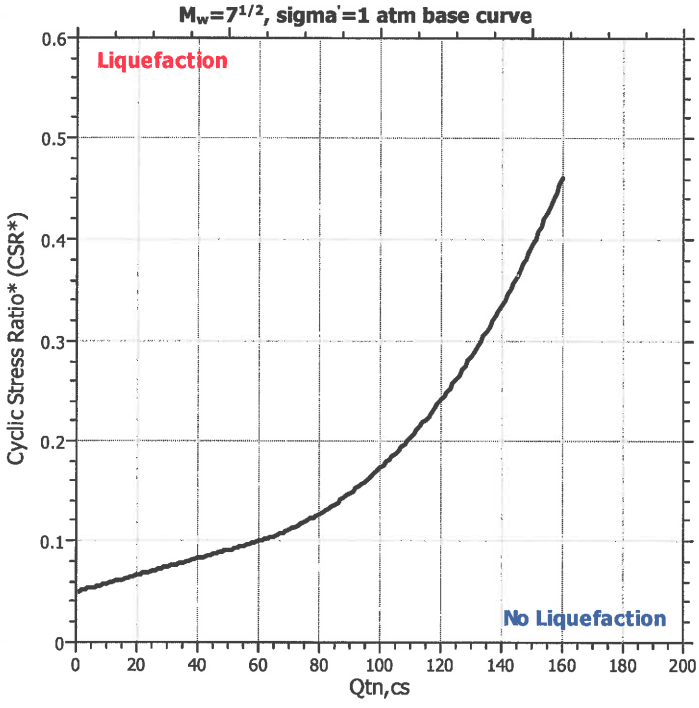
Location : 555 Sixth Street, Hermosa Beach, California

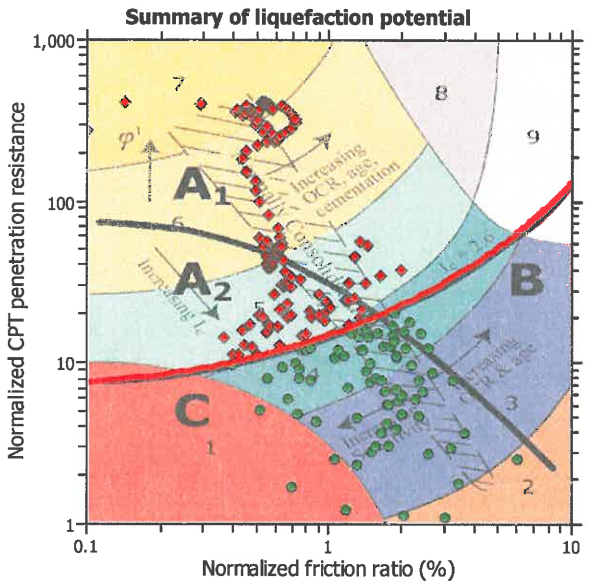
CPT file : CPT-3

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	45.00 ft	Excavation:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	45.00 ft	Excavation depth:	15.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	0.60 tsf	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

