GEOTECHNICAL INVESTIGATION
SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

PREPARED FOR:
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11455 El Camino Real, #200
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PREPARED BY:
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May 31, 2012
Project No. 2012015

NOVA

Mr. Jerry Gammieri
Vice President of Construction/Development
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11455 El Camino Real #200
San Diego, California 92130

May 31, 2012
Project No. 2012015

Subject: Geotechnical Investigation
Solana 101 Mixed Use Project
Highway 101 and Dahlia Drive
Solana Beach, California

Dear Mr. Gammieri:

In accordance with your authorization, we have prepared this geotechnical investigation report for the Solana 101 Mixed Use Project in the City of Solana Beach, California. This report presents our geotechnical findings, conclusions, and recommendations regarding the proposed development.

We appreciate the opportunity to be of service on this project.

Respectfully submitted,
NOVA Services, Inc.

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1. INTRODUCTION

In accordance with our proposal dated March 9, 2012, we have prepared this geotechnical investigation report for the design of the Solana 101 Mixed Use Project to be located on the north-west corner of Highway 101 and Dahlia Drive, in Solana Beach, California. This report presents the results of our background review, subsurface evaluation, laboratory testing, geotechnical analyses, conclusions regarding the geotechnical conditions at the subject site, and recommendations for design and construction.

2. SCOPE OF SERVICES

Our scope of services for this project included review of pertinent background data, performance of a geologic reconnaissance and subsurface evaluation, and engineering analysis with regard to the proposed project. Specifically, we performed the following tasks:

- Reviewing background data listed in the References section of this report. The data reviewed included geotechnical reports, topographic maps, geologic data, fault maps, and a site plan for the project.
- Obtaining County of San Diego Department of Environmental Health (DEH) boring permits. Work was conducted under DEH boring permit LMON108422.
- Marking the boring locations for utility clearance. Underground Service Alert (USA) was notified and a private utility locator marked the existing underground utilities at the boring locations.
- Performing a geologic reconnaissance of the site, including the observation of geologic conditions and the evaluation of possible geologic hazards, which may impact the proposed project.
- Performing a subsurface exploration consisting of drilling, logging, and sampling of eight exploratory soil borings to evaluate subsurface conditions.
- Performing geotechnical laboratory testing on selected soil samples.
- Compiling and analyzing the data obtained from our research, subsurface exploration, and laboratory testing.
- Preparing this report presenting our findings, conclusions, and recommendations regarding the design and construction of the project.

3. SITE AND PROJECT DESCRIPTION

The subject site is located on five parcels with an approximate area of 1.9 acres bounded by Highway 101 to the east, Dahlia Drive to the south, Sierra Avenue to the west and existing commercial development to the north in the Solana Beach, California as shown in Figure 1, Site Location Map. The five parcels are currently occupied by one-story office, retail and residential buildings and a trailer park on the northern portion of the site. Current surface elevation at the site varies from El. 61 to 68 feet above mean sea level (msl). Vegetation at the site consists of isolated trees and grass.

Based on our review of preliminary plans prepared by Hanna Gabriel Wells Architects, the proposed development consists of two- to three-story residential, retail and office structures with two levels of underground parking extending to El. 39 feet (msl). It is anticipated that the buildings will include conventional wood, masonry and/or steel frame structures with concrete underground parking. The underground parking excavation will be shored with temporary soldier beams and tiebacks.

4. SUBSURFACE EXPLORATION AND LABORATORY TESTING

Our subsurface exploration was conducted on April 14, 2012. The exploration consisted of drilling, logging, and sampling of eight exploratory borings to maximum depths of approximately 50½ feet below existing ground surface at the locations shown in Figure 2, Boring Location Map. The borings were used to evaluate subsurface conditions and collect relatively undisturbed and bulk soil samples at selected depths for laboratory testing. The borings were drilled using a truck-mounted, 6-inch diameter hollow-stem auger equipped drill rig and were backfilled with bentonite grout. Logs of the borings are included in Appendix A.

Laboratory testing of representative soil samples included in-situ dry density and moisture content, gradation, Atterberg limits, expansion index, consolidation, direct shear, Proctor density, and soil corrosivity. The results of the in-situ dry density and moisture content tests are presented on the boring logs in Appendix A. The results of the other laboratory tests performed are presented in Appendix B.

5. GEOLOGY AND SUBSURFACE CONDITIONS

Our discussion of the geologic conditions at the site is based on our current field exploration and review of available geotechnical and geologic literature. Our findings regarding regional and local geology, including faulting and seismicity, and groundwater conditions at the subject site are provided in the following sections.

5.1. Regional Geologic Setting

The project area is located in the western San Diego County portion of the Peninsular Ranges Geomorphic Province. This geomorphic province encompasses an area that extends approximately 900 miles from the Transverse Ranges and the Los Angeles Basin south to the southern tip of Baja California (Norris and Webb, 1990). The province varies in width from approximately 30 to 100 miles. In general, the province consists of rugged mountains underlain by Jurassic metavolcanic and metasedimentary rocks, and Cretaceous igneous rocks of the southern California batholith. In the coastal portion of the province in San Diego County that includes the project area, the metamorphic and granitic basement rocks are overlain by sedimentary materials that are Cretaceous, Tertiary, and Quaternary age. The regional geology in the vicinity of the project area is presented Figure 3, Regional Geologic Map.

The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending roughly northwest. Several of these faults, which are shown on Figure 4, are considered active faults. The Whittier–Elsinore, and San Jacinto faults are active fault systems located northeast of the project area and the Rose Canyon, Agua Blanca–Coronado Bank and San Clemente faults are active faults located west of the project area. Major tectonic activity associated with these and other faults within this regional tectonic framework consists primarily of right-lateral, strike-slip movement. Further discussion of faulting relative to the site is provided in the Faulting and Seismicity section of this report.

5.2. Site Geology

Geologic units encountered during our subsurface evaluation included surficial soils consisting of undocumented fill overlying late to middle Pleistocene-age Old Paralic Deposits. A geologic cross-section of the project area is presented in Figure 5. The following sections provide generalized descriptions of the materials encountered. Detailed descriptions are provided in Appendix A.

5.2.1. Artificial Fill - Undocumented (Afu)

Artificial fill materials were encountered at the existing surface or directly underneath the existing pavement section, extending to maximum depths of 7 feet below existing ground surface (bgs). The artificial fill consists of light to dark brown, damp to moist, loose to medium dense, sand and silty sand. Documentation regarding the placement of the artificial fill is currently unavailable.

5.2.2. Old Paralic Deposits – Unit 6 (Qop6)

Old Paralic Deposits – Unit 6, late to middle Pleistocene (Kennedy and Tan, 2008) materials were encountered underlying fill in our exploratory borings, extending to the maximum exploration depth of 50½ feet bgs. Old Paralic deposit materials consist generally of light brown to reddish brown, damp to moist, weakly to moderately cemented, weathered, friable, silty sandstone. The Old Paralic Deposits are considered suitable for support of the proposed structures.

5.3. Groundwater

Groundwater was not encountered during our subsurface exploration. However, groundwater was encountered at a depth of 25 to 30 feet bgs at a site located 0.4 miles north of the project (SCS Engineers, 2010). Based on available historical data, we recommend a design groundwater level at El. 42 msl. Fluctuations in the groundwater level may occur due to variations in ground surface topography, subsurface geologic conditions and structure, rainfall, irrigation, and other factors.

5.4. Expansion Potential

Based on our observations and the results of the laboratory testing, the existing fill and formation exhibit very low expansion potential. Expansive soils are not anticipated at the site.

5.5. Rippability

The on-site materials are expected to be rippable with heavy-duty earthmoving equipment in good work condition. However, cemented zones or concretions have been observed at excavations for similar construction in this area and some difficult excavation should be anticipated.

6. FAULTING AND SEISMICITY

The subject site is not located within a State of California Earthquake Fault Zone (formerly known as an Alquist-Priolo Special Studies Zone, Hart and Bryant, 1997). However, the site is located in a seismically active area, as is the majority of southern California, and the potential for strong ground motion in the project area is considered significant during the design life of the proposed structure. As noted, Figure 4 shows the approximate site location relative to the major faults in the region. The active Rose Canyon fault is located approximately 2.3 miles west of the site. Table 1 lists selected principal known active faults that may affect the subject site, the approximate fault-to-site distances and the maximum moment magnitude (M_{max}) as published by the 2008 USGS National Seismic Hazard Maps webpage (USGS, 2008).

Table 1 – Principal Active Faults

Fault	Approximate Fault-to-Site Distance[1] miles (kilometers)	Maximum Moment Magnitude [2] (M_{max})
Rose Canyon	2.3 (3.7)	6.9
Newport-Inglewood (Offshore)	14.8 (23.8)	7.0
Coronado Bank	16.7 (26.9)	7.4
Elsinore (Temecula Segment)	28.7 (46.2)	7.1
Earthquake Valley	41.8 (67.3)	6.8
Palos Verdes	42.5 (68.4)	7.3

Notes:
[1] USGS, 2008
[2] Ellsworth Relation, USGS (2008)

The principal seismic hazards at the subject site are surface fault rupture and ground motion, liquefaction, seismically induced settlement, seiches and tsunamis. A brief description of these and other hazards and the potential for their occurrence on site are discussed below.

6.1. Surface Fault Rupture

Based on our review of the referenced literature and our site reconnaissance, no active faults are known to cross the project site. Therefore, the probability of damage from surface fault

rupture is considered to be low. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

6.2. Strong Ground Motion

The 2010 California Building Code (CBC) recommends that the design of structures be based on the horizontal peak ground acceleration (PGA) having a 2 percent probability of exceedance in 50 years which is defined as the Maximum Considered Earthquake (MCE). The statistical return period for PGA_{MCE} is approximately 2,475 years. The USGS National Seismic Hazards Mapping (2008) website was used to perform a probabilistic seismic analysis to estimate the potential peak ground acceleration (PGA) at the site. The analysis was conducted using next generation attenuation relationships from Boore-Atkinson (2008), Campbell-Bozorgnia (2008) and Chiou-Youngs (2008). According to the results of our field investigation and 2010 CBC guidelines, the applicable Site Class is C consisting of a very dense soil and soft rock profile with average shear wave velocity in the upper 100 feet between 1,200 ft/s and 2,500 ft/s. Based on the probabilistic analysis, the PGA with 2 percent probability of exceedance in 50 years is 0.49 g.

6.3. Liquefaction

Liquefaction is the phenomenon in which loosely deposited granular soils with silt and clay contents of less than approximately 35 percent and non-plastic silts located below the water table undergo rapid loss of shear strength when subjected to strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to a rapid rise in pore water pressure, and causes the soil to behave as a fluid for a short period of time. Based on the dense nature of the formational materials onsite and the absence of groundwater, the liquefaction potential at the project site is considered negligible.

6.4. Flooding, Seiches and Tsunamis

Based on our review of the relevant FEMA (1997) flood map, the site is not within the 100-year flood zone. Seiches are standing wave oscillations of an enclosed water body after the original driving force has dissipated. The potential for the site to be adversely impacted by earthquake-induced seiches is considered to be negligible due to the distance to enclosed bodies of water. Tsunamis are seismic sea waves with a long wavelength (long compared to the ocean depth) generated by sudden movements of the ocean bottom during earthquakes, landslides, or volcanic activity. According to the Tsunami Inundation Map – Del Mar Quadrangle (USGS, 2009), the site is not within the potential tsunami inundation area.

7. CONCLUSIONS

Based on the results of our subsurface evaluation, laboratory testing, and data analysis, construction of the proposed structures is feasible from a geotechnical standpoint, provided the recommendations of this report are incorporated in the design and construction of the project. Geotechnical considerations include the following:

- We understand that the proposed building will have two levels of underground parking. Consequently, excavations to approximately 30 feet below existing grade will be performed. Considering the depths of excavations and presence of existing buildings and utilities in close proximity, temporary shoring will be utilized during construction of the project.

- Due to the relatively close proximity of existing structures, the potential for distress to nearby structures will be a construction consideration in some areas. We recommend that an evaluation of potentially at-risk structures be performed prior to the start of the excavation work and monitoring be performed during excavation operations. Appropriate instrumentation and monitoring recommendations are presented in Section 8 of this report.

- The site is underlain by undocumented fill and Old Paralic Deposits.

- Groundwater was not encountered during our subsurface exploration. However, based on available historical data, a design groundwater level at El. 42 (msl) is recommended for the project.

- In general, the on-site materials are suitable for reuse as compacted fill, and are considered generally excavatable with conventional, heavy-duty earth moving construction equipment. However, contaminated soil or fill with abundant debris should not be used as compacted fill.

- Cemented zones may be encountered in native soils at the site and difficult excavations should be anticipated.

- Based on the Caltrans (2003) corrosion criteria, the project site would not be classified as a corrosive site.

- Based on the evidence presented herein, it is our opinion that active or potentially active faults do not cross the subject property.

- The potential for strong ground motions to occur at the site is significant. Accordingly, the potential for strong seismic accelerations should be considered in the design of proposed improvements.

8. RECOMMENDATIONS

Based on our review of the preliminary plans, the following recommendations are presented for the anticipated improvements associated with the project. Our office should review the detailed project plans once they are available and provide additional recommendations, if needed.

8.1. Earthwork and Site Preparation

In general, earthwork should be performed in accordance with the recommendations presented in this report. NOVA should be contacted for questions regarding the recommendations or guidelines presented herein.

8.1.1. Site Preparation

Site preparation should begin with the removal of vegetation, utility lines, asphalt, concrete, surficial soil, and deleterious materials from areas to be graded. Tree stumps, roots, and other organic material should be removed from the site. Debris and unsuitable material generated during clearing and grubbing should be removed and disposed of at a legal dumpsite.

8.1.2. Removals

We recommend unsuitable materials such as organic matter or oversized material be selectively removed and disposed of offsite. The extent and depths of removals should be evaluated by NOVA's representative in the field based on the materials exposed.

8.1.3. Excavation Characteristics

Our evaluation of the excavation characteristics of the on-site materials is based on the results of our exploration and experience with similar materials. In our opinion, the on-site materials are generally expected to be excavatable with conventional heavy-duty earthmoving equipment. Buried utilities and slabs may be difficult to excavate in some areas.

8.1.4. Materials for Fill

Clean on-site soils with an organic content of less than 3 percent by volume (or 1 percent by weight) are suitable for use as fill. Soil material to be used as fill should not contain contaminated materials, rocks, or lumps over 4 inches in largest dimension, and not more than 40 percent larger than 3/4 inch. Utility trench backfill material should not contain rocks or lumps over 3 inches in largest dimension. Larger chunks, if generated during excavation, may be broken into acceptably sized pieces or disposed of offsite. Any imported fill material should be a low or very low expansion potential (Expansion Index of 50 or less) granular soil with a plasticity index of 12 or less. Import material should also have low corrosion potential (chloride content less than 500 parts per million [ppm], soluble sulfate content of less than 0.1 percent, and pH of 5.5 or more). Materials for use as fill should be evaluated by a NOVA representative prior to filling or importing.

8.1.5. Compacted Fill

Prior to placement of compacted fill, the contractor should request an evaluation of the exposed ground surface by NOVA. Unless otherwise recommended, the exposed ground surface should then be scarified to a depth of approximately 8 inches and watered or

dried, as needed, to achieve generally consistent moisture contents at or near the optimum moisture content. The scarified materials should then be compacted to 90 percent relative compaction in accordance with ASTM Test Method D1557. The evaluation of compaction by NOVA should not be considered to preclude any requirements for observation or approval by governing agencies. It is the contractor's responsibility to notify NOVA and the appropriate governing agency when project areas are ready for observation, and to provide reasonable time for that review.

Fill materials should be moisture conditioned to near optimum moisture content prior to placement. The optimum moisture content will vary with material type and other factors. Moisture conditioning of fill soils should be generally consistent within the soil mass. Prior to placement of additional compacted fill material following a delay in the grading operations, the exposed surface of previously compacted fill should be prepared to receive fill. Preparation may include scarification, moisture conditioning, and recompaction.

Compacted fill should be placed in horizontal lifts of approximately 8 inches in loose thickness. Prior to compaction, each lift should be watered or dried as needed to achieve near optimum moisture condition, mixed, and then compacted by mechanical methods, using sheepsfoot rollers, multiple-wheel pneumatic-tired rollers, or other appropriate compacting rollers, to a relative compaction of 90 percent as evaluated by ASTM D1557. Successive lifts should be treated in a like manner until the desired finished grades are achieved.

8.1.6. Excavation and Shoring

We recommend that trenches and excavations be designed and constructed in accordance with Occupational Safety and Health Administration (OSHA) regulations. These regulations provide trench sloping and shoring design parameters for trenches up to 20 feet deep based on a description of the soil types encountered. Trenches over 20 feet deep should be designed by the Contractor’s engineer based on site-specific geotechnical analyses. For planning purposes, we recommend that the following OSHA soil classifications be used:

Fill	*Type C*
Old Paralic Deposits	*Type C*

Upon making the excavations, the soil classifications and excavation performance should be evaluated in the field by NOVA in accordance with OSHA regulations. For trench or other temporary excavations, OSHA requirements regarding personnel safety should be met by laying back the slopes no steeper than 1.5:1 (horizontal:vertical) for fill and Old Paralic Deposits material. Temporary excavations that encounter seepage may be stabilized by placing sandbags or gravel along the base of the seepage zone. Excavations encountering seepage should be evaluated on a case-by-case basis. As an alternative to laying back the

side walls, the excavations may be shored or braced. Temporary earth retaining systems will be subjected to lateral loads resulting from earth pressures as shown on Figure 6. The design of the earth pressure diagram assumes that spoils from the excavation or other surcharge loads will not be placed above the excavation within a 1:1 plane extending up and back from the excavation. If spoil piles are placed closer than this to the braced excavation, the resulting surcharge loads should be considered in the bracing design.

