

## APPENDIX C – GEOTECHNICAL INVESTIGATION



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**GEOTECHNICAL EVALUATION  
NEWPORT BOULEVARD AND  
32<sup>ND</sup> STREET MODIFICATIONS  
NEWPORT BEACH, CALIFORNIA**

**PREPARED FOR:**  
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October 23, 2013  
Project No. 208665001

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Mr. Jeff Wilkerson  
VA Consulting, Inc.  
6400 Oak Canyon, Suite 150  
Irvine, California 92618

Subject: Geotechnical Evaluation  
Newport Boulevard and 32<sup>nd</sup> Street Modifications  
Newport Beach, California

Dear Mr. Wilkerson:

Enclosed please find our report presenting the results of our geotechnical evaluation for the Newport Boulevard and 32<sup>nd</sup> Street Modifications project in Newport Beach, California. Our evaluation was performed to assess the soil and pavement conditions at the project site and to develop geotechnical recommendations for the design and the construction of the proposed improvements. This report presents our geotechnical findings, conclusions, and recommendations relative to the project.

Ninyo & Moore appreciates the opportunity to be of service on this project.

Respectfully submitted,  
**NINYO & MOORE**



Jennifer Schmidt, PG  
Project Geologist



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Chief Geotechnical Engineer



Lawrence Jansen, PG, CEG  
Principal Geologist



JRS/LTJ/DBC/lr/sc

Distribution: (1) Addressee (via e-mail)

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## **1. INTRODUCTION**

In accordance with your request, we have performed a geotechnical evaluation for the proposed Newport Boulevard and 32<sup>nd</sup> Street Modifications project in Newport Beach, California (Figure 1). The project will include pavement improvements and roadway widening along Newport Boulevard and at the intersection of Newport Boulevard and 32<sup>nd</sup> Street. The purpose of our study was to evaluate the subsurface conditions and to provide geotechnical design parameters for the project. This report presents the results of our study, including our findings and recommendations relative to the geotechnical aspects of the project.

## **2. SCOPE OF SERVICES**

The scope of our geotechnical services included the following:

- Attendance at a project kick-off meeting with the client and City of Newport Beach representatives to discuss project details.
- Project coordination, planning, permit acquisition, and scheduling of the subsurface exploration.
- Review of readily available background data, including in-house geotechnical data, published geotechnical literature, aerial photographs, geologic maps, and project-related plans provided by the client.
- Reconnaissance of the site to locate proposed borings and coordinate with Underground Services Alert for underground utility location.
- Traffic control in general accordance with the Work Area Traffic Control Handbook.
- Subsurface exploration consisting of the drilling, logging, and sampling of six small-diameter hollow-stem auger exploratory borings. The borings were logged by our representative and bulk and relatively undisturbed samples were collected at selected intervals. The borings were backfilled with on-site soil after drilling and the soil samples were returned to our laboratory for testing.
- Laboratory testing of selected, representative soil samples to evaluate R-value and corrosivity.
- Data compilation and engineering analysis of the information obtained from our background review, subsurface evaluation, and laboratory testing.

- Preparation of this geotechnical report presenting our findings, conclusions, and recommendations pertaining to the design and construction of the proposed roadway improvements.

### **3. SITE DESCRIPTION AND PROPOSED CONSTRUCTION**

The project site is located in a commercial area on the Balboa Peninsula. Outlying properties are predominantly residential. The proposed street modifications are located on Newport Boulevard between 30<sup>th</sup> Street and Via Lido and on 32<sup>nd</sup> Street at the intersection of Newport Boulevard. The site topography is relatively flat with ground surface elevations ranging from approximately 4 to 8 feet above mean sea level. Pavement distress observed on Newport Boulevard between 32<sup>nd</sup> Street and Finley Avenue included moderate longitudinal and alligator cracking, moderate raveling, and minor potholes. The majority of the cracking and potholes along this section have been previously patched and/or sealed. Pavements in the remainder of the roadway modification area are generally in good condition with some minor transverse cracking.

Concept plans (VA Consulting, 2013) show proposed improvements consisting of the widening and modifications of Newport Boulevard and 32<sup>nd</sup> Street to include an additional through-lane on northbound Newport Boulevard from 30<sup>th</sup> Street to 32<sup>nd</sup> Street and on southbound Newport Boulevard from Via Lido to 32<sup>nd</sup> Street (Figure 2). Curbside parking stalls will be removed and concrete bike lanes will be added. An existing building at the northwest corner of Newport Boulevard and 32<sup>nd</sup> Street will be removed to accommodate road widening at this location and the addition of a parking lot with sixteen new parking stalls. Other improvements will include raised median island construction, median landscaping and irrigation, striping, signing, and minor utility trenching for laterals.

### **4. SUBSURFACE EXPLORATION AND LABORATORY TESTING**

Our subsurface evaluation was performed on September 12, 2013, and consisted of the drilling, logging, and sampling of six small-diameter borings. The borings were advanced to depths of up to approximately 6½ feet. A representative from our firm logged the borings and obtained bulk and relatively undisturbed soil samples at selected depths for laboratory testing. The approximate

locations of the borings are presented on Figure 2. Logs of the borings are presented in Appendix A.