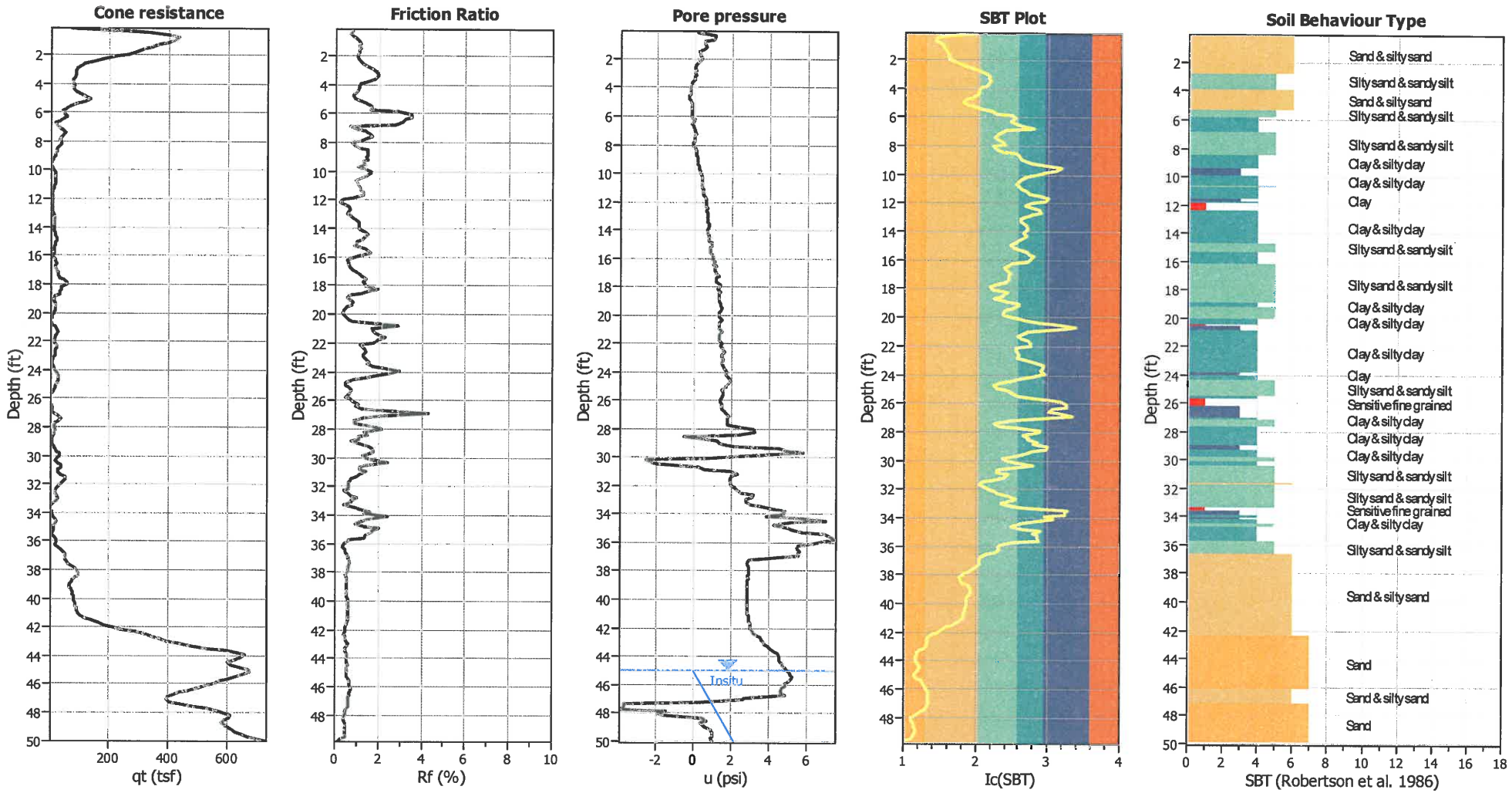






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



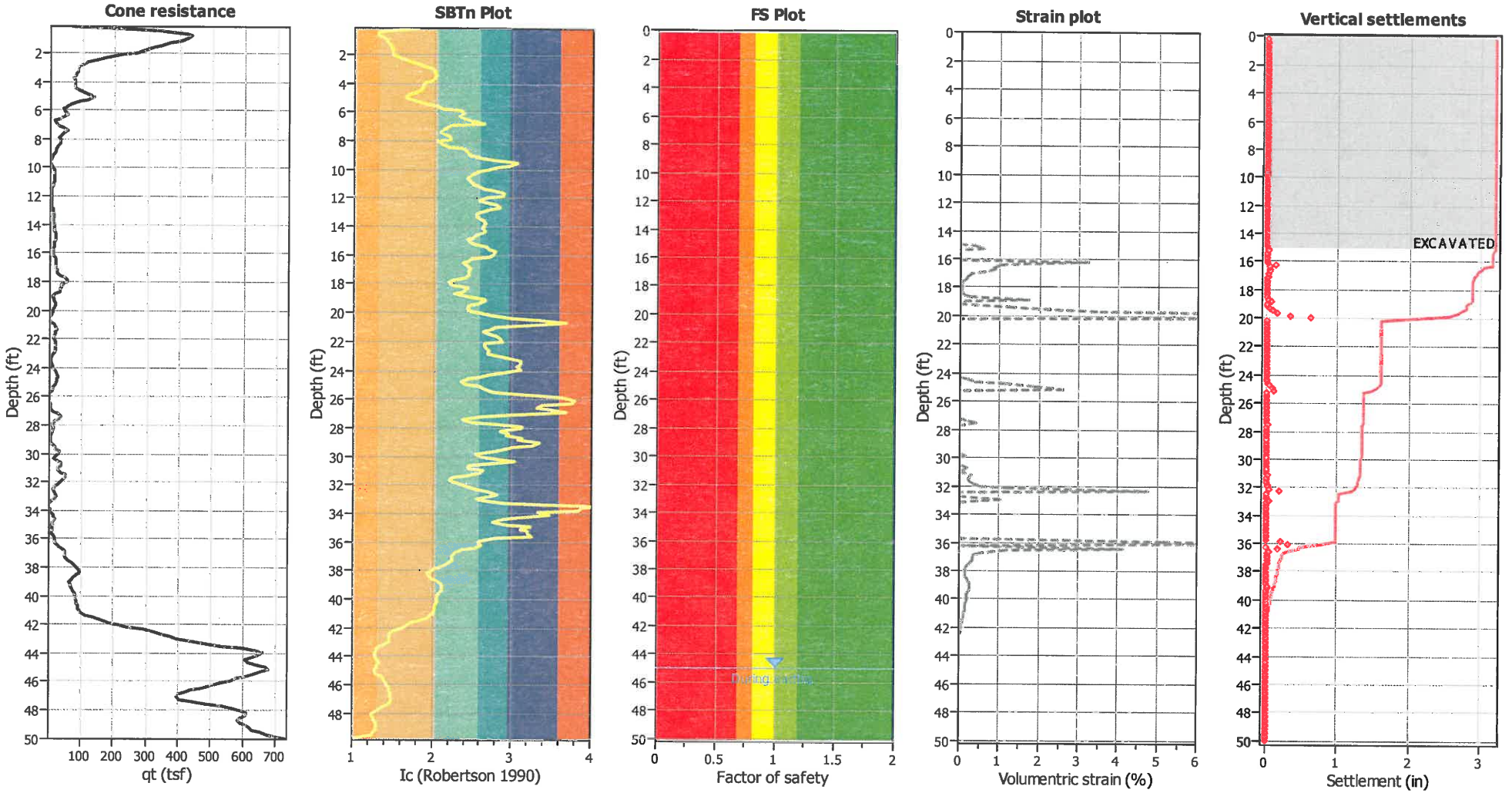
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	45.00 ft	Footing load:	0.60 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	45.00 ft	Excavation depth:	15.00 ft	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



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I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

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LIQUEFACTION ANALYSIS REPORT

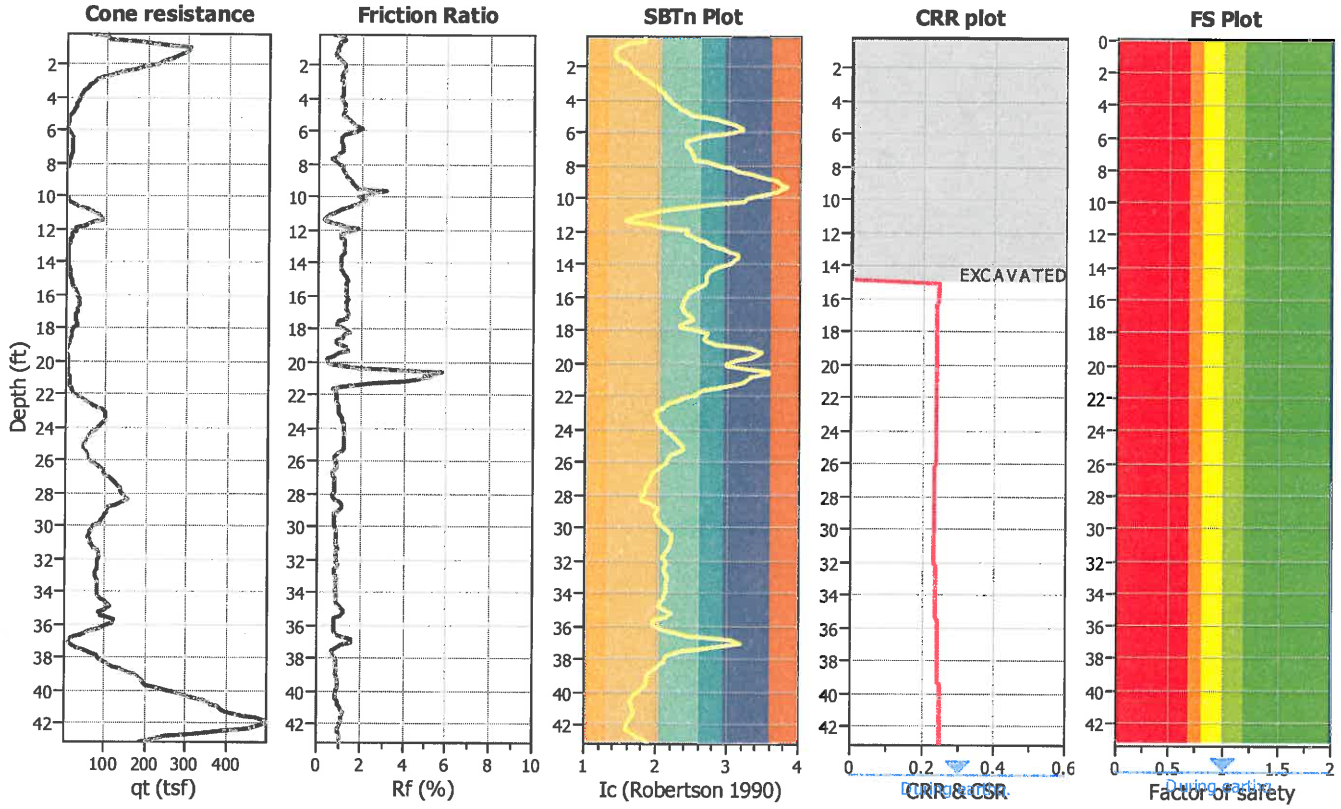
Project title : E&B Hermosa Beach

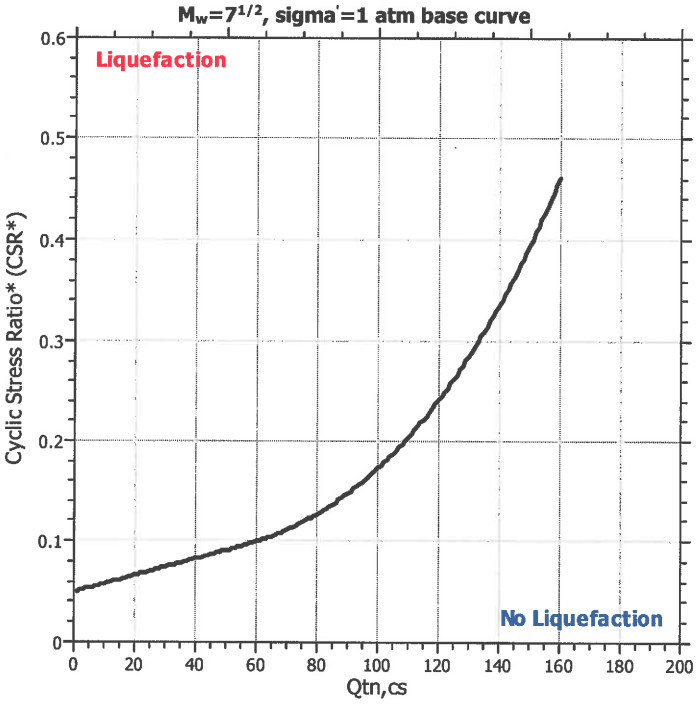
Location : 555 Sixth Street, Hermosa Beach, California