We anticipate that settlement of the ground surface will occur behind the shoring wall during excavation. The amount of settlement depends heavily on the type of shoring system, the contractor's workmanship, and soil conditions. We recommend that structures/improvements in the vicinity of the planned shoring installation be reviewed with regard to foundation support and tolerance to settlement. To reduce the potential for distress to adjacent structures, we recommend that the shoring system be designed to limit ground settlement behind the shoring system to 0.5 inches or less. We recommend that an experienced structural engineer design the shoring systems. The shoring parameters presented in this report should be considered as guidelines.

We recommend that excavated areas be backfilled as soon as practicable. The stability of the excavations decreases over time as the soil dries and weathers. On-site safety of personnel is the responsibility of the contractor.

8.1.7. Ground Surface Settlement

We also recommend an array of ground survey points be installed to monitor settlement. The survey points should be installed on the shoring system and incrementally away from the excavation. The contractor should be responsible for maintaining the total settlement beneath adjacent buildings to less than 1/2 inch. If settlements reach 1/4 inch, we recommend that a review of the contractor's methods be performed and appropriate changes be made, if needed.

Consideration should be given to placing survey monitoring points on nearby structures to monitor the performance of the structures. In this way, a record of the performance of the structure will be maintained and available. This information, in conjunction with preconstruction surveys, is helpful in reducing potential claims and expediting and limiting settlement of legitimate claims.

8.1.8. Construction Dewatering

Although not anticipated, the contractor should evaluate appropriate dewatering measures during excavation operations. Considerations for construction dewatering should include anticipated drawdown, volume of pumping, potential for settlement, and

groundwater discharge. Disposal of groundwater should be performed in accordance with guidelines of the Regional Water Quality Control Board.

8.1.9. Excavation Bottom Stability

In general, we anticipate that the bottom of the excavation will be stable and should provide suitable support to the proposed building. Excavations that are close to or below the water table (if encountered) may be unstable. Unstable bottom conditions may be mitigated by overexcavation of the bottom to suitable depths and replacing with a 1-foot thick gravel or lean concrete mud mat. Any loose, soft or deleterious material should be removed prior to placement of gravel or lean concrete. Recommendations for stabilizing excavation bottoms should be based on evaluation in the field by the geotechnical consultant at the time of construction.

8.1.10. Drainage

Roof, pad, and slope drainage should be diverted away from slopes and structures to suitable discharge areas by nonerodible devices (e.g., gutters, downspouts, concrete swales, etc.). Positive drainage adjacent to structures should be established and maintained. Positive drainage may be accomplished by providing drainage away from the foundations of the structure at a gradient of 2 percent or steeper for a distance of 5 feet outside the building perimeter, and further maintained by a graded swale leading to an appropriate outlet, in accordance with the recommendations of the project civil engineer and/or landscape architect.

Surface drainage on the site should be provided so that water is not permitted to pond. A gradient of 2 percent or steeper should be maintained over the pad area and drainage patterns should be established to divert and remove water from the site to appropriate outlets.

Care should be taken by the contractor during grading to preserve any berms, drainage terraces, interceptor swales or other drainage devices on or adjacent to the property. Drainage patterns established at the time of grading should be maintained for the life of the project. The property operators should be made very clearly aware that altering drainage patterns might be detrimental to slope stability and foundation performance.

8.2. Seismic Design Parameters

Based on our understanding of the proposed structure and definitions provided in 2010 CBC, the Occupancy Category is II and the Seismic Design Category is D_2. As noted, the soil profile at the site corresponds to Site Class C consisting of a very dense soil and soft rock. Table 2 presents the seismic design parameters for the site in accordance with 2010 CBC and mapped spectral acceleration parameters (United States Geological Survey [USGS], 2011).

Table 2 – CBC Seismic Design Parameters

Factors	Values
Site Class	C
Site Coefficient, F_a	1.000
Site Coefficient, F_v	1.300
Mapped Short Period Spectral Acceleration, S_S	1.467g
Mapped One-Second Period Spectral Acceleration, S_1	0.559g
Short Period Spectral Acceleration Adjusted For Site Class, S_{MS}	1.467g
One-Second Period Spectral Acceleration Adjusted For Site Class, S_{M1}	0.727g
Design Short Period Spectral Acceleration, S_{DS}	0.978g
Design One-Second Period Spectral Acceleration, S_{D1}	0.484g

8.3. Foundations

Based on our understanding of the project, it is anticipated that the proposed structures and underground parking will be supported on conventional spread footings or a mat foundation system founded in Old Paralic Deposits. The following foundation design parameters are provided based on our preliminary analysis. The foundation design parameters are not intended to preclude differential movement of soils. Minor cracking (considered tolerable) of foundations may occur.

8.3.1. Allowable Bearing Capacity

The proposed structure may be founded on conventional spread footings or a mat foundation supported on formational material using an allowable bearing capacity of 5,000 pounds per square foot (psf). Exterior footings may be founded on a minimum 2 feet of compacted fill using an allowable bearing capacity of 2,000 pounds per square foot (psf). The allowable bearing capacities may be increased by one-third when considering loads of a short duration such as wind or seismic forces.

8.3.2. Shallow Foundations

Foundations should have an embedment depth of 24 inches or more below the lowest adjacent grade. Continuous footings should be 18 or more inches wide and spread foundations should be 24 or more inches square. Footings and mat foundations should be reinforced in accordance with the structural engineer's recommendations. From a geotechnical standpoint, we recommend that footings founded in low expansive granular materials be reinforced with four No. 4 or larger reinforcing bars, two placed near the top and two near the bottom of the footings.

8.3.3. Mat Foundations

Mat foundations typically experience some deflection due to loads placed on the mat and the reaction of the soils underlying the mat. A design coefficient of subgrade reaction, $\mathbf{K_{v1}}$, of 200 pounds per cubic inch (pci) may be used for evaluating such deflections at the subject site. This value is based on a unit square foot area and should be adjusted for the planned mat size. The coefficient of subgrade reaction $\mathbf{K_b}$ for a mat of a specific width, may be evaluated using the following equation:

$$\mathbf{K_b = K_{v1}[(b+1)/2b]^2}$$

where **b** is the width of the foundation.

8.3.4. Foundation Lateral Resistance

For resistance of foundations to lateral loads, we recommend allowable passive pressures exerted by equivalent fluid weights of 250 pounds per cubic foot (pcf) in compacted fill and 350 pcf in formational materials. This value assumes that the ground is horizontal for a distance of 10 feet or more, or three times the height generating the passive pressure, whichever is greater. We recommend that the upper 1 foot of soil not protected by pavement or a concrete slab be neglected when calculating passive resistance.

For frictional resistance to lateral loads, we recommend a coefficient of friction of 0.35 be used between soil and concrete. If passive pressure and frictional resistance are to be used in combination, we recommend that the friction coefficient be reduced by two-thirds. The passive pressure values may be increased by one-third when considering loads of short duration such as wind or seismic forces.

8.3.5. Settlement

We estimate that the proposed structure, designed and constructed as recommended herein, will undergo total settlements of less than approximately 1 inch. Differential settlements are typically less than about one-half of the total settlement.

8.3.6. Slabs-on-Grade

We recommend that slab-on-grade floors, underlain by very low to low expansive materials, be 5 or more inches in thickness and be reinforced with No. 3 or larger reinforcing bars spaced 18 inches on center each way. Additional slab thickness and reinforcement recommendations should be provided by the structural engineer.

It is also recommended that an impermeable vapor barrier such as Stego-wrap or similar material be placed over the subgrade material and underlying the concrete slab. The vapor barrier should be integrated with the basement wall drainage system to protect from moisture and vapor migration.

Exterior concrete flatwork should be 5 inches or more in thickness and should be reinforced with No. 3 reinforcing bars placed at 24 inches on-center both ways. The vapor barrier may be deleted for exterior flatwork.

8.4. Retaining Walls

For the design of site retaining walls that are not restrained against movement by rigid corners or structural connections, an active pressure represented by an equivalent fluid weight of 40 pcf may be assumed. Restrained walls (non-yielding) may be designed for an at-rest pressure represented by an equivalent fluid weight of 55 pcf. This pressure assumes low-expansive, level backfill and free draining conditions. Yielding and restrained walls retaining sloping backfill inclined at 2:1 may be designed using equivalent fluid weights of 60 pcf and 90 pcf, respectively. A drain should be provided behind the retaining wall and should be connected to an appropriate outlet. Retaining walls may be founded on a continuous footing based completely in compacted fill or formational materials. The foundation may be designed in accordance with our recommendations presented under the Shallow Foundations section of this report.

Basement walls which are restrained from movement at the top and have a level backfill surface may be designed for an “at rest” pressure as shown in Figure 7. The walls should be waterproofed as shown in Figure 8. The values presented assume very low to low expansive backfill behind the walls and free-draining conditions. Drainage measures should include free-draining backfill materials and perforated drains. Due to the depth of the walls, a sump pump may be used to outlet the drains. If it is decided that the underground retaining walls will be undrained, the walls should be designed to resist hydrostatic pressure.

8.5. Corrosion

Laboratory testing was performed on two representative samples of on-site soils to evaluate pH and electrical resistivity, as well as chloride and sulfate contents. The pH and electrical resistivity tests were performed in accordance with California Test 643 and the sulfate and chloride tests were performed in accordance with California Tests 417 and 422, respectively. These laboratory test results are presented in Appendix C.

The results of the corrosivity testing indicated electrical resistivity values of 780 and 590 ohm-cm. The soil pH values of the samples were 6.8 and 8.0. The tests indicated chloride content of 11 and 300 ppm. Sulfate content was not detected in one sample and was 250 ppm (i.e. 0.025 percent) in the second. Based on Caltrans criteria, the on-site soils would be classified as non-corrosive, which is defined as soil with less than 500 ppm chlorides, less than 0.2 percent sulfates, and a pH greater than 5.5.

8.6. Concrete

Concrete in contact with soil or water that contains high concentrations of soluble sulfates can be subject to chemical deterioration. Laboratory testing indicated a sulfate content of the sample tested of 0.025 percent, which is considered negligible for sulfate attack (ACI, 2005). We recommend that 3 inches of concrete cover be provided over reinforcing steel for cast-in-place structures in contact with the soil. Although the results of the sulfate tests were not significantly high, due to the variability in the on-site soils and the potential future use of reclaimed water at the site, we recommend that Type II/V cement be used for concrete structures in contact with soil. In addition, we recommend a water to cement ratio of no more than 0.45.

In order to reduce the potential for shrinkage cracks in the concrete during curing, we recommend that for slabs on grade, the concrete be placed with a slump in accordance with Table 5.2.1 of Section 302.1R of The Manual of Concrete Practice, "Floor and Slab Construction," or Table 2.2 of Section 332R in The Manual of Concrete Practice, "Guide to Residential Cast-in-Place Concrete Construction." If a higher slump is needed for screening and leveling, a super plasticizer is recommended to achieve the higher slump without changing the water to cement ratio. The slump should be checked periodically at the site prior to concrete placement. We also recommend that crack control joints be provided in slabs in accordance with the recommendations of the structural engineer to reduce the potential for distress due to minor soil movement and concrete shrinkage. We further recommend that concrete cover over reinforcing steel for slabs on grade and foundations is in accordance with CBC 1907.7. The structural engineer should be consulted for additional concrete specifications.

8.7. Pre-Construction Meeting

We recommend that a pre-construction meeting be held prior to commencement of grading. The owner or his representative, the agency representatives, the architect, the civil engineer, NOVA, and the contractor should be in attendance to discuss the plans, the project, and the proposed construction schedule.

8.8. Plan Review and Construction Observation

Project plans were not available at the time of our evaluation and we understand development plans for the site are preliminary at this time. After site plans are developed, our office should review those plans to provide additional recommendations, if needed. Depending on the type and extent of the proposed development, additional subsurface evaluation may be recommended.

The conclusions and recommendations presented in this report are based on analysis of observed conditions in widely spaced exploratory trenches and borings. If conditions are found to vary from those described in this report, NOVA should be notified, and additional recommen-

dations will be provided upon request. NOVA should review the final project drawings and specifications prior to the commencement of construction. NOVA should perform the needed observation and testing services during construction operations. In addition, per guidelines by the City of San Diego, NOVA needs to be retained to observed subsurface excavations in order to confirm our opinion regarding the absence of active or potentially active faulting at the site.

The recommendations provided in this report are based on the assumption that NOVA will provide geotechnical observation and testing services during construction. In the event that it is decided not to utilize the services of NOVA during construction, we request that the selected consultant provide the client with a letter (with a copy to NOVA) indicating that they fully understand NOVA's recommendations, and that they are in full agreement with the design parameters and recommendations contained in this report. Construction of proposed improvements should be performed by qualified subcontractors utilizing appropriate techniques and construction materials.

9. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. NOVA should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which NOVA has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

10. SELECTED REFERENCES

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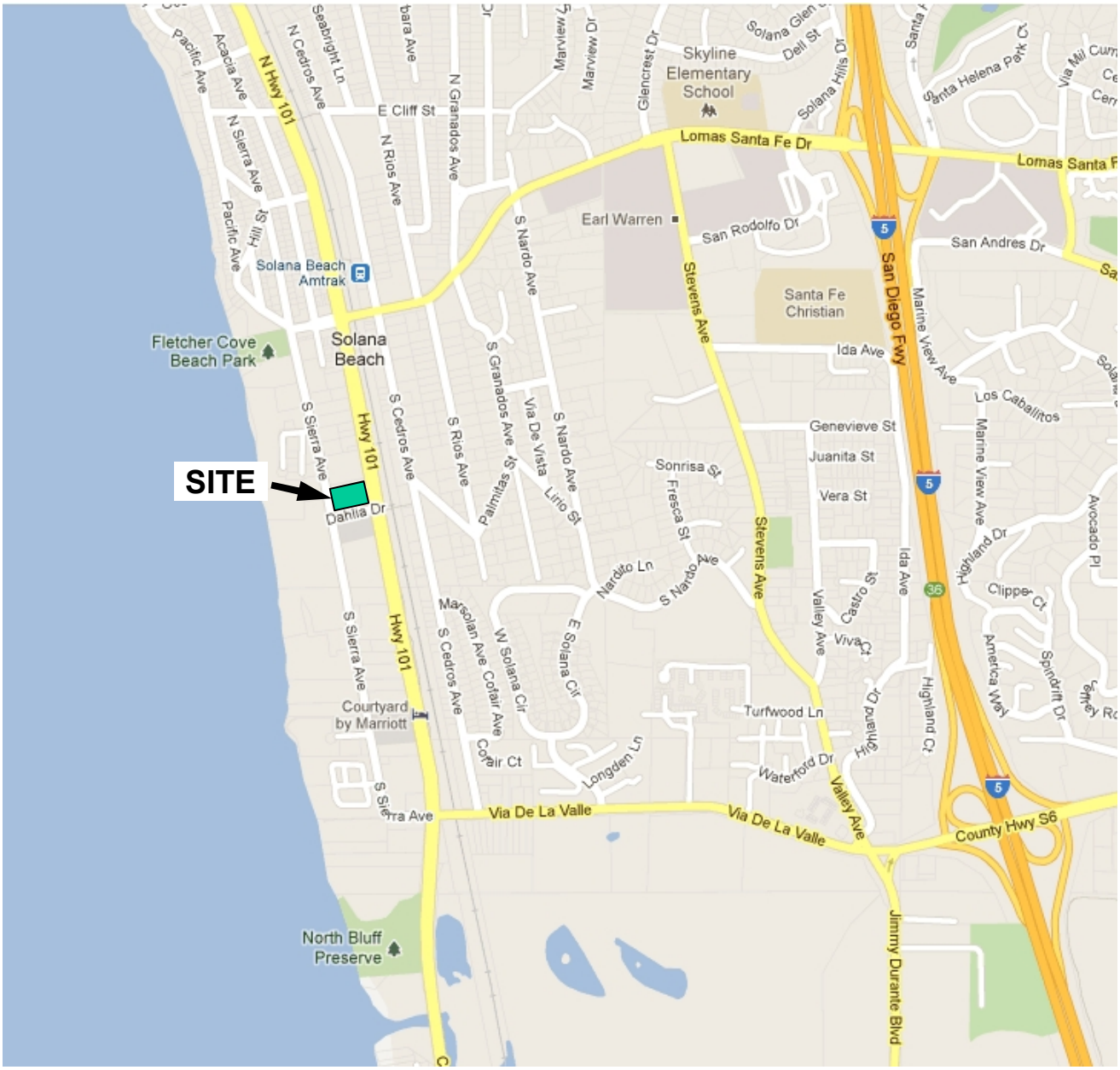


NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

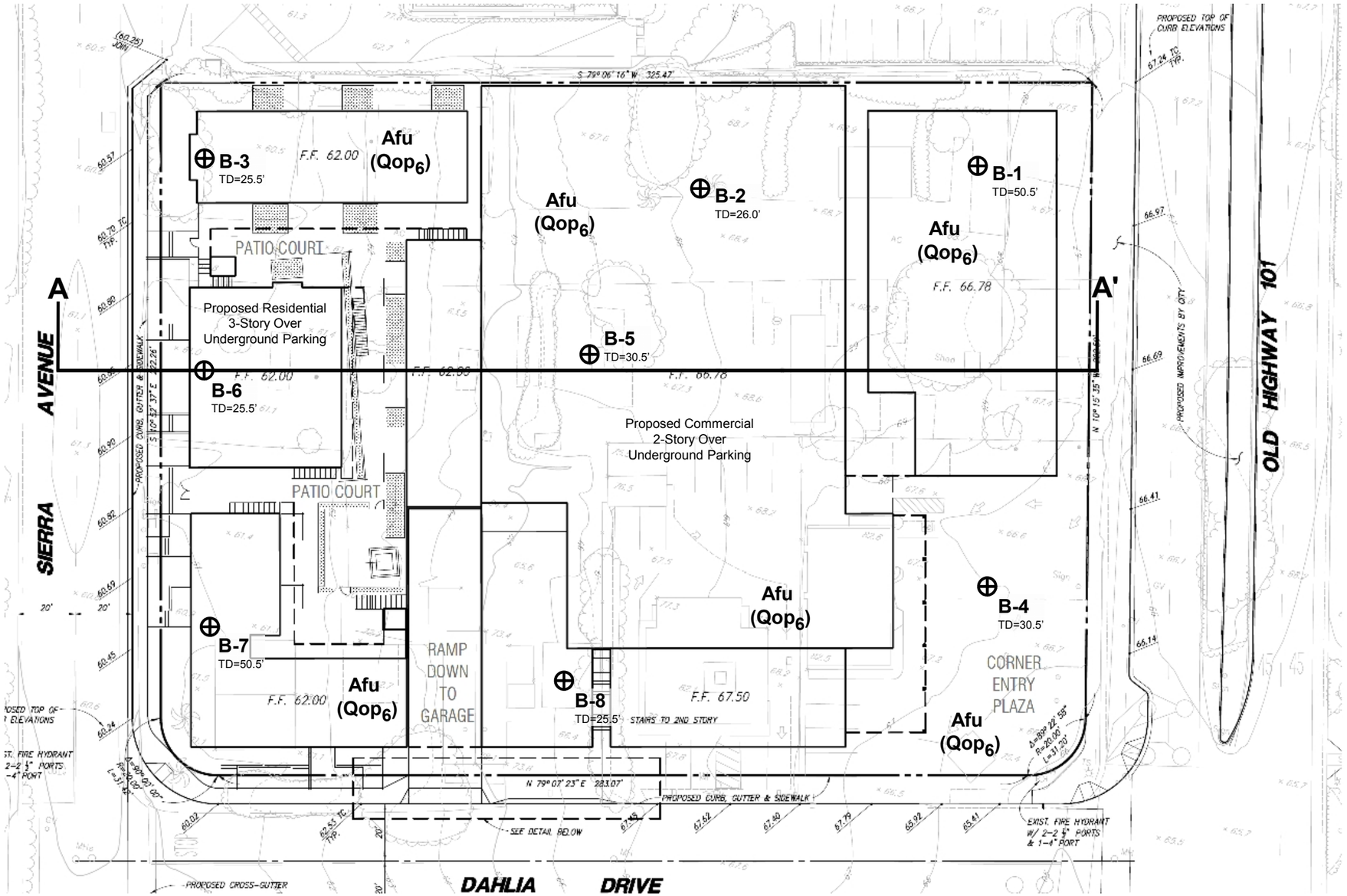
SOURCE: GOOGLE MAPS, 2012.

NOVA

SITE LOCATION MAP

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SAN DIEGO, CALIFORNIA

DATE:	PROJECT No.:	FIGURE
5/12	2012015	1



LEGEND

Afu	ARTIFICIAL FILL – UNDOCUMENTED
Qop_6	OLD PARALIC DEPOSITS (BRACKETED WHERE BURIED)
⊕B-8 TD=25.5'	APPROXIMATE LOCATION OF EXPLORATORY BORING TD – TERMINATION DEPTH IN FEET
A A'	APPROXIMATE LOCATION OF CROSS SECTION

N

SCALE 1"=40'

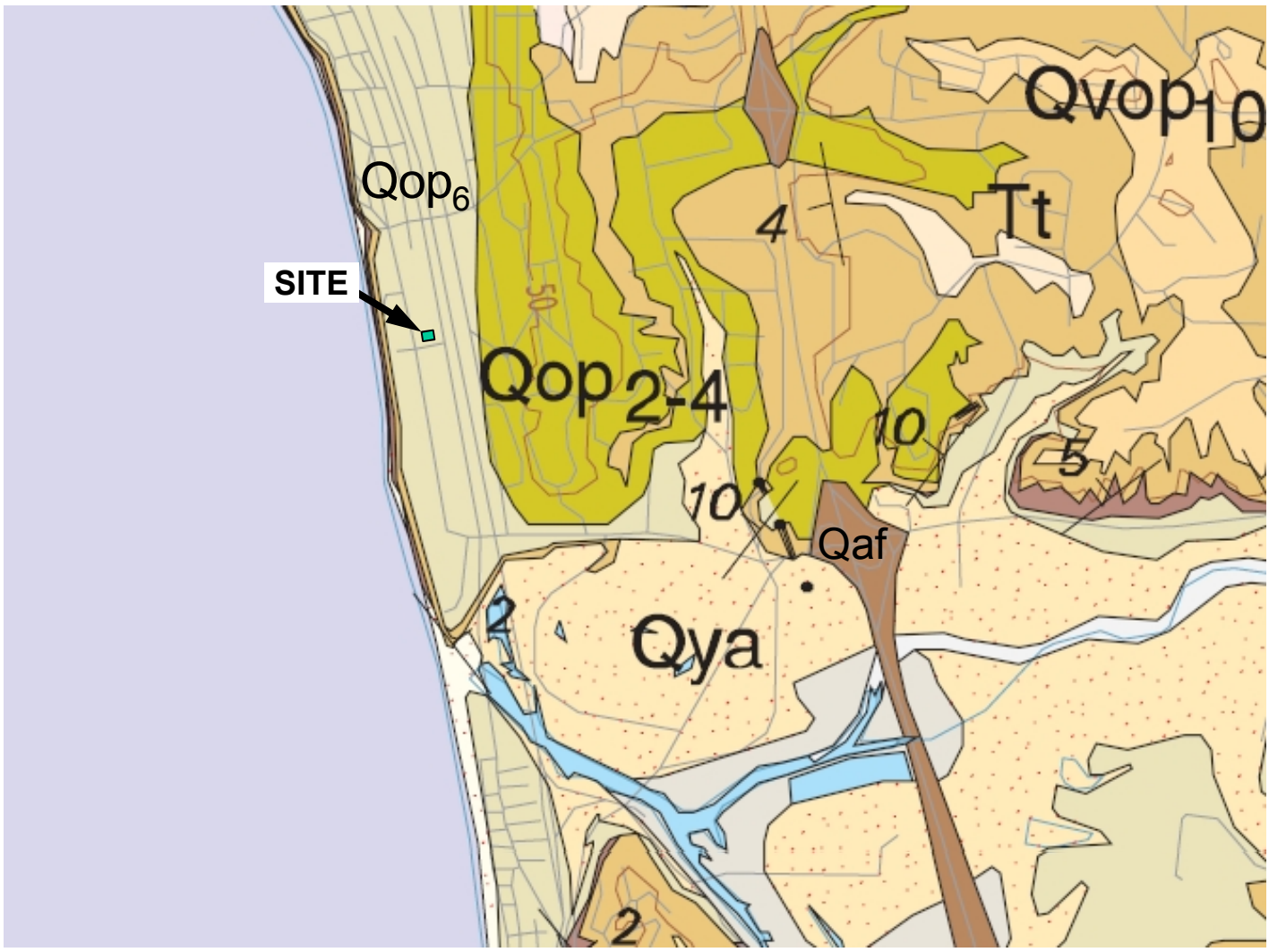
NOVA

BORING LOCATION MAP

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE:	PROJECT NO.:	FIGURE:
5/12	2012015	**2**

NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.



LEGEND

Qaf	ARTIFICIAL FILL
Qya	YOUNG ALLUVIUM
Qop2-4	OLD PARALIC DEPOSITS, UNITS 2-4
Qop6	OLD PARALIC DEPOSITS, UNIT 6
Qvop10	VERY OLD PARALIC DEPOSITS, UNIT 10
Tt	TORREY SANDSTONE

70 U D — FAULT: SOLID WHERE ACCURATELY LOCATED; DASHED WHERE APPROXIMATELY LOCATED; DOTTED WHERE CONCEALED. ARROW AND NUMBER INDICATE DIRECTION AND ANGLE OF DIP OF FAULT PLANE

CONTACT BETWEEN GEOLOGIC UNITS; DASHED FOR APPROXIMATE CONTACT BETWEEN PARALIC DEPOSITS

2 — STRIKE AND DIP OF BEDS

N

SCALE: 1" = 1,500'

NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

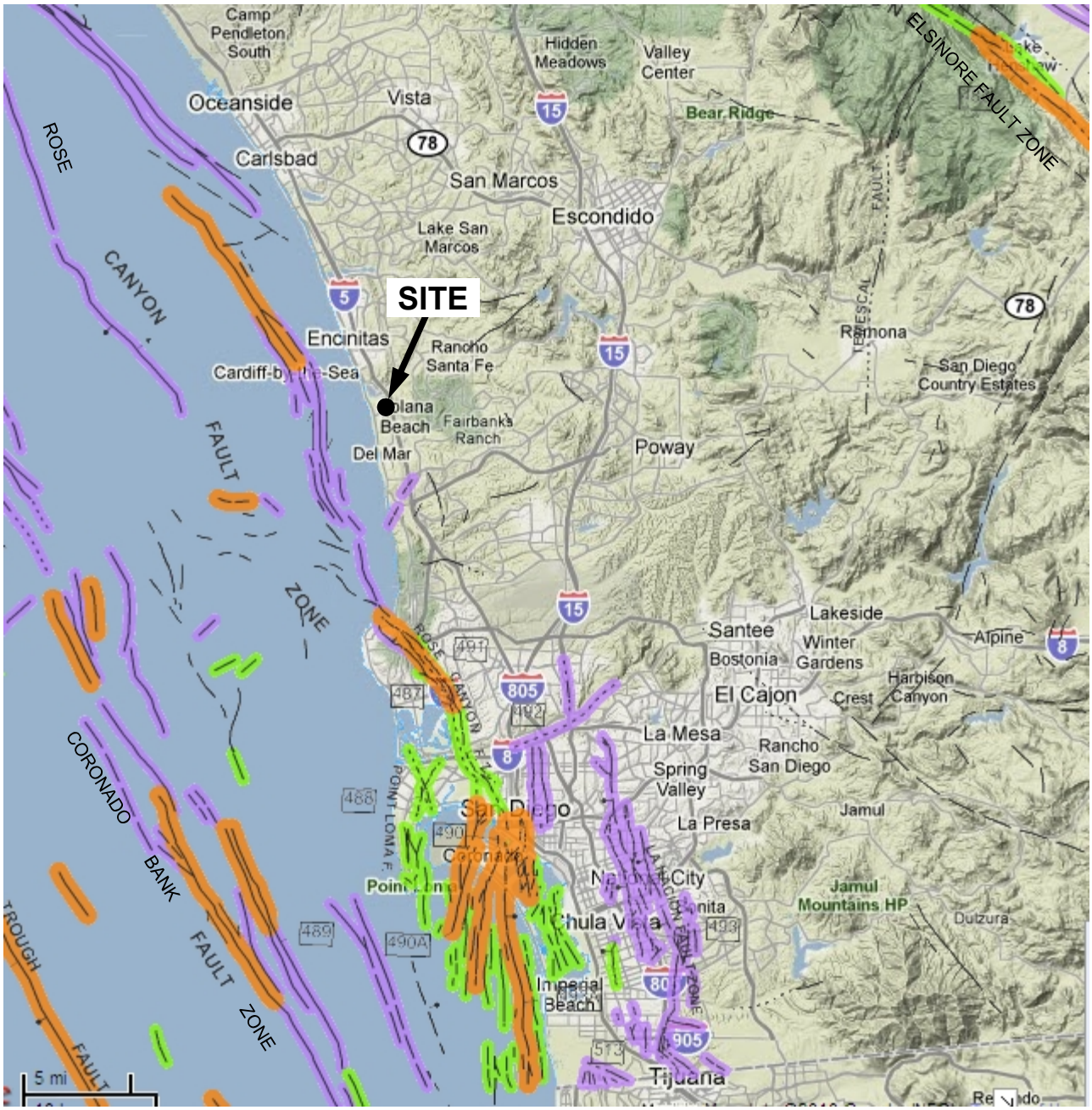
SOURCE: GEOLOGIC MAP OF THE SAN DIEGO 30' X 60' QUADRANGLE, 2005.

NOVA

REGIONAL GEOLOGIC MAP

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	3



LEGEND

- HOLOCENE FAULT DISPLACEMENT
- LATE QUATERNARY FAULT DISPLACEMENT
- QUATERNARY FAULT DISPLACEMENT
- PRE-QUATERNARY FAULT DISPLACEMENT

N

SCALE 1" = 8 MILES

NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

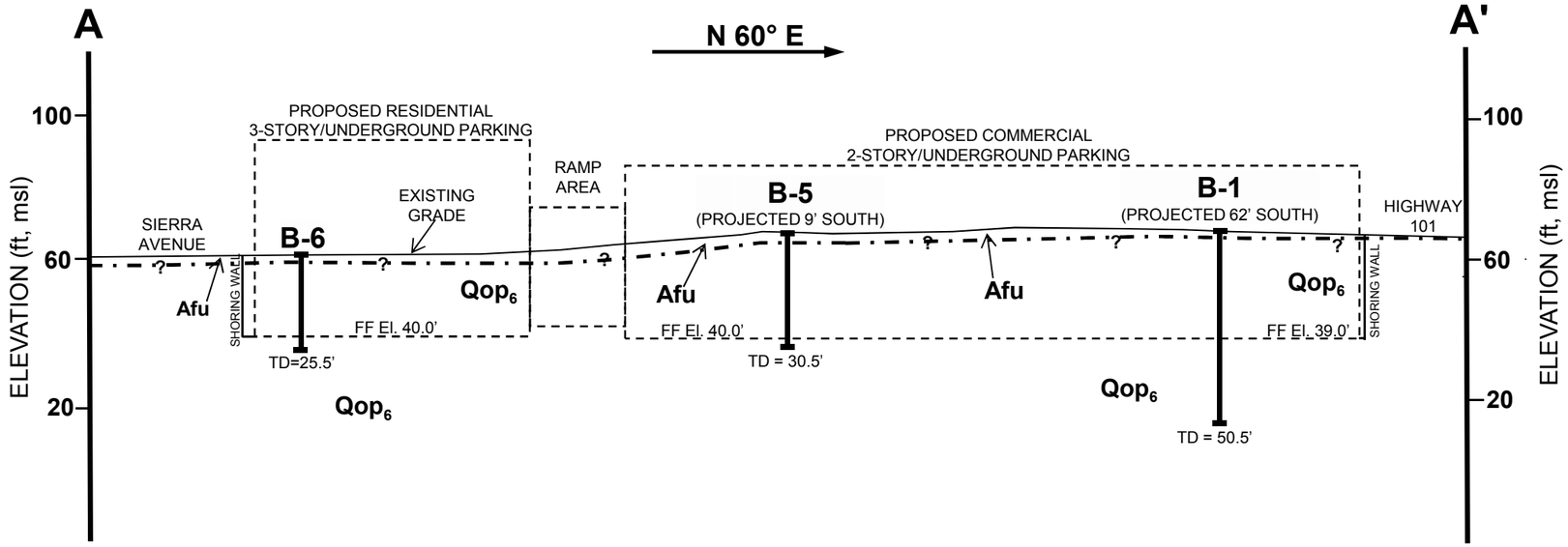
SOURCE: 2010 FAULT ACTIVITY MAP OF CALIFORNIA, CALIFORNIA GEOLOGICAL SURVEY.