Geotechnical laboratory testing was performed on representative soil samples to evaluate R-value and soil corrosivity. The results of the laboratory testing are presented in Appendix B.

## 5. SUBSURFACE CONDITIONS

Review of referenced geologic maps (Morton, 2004) indicates that the site is underlain by eolian and estuarine alluvial deposits. These deposits are described as consisting of unconsolidated sand, silt, and clay with variable amounts of organic matter. The subsurface conditions encountered at our boring locations are summarized below. Detailed descriptions of the subsurface conditions are presented on the boring logs in Appendix A.

Measurements of the existing pavement sections were obtained at our boring locations. The pavement sections encountered consisted primarily of asphalt concrete over aggregate base. Portland cement concrete (PCC) was encountered below the asphalt concrete in borings B-2 and B-5. The thickness of the PCC and presence of base at these locations is unknown due to drilling refusal in the concrete. Table 1 presents a summary of the existing pavement sections encountered in our exploratory borings. Variable thicknesses should be anticipated.

**Table 1 – Existing Pavement Sections**

<b>Boring No.</b>	<b>Street</b>	<b>Asphalt Concrete (inches)</b>	<b>Aggregate Base (inches)</b>
B-1	Newport Boulevard - Southbound	10	4
B-2	Newport Boulevard - Northbound	11	Unknown*
B-3	Newport Boulevard - Southbound	4.5	4
B-4	Newport Boulevard - Northbound	6	12
B-5	Newport Boulevard - Northbound	6	Unknown*
B-6	32 <sup>nd</sup> Street - Westbound	6.5	5
*Drilling refusal in concrete; thickness unknown			

The pavements were underlain by fill soil and alluvial deposits to the depths explored. In general, the soil conditions beneath the pavements were comprised of moist to saturated,

very loose to medium dense, silty sand. Scattered, relatively minor amounts of clayey sand, sandy silt and clayey silt were also observed at the boring locations.

## **6. GROUNDWATER**

Groundwater was encountered in borings B-1, B-3, B-4 and B-6 at depths ranging from approximately 3 to 5 feet below the ground surface at the time of drilling. It should be noted that the depths to groundwater were evaluated at the time of drilling and stabilized groundwater elevations were not established; therefore, groundwater may be shallower than encountered at the time of drilling. In addition, fluctuations in the level of groundwater will occur due to tidal fluctuations, variations in ground surface topography, subsurface stratification, rainfall, irrigation practices, and other factors which may not have been evident at the time of our field evaluation.

## **7. CONCLUSIONS**

Based on the results of our geotechnical evaluation, it is our opinion that the proposed improvements are feasible, provided the recommendations presented in this report are incorporated into the design and construction of the project. Our conclusions are based on the findings of this evaluation and are as follows:

- The project site is underlain by fill and alluvium generally consisting of very loose to medium dense, silty sand with minor amounts of clayey sand and sandy to clayey silt.
- The on-site granular soils are generally suitable for use as structural backfill provided deleterious materials are removed. Soil excavated from below groundwater levels will be wet and will involve drying to be suitable for compaction.
- During our subsurface evaluation, groundwater was encountered at depths ranging from approximately 3 to 5 feet below the existing ground surface. Groundwater should be anticipated at depths of approximately 3 feet or less. Trench excavations that extend below groundwater will involve dewatering in order to construct the proposed improvements under a dry condition.
- Trench excavations that extend below groundwater or deeper than 4 feet will involve temporary shoring to support the excavation sidewalls and to reduce the potential settlement that could affect the roadway and adjacent structures and/or pipelines. Shoring should be used in accordance with Occupational Safety Health Administration (OSHA) regulations. The on-site soils should be considered as Type C soils in accordance with OSHA regulations.

- Existing utilities and structures are present along the project alignment that will involve protection in-place during construction. The contractor should take care to keep from damaging and/or undermining the utilities and adjacent structures.
- Our limited laboratory corrosion testing indicates that the on-site soils should be considered non-corrosive based on California Department of Transportation (Caltrans, 2003) corrosion guidelines.

## **8. RECOMMENDATIONS**

The recommendations presented in the following sections provide general geotechnical criteria regarding the design and construction of the proposed roadway modification project. These recommendations are based on our evaluation of the site geotechnical conditions and our understanding of the planned improvements.

### **8.1. Earthwork**

We anticipate that earthwork for the project will include relatively shallow excavations of approximately 2 feet or less for new pavements, pavement subgrade preparation, trenching and backfill for utility laterals, and removal of foundations and abandoned utilities for new parking lot construction. Earthwork operations should be performed in accordance with the following recommendations, as well as the grading specifications of the governing agencies.

#### **8.1.1. Pre-Construction Conference**

We recommend that a pre-construction conference be held. The owner and/or their representative, the governing agencies' representatives, the civil engineer, Ninyo & Moore, and the contractor should attend to discuss the work plan, project schedule, and excavation issues.