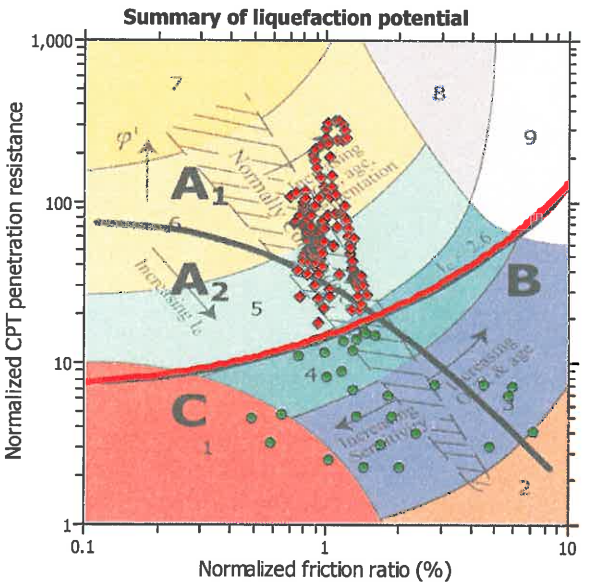
CPT file : CPT-4

Input parameters and analysis data

Analysis method:	NCEER (1998)	G.W.T. (in-situ):	45.00 ft	Excavation:	Yes	Clay like behavior applied:	Sands only
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	45.00 ft	Excavation depth:	15.00 ft	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Footing load:	0.60 tsf	Limit depth:	N/A
Earthquake magnitude M_w:	7.00	Ic cut-off value:	2.60	Trans. detect. applied:	No		
Peak ground acceleration:	0.44	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

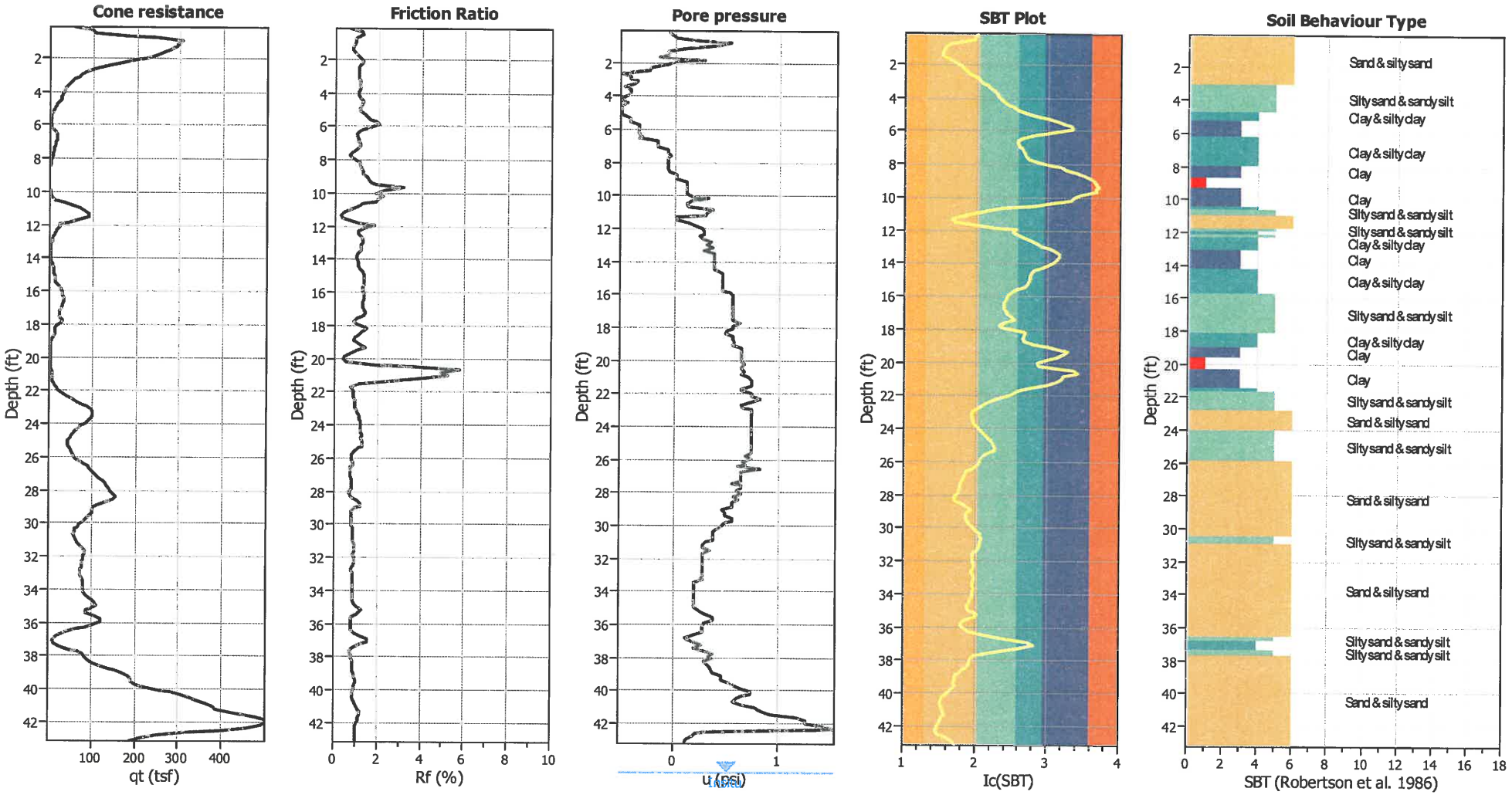






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and strength loss possible depending on soil plasticity, brittleness/sensitivity, strain to peak undrained strength and ground geometry

CPT basic interpretation plots



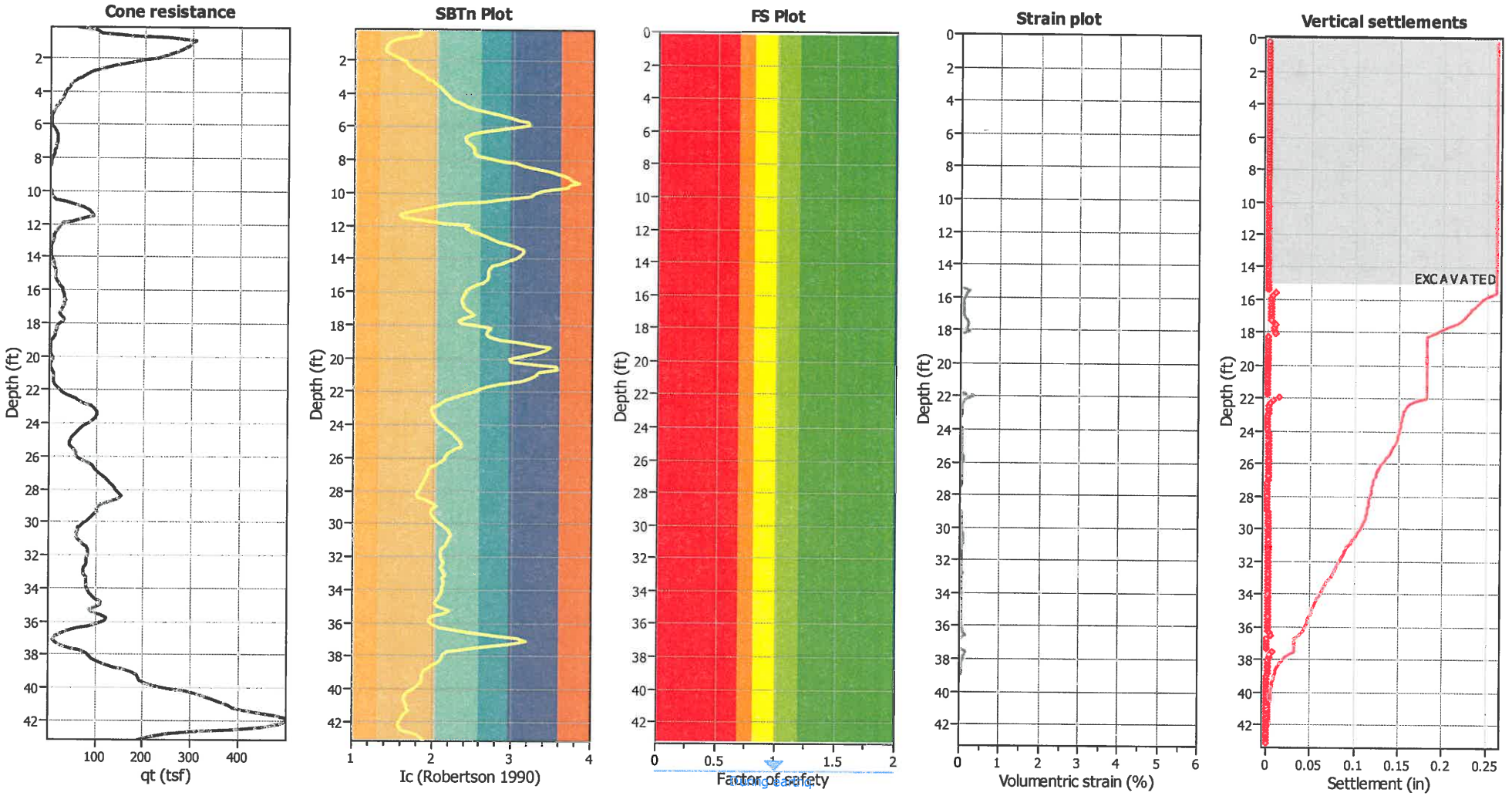
Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	45.00 ft	Footing load:	0.60 tsf
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.44	Excavation:	Yes	Limit depth applied:	No
Depth to water table (insitu):	45.00 ft	Excavation depth:	15.00 ft	Limit depth:	N/A