NOVA

FAULT LOCATION MAP

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	4



CROSS SECTION A-A'
SCALE 1"=40'

LEGEND

Afu	ARTIFICIAL FILL – UNDOCUMENTED
Qop_6	OLD PARALIC DEPOSITS – UNIT 6 (BRACKETED WHERE BURIED)
B-8 TD=25.5'	APPROXIMATE LOCATION OF EXPLORATORY BORING (NOVA, 2012) TD – TERMINATION DEPTH IN FEET
– · – · – ·	APPROXIMATE LOCATION OF GEOLOGIC CONTACT (QUERIED WHERE UNCERTAIN)

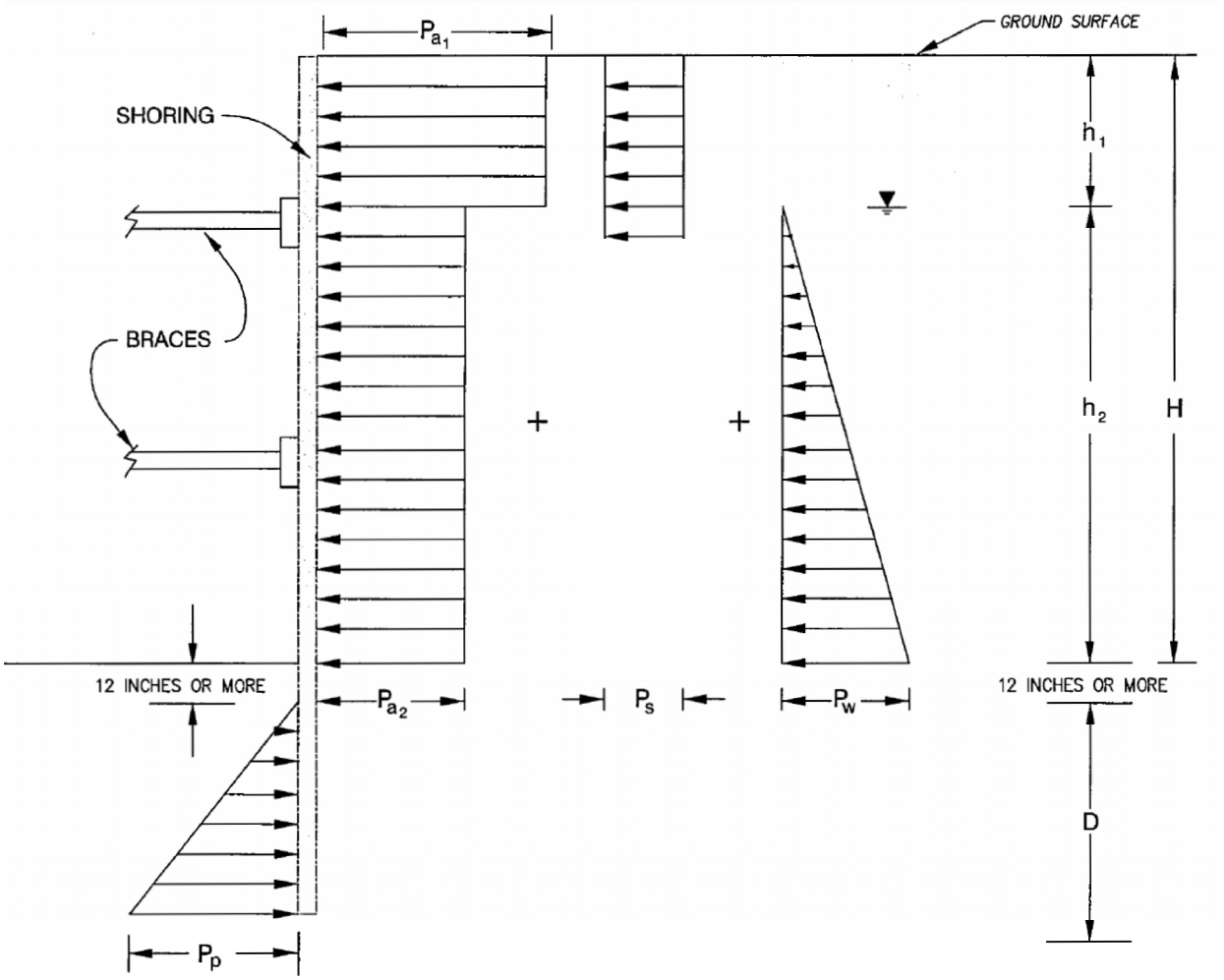
NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

NOVA

GEOLOGIC CROSS SECTION

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE:	PROJECT NO.:	FIGURE:
5/12	2012015	**5**



NOTES:

1. APPARENT LATERAL EARTH PRESSURES, P_{a1} AND P_{a2}
   P_{a1} = 24.5 H psf
   P_{a2} = 13 H psf
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE, P
   P_S = 100 psf (UPPER 10 FT OF EXCAVATION)
3. WATER PRESSURE, P_W
   P_W = 62.4 h_2 psf
4. PASSIVE PRESSURE, P_P
   P_P = 350 D psf (above groundwater table)
   P_P = 175 D psf (below groundwater table
5. H, h_1, h_2 AND D ARE IN FEET
6. ▼ GROUNDWATER TABLE

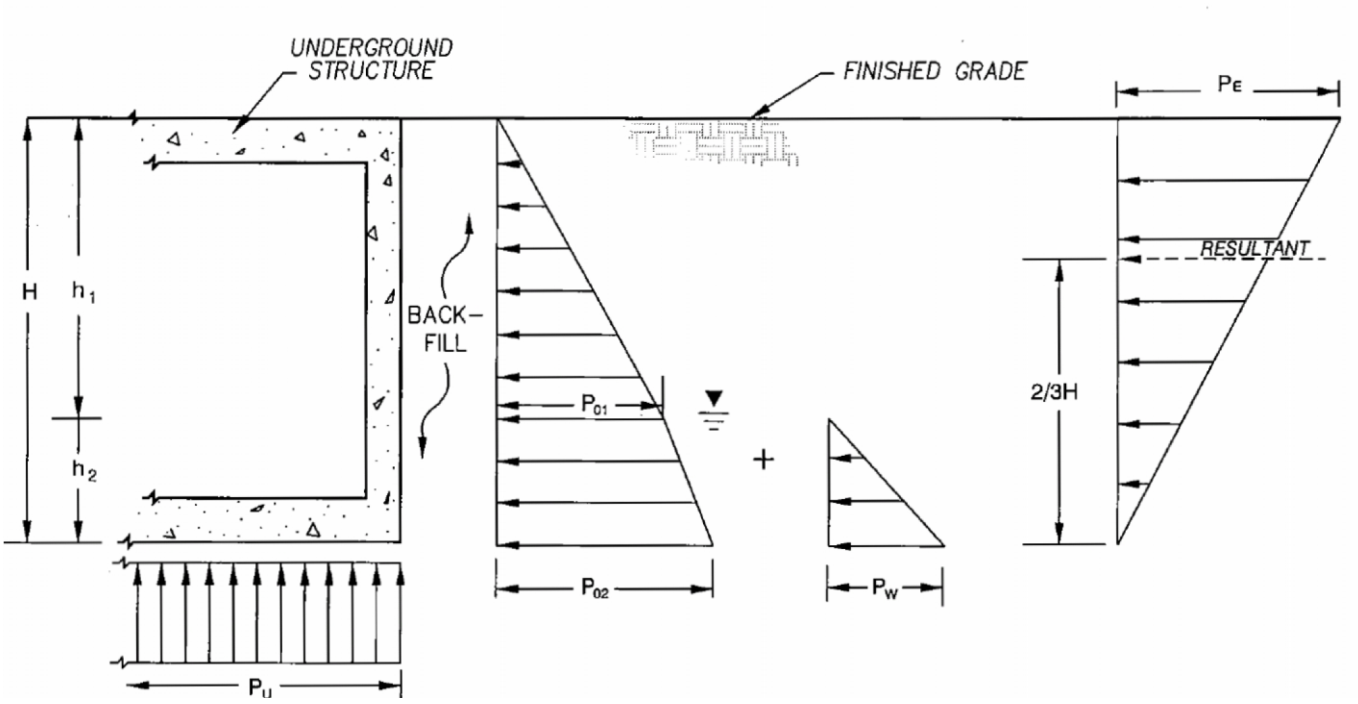
NOT TO SCALE

NOVA

LATERAL EARTH PRESSURES FOR BRACED EXCAVATIONS (GRANULAR SOIL)

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**6**



UPLIFT PRESSURE | **STATIC PRESSURE** | **WATER PRESSURE** | **DYNAMIC PRESSURE**

NOTES:

1. APPARENT LATERAL EARTH PRESSURES, P_{01} AND P_{02}
   $P_{01} = 55\ h_1$ psf
   $P_{02} = 55\ h_1 + 28\ h_2$ psf
2. WATER PRESSURE, P_W
   $P_W = 62.4\ h_2$ psf
3. DYNAMIC LATERAL EARTH PRESSURE IS BASED ON A PEAK GROUND ACCELERATION OF 0.34g
   $P_E = 18\ H$ psf
4. UPLIFT PRESSURE, P_U
   $P_U = 62.4\ h_2$ psf
5. SURCHARGE PRESSURES CAUSED BY VEHICLES OR NEARBY STRUCTURES ARE NOT INCLUDED
6. H, h_1 AND h_2 ARE IN FEET
7. ▼ GROUNDWATER TABLE

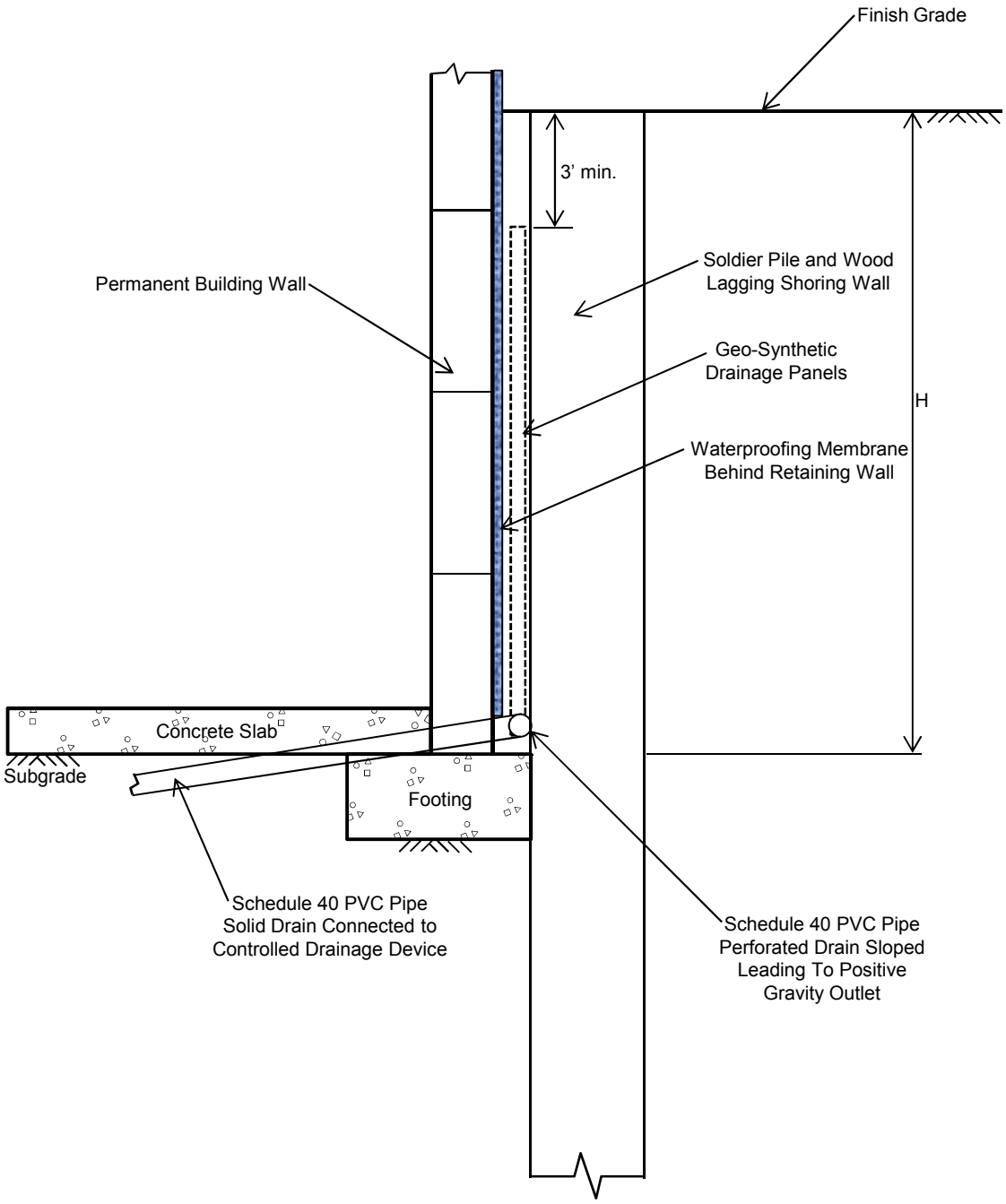
NOT TO SCALE

NOVA

LATERAL EARTH PRESSURES FOR PERMANENT UNDERGROUND STRUCTURES

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**7**



NO SCALE

NOVA

BASEMENT WALL DRAINAGE DETAIL

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SAN DIEGO, CALIFORNIA

DATE:	PROJECT No.:	FIGURE
5/12	2012015	**8**

APPENDIX A

BORING LOGS

Field Procedure for the Collection of Disturbed Samples

Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples

Bulk samples of representative earth materials were obtained from the exploratory boring. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler

Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The sampler was driven into the ground 12 to 18 inches with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586. The blow counts were recorded for every 6 inches of penetration; the blow counts reported on the logs are those for the last 12 inches of penetration. Soil samples were observed and removed from the sampler, bagged, sealed and transported to the laboratory for testing.

Field Procedure for the Collection of Relatively Undisturbed Samples

Relatively undisturbed soil samples were obtained in the field using the following method.

The Modified Split-Barrel Drive Sampler

The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sample barrel was driven into the ground with the weight of a 140-pound hammer, in general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer, and the number of blows per foot of driving are presented on the boring logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

Boring Log

PROJECT:	Solana 101 Mixed Use Project	**PROJECT NO.:** 2012015	**LOG OF BORING NO.:** **B-1**
BORING LOCATION:	See Figure 1	**ELEVATION AND DATUM:**	68 ft. ± (MSL)
DRILLING CONTRACTOR:	Baja Exploration	**DATE STARTED:** 4/14/12	**DATE FINISHED:** 4/14/12
DRILLING METHOD:	6-inch Diameter Hollow Stem Auger	**TOTAL DEPTH:**	50.5 ft.
DRILLING EQUIPMENT:	CME 75 Truck Mounted Drill Rig	**DEPTH TO WATER**	**Start:** NA **Completion:** NA
SAMPLING METHOD:	Bulk, Mod. Cal., and SPT	**LOGGED BY:**	CMD
HAMMER WT.:	140 lbs	**DROP:** 30-inches (Autotrip)	**REVIEWED BY:** AB

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
0					SM	**ARTIFICIAL FILL:**			
1	■					Dark brown, moist, loose, fine-grained, silty SAND.			
2	■					**OLD PARALIC DEPOSITS - UNIT 6 :** Reddish brown, moist, weakly cemented, silty SANDSTONE; highly weathered, friable, trace manganese.			
3	■								
4	■								
5	■		■			@ 5': Becomes damp.			
6	■		■	18				6.9	
7	■		■						
8	■								
9	■								
10	■		■			@ 10': Becomes reddish brown to tan; oxidation stains.			
11	■		■	16				4.2	
12	■								
13	■								
14	■								
15	■								

PROJECT:	Solana 101 Mixed Use Project	PROJECT NO.: 2012015	BORING NO.: B-1 cont'd

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
16				18		**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Light brown to tan, damp to moist, weakly cemented, fine-grained SANDSTONE; friable, oxidation stains.		3.1	
17									
18									
19									
20						@ 20': Fine- to medium-grained.			
21				36				1.8	
22									
23									
24									
25				50/ 3"		@ 25': No recovery.			
26									
27									
28									
29									
30				50/ 3"		Tan, damp to moist, very dense, fine SANDSTONE; weakly cemented.			
31									
32									
33									
34									
35									

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
36				50/ 6"		**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Light tan, dry to damp, weakly cemented, fine-grained, silty SANDSTONE; oxidation stains.		3.6	
37									
38									
39									
40				50/ 4"		@ 40': Grades to tan.		7.5	
41									
42									
43									
44									
45				50/ 5"		@ 45': Grades to light tan, oxidation stains.		7.8	
46									
47									
48									
49									
50				50/ 5"				5.3	
51						Total Depth = 50.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite grout on 4/14/12.			
52									
53									
54									
55									

Boring Log

PROJECT:	Solana 101 Mixed Use Project	**PROJECT NO.:**	2012015	**LOG OF BORING NO.:**	**B-2**
BORING LOCATION:	See Figure 1	**ELEVATION AND DATUM:**	68 ft. ± (MSL)		
DRILLING CONTRACTOR:	Baja Exploration	**DATE STARTED:**	4/14/12	**DATE FINISHED:**	4/14/12
DRILLING METHOD:	6-inch Diameter Hollow Stem Auger	**TOTAL DEPTH:**	26 ft.		
DRILLING EQUIPMENT:	CME 75 Truck Mounted Drill Rig	**DEPTH TO WATER**	**Start:** NA	**Completion:**	
SAMPLING METHOD:	Bulk, Mod. Cal., and SPT	**LOGGED BY:**	CMD		
HAMMER WT.:	140 lbs	**DROP:**	30-inches (Autotrip)	**REVIEWED BY:**	AB

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
1					SM	**ARTIFICIAL FILL:** Brown, damp, medium dense, fine-grained, silty SAND.			
2									
3									
4									
5				19		**OLD PARALIC DEPOSITS - UNIT 6 :** Light brown, damp, weakly cemented, fine SANDSTONE; friable, oxidation stains.		4.0	
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

PROJECT: Solana 101 Mixed Use Project	PROJECT NO.: 2012015	BORING NO.: B-2 cont'd

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
16						**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Light brown, damp, weakly cemented, fine SANDSTONE; friable, oxidation stains.			
17									
18									
19									
20									
21									
22									
23									
24									
25				79/ 11"		@25': Tan, moderately cemented; oxidation stains.			
26						Total Depth = 26 feet. Groundwater not encountered during drilling. Backfilled with bentonite grout on 4/14/12.			
27									
28									
29									
30									
31									
32									
33									
34									
35									