#### **8.1.2. Site Preparation**

Prior to roadway improvements, the area should be cleared of existing surface obstructions, reflectors, and other deleterious materials. If pavement reconstruction is being performed, existing utilities should be re-routed or protected from damage by construction activities. Holes resulting from the removal of buried obstructions that extend below the finish grade should be backfilled with compacted fill.

### **8.1.3. Excavation Characteristics**

Based on our field exploration and experience, we anticipate that excavation within the existing fill and alluvium at the site may be accomplished with conventional earthmoving equipment in good condition. Excavations that extend below groundwater will be unstable and subject to caving. Shoring is anticipated for excavations that encounter groundwater.

### **8.1.4. Braced Excavations**

Trenches or other excavations that extend below groundwater and/or deeper than approximately 4 feet should be shored. Shoring systems should be installed prior to excavating below groundwater to avoid caving and undermining of adjacent improvements. Shoring systems with continuous sheeting should be provided. Shoring systems should be designed using the lateral earth pressures presented on Figure 3 for braced excavations below groundwater in granular soil. The recommended design pressures are based on the assumptions that the shoring system is constructed without raising the ground surface elevation behind the shoring, that there are no surcharge loads, such as soil stockpiles and construction materials, and that no loads act above a 1:1 (horizontal to vertical) plane extending up and back from the base of the sheet pile system. For shoring subjected to the above-mentioned surcharge loads, the contractor should include the effect of these loads on the lateral earth pressures against the shoring system.

The contractor should retain a qualified and experienced engineer to design the shoring system. The shoring parameters presented in this report are minimum requirements, and the contractor should evaluate the adequacy of these parameters and make the required modifications for their design. We recommend that the contractor take appropriate measures to protect workers. OSHA requirements pertaining to worker safety should be observed. The on-site soils should be considered as soil Type C in accordance with OSHA requirements.

#### **8.1.5. Construction Dewatering**

Groundwater is anticipated at depths of approximately 3 feet or less and excavations that extend below groundwater will involve dewatering. Dewatering may include pumping of groundwater from well points within or outside of the shored excavation. Dewatering should be limited to not more than approximately 2 feet below the bottom of excavations. The dewatering system design should be performed by a specialty dewatering contractor. Disposal of groundwater should be performed in accordance with guidelines of the Regional Water Quality Control Board.

#### **8.1.6. Excavation Bottom Stability**

Excavations close to or below the groundwater (before or after dewatering) will encounter wet and potentially unstable ground conditions. Wet soils may be subject to pumping under equipment loading.

Where new pavement construction occurs, subgrade soils close to groundwater may be subject to pumping under compaction equipment loads. Repeated compaction effort and/or vibratory compaction equipment may result in pumping and unstable subgrade conditions. In the event pumping/unstable subgrade conditions occur due to shallow groundwater conditions, we recommend no vibratory compaction equipment. Static smooth drum rollers or other non-vibratory equipment should be used for compaction. If unstable subgrade conditions persist, additional stabilization measures may be appropriate. Additional stabilization may involve geogrid reinforcement, over-excavation and replacement with crushed aggregate, or other methods. Recommendations for subgrade stabilization should be prepared by Ninyo & Moore at the time of construction based on evaluation of the conditions encountered.

The bottoms of the trenches that are near or below groundwater will be relatively unstable. In general, unstable bottom conditions may be mitigated by overexcavating the trench bottom 1 to 2 feet and replacing with gravel wrapped in a geotextile filter fabric (Mirafi 140N or equivalent). Recommendations for stabilizing excavation

bottoms should be based on evaluation in the field by Ninyo & Moore at the time of construction.

#### **8.1.7. Trench Backfill**

Soils encountered at the site should generally be suitable for reuse as backfill for trenches provided they are free of organic material, clay lumps, debris, and rocks larger than approximately 4 inches in diameter. Excavations that extend to groundwater will involve wet soils. Wet soils should be processed to near-optimum moisture content prior to their placement as trench backfill. Fill material imported to the site (if any), should be granular, non-expansive soil, and free of trash, debris, roots, vegetation, or other deleterious materials. “Non-expansive” soils can be defined as having a “very low” expansion potential in accordance with the California Building Code (CBC) (an expansion index ranging from 0 to 20). Fill should generally be free of rocks or hard lumps of material in excess of 4 inches in diameter. Rocks or hard lumps larger than approximately 4 inches in diameter should be broken into smaller pieces or should be removed from the site. Materials for use as imported structural fill should be evaluated by Ninyo & Moore prior to importing.

Backfill should be compacted to a relative compaction of 90 percent as evaluated ASTM International (ASTM) D 1557. Lift thickness for backfill will depend on the type of compaction equipment utilized, but fill should generally be placed in lifts not exceeding 8 inches in loose thickness. Special care should be exercised to avoid damaging utilities during compaction of the backfill.