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to
9. Very stiff fine grained

Estimation of post-earthquake settlements



Abbreviations

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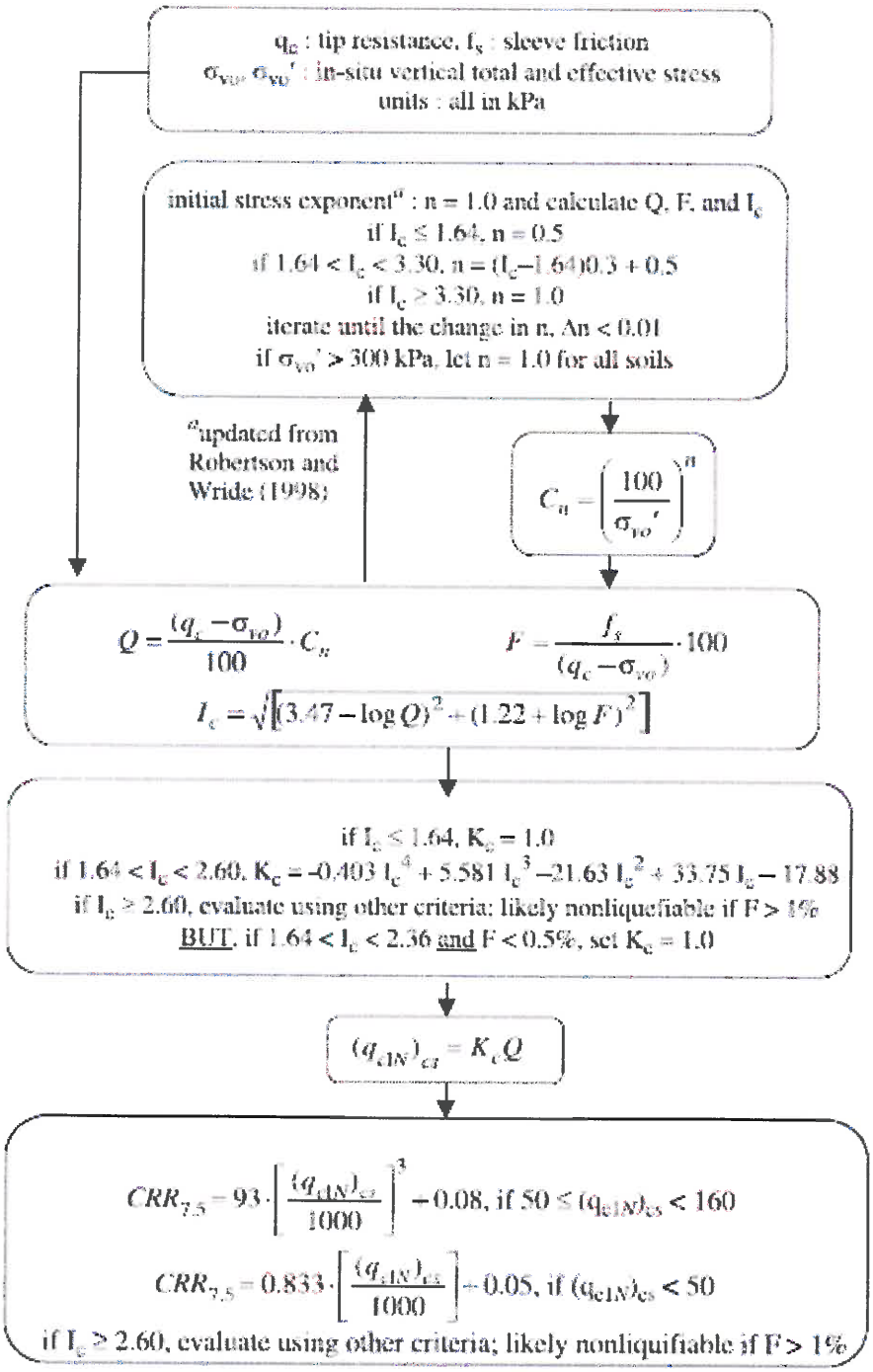
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Procedure for the evaluation of soil liquefaction resistance (sandy soils)

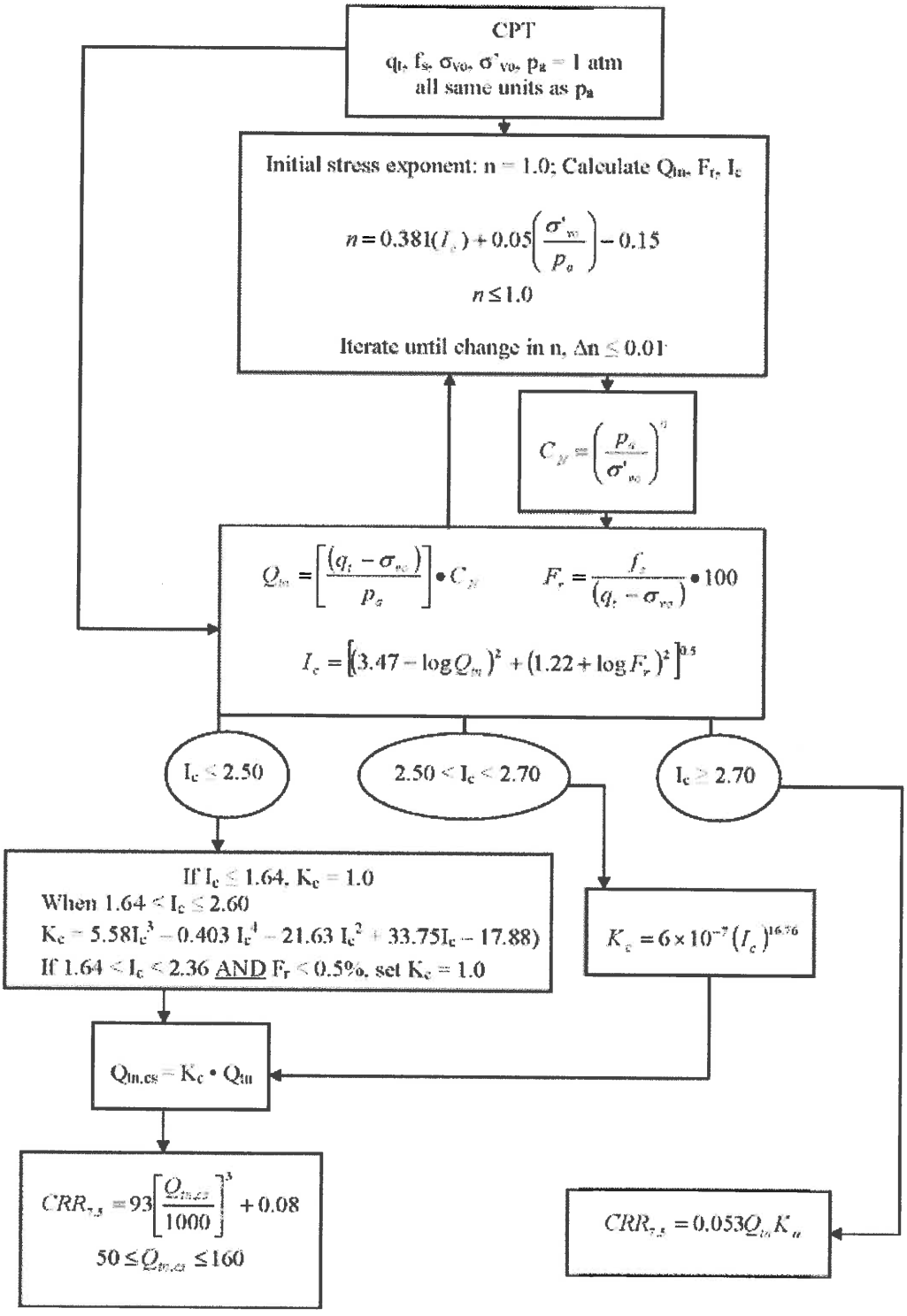
Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:



[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

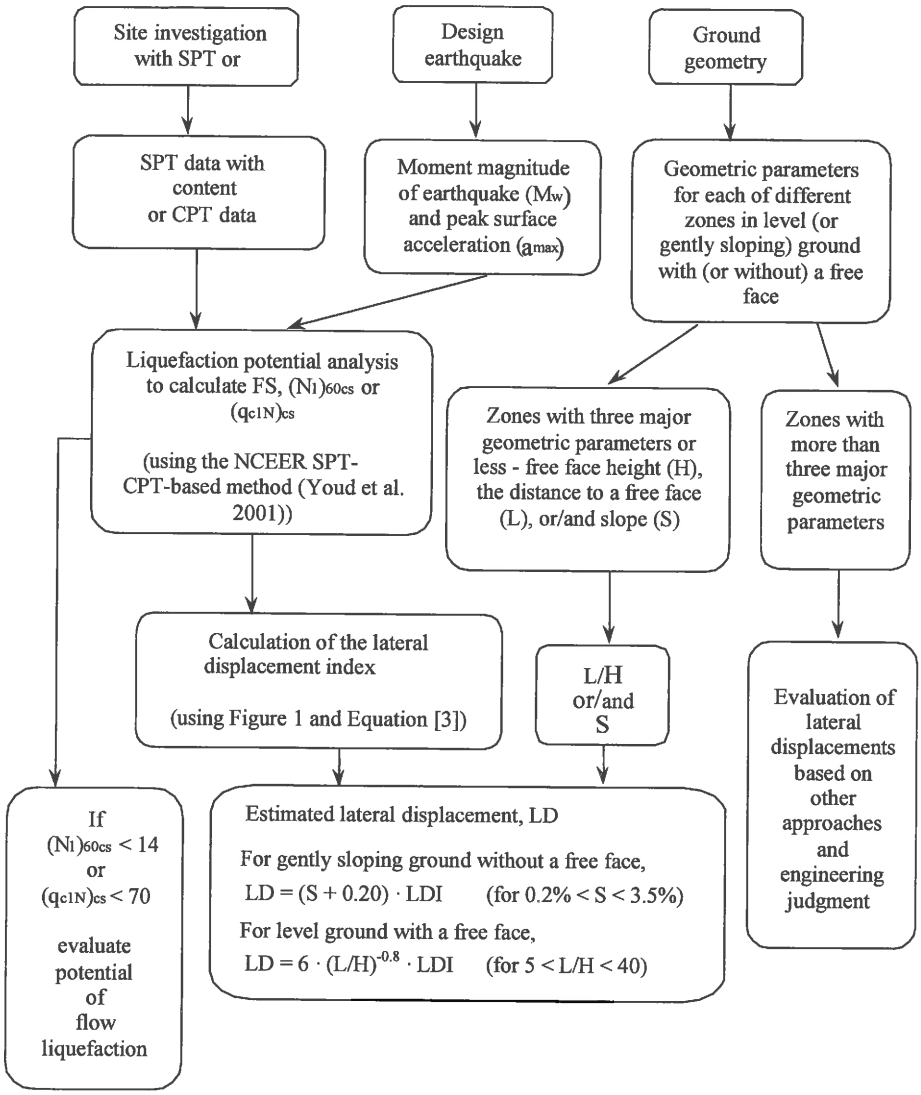
Procedure for the evaluation of soil liquefaction resistance (all soils)

Calculation of soil resistance against liquefaction is performed according to the Robertson & Wride (1998) procedure. This procedure used in the software, slightly differs from the one originally published in NCEER-97-0022 (Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils). The revised procedure is presented below in the form of a flowchart[1]:

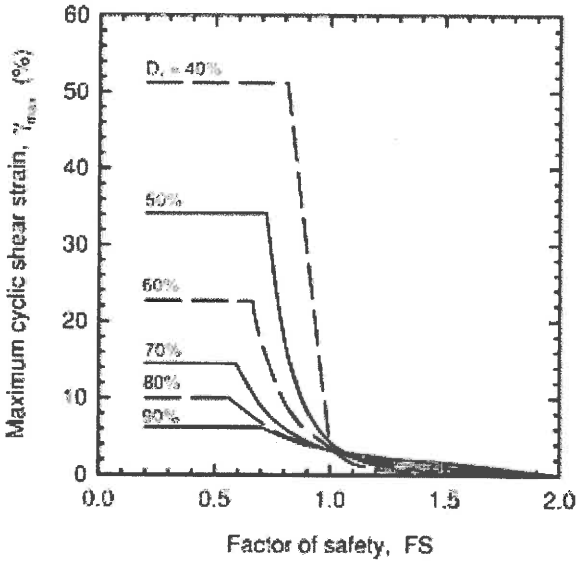


[1] P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering – from case history to practice, IS-Tokyo, June 2009

Procedure for the evaluation of liquefaction-induced lateral spreading displacements



[1] Flow chart illustrating major steps in estimating liquefaction-induced lateral spreading displacements using the proposed approach



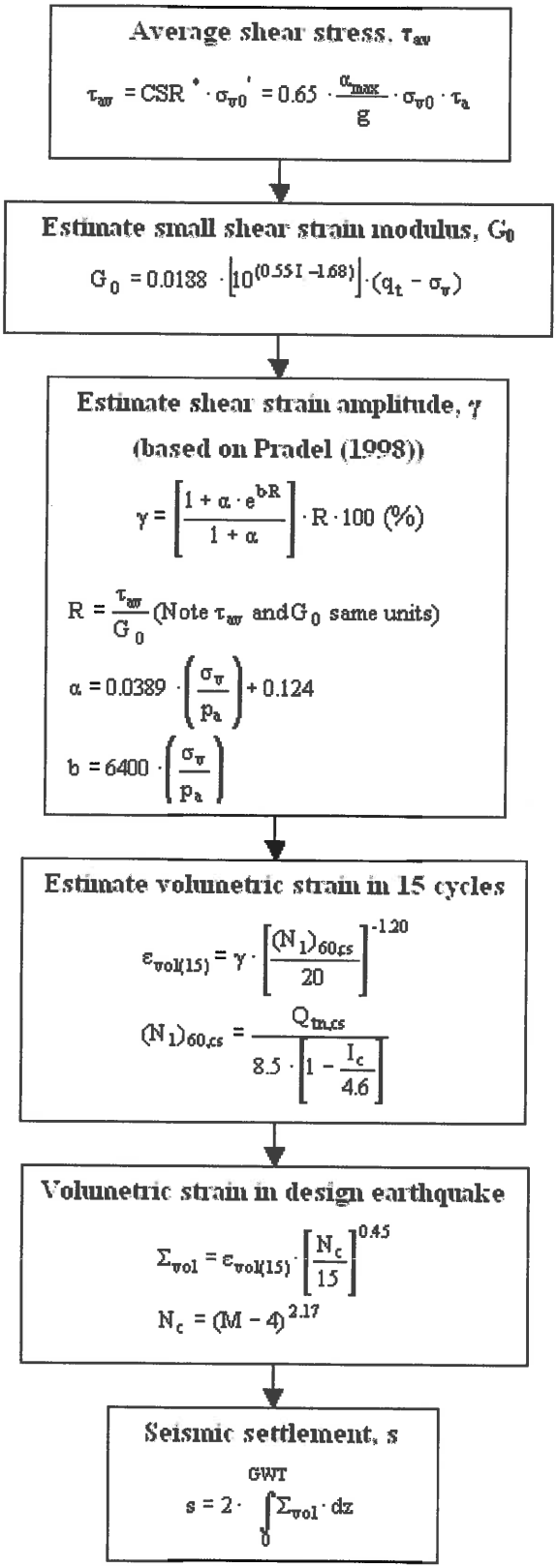
[1] **Figure 1**

$$LDI = \int_0^{Z_{max}} \gamma_{max} dz$$

[1] **Equation [3]**

[1] "Estimating liquefaction-induced ground settlements from CPT for level ground", G. Zhang, P.K. Robertson, and R.W.I. Brachman

Procedure for the estimation of seismic induced settlements in dry sands



Robertson, P.K. and Lisheng, S., 2010, "Estimation of seismic compression in dry soils using the CPT" FIFTH INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN GEOTECHNICAL EARTHQUAKE ENGINEERING AND SOIL DYNAMICS, Symposium in honor of professor I. M. Idriss, San Diego, CA

Liquefaction Potential Index (LPI) calculation procedure

Calculation of the Liquefaction Potential Index (LPI) is used to interpret the liquefaction assessment calculations in terms of severity over depth. The calculation procedure is based on the methology developed by Iwasaki (1982) and is adopted by AFPS.