Boring Log

PROJECT:	Solana 101 Mixed Use Project	**PROJECT NO.:**	2012015	**LOG OF BORING NO.:**	**B-3**
BORING LOCATION:	See Figure 1	**ELEVATION AND DATUM:**	61 ft. ± (MSL)		
DRILLING CONTRACTOR:	Baja Exploration	**DATE STARTED:**	4/14/12	**DATE FINISHED:**	4/14/12
DRILLING METHOD:	6-inch Diameter Hollow Stem Auger	**TOTAL DEPTH:**	25.5 ft.		
DRILLING EQUIPMENT:	CME 75 Truck Mounted Drill Rig	**DEPTH TO WATER**	**Start:** NA	**Completion:**	
SAMPLING METHOD:	Bulk, Mod. Cal., and SPT	**LOGGED BY:**	CMD		
HAMMER WT.:	140 lbs	**DROP:**	30-inches (Autotrip)	**REVIEWED BY:**	AB

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
1					SM	**ARTIFICIAL FILL:** Dark brown to brown, moist, loose to medium dense, fine-grained, silty SAND.			
2									
3									
4									
5									
6									
7						**OLD PARALIC DEPOSITS - UNIT 6 :** Reddish brown, damp, weakly cemented, fine SANDSTONE; friable, oxidation stains.			
8									
9									
10				18					
11									
12									
13									
14									
15									

PROJECT: Solana 101 Mixed Use Project **PROJECT NO.:** 2012015 **BORING NO.:** **B-3** cont'd

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
16						**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Reddish brown, damp, weakly cemented, fine SANDSTONE; friable, oxidation stains.			
17									
18									
19									
20				75/ 9"		@ 20': Becomes tan.			
21							109.4	8.7	
22									
23									
24									
25				50/ 5"		@ 25': Moderately cemented.		6.0	
26						Total Depth = 25.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite grout on 4/14/12.			
27									
28									
29									
30									
31									
32									
33									
34									
35									

Boring Log

PROJECT:	Solana 101 Mixed Use Project	**PROJECT NO.:**	2012015	**LOG OF BORING NO.:**	**B-4**
BORING LOCATION:	See Figure 1	**ELEVATION AND DATUM:**	67 ft. ± (MSL)		
DRILLING CONTRACTOR:	Baja Exploration	**DATE STARTED:**	4/14/12	**DATE FINISHED:**	4/14/12
DRILLING METHOD:	6-inch Diameter Hollow Stem Auger	**TOTAL DEPTH:**	30.5 ft.		
DRILLING EQUIPMENT:	CME 75 Truck Mounted Drill Rig	**DEPTH TO WATER**	**Start:** NA	**Completion:**	
SAMPLING METHOD:	Bulk, Mod. Cal., and SPT	**LOGGED BY:**	CMD		
HAMMER WT.:	140 lbs	**DROP:**	30-inches (Autotrip)	**REVIEWED BY:**	AB

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
						ASPHALT CONCRETE: 3.5 inches thick.			
1	■				SM	**ARTIFICIAL FILL:** Brown, moist, medium dense, fine-grained, silty SAND.			
2	■								
3	■								
4	■								
5	■								
6									
7						**OLD PARALIC DEPOSITS - UNIT 6 :** Reddish brown, damp, weakly cemented, fine SANDSTONE; friable.			
8									
9									
10			■	15		@ 10': Grades to tan; oxidation stains, slightly micaceous.			
11			■						
12									
13									
14									
15									

PROJECT: Solana 101 Mixed Use Project	PROJECT NO.: 2012015	BORING NO.: B-4 cont'd

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
16						**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Reddish brown, damp, weakly cemented, fine SANDSTONE; friable.			
17									
18									
19									
20				79/ 9"		@ 20': Grades to fine- to medium-grained; oxidation stains.			
21							101.7	3.1	
22									
23									
24									
25									
26									
27									
28									
29									
30				50/ 4"		@ 30': Grades to light tan, weakly cemented, friable		5.0	
31						Total Depth = 30.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite grout on 4/14/12.			
32									
33									
34									
35									

Boring Log

PROJECT:	Solana 101 Mixed Use Project	**PROJECT NO.:**	2012015	**LOG OF BORING NO.:**	**B-5**
BORING LOCATION:	See Figure 1	**ELEVATION AND DATUM:**	67 ft. ± (MSL)		
DRILLING CONTRACTOR:	Baja Exploration	**DATE STARTED:**	4/14/12	**DATE FINISHED:**	4/14/12
DRILLING METHOD:	6-inch Diameter Hollow Stem Auger	**TOTAL DEPTH:**	30.5 ft.		
DRILLING EQUIPMENT:	CME 75 Truck Mounted Drill Rig	**DEPTH TO WATER**	**Start:** NA	**Completion:**	
SAMPLING METHOD:	Bulk, Mod. Cal., and SPT	**LOGGED BY:**	CMD		
HAMMER WT.:	140 lbs	**DROP:**	30-inches (Autotrip)	**REVIEWED BY:**	AB

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
1					SM	**ARTIFICIAL FILL:** Brown, moist, medium dense, fine-grained, silty SAND; trace gravel.			
2	■					**OLD PARALIC DEPOSITS - UNIT 6 :** Reddish brown, damp, weakly cemented, silty SANDSTONE; friable, oxidation stains.			
3	■								
4	■								
5	■								
6									
7									
8									
9									
10			■						
11			■	29				3.6	
12									
13									
14									
15									

PROJECT: Solana 101 Mixed Use Project	PROJECT NO.: 2012015	BORING NO.: B-5 cont'd

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
16						**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Reddish brown, damp, medium dense, fine SANDSTONE; weakly cemented, oxidation stains.			
17									
18									
19									
20						@ 20': Grades to light tan; micaceous.			
21				43					
22									
23									
24									
25									
26									
27									
28									
29									
30				50/ 3"		@ 30': Moderately cemented.		5.5	
31						Total Depth = 30.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite grout on 4/14/12.			
32									
33									
34									
35									

Boring Log

PROJECT:	Solana 101 Mixed Use Project	**PROJECT NO.:**	2012015	**LOG OF BORING NO.:**	**B-6**
BORING LOCATION:	See Figure 1	**ELEVATION AND DATUM:**	61 ft. ± (MSL)		
DRILLING CONTRACTOR:	Baja Exploration	**DATE STARTED:**	4/14/12	**DATE FINISHED:**	4/14/12
DRILLING METHOD:	6-inch Diameter Hollow Stem Auger	**TOTAL DEPTH:**	25.5 ft.		
DRILLING EQUIPMENT:	CME 75 Truck Mounted Drill Rig	**DEPTH TO WATER**	**Start:** NA	**Completion:**	
SAMPLING METHOD:	Bulk, Mod. Cal., and SPT	**LOGGED BY:**	CMD		
HAMMER WT.:	140 lbs	**DROP:**	30-inches (Autotrip)	**REVIEWED BY:**	AB

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
0					SM	**ARTIFICIAL FILL:**			
1						Brown, moist, loose, fine silty SAND.			
						OLD PARALIC DEPOSITS - UNIT 6 :			
2						Reddish brown, damp, weakly cemented, SANDSTONE; friable, oxidation staining.			
3									
4									
5									
6									
7									
8									
9									
10						@ 10': Grades to tan.			
11				40				1.7	
12									
13									
14									
15									

PROJECT: Solana 101 Mixed Use Project	PROJECT NO.: 2012015	BORING NO.: B-6 cont'd

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
16						**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Tan, damp, weakly cemented, fine SANDSTONE; friable, oxidation stains.			
17									
18									
19									
20									
21									
22									
23									
24									
25			☒	50/ 3"		@ 25': No recovery.			
26						Total Depth = 25.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite grout on 4/14/12.			
27									
28									
29									
30									
31									
32									
33									
34									
35									

Boring Log

PROJECT:	Solana 101 Mixed Use Project	**PROJECT NO.:** 2012015	**LOG OF BORING NO.:** **B-7**
BORING LOCATION:	See Figure 1	**ELEVATION AND DATUM:**	61 ft. ± (MSL)
DRILLING CONTRACTOR:	Baja Exploration	**DATE STARTED:** 4/14/12	**DATE FINISHED:** 4/14/12
DRILLING METHOD:	6-inch Diameter Hollow Stem Auger	**TOTAL DEPTH:** 50.5 ft.	
DRILLING EQUIPMENT:	CME 75 Truck Mounted Drill Rig	**DEPTH TO WATER**	**Start:** NA **Completion:**
SAMPLING METHOD:	Bulk, Mod. Cal., and SPT	**LOGGED BY:** CMD	
HAMMER WT.: 140 lbs	**DROP:** 30-inches (Autotrip)	**REVIEWED BY:** AB	

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
0					SM	**ARTIFICIAL FILL:**			
1	■					Brown, damp, loose, fine-grained, silty SAND.			
2	■					**OLD PARALIC DEPOSITS - UNIT 6 :** Light reddish brown, damp, weakly cemented, fine SANDSTONE; friable, oxidation stains.			
3	■								
4	■								
5	■		■						
6			■	22				3.9	
7									
8									
9									
10			■						
11			■	16				5.1	
12									
13									
14									
15									

PROJECT:	Solana 101 Mixed Use Project	PROJECT NO.: 2012015	BORING NO.: B-7 cont'd

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
16				87/ 9"		**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Tan, moist, weakly cemented, fine SANDSTONE to SILTSTONE; friable.		8.1	
17									
18									
19									
20				50/ 5"		@20': Grades to light tan; slightly micaceous, oxidation stains.		9.0	
21									
22									
23									
24									
25				50/ 5"					
26									
27									
28									
29									
30				50/ 4"		@30': Moderately cemented.		8.6	
31									
32									
33									
34									
35									

PROJECT: Solana 101 Mixed Use Project	PROJECT NO.: 2012015	BORING NO.: B-7 cont'd

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
36				50/ 4"		**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Light tan, damp, weakly cemented, silty SANDSTONE; friable, oxidation stains.		5.2	
37									
38									
39									
40				50/ 4"		@ 40': Grades to tan.		5.6	
41									
42									
43									
44									
45				50/ 3"				7.0	
46									
47									
48									
49									
50				50/ 3"				5.2	
51						Total Depth = 50.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite grout on 4/14/12.			
52									
53									
54									
55									

Boring Log

PROJECT:	Solana 101 Mixed Use Project	**PROJECT NO.:**	2012015	**LOG OF BORING NO.:**	**B-8**
BORING LOCATION:	See Figure 1	**ELEVATION AND DATUM:**	66 ft. ± (MSL)		
DRILLING CONTRACTOR:	Baja Exploration	**DATE STARTED:**	4/14/12	**DATE FINISHED:**	4/14/12
DRILLING METHOD:	6-inch Diameter Hollow Stem Auger	**TOTAL DEPTH:**	25.5 ft.		
DRILLING EQUIPMENT:	CME 75 Truck Mounted Drill Rig	**DEPTH TO WATER**	**Start:** NA	**Completion:**	
SAMPLING METHOD:	Bulk, Mod. Cal., and SPT	**LOGGED BY:**	CMD		
HAMMER WT.:	140 lbs	**DROP:**	30-inches (Autotrip)	**REVIEWED BY:**	AB

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
						ASPHALT CONCRETE: 3.5 inches thick.			
1					SM	**ARTIFICIAL FILL:** Light brown, damp, medium dense, fine-grained, silty SAND.			
2									
3									
4									
5									
6									
7						**OLD PARALIC DEPOSITS - UNIT 6 :** Reddish brown, damp, weakly cemented, silty SANDSTONE; friable, oxidation stains.			
8									
9									
10				26				3.5	
11									
12									
13									
14									
15									

PROJECT: Solana 101 Mixed Use Project	PROJECT NO.: 2012015	BORING NO.: B-8 cont'd

Depth (ft.)	SAMPLES: Bulk	SAMPLES: Mod. Cal	SAMPLES: SPT	Blows / ft.	USCS Classification	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture Content (%)	REMARKS
16						**OLD PARALIC DEPOSITS - UNIT 6 (continued):** Reddish brown, damp, weakly cemented, fine SANDSTONE; friable, oxidation stains.			
17									
18									
19									
20									
21									
22						@ 22': Interbedded with olive brown sand.			
23									
24									
25				50/ 6"		@ 25': Grades to tan, moderately weathered.			
26						Total Depth = 25.5 feet. Groundwater not encountered during drilling. Backfilled with bentonite grout on 4/14/12.			
27									
28									
29									
30									
31									
32									
33									
34									
35									

APPENDIX B

LABORATORY TESTING

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the exploratory excavations in Appendix A.

Moisture and Density

The moisture content of samples obtained from the exploratory excavations was evaluated in accordance with ASTM D 2216. The test results are presented on Appendix A.

Gradation Analysis

Gradation analysis tests were performed on a selected a representative soil sample in general accordance with ASTM D 422. The grain-size distribution curve is shown on Figures B-1 through B-4. These test results were utilized in evaluating the soil classifications in accordance with the Unified Soil Classification System.

Atterberg Limits

Tests were performed on selected representative fine-grained soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D 4318. These test results were utilized to evaluate the soil classification in accordance with the Unified Soil Classification System. The test results and classification are shown on Figure B-5.

Expansion Index Test

The expansion index of selected materials was evaluated in general accordance with ASTM D 4829. Specimens were molded under a specified compactive energy at approximately 50 percent saturation (plus or minus 1 percent). The prepared 1-inch thick by 4-inch diameter specimens were loaded with a surcharge of 144 pounds per square foot and were inundated with tap water. Readings of volumetric swell were made for a period of 24 hours. The results of these tests are presented on Figure B-6.

Consolidation Test

Consolidation tests were performed on selected relatively undisturbed soil samples in general accordance with ASTM D 2435. The samples were inundated during testing to represent adverse field conditions. The percent of consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. The results of the tests are summarized on Figures B-7 and B-8.

Direct Shear Tests

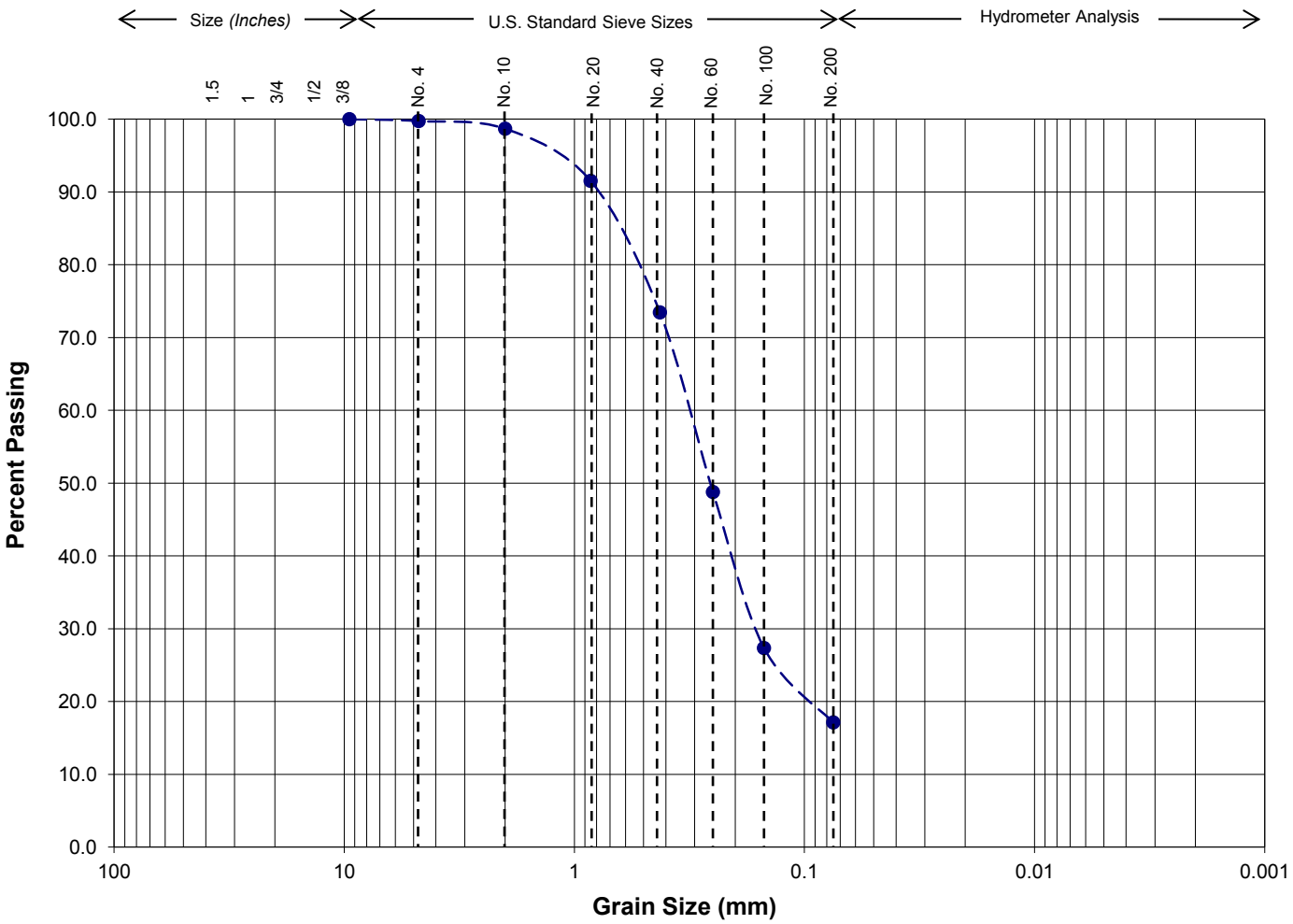
Direct shear tests were performed on relatively undisturbed samples in general accordance with ASTM D 3080-04 to evaluate the shear strength characteristics of selected materials. The samples were inundated during shearing to represent adverse field conditions. The results are shown on Figures B-9 through B-11.