#### **8.1.8. Modulus of Soil Reaction for Pipe Design**

The modulus of soil reaction is used to characterize the stiffness of soil along the sides of buried flexible pipelines for the purpose of evaluating deflection caused by the weight of the backfill above the pipe. We recommend that a modulus of soil reaction of 1,000 pounds per square inch be used for design for access pits exposing granular soil in the pipe zone, provided that granular pipe zone backfill material is placed adjacent to the pipe, as previously recommended.

### **8.1.9. Lateral Earth Pressures for Thrust Blocks**

Thrust restraint for water pressure inside the pipe may be achieved by transferring the thrust force to the soil outside the pipe through a thrust block. Thrust blocks may be designed using the lateral passive earth pressures presented on Figure 4.

## **8.2. Pavement Improvements**

Pavement designs were prepared for structural pavement overlays and new pavement construction. The pavement designs were based on our evaluation of existing pavement sections, the subgrade soil conditions and our laboratory testing.

The R-value characteristics of the subgrade soils were evaluated from representative soil samples obtained from our exploratory borings. Laboratory R-value testing indicates that the R-values of the materials encountered in our borings ranged from 71 to 77. Considering the possible soil variation throughout the study area, an R-value of 60 was used for the design. Traffic index (TI) values were provided to us by VA Consulting and included a TI of 7.0 for the number 1 lanes and a TI of 9.5 for the number 2 and 3 lanes and all lanes south of 32<sup>nd</sup> Street. In addition, we assumed a TI of 5.0 for the new parking lot construction. Our pavement analysis was performed using the methodology outlined by the Institute for Transportation Studies (Institute for Transportation Studies, 1984) and the Highway Design Manual (Caltrans, 2008). The analysis assumes an approximately 10-year design life for pavement overlays and a 20-year design life for new pavements.

Based on the design R-values and TIs, recommendations for pavement overlays and new pavement construction are provided in Table 2. The recommended pavement overlay thicknesses do not include pavement grinding. To maintain the recommended pavement section, the depth of grinding should be added to the pavement overlay thickness. It should be noted that the pavement overlay recommendations were based on the existing pavement section measured in boring B-3, which was the relatively thinner pavement section encountered. The pavement overlay recommendations also include a Rubberized Hot Mix Asphalt (RHMA) alternative. The RHMA alternative allows for thinner overlay that maintains the design structural section. Factors such as existing grade/drainage conditions,

construction constraints, and economic considerations should be considered in selecting the appropriate pavement alternative.

**Table 2 – Structural Pavement Recommendations**

Traffic Index	Structural Overlay Options		New Construction		
	HMA (feet)	RHMA-G/DGHMA (feet)	AC/AB or AC/CMB (feet)	Full Depth AC (feet)	PCC (feet)
5.0	--	--	0.20/0.35	0.30	0.45
7.0	0.25	0.15/0	0.35/0.35	0.45	0.60
9.5	0.45	0.15/0.15	0.5/0.35	0.65	0.65

**Notes:**  
 AC – Asphalt Concrete  
 AB – Caltrans Class II Aggregate Base  
 CMB – Crushed Miscellaneous Base  
 DGHMA – Dense Graded HMA  
 HMA – Hot Mix Asphalt  
 PCC – Portland Cement Concrete  
 RHMA-G – Gap Graded Rubberized HMA

**8.2.1. Asphalt Overlay**

The purpose of an asphalt concrete overlay is to improve the performance and lengthen the remaining design life of the existing pavement structural section. Pavement grinding should be performed prior to the overlay to provide a fresh pavement surface. After grinding, cracks approximately 1/8 inch wide or more should be sealed with a crack sealant. Then the surface should be cleaned of loose debris and a tack coat of liquid asphalt consisting of a 0.1 gallon per square yard application of SS-1, or equivalent, should be applied. In order to maintain pavement grades along concrete gutters, existing pavements are typically cold-milled along the gutters to allow for the placement of the recommended overlay thickness while maintaining pavement grades at the gutter interface.

A qualified subcontractor should install the asphalt overlay in accordance with the recommendations of the Asphalt Institute, or equivalent association. Routine

maintenance should be expected including periodic sealing of the pavement and repair of cracks or other isolated distress. The selected alternative for the project depends on a number of variables, including availability and cost of different materials, construction requirements/constraints, and site-specific soil conditions.

### **8.2.2. New Pavement Construction**

In areas where the roadway will be widened or the existing pavement section is reconstructed, new pavement sections consisting of asphalt concrete over aggregate base, full-depth asphalt concrete, or PCC may be used as recommended in Table 2.

Prior to placement of the new structural pavement section, the subgrade soils should be prepared appropriately. The upper approximately 12 inches of the subgrade beneath new pavements should be scarified, moisture conditioned, and re-compacted to a relative compaction of 90 percent as evaluated by ASTM test method D1557. If a full-depth AC section is selected, the pavement subgrade should be compacted to 95 percent or more relative compaction. The subgrade compaction should also result in a non-yielding condition to allow for pavement construction. In the event unstable subgrade conditions are encountered, as described in the previous earthwork sections of this report, stabilization measures should be performed to achieve a non-yielding condition for pavement construction.