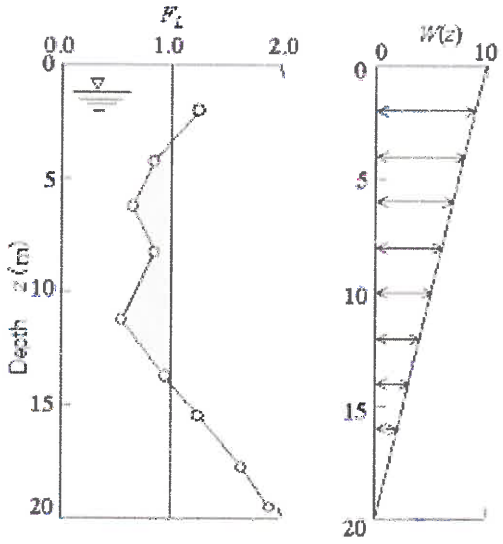
To estimate the severity of liquefaction extent at a given site, LPI is calculated based on the following equation:

$$\mathbf{LPI} = \int_0^{20} (10 - 0{,}5z) \times F_L \times dz$$

where:
F_L = 1 - F.S. when F.S. less than 1
F_L = 0 when F.S. greater than 1
z depth of measurment in meters

Values of LPI range between zero (0) when no test point is characterized as liquefiable and 100 when all points are characterized as susceptible to liquefaction. Iwasaki proposed four (4) discrete categories based on the numeric value of LPI:

- LPI = 0 : Liquefaction risk is very low
- 0 < LPI <= 5 : Liquefaction risk is low
- 5 < LPI <= 15 : Liquefaction risk is high
- LPI > 15 : Liquefaction risk is very high



Graphical presentation of the LPI calculation procedure

References

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- Robertson, P.K. and Cabal, K.L., 2007. Guide to Cone Penetration Testing for Geotechnical Engineering. Available at no cost at http://www.geologismiki.gr/
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- Zhang, G., Robertson. P.K., Brachman, R., 2002, Estimating Liquefaction Induced Ground Settlements from the CPT, Canadian Geotechnical Journal, 39: pp 1168-1180
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- Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, ASCE, Journal of Geotechnical & Geoenvironmental Engineering, Vol. 124, No. 4, 364-368
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- P.K. Robertson, 2009, Interpretation of Cone Penetration Tests - a unified approach., Canadian Geotechnical Journal, Vol. 46, No. 11, pp 1337-1355
- P.K. Robertson, 2009. "Performance based earthquake design using the CPT", Keynote Lecture, International Conference on Performance-based Design in Earthquake Geotechnical Engineering - from case history to practice, IS-Tokyo, June 2009
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APPENDIX F

APPENDIX F

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1.0 General

1.1 Intent: These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 Geotechnical Consultant: Prior to commencement of work, the owner shall employ a geotechnical consultant. The geotechnical consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed

immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation: In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas: All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General: Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import: If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers: Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning: Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

4.3 Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

4.5 Compaction Testing: Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing: Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum 90 percent of maximum from 1 foot above the top of the conduit to the surface, except in traveled ways (see Section 7.6 below).

7.3 Jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

7.4 Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.5 Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

7.6 Trench backfill in the upper foot measured from finish grade within existing or future traveled way, shoulder, and other paved areas (or areas to receive pavement) should be placed to a minimum 95 percent relative compaction.

APPENDIX G

APPENDIX G

California Environmental Quality Act (CEQA)
Geology and Soils

a) Would the project expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	*Potentially Significant Impact*	*Less than Significant With Mitigation Incorporation*	*Less than Significant Impact*	*No Impact*
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42?	☐	☐	☒	☐

The site is not located within a fault-rupture hazard zone as defined by the Alquist-Priolo Special Studies Zones Act (CDMG, 1999. Evidence of active faulting was also not observed during our site exploration conducted in May 2012. Based on mapping by the State of California (Jennings, 1994), there are no active faults mapped at the site. Based on the USGS (2002/2008), the closest active faults to the site are the Palos Verdes Fault located 3.0 kilometers (1.9 miles) west of the site and the Newport Inglewood Fault located 9.4 kilometers (5.8 miles) east of the site. Therefore, the potential for primary ground rupture is considered less than significant.

ii) Strong seismic ground shaking?	*Potentially Significant Impact*	*Less than Significant With Mitigation Incorporation*	*Less than Significant Impact*	*No Impact*
	☐	☐	☒	☐

The primary seismic hazard for the site is ground shaking due to a future earthquake on one of the major regional active faults, such as the Palos Verdes, Newport Inglewood, Santa Monica, Malibu Coast, Puente Hills Faults, and many other regionally active faults. The site will undergo strong seismic shaking during an earthquake event on a regionally active fault; however, the potential for structural damage at the site due to strong seismic ground shaking will be mitigated by structural design in accordance with the geotechnical report recommendations, the 2010 California Building Code (CBC), and grading practice in accordance with the City of Hermosa Beach and the County of Los Angeles. Therefore, with the design of the proposed project in accordance with the geotechnical recommendations, the 2010 CBC and the grading/building standards of the City of Hermosa Beach and County of Los Angeles, the potential for seismically induced structural damage will be less than significant.

iii) Seismic-related ground failure, including liquefaction?	*Potentially Significant Impact*	*Less than Significant With Mitigation Incorporation*	*Less than Significant Impact*	*No Impact*
	☐	☐	☒	☐

The site is not located within an area of potential liquefaction, as mapped by the State of California (CDMG, 1998 and 1999). Based on the dense native sand dune deposits and the depth to groundwater at the completion of grading, the liquefaction potential is considered to be less than significant. There is a potential for seismic settlement of the dry landfill material that will be left in place locally at the site. After removal of the upper 15 feet of landfill, the remaining landfill material could settle on the order of 3.5 inches during a future large earthquake. Therefore, ground improvements and/or deep foundations are recommended for structures that are sensitive to settlements.

iv) Landslides?	*Potentially Significant Impact*	*Less than Significant With Mitigation Incorporation*	*Less than Significant Impact*	*No Impact*
	☐	☐	☐	☒

The site is relatively flat. There are no landslides mapped at the site. Landslides were not observed during site explorations at the site. Therefore, no impact related to landslides will occur.

b) Would the project result in substantial soil erosion or the loss of topsoil?	*Potentially Significant Impact*	*Less than Significant With Mitigation Incorporation*	*Less than Significant Impact*	*No Impact*
	☐	☐	☒	☐

The site currently is developed as a City Maintenance Yard and no portions are in the native conditions. The project plans indicate that the planned development will result in engineered fill at the completion of grading at the site. The site will consist of paved areas and structures. The potential for soil erosion of the loss of topsoil is considered a less than significant impact.

c) Would the project be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
	☐	☐	☒	☐

There are no landslides mapped at the site and the project plan shows relatively level building pads, so slope stability is not an issue for the completed project. . There will be temporary excavations made around the perimeter of the site in order to remove the upper 15 feet of the landfill. These excavations will be provided with shoring designed by the Shoring Engineer with input from the Geotechnical Engineer. The potential for on- or off-site landsliding is considered less than significant.