Proctor Density Tests

The maximum dry density and optimum moisture content of selected representative soil samples were evaluated using the Modified Proctor method in general accordance with ASTM D 1557. The results of these tests are summarized on Figures B-12.

Soil Corrosivity Tests

A soil pH, and resistivity test were performed on a representative sample in general accordance with California Test (CT) 643. The chloride content of a selected sample was evaluated in general accordance with CT 422. The sulfate content of a selected sample was evaluated in general accordance with CT 417. The test results are presented on Figure B-13.



Gravel	Sand	Fines

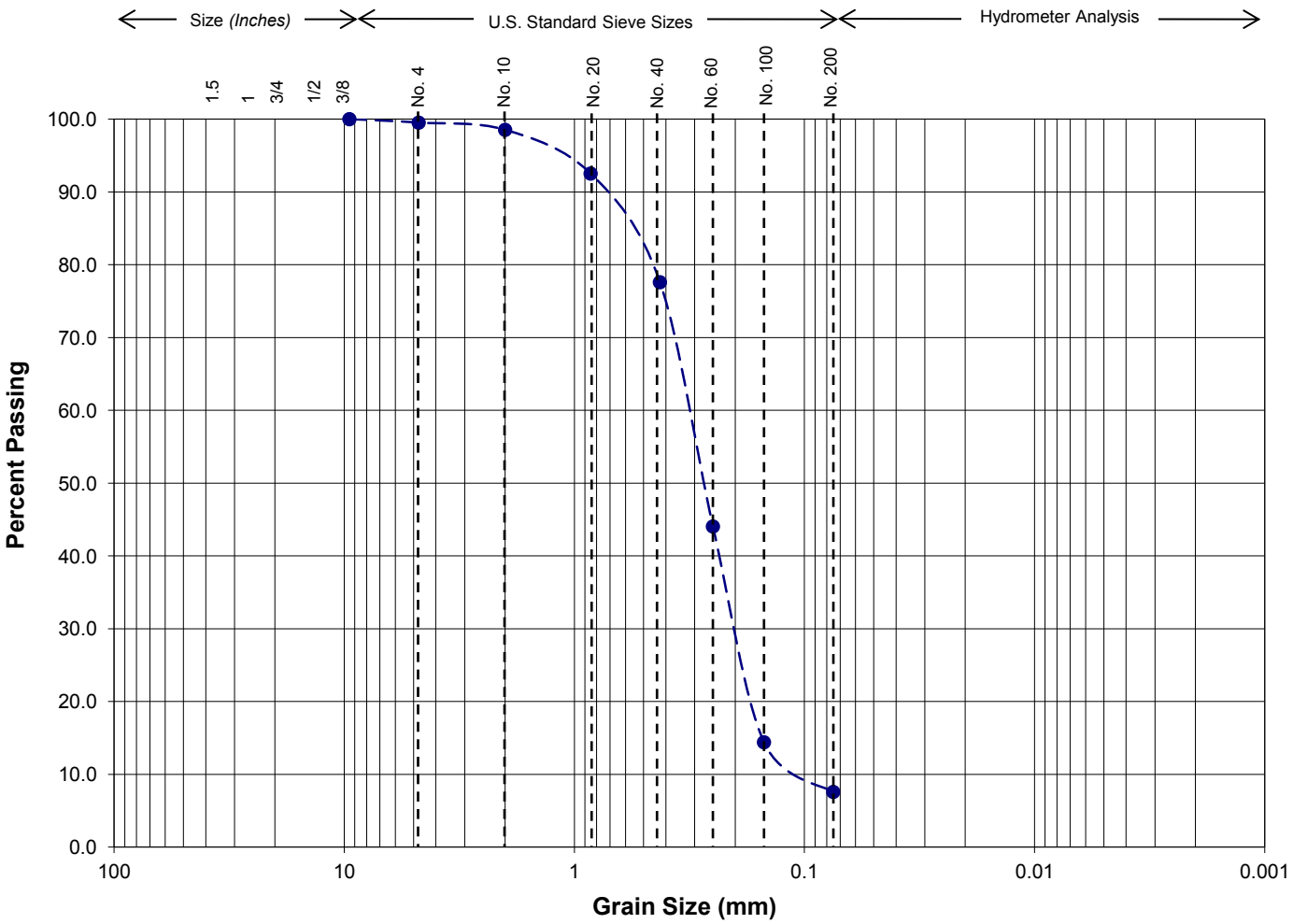
Sample Location:	B-1
Depth (ft.):	35.0 - 35.5
Description:	SILTY SANDSTONE
Equivalent USCS Soil Type:	SM
Passing No. 200 (%):	17

NOVA

GRADATION ANALYSIS TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-1**



Gravel	Sand	Fines

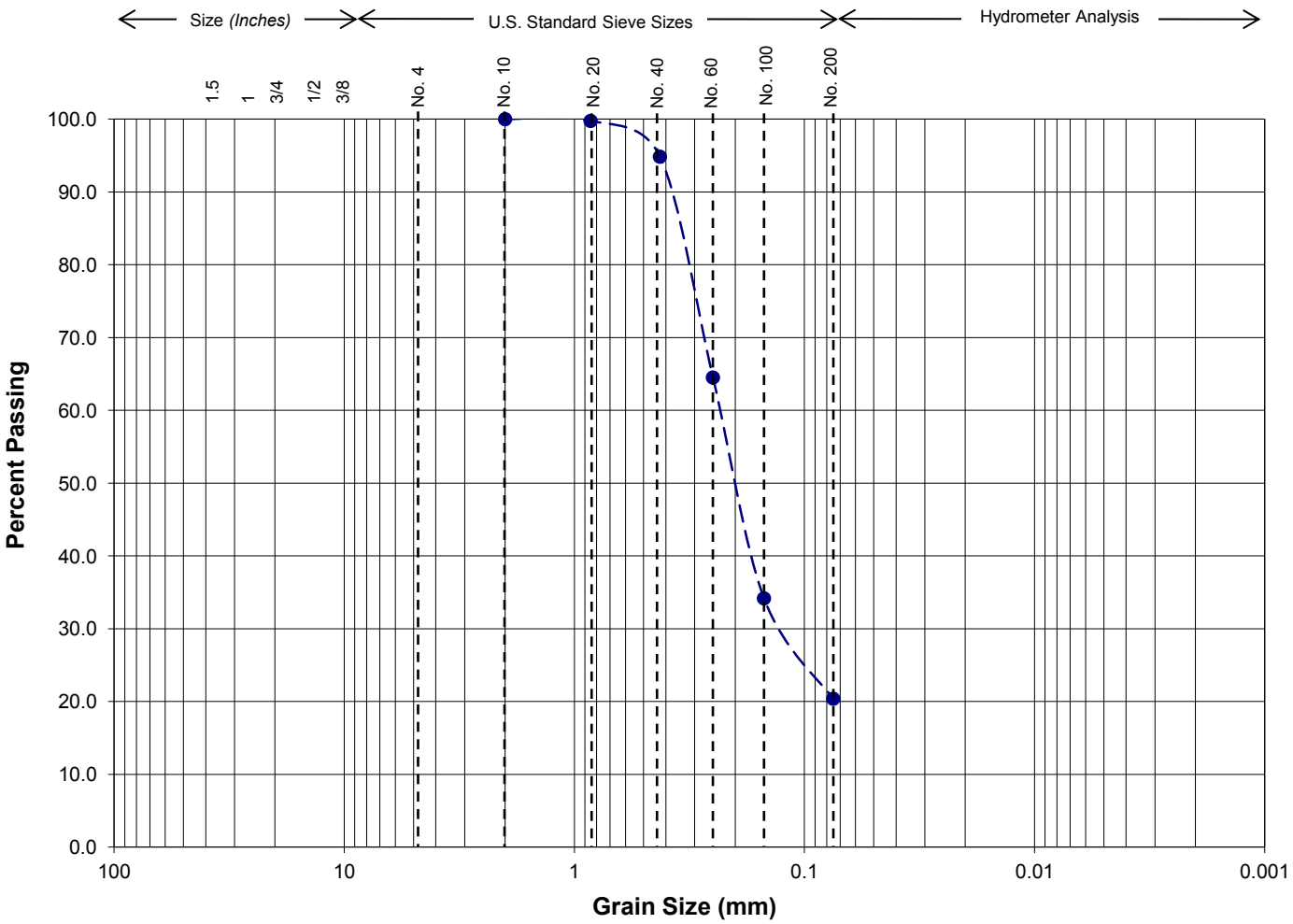
Sample Location:	B-2
Depth (ft.):	25.0 - 26.0
Description:	SANDSTONE
Equivalent USCS Soil Type:	SP-SM
Passing No. 200 (%):	8

NOVA

GRADATION ANALYSIS TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-2**



Gravel	Sand	Fines

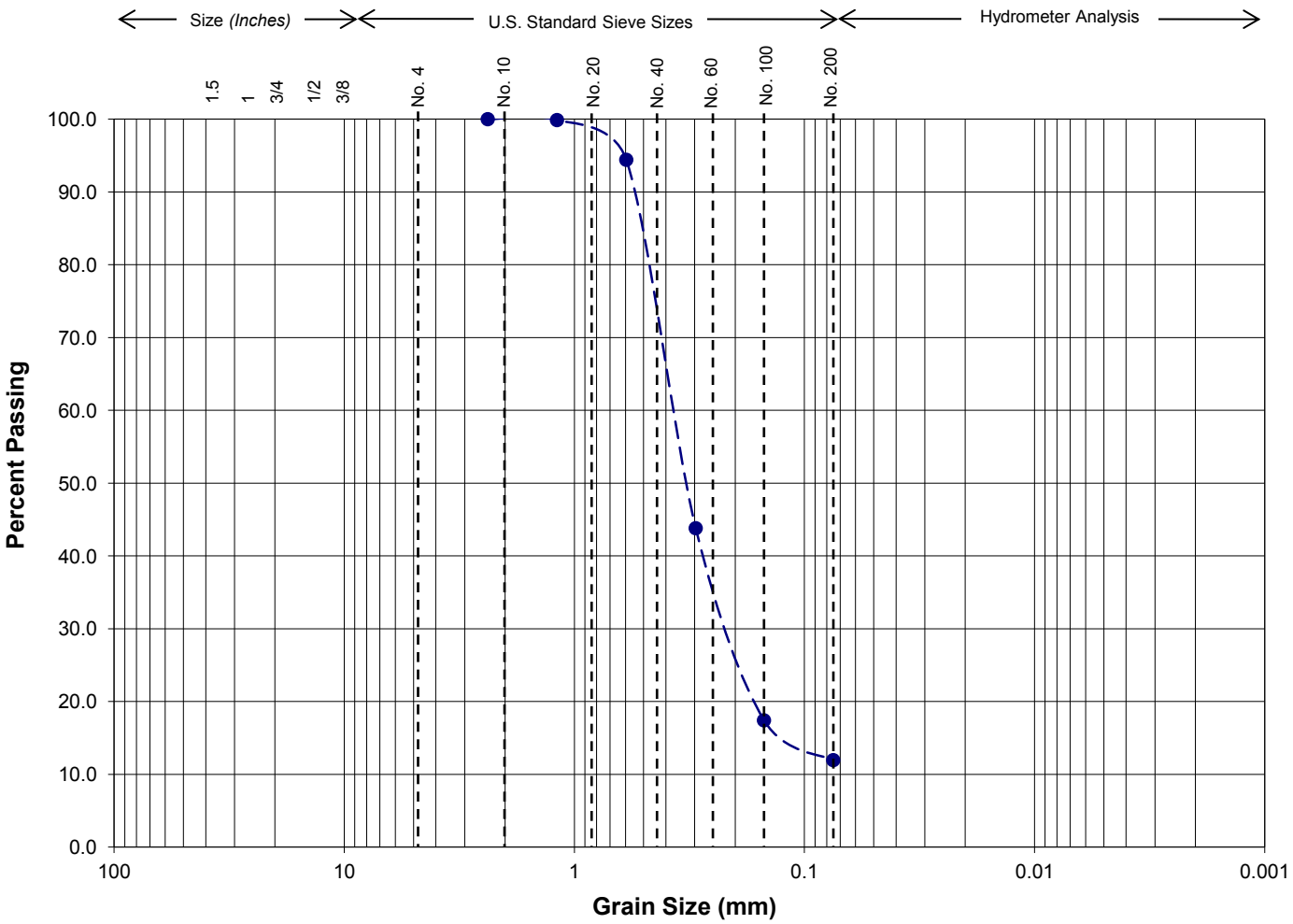
Sample Location:	B-7
Depth (ft.):	40.0 - 40.5
Description:	SILTY SANDSTONE
Equivalent USCS Soil Type:	SM
Passing No. 200 (%):	20

NOVA

GRADATION ANALYSIS TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-3**



Gravel	Sand	Fines

Sample Location:	B-8
Depth (ft.):	10.0 - 11.5
Description:	SILTY SANDSTONE
Equivalent USCS Soil Type:	SM
Passing No. 200 (%):	12

NOVA

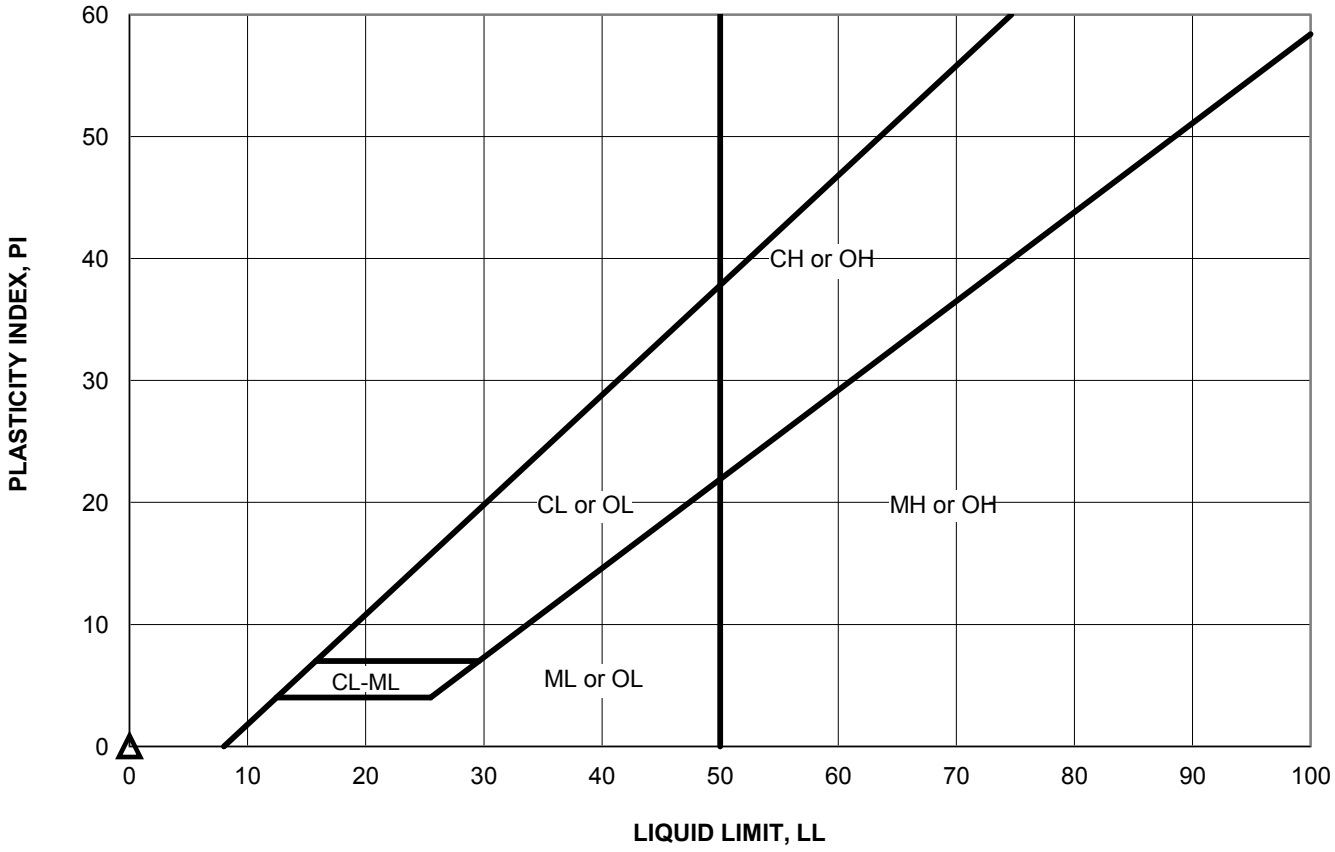
GRADATION ANALYSIS TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-4**