### **8.2.3. Material Specifications**

Asphalt concrete should conform to the latest edition of the Standard Specifications for Public Works Construction Section 203-1 for asphalt and 203-6 for aggregates. Class 2 aggregate base should conform to the latest edition of the State of California Standard Specifications, Section 26-1.02A. Crushed Miscellaneous Base should conform to the latest edition of the Standard Specifications for Public Works Construction, Section 200-2.4. Hot-Mix Asphalt (HMA) materials should conform to the Standard Specifications for Public Works Construction “Greenbook,” Section 203-6. Placement and rolling of HMA materials should conform to the Greenbook Section 302-5. RHMA materials should conform to Greenbook Section 203-11.

Base material should be placed at a relative compaction of 95 percent or more as evaluated by ASTM D 1557. Grinding and recycling existing asphalt concrete and existing base material may be considered as a potential source of Crushed Miscellaneous Base material provided they meet the requirements in the Standard Specifications.

### **8.3. Corrosion**

Laboratory testing was performed to evaluate pH, minimum electrical resistivity, water-soluble chloride content, and water-soluble sulfate content of site soils. The pH and minimum electrical resistivity tests were performed in accordance with California Test Method 643. Sulfate and chloride content tests were performed in accordance with California Test Methods 417 and 422, respectively. The laboratory results are presented in Appendix B.

The results of our limited corrosivity testing indicated an electrical resistivity of approximately 2,390 to 5,505 ohm-centimeters, a soil pH of approximately 8.5 to 8.8, a chloride content of approximately 80 to 260 parts per million (ppm), and a sulfate content of approximately 0.003 to 0.004 percent (25 to 40 ppm). Based on the laboratory test results and Caltrans (2003) corrosion criteria, the project site can be classified as non-corrosive, which is defined as having earth materials with less than 500 ppm chlorides, less than 0.20 percent sulfates (i.e., 2,000 ppm), an electrical resistivity of 1,000 ohm-centimeters or more, and a pH of 5.5 or greater.

The site soils may, therefore, be considered to be non-corrosive to ferrous metals. Corrosion protection for improvements in contact with soil be designed by a corrosion engineer.

### **8.4. Concrete**

Concrete in contact with soil or water that contains high concentrations of soluble sulfates can be subject to chemical and/or physical deterioration. Based on the CBC criteria (2010) and American Concrete Institute (ACI) criteria (ACI, 2011), the potential for sulfate attack is negligible for water-soluble sulfate contents in soil ranging less than 1,000 ppm. As

indicated above, the soil samples tested for this evaluation indicate a water-soluble sulfate content of 25 to 40 ppm. Accordingly, the on-site soils are considered to have a negligible potential for sulfate attack.

In order to reduce the potential for shrinkage cracks in the concrete during curing, we recommend that the concrete be placed with a slump of 4 inches based on ASTM C 143. The slump should be checked periodically at the site prior to concrete placement. The structural engineer should be consulted for additional concrete specifications.

## **9. CONSTRUCTION OBSERVATION**

Ninyo & Moore should observe and test fill placement and compaction. The frequency of testing and the time of observation will vary depending on the contractor's method of operation and quality of work, as well as the requirements of the governing agency.

The recommendations provided in this report are based on the assumption that Ninyo & Moore will provide geotechnical observation and testing services during construction. In the event that the services of Ninyo & Moore are not used during construction, we request that the selected consultant provide the City of Newport Beach Public Works with a letter (with a copy to Ninyo & Moore) indicating that they fully understand Ninyo & Moore's recommendations, and that they are in full agreement with the design parameters and recommendations contained in this report.

## **10. 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. Please also note that 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. Ninyo & Moore 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 and may not provide sufficient data to prepare an accurate bid by some 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 can 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 Ninyo & Moore 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.