The site is not located within an area of potential liquefaction, as mapped by the State of California (CDMG, 1998 and 1999). Based on the dense native alluvial soils and the depth to groundwater at the completion of grading, the potential for lateral spreading and liquefaction is considered to be less than significant.

There is a potential for seismic settlement of the landfill materials to be left in place, up to 3.5 inches. The structures that are sensitive to settlements will be protected from these settlements by either ground improvements or deep foundations. The potential for on- or off-site seismic settlements is considered to be less than significant provided the recommendations in the geotechnical report are implemented during grading and construction.

Based on laboratory testing, the in-place native soil has high dry density and low compressibility. The recommended remedial earthwork includes removal of the upper 15 feet of landfill material and replacement with engineered fill. Due to the soil characteristics of the in-place native soils and engineered fill, collapse of the soil material is considered less than significant for the majority of the site. Collapse potential for the landfill material that is left in place is considered slight to moderate. The potential for on- or off-site seismic settlements is considered to be less than significant provided the recommendations in the geotechnical report are implemented during grading and construction.

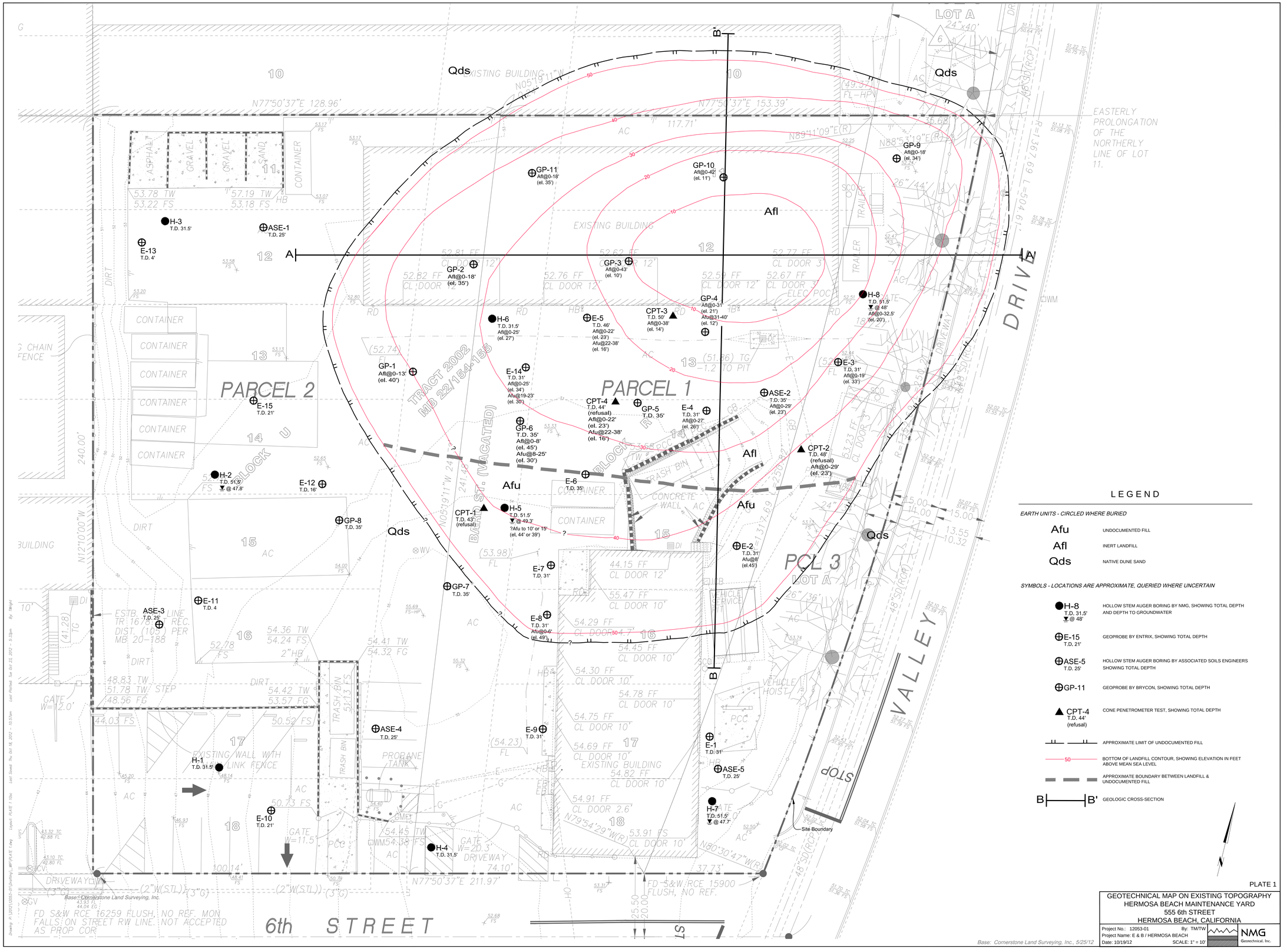
Note that the topics of regional settlement due to oil extraction and regional seismicity potentially due to produced water injection are being addressed in the technical report prepared by GeoSyntec. These issues are beyond the scope of this geotechnical work.

d) Would the project be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	*Potentially Significant Impact*	*Less than Significant With Mitigation Incorporation*	*Less than Significant Impact*	*No Impact*
	☐	☐	☐	☒

Site specific laboratory testing of earth material which would be utilized for engineered fill at the site indicates an expansion potential of "Very Low" to "Low" category. If soil material is imported to the site from other sources, it shall have similar soil characteristics ("very low" expansion potential and granular nature). Therefore, there is no potential impact as a result of expansive soil.

e) Would the project have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	*Potentially Significant Impact*	*Less than Significant With Mitigation Incorporation*	*Less than Significant Impact*	*No Impact*
	☐	☐	☐	☒

We understand the site will be served by sanitary sewer and will not require the use of septic tanks or alternative waste water disposal systems. Therefore, this issue is considered no impact.



LEGEND

EARTH UNITS - CIRCLED WHERE BURIED

Afu	UNDOCUMENTED FILL
Afl	INERT LANDFILL
Qds	NATIVE DUNE SAND

SYMBOLS - LOCATIONS ARE APPROXIMATE, QUERIED WHERE UNCERTAIN

●H-8 T.D. 31.5' ▼@ 48'	HOLLOW STEM AUGER BORING BY NMG, SHOWING TOTAL DEPTH AND DEPTH TO GROUNDWATER
⊕E-15 T.D. 21'	GEOPROBE BY ENTRIX, SHOWING TOTAL DEPTH
⊕ASE-5 T.D. 25'	HOLLOW STEM AUGER BORING BY ASSOCIATED SOILS ENGINEERS SHOWING TOTAL DEPTH
⊕GP-11	GEOPROBE BY BRYCON, SHOWING TOTAL DEPTH
▲CPT-4 T.D. 44' (refusal)	CONE PENETROMETER TEST, SHOWING TOTAL DEPTH
	APPROXIMATE LIMIT OF UNDOCUMENTED FILL
50	BOTTOM OF LANDFILL CONTOUR, SHOWING ELEVATION IN FEET ABOVE MEAN SEA LEVEL
	APPROXIMATE BOUNDARY BETWEEN LANDFILL & UNDOCUMENTED FILL
B B'	GEOLOGIC CROSS-SECTION

PLATE 1

GEOTECHNICAL MAP ON EXISTING TOPOGRAPHY
HERMOSA BEACH MAINTENANCE YARD
555 6th STREET
HERMOSA BEACH, CALIFORNIA

Project No.: 12053-01 By: TM/TW
Project Name: E & B / HERMOSA BEACH
Date: 10/19/12 SCALE: 1" = 10'

NMG Geotechnical, Inc.