SYMBOL	SAMPLE LOCATION	SAMPLE DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS (% Finer than No. 40)	USCS (Entire Sample)
Δ	B-2	25.0 - 26.0	-	NP	-	SM	SM

NP - INDICATES NON-PLASTIC



PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

NOVA

ATTERBERG LIMIT TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-5**

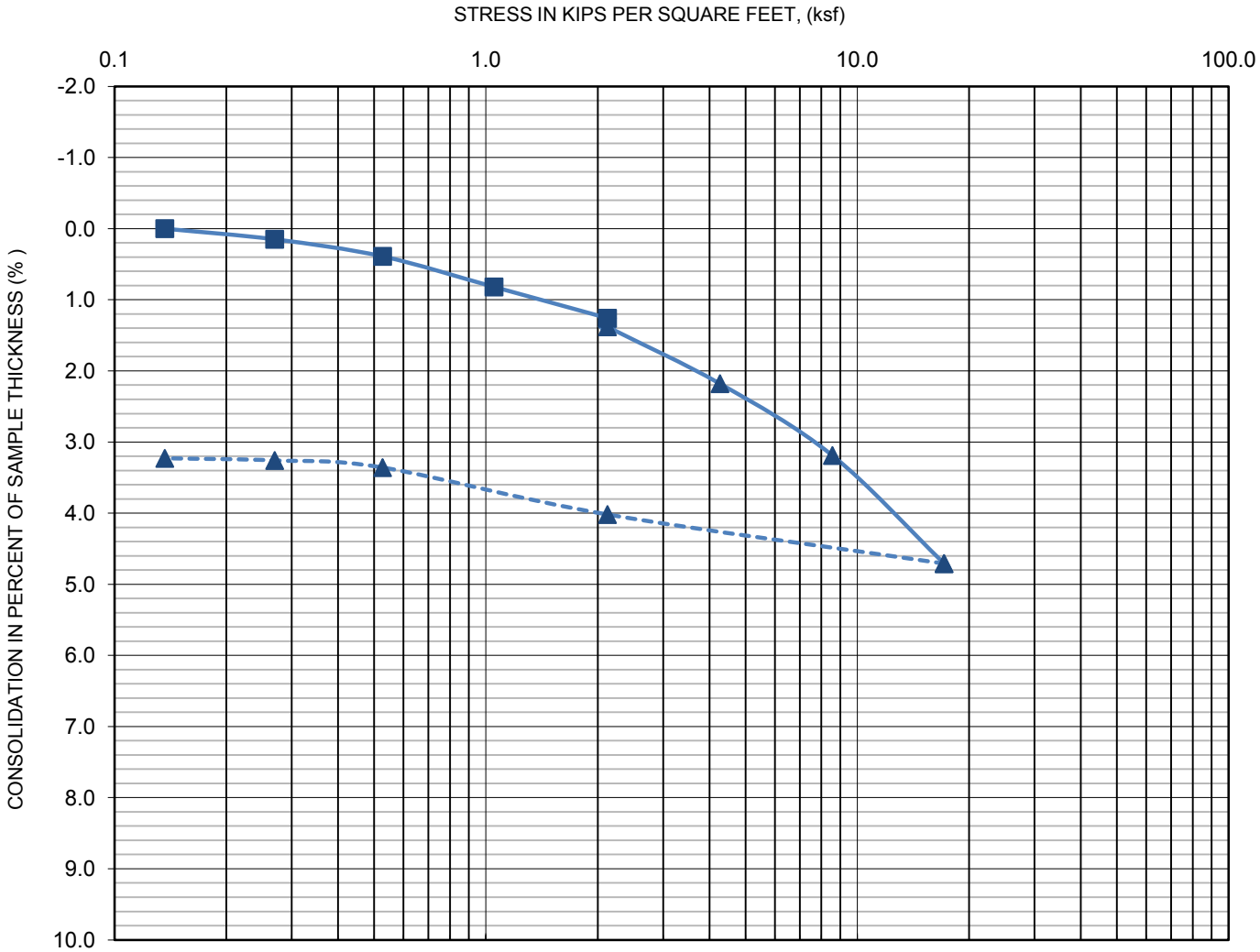
Sample Location	Sample Depth (ft)	Initial Moisture (%)	Compacted Dry Density (pcf)	Final Moisture (%)	Volumetric Swell (inch)	Expansion Index	Expansion Potential
B-1	0.5 - 5.0	7.7	115.4	11.8	0.002	2	Very Low
B-4	0.0 - 5.0	7.5	112.2	15.3	0.001	1	Very Low

NOVA

EXPANSION INDEX

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-6**



Loading Prior to H2O
Loading After H2O
Rebound

Boring No. :	B-3
Depth (ft.) :	20.0 - 21.5
Soil Type :	SANDSTONE

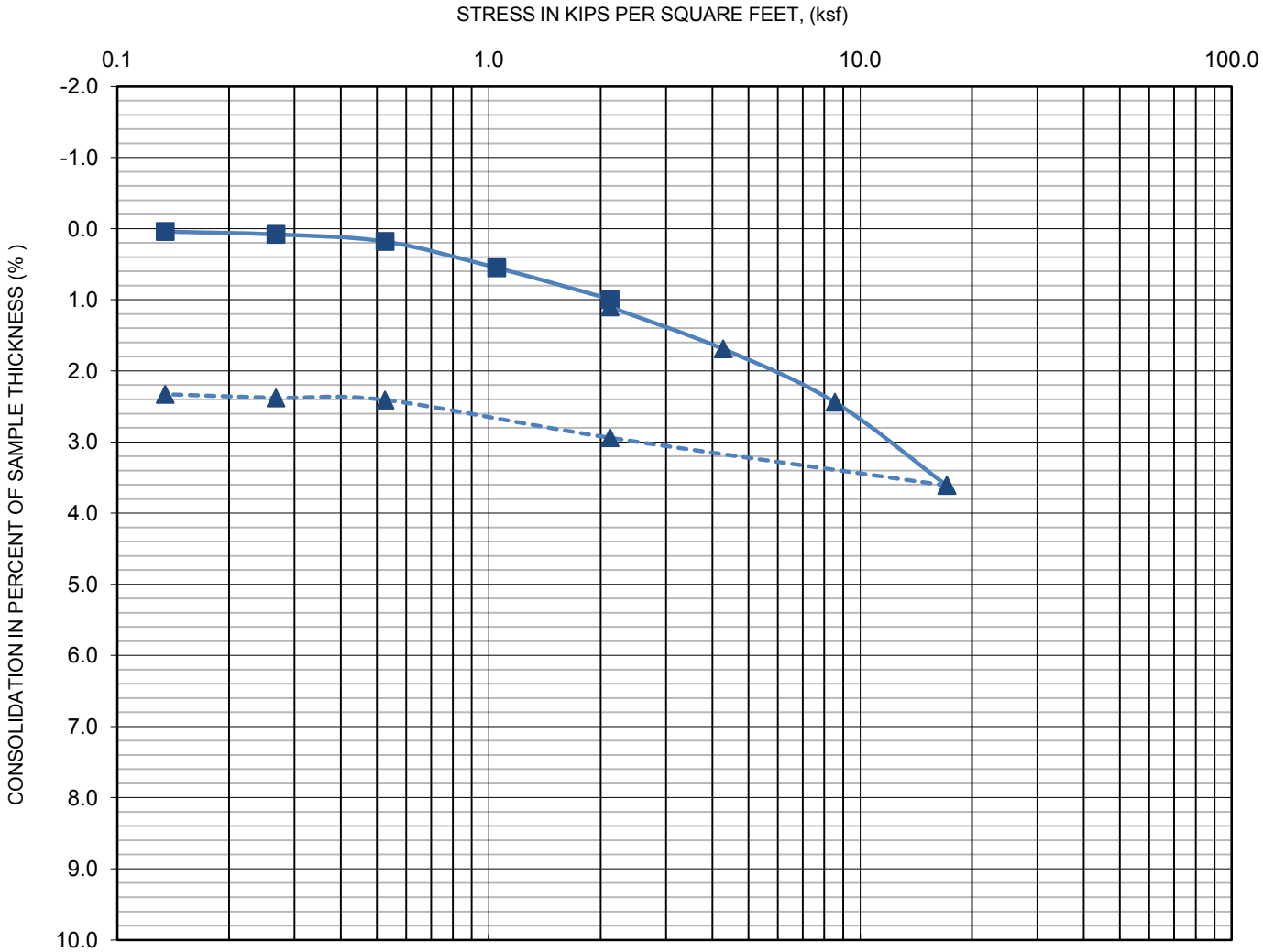
NOTES: SAMPLE TESTED AT FIELD MOISTURE CONTENT. WATER ADDED AT 2 KSF.
PERFORMED IN GENERAL CONFORMANCE WITH ASTM D 2435.

NOVA

CONSOLIDATION TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-7**



Loading Prior to H2O
Loading After H2O
Rebound

Boring No. :	B-4
Depth (ft.) :	20.0 - 21.5
Soil Type :	SANDSTONE

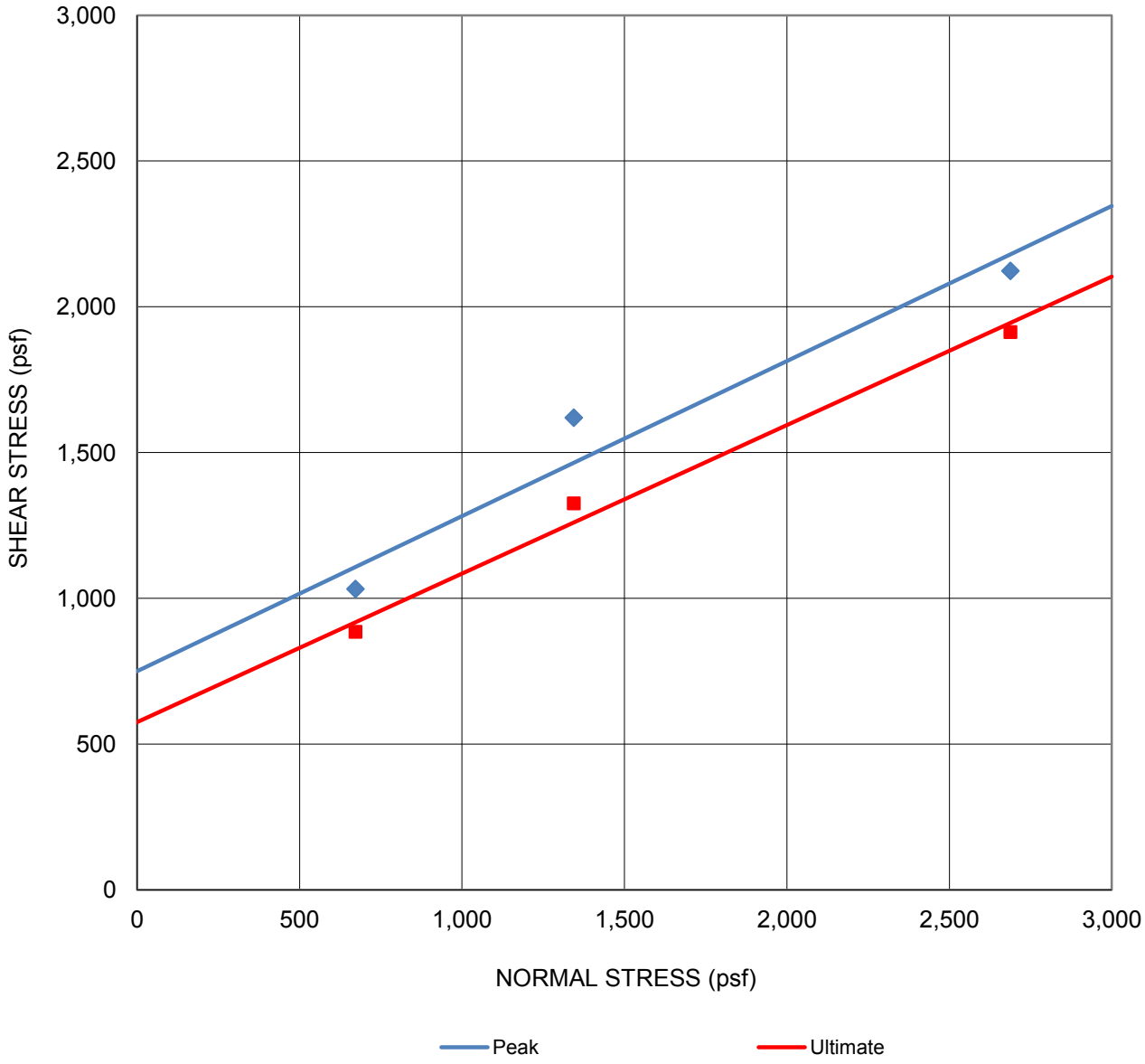
NOTES: SAMPLE TESTED AT FIELD MOISTURE CONTENT. WATER ADDED AT 2 KSF.
PERFORMED IN GENERAL CONFORMANCE WITH ASTM D 2435.

NOVA

CONSOLIDATION TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-8**



Apparent Cohesion (C):	750 psf	575 psf
Friction Angle (Φ):	28 °	27 °

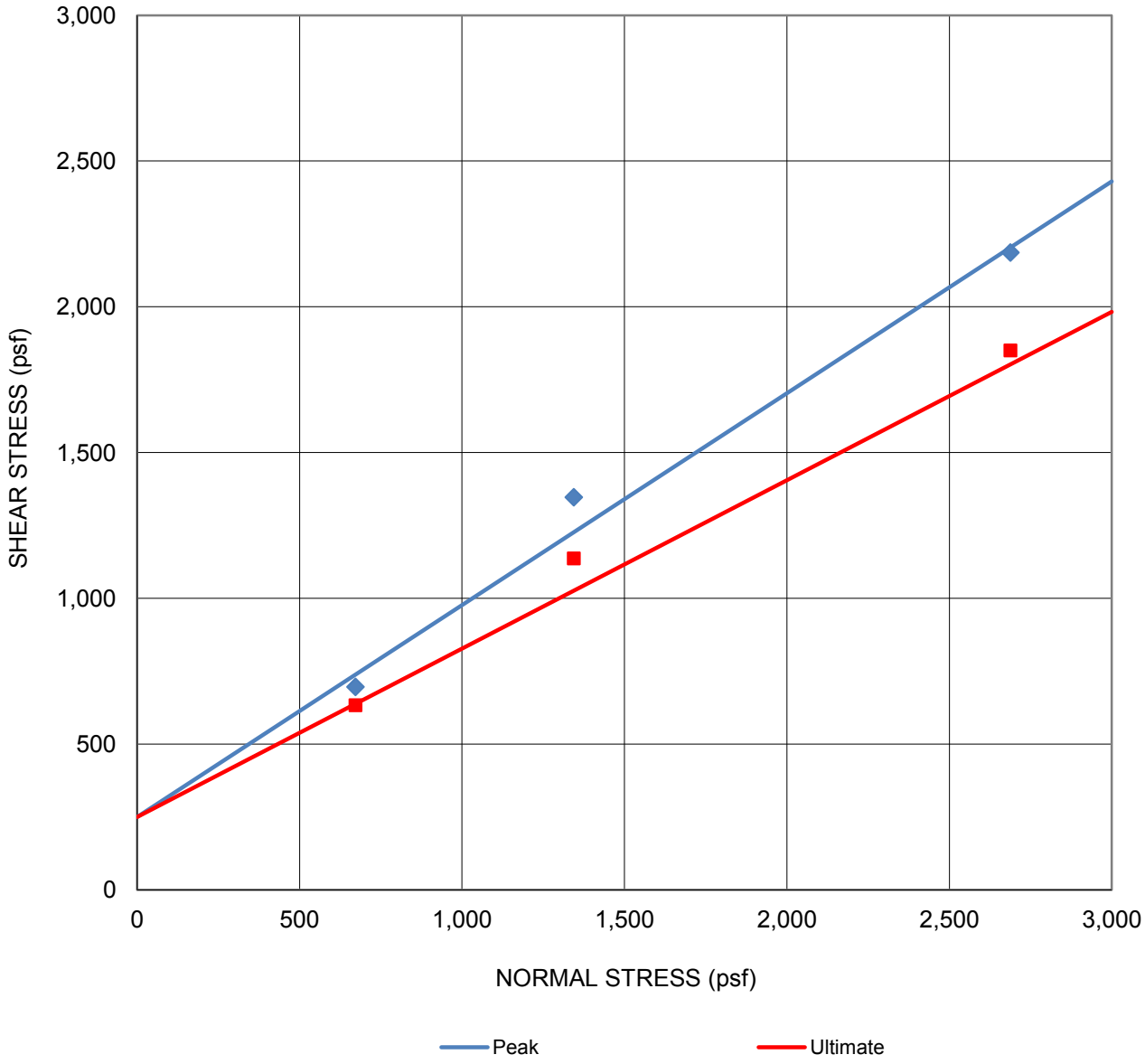
Sample Location:	B-3
Sample Depth (ft.):	20.0 - 21.5
Soil Type:	SANDSTONE