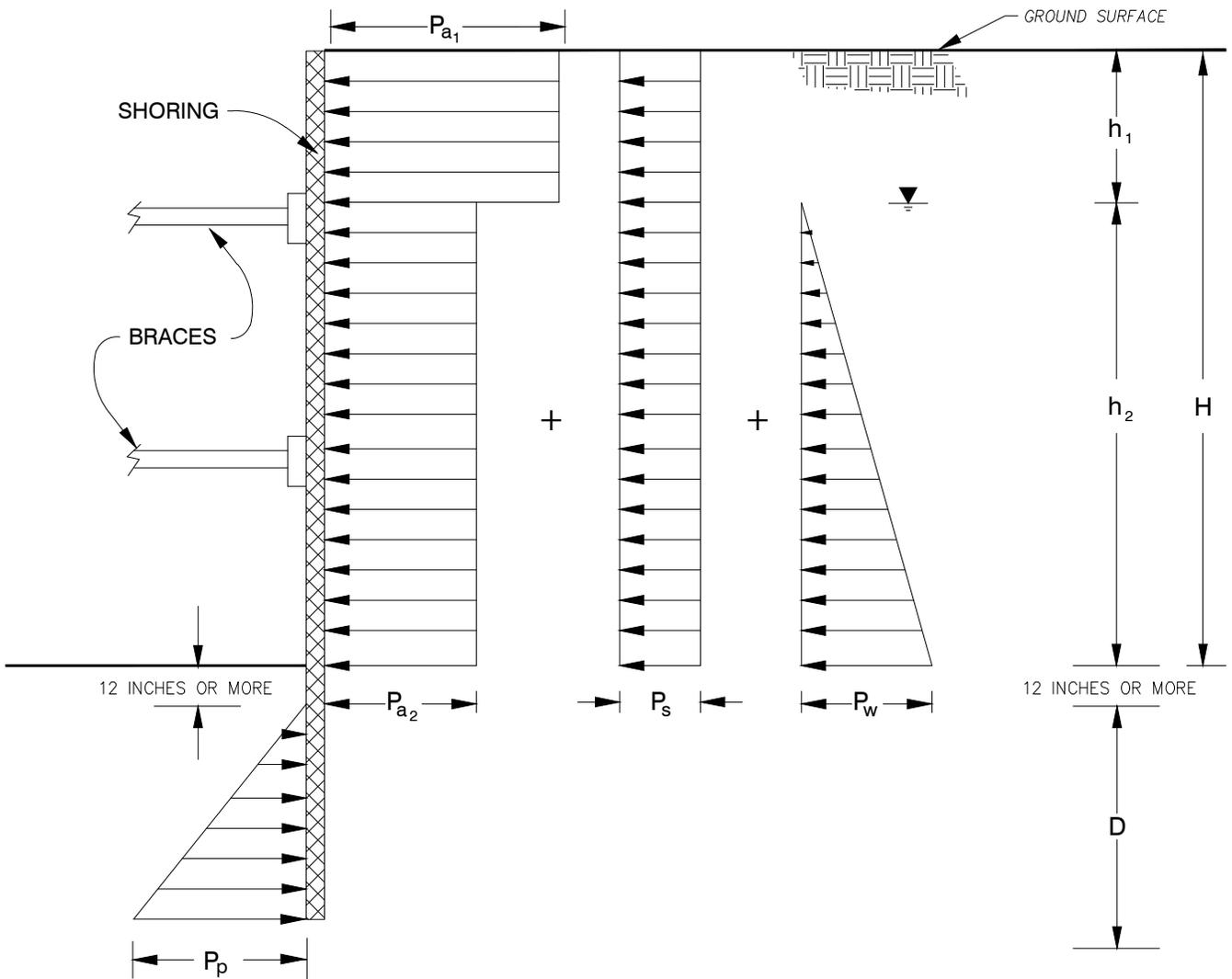
## 11. REFERENCES

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- Ninyo & Moore, 2012, Proposal for Geotechnical Consulting Services, Newport Boulevard and 32<sup>nd</sup> Street Modification Project, Newport Beach, California, Proposal No. P-15457, dated March 20.
- United States Geological Survey, 1965 (Photorevised 1981), Newport Beach, California Quadrangle Map, 7.5 Minute Series: Scale 1:24,000.
- VA Consulting, Inc., 2013, Concept Plan for Newport Boulevard and 32<sup>nd</sup> Street Widening, Alternative 5, dated July 2.

<b>AERIAL PHOTOGRAPHS</b>				
<b>Source</b>	<b>Date</b>	<b>Scale</b>	<b>Flight</b>	<b>Numbers</b>
USDA	6-2-53	1:20,000	AXK-6K	67 & 68







NOTES:

1. APPARENT LATERAL EARTH PRESSURES,  $P_{a1}$  AND  $P_{a2}$   
 $P_{a1} = 24 h_1$  psf  
 $P_{a2} = 12 h_2$  psf
2. CONSTRUCTION TRAFFIC INDUCED SURCHARGE PRESSURE,  $P_s$   
 $P_s = 120$  psf
3. WATER PRESSURE,  $P_w$   
 $P_w = 62.4 h_2$  psf
4. PASSIVE PRESSURE,  $P_p$   
 $P_p = 180 D$  psf
5. SURCHARGES FROM EXCAVATED SOIL OR CONSTRUCTION MATERIALS ARE NOT INCLUDED
6.  $H, h_1, h_2$  AND  $D$  ARE IN FEET
7. GROUNDWATER TABLE,  $h$  IS ASSUMED TO BE 3 FEET

NOT TO SCALE

**Ninyo & Moore**

**LATERAL EARTH PRESSURES FOR BRACED EXCAVATION  
BELOW GROUNDWATER (GRANULAR SOIL)**

FIGURE

PROJECT NO.