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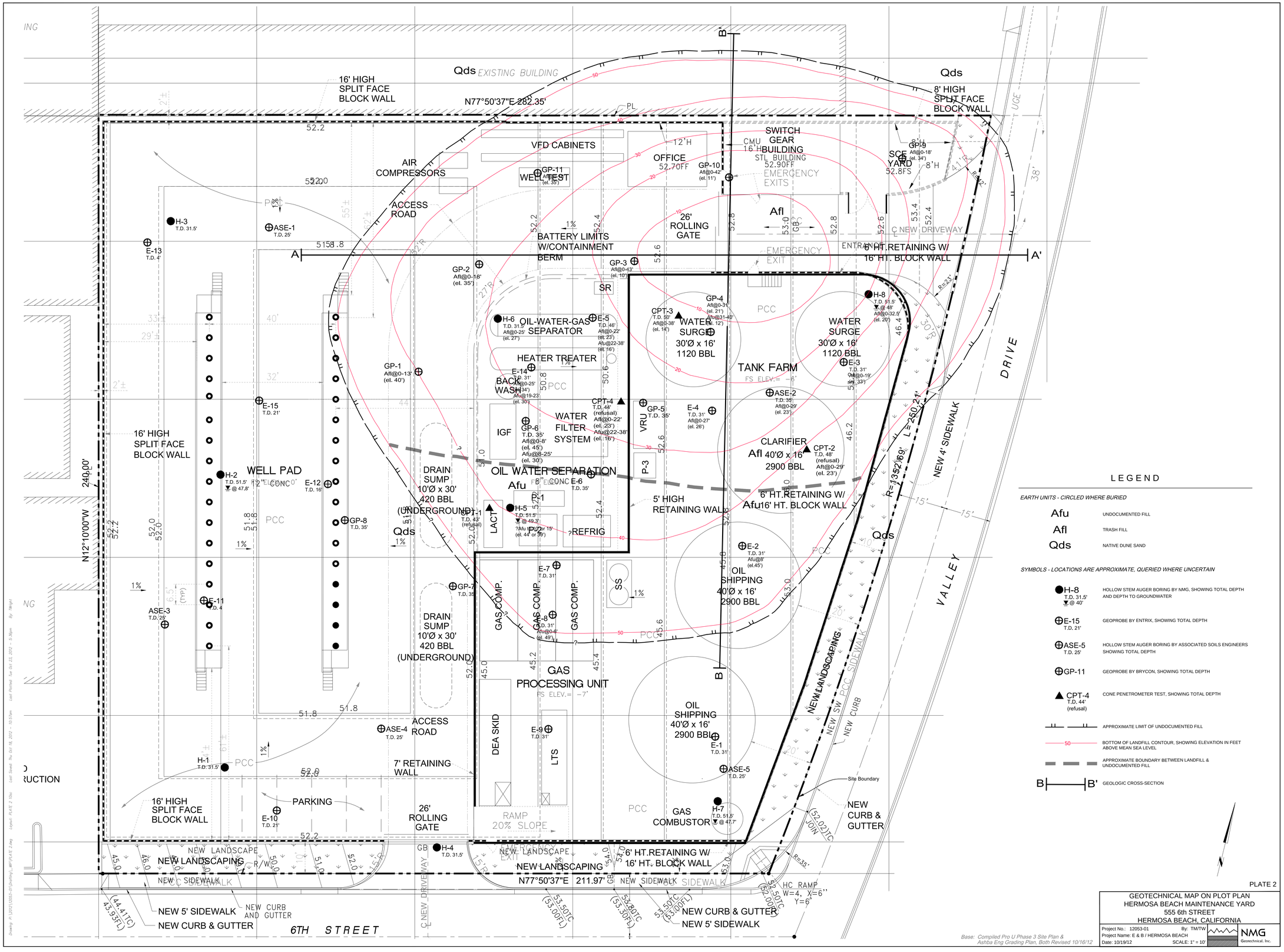

Base: Compiled Pro U Phase 3 Site Plan & Ashba Eng Grading Plan, Both Revised 10/16/12

PLATE 2

GEOTECHNICAL MAP ON PLOT PLAN
HERMOSA BEACH MAINTENANCE YARD
555 6th STREET
HERMOSA BEACH, CALIFORNIA

Project No.: 12053-01 By: TM/TW
Project Name: E & B / HERMOSA BEACH
Date: 10/19/12 SCALE: 1" = 10'

NMG Geotechnical, Inc.

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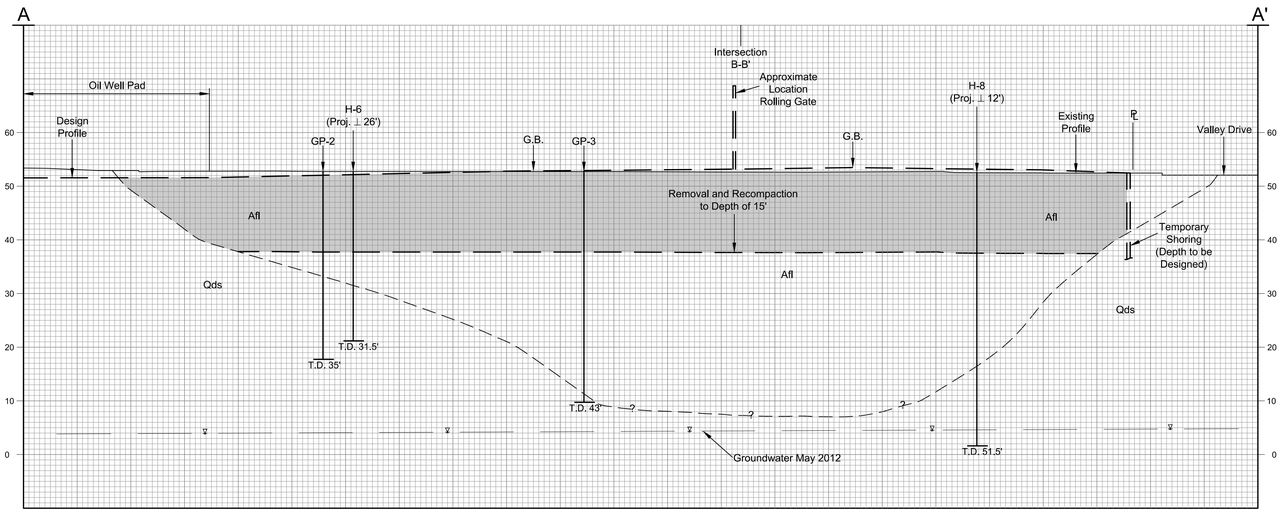
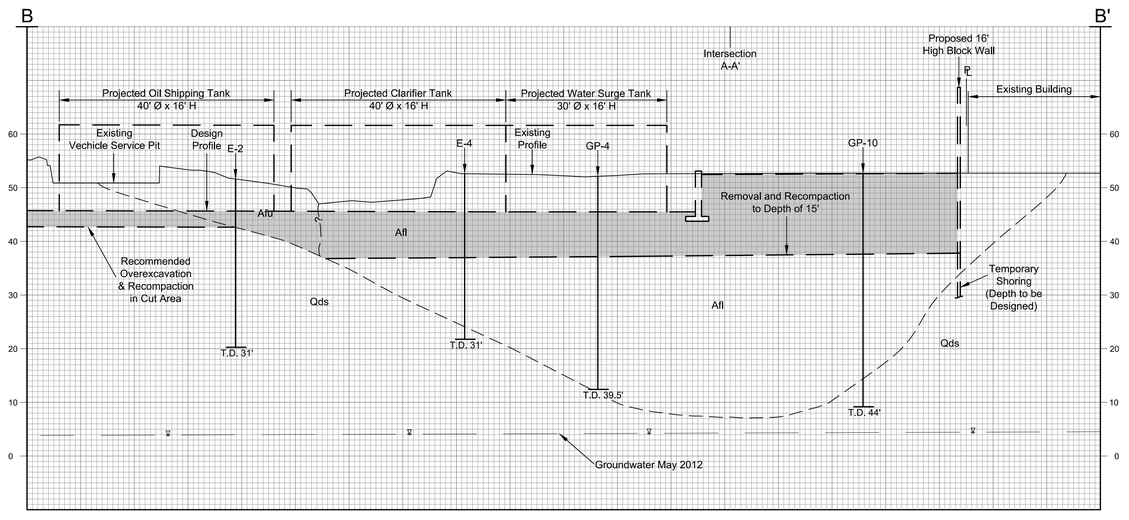


N 73° E



N 13° W

PLATE 3

CROSS SECTIONS A-A' & B-B'	Project No.: 12053-01 By: TM/TW Project Name: E & B / HERMOSA BEACH Date: 10/19/12 SCALE: 1" = 10'	NMG Geotechnical, Inc.

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