NOVA

DIRECT SHEAR TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-9**



Apparent Cohesion (C):	250 psf	250 psf
Friction Angle (Φ):	36 °	30 °

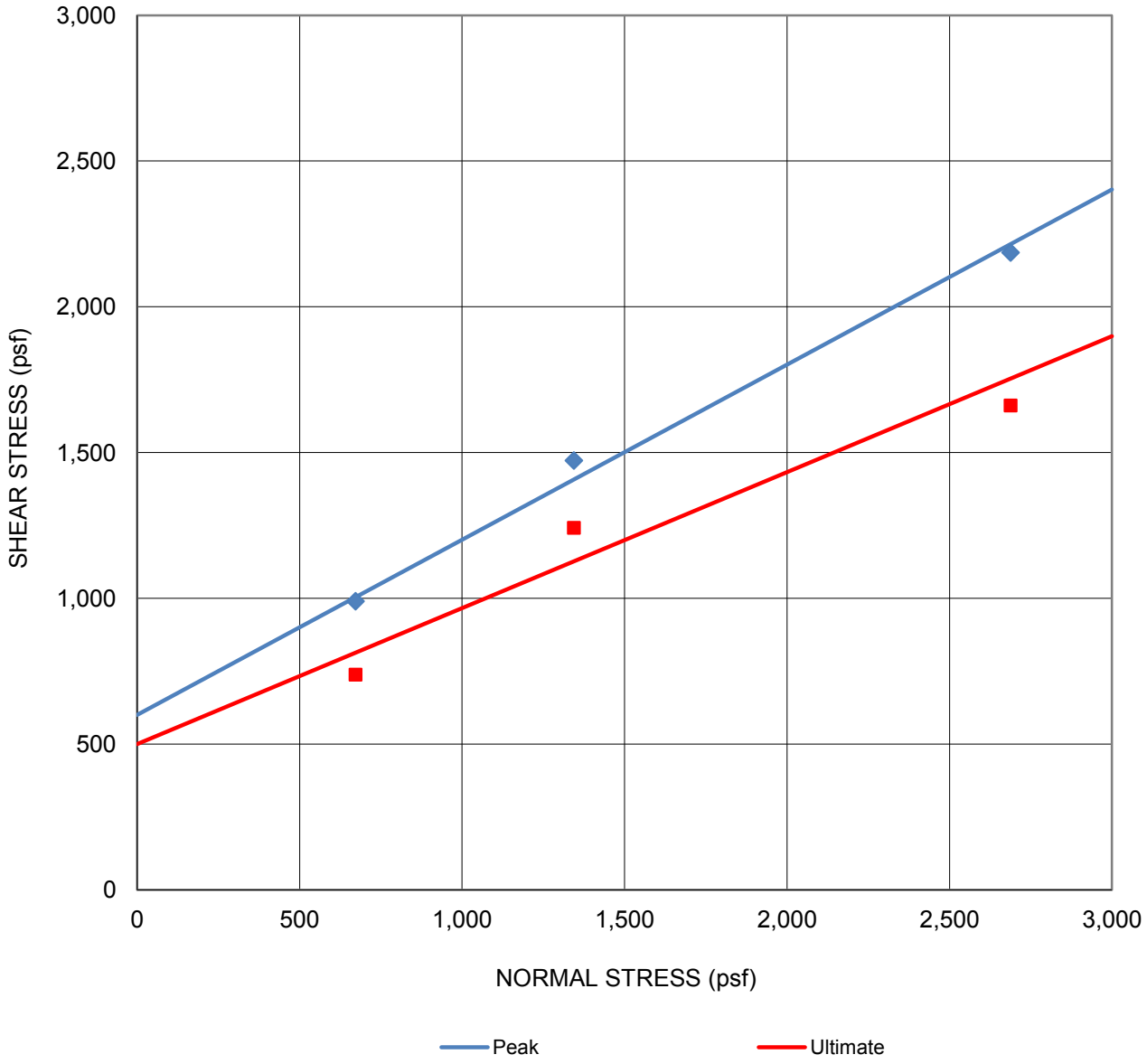
Sample Location:	B-4
Sample Depth (ft.):	20.0 - 21.5
Soil Type:	SANDSTONE

NOVA

DIRECT SHEAR TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-10**



Apparent Cohesion (C):	600 psf	500 psf
Friction Angle (Φ):	31 °	25 °

Sample Location:	B-7
Sample Depth (ft.):	20.0 - 35.0
USCS Soil Type:	SM

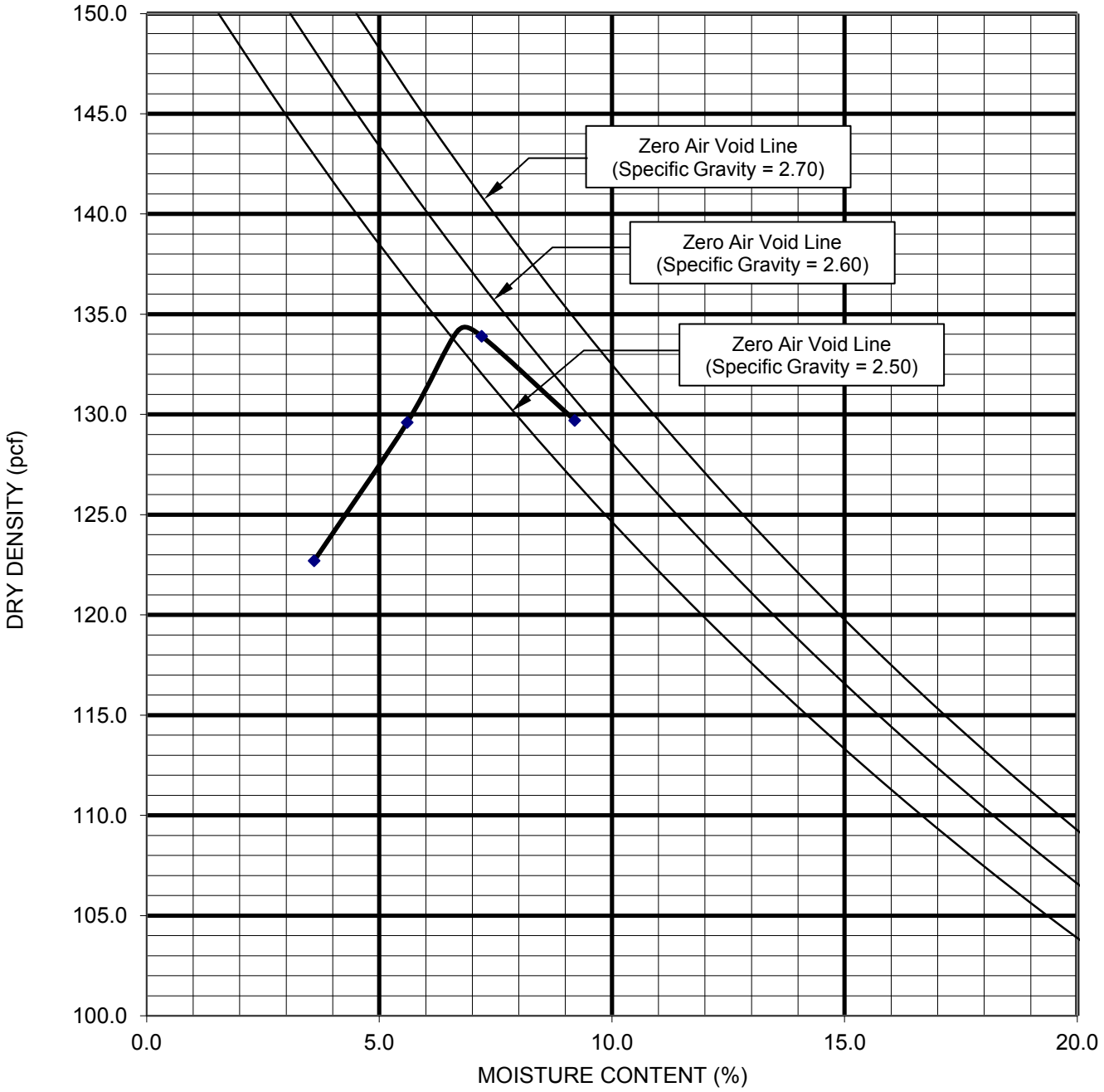
NOTE: SAMPLE WAS REMOLDED TO 125 PCF AT 8% MOISTURE CONTENT.

NOVA

DIRECT SHEAR TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-11**



Sample Location	Depth (ft.)	Soil Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-7	0.0 - 5.0	Light Reddish Brown SAND	134.2	6.7
Dry Density and Moisture Content Values Corrected for Oversize (ASTM D4718)			N/A	N/A

PERFORMED IN GENERAL ACCORDANCE WITH: ☑ ASTM D 1557 ☐ ASTM D 698 METHOD: ☑ A ☐ B ☐ C

NOVA

PROCTOR DENSITY TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-12**

Sample Location	Sample Depth (ft)	pH	Resistivity (Ohm-cm)	Sulfate Content (ppm)	Sulfate Content (%)	Chloride Content (ppm)	Chloride Content (%)
B-1	0.5 - 5.0	6.8	780	250	0.025	300	0.030
B-7	0.5 - 5.0	8.0	590	ND	ND	11	0.001

NOVA

CORROSIVITY TEST RESULTS

SOLANA 101 MIXED USE PROJECT
HIGHWAY 101 AND DAHLIA DRIVE
SOLANA BEACH, CALIFORNIA

DATE	PROJECT NO.	FIGURE
5/12	2012015	**B-13**

APPENDIX C
TYPICAL EARTHWORK GUIDELINES

These typical earthwork guidelines present the usual and minimum recommendations for grading operations performed under the observation and testing of NOVA. Deviation from these recommendations may be allowed, where specifically superseded in this report, or in other written communication signed by the Geotechnical Engineer.

1.0 GENERAL

- The Geotechnical Engineer is the Owner's or Builder's representative on the project. For the purposes of these specifications, observation and testing by the Geotechnical Engineer includes that observation and testing performed by any person or persons employed by, and responsible to, the licensed Geotechnical Engineer signing the grading report.
- All clearing, site preparation or earthwork performed on the project shall be conducted by the Contractor under the observation of the Geotechnical Engineer.
- It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Geotechnical Engineer and to place, spread, mix, water and compact the fill in accordance with the specifications of the Geotechnical Engineer. The Contractor shall also remove all material considered unsatisfactory by the Geotechnical Engineer.
- It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of compaction. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement and time of year.
- A final report will be issued by the Geotechnical Engineer attesting to the Contractor's conformance with these specifications.

2.0 SITE PREPARATION

- All vegetation and deleterious material such as rubbish shall be disposed of off-site. The removal must be concluded prior to placing fill.
- The Civil Engineer shall locate all houses, sheds, sewage disposal systems, large trees or structures onsite, or on the grading plan to the best of his knowledge prior to ground preparation.
- Soil or rock materials determined by the Geotechnical Engineer as being unsuitable for placement in compacted fills shall be removed and wasted from the site. Any material incorporated as part of a compacted fill must be approved by the Geotechnical Engineer.
- After the ground surface to receive fill has been cleared, it shall be scarified, disced or bladed by the Contractor until it is uniform and free from ruts, hollows, hummocks or other uneven features which may prevent uniform compaction.
- The scarified ground surface shall then be brought to optimum moisture content, mixed as required, and compacted as specified. If the scarified zone is greater than twelve inches in depth, the excess shall be removed and placed in lifts restricted to six inches. Prior to placing fill, the ground surface to receive fill shall be inspected, tested and approved by the Geotechnical Engineer. In areas where it is necessary to obtain the approval of the controlling agency, prior to placing fill, it will be the Contractor's responsibility to notify the proper authorities.

- Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipe lines or others not located prior to grading are to be removed or treated in a manner prescribed by the Geotechnical Engineer and/or the controlling agency for the project.

3.0 COMPACTED FILLS

- Any material imported or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Geotechnical Engineer. Roots, tree branches and other matter missed during clearing shall be removed from the fill as directed by the Geotechnical Engineer.
- Rock fragments less than four inches in the largest dimension may be utilized in the fill, provided:
  - They are not placed in concentrated pockets
  - There is a sufficient percentage of fine-grained material to surround the rocks.
  - The distribution of the rocks is observed by the Geotechnical Engineer.
- Rocks greater than six inches in the largest dimension shall be taken off-site, or placed in accordance with the recommendation of the Geotechnical Engineer in areas designated as suitable for rock disposal. Details for rock disposal such as location, moisture control, percentage of the rock placed, etc., will be referred to in the "Conclusions and Recommendations" sections of this report, if applicable.
- Material that is spongy, subject to decay, or otherwise considered unsuitable shall not be used in the compacted fill.
- Representative samples of materials to be utilized as compacted fill shall be analyzed in the laboratory by the Geotechnical Engineer to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material shall be conducted by the Geotechnical Engineer as soon as possible.
- Material used in the compaction process shall be evenly spread, watered or dried, processed and compacted in this lifts not to exceed six inches in thickness to obtain a uniformly dense layer. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Geotechnical Engineer.
- If the moisture content or relative compaction varies from that required by the Geotechnical Engineer, the Contractor shall rework the fill until it is approved by the Geotechnical Engineer.
- Each layer shall be compacted to minimum project standards in compliance with the testing methods specified by the controlling governmental agency and in accordance with the recommendations of the Geotechnical Engineer; in general, ASTM D1557 will be used.
- All fill shall be keyed and benched through all topsoil, colluvium, alluvium or creep material, into sound bedrock or firm material where the slope receiving fill exceeds a ratio of five horizontal to one vertical, in accordance with the recommendations of the Geotechnical Engineer.
- The key for hillside fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in this report.
- Drainage terraces and subdrainage devises shall be constructed in compliance with the ordinances of the controlling governmental agency, or with the recommendation of the Geotechnical Engineer.

- The Contractor will be required to obtain the specified minimum relative compaction out to the finish slope face of fill slopes, buttresses and stabilization fills. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure which produces the required compaction.
- The Contractor shall prepare a written detailed description of the method or methods he will employ to obtain the required slope compaction. Such documents shall be submitted to the Geotechnical Engineer for review and comments prior to the start of grading.
- If the method other than overbuilding and cutting back to the compacted core is to be employed, slope tests will be made by the Geotechnical Engineer during construction of the slopes to determine if the required compaction is being achieved. Where failing tests occur or other field problems arise, the Contractor will be notified by the Geotechnical Engineer.
- If the method of achieving the required slope compaction selected by the Contractor fails to produce the necessary results, the Contractor shall rework or rebuild such slopes until the required degree of compaction is obtained, at no additional cost to the Owner or Geotechnical Engineer.
- All fill slopes should be planted or protected from erosion in accordance with the project specifications and/or as recommended by a landscape architect, or by means approved by the governing authorities.
- Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials; and the transition shall be stripped of all soil prior to placing fill.
- The cut slope should be evaluated by the Geotechnical Engineer prior to placement of fill upon the cut slope.
- Pad areas in natural ground and cut shall be approved by the Geotechnical Engineer. Finished surfaces of these pads may require scarification and recompaction.

4.0 CUT SLOPES

- The Geotechnical Engineer shall inspect all cut slopes and shall be notified by the Contractor when cut slopes are started.
- If any conditions not anticipated in this report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding, joints or fault planes are encountered during grading, these conditions shall be analyzed by the Geotechnical Engineer; and recommendations shall be made to treat these problems.
- Cut slopes that face in the same direction as the prevailing drainage shall be protected from slope wash by a non-erosive interceptor swale placed at the top of the slope.
- Unless otherwise specified in this report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.
- Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies and/or in accordance with the recommendations of the Geotechnical Engineer.
- All cut slopes should be planted or protected from erosion in accordance with the project specifications and/or as recommended by a landscape architect, or by means approved by the governing authorities.

5.0 GRADING CONTROL

- Inspection of the fill placement shall be provided by the Geotechnical Engineer and/or his representative during the progress of grading
- In general, density tests should be made at intervals not exceeding two feet of fill height or every 1000 cubic yards of fill placed. These criteria will vary depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction in being achieved.
- Where sheeps-foot rollers are used, the soil may be disturbed to a depth of several inches. Density determinations shall be taken in the compacted material below the disturbed surface at a depth determined by the Geotechnical Engineer or his representative.
- Density tests should be made on the surface material to receive fill as required by the Geotechnical Engineer.
- Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction or improper moisture is in evidence, the particular layer or portion shall be reworked until the required density and/or moisture content has been attained. No additional fill shall be placed over an area until the last placed lift of fill has been tested and found to meet the density and moisture requirements and that lift approved by the Geotechnical Engineer.
- All cleanout, processed ground to receive fill, key excavations, subdrains and rock disposal must be inspected and approved by the Geotechnical Engineer (and often by the governing authorities) prior to placing any fill. It shall be the Contractor's responsibility to notify the Geotechnical Engineer and governing authorities when such areas are ready for inspection.
- Observation and testing by the Geotechnical Engineer shall be conducted during the filling and compacting operations in order that he will be able to state in his opinion all cut and filled areas are graded in accordance with the approved specifications.

6.0 CONSTRUCTION CONSIDERATIONS

- Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.
- During construction, the Contractor shall properly grade all surfaces to maintain good drainage and prevent ponding of water. The Contractor shall take remedial measures to control surface water and to prevent erosion of graded area until such time as permanent drainage and erosion control measures have been installed.
- Where the work is interrupted by heavy rains, fill operations shall not be resumed until field observations and tests by the Geotechnical Engineer indicate the moisture content and density of the fill are within the limits previously specified.
- Upon completion of grading and termination of observations by the Geotechnical Engineer, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features shall be performed without the approval of the Geotechnical Engineer.
- Care shall be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of a permanent nature on or adjacent to the property.