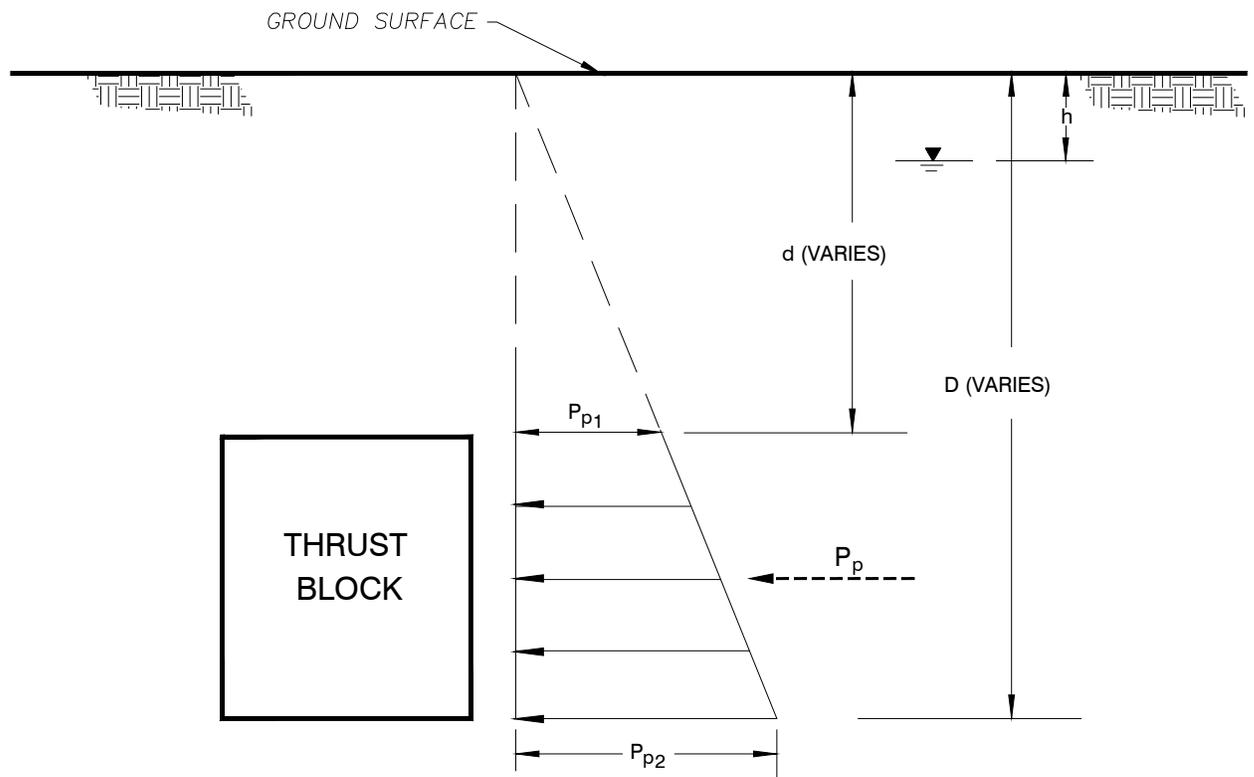
DATE

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NOTES:

1. GROUNDWATER BELOW BLOCK  
 $P_p = 180 (D^2 - d^2) \text{ lb/ft}$
2. GROUNDWATER ABOVE BLOCK  
 $P_p = 1.5 (D - d) [ 125 h + 58 (D + d) ] \text{ lb/ft}$
3. ASSUMES BACKFILL IS GRANULAR MATERIAL
4. ASSUMES THRUST BLOCK IS ADJACENT TO COMPETENT MATERIAL
5. D, d AND h ARE IN FEET
6. GROUNDWATER TABLE

NOT TO SCALE

**Ninyo & Moore**

**THRUST BLOCK LATERAL EARTH PRESSURE DIAGRAM**

FIGURE

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## APPENDIX A

### BORING LOGS

#### **Field Procedure for the Collection of Disturbed Samples**

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

##### **Bulk Samples**

Bulk samples of representative earth materials were obtained from the exploratory borings. The samples were bagged 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.

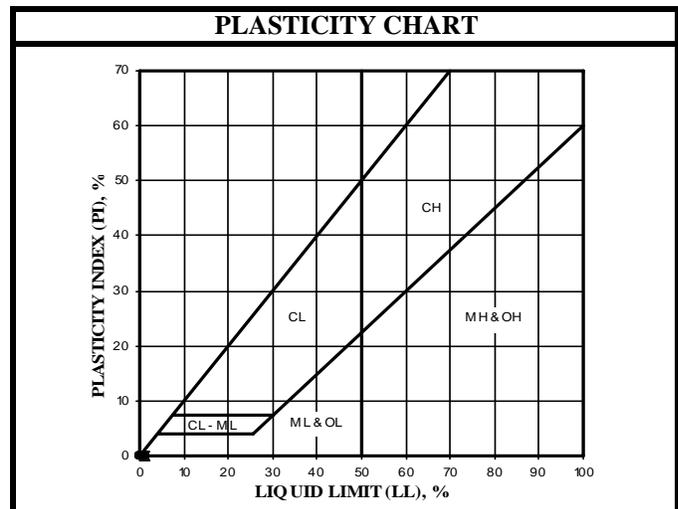
##### **The Modified Split-Barrel Drive Sampler**

The sampler, with an external diameter of 3 inches, was lined with 1-inch-long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler barrel was driven into the ground with the weight of a 140-pound hammer mounted on the drill rig in general accordance with ASTM International (ASTM) D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer or bar, 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 sampler barrel in the brass rings, sealed, and transported to the laboratory for testing.

## U.S.C.S. METHOD OF SOIL CLASSIFICATION

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES	
<b>COARSE-GRAINED SOILS</b> (More than 1/2 of soil > No. 200 Sieve Size)	<b>GRAVELS</b> (More than 1/2 of coarse fraction > No. 4 sieve size)	 GW	Well graded gravels or gravel-sand mixtures, little or no fines	
		 GP	Poorly graded gravels or gravel-sand mixtures, little or no fines	
		 GM	Silty gravels, gravel-sand-silt mixtures	
		 GC	Clayey gravels, gravel-sand-clay mixtures	
	<b>SANDS</b> (More than 1/2 of coarse fraction < No. 4 sieve size)	 SW	Well graded sands or gravelly sands, little or no fines	
		 SP	Poorly graded sands or gravelly sands, little or no fines	
		 SM	Silty sands, sand-silt mixtures	
		 SC	Clayey sands, sand-clay mixtures	
	<b>FINE-GRAINED SOILS</b> (More than 1/2 of soil < No. 200 sieve size)	<b>SILTS &amp; CLAYS</b> Liquid Limit < 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	
<b>SILTS &amp; CLAYS</b> Liquid Limit > 50		 MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		 CH	Inorganic clays of high plasticity, fat clays	
		 OH	Organic clays of medium to high plasticity, organic silty clays, organic silts	
<b>HIGHLY ORGANIC SOILS</b>		Pt	Peat and other highly organic soils	

GRAIN SIZE CHART		
CLASSIFICATION	RANGE OF GRAIN	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	306 to 76.2
GRAVEL	3" to No. 4	76.2 to 4.76
Coarse	3" to 3/4"	76.2 to 19.1
Fine	3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to No. 200	4.76 to 0.075
Coarse	No. 4 to No. 10	4.76 to 2.00
Medium	No. 10 to No. 40	2.00 to 0.420
Fine	No. 40 to No. 200	0.420 to 0.075
SILT & CLAY	Below No. 200	Below 0.075



# BORING LOG EXPLANATION SHEET

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	
	Bulk	Driven						
0	█							<p>Bulk sample.</p> <p>Modified split-barrel drive sampler.</p> <p>No recovery with modified split-barrel drive sampler.</p> <p>Sample retained by others.</p> <p>Standard Penetration Test (SPT).</p> <p>No recovery with a SPT.</p> <p>Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.</p> <p>No recovery with Shelby tube sampler.</p> <p>Continuous Push Sample.</p> <p>Seepage.</p> <p>Groundwater encountered during drilling.</p> <p>Groundwater measured after drilling.</p>
5								<p>XX/XX</p>
10								
15							SM	<p><u>MAJOR MATERIAL TYPE (SOIL):</u> Solid line denotes unit change.</p>
15							CL	<p>Dashed line denotes material change.</p> <p>Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Shear Bedding Surface</p>
20								<p>The total depth line is a solid line that is drawn at the bottom of the boring.</p>



## BORING LOG

Explanation of Boring Log Symbols

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FIGURE

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>9/12/13</u> BORING NO. <u>B-1</u>	
	Bulk	Driven						GROUND ELEVATION <u>6± (MSL)</u>	SHEET <u>1</u> OF <u>1</u>
								METHOD OF DRILLING <u>8" Hollow-Stem Auger (JDK Drilling)</u>	
								DRIVE WEIGHT <u>140 lbs. (Cathead)</u> DROP <u>30"</u>	
								SAMPLED BY <u>JRS</u> LOGGED BY <u>JRS</u> REVIEWED BY <u>L TJ</u>	
								<b>DESCRIPTION/INTERPRETATION</b>	
0								<b>ASPHALT CONCRETE:</b> Approximately 10 inches thick.	
							SM	<b>BASE:</b> Medium brown, moist, medium dense, silty SAND; few gravel; approximately 4 inches thick.	
							SC		
							SM	<b>FILL:</b> Medium brown, moist, medium dense, clayey SAND; trace pieces of brick.	
							SM	Medium brown, moist, medium dense, silty SAND; pockets of sandy CLAY.	
							SM	<b>ALLUVIUM:</b> Yellowish brown, moist, very loose, silty SAND.	
5			5					@ 4.5': Groundwater was encountered during drilling. Gray; saturated.	
								Total Depth = 6.5 feet. Groundwater was encountered at 4.5 feet during drilling. Backfilled with on-site soils and capped with rapid-set concrete on 9/12/13.	
								<u>Note:</u> Groundwater may rise to a level higher than that measured in borehole due to seasonal variations in precipitation and several other factors as discussed in the report.	
10									
15									
20									



**BORING LOG**

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FIGURE  
A-1

DEPTH (feet)	Bulk	SAMPLES	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>9/12/13</u> BORING NO. <u>B-2</u>
	Driven							GROUND ELEVATION <u>8± (MSL)</u> SHEET <u>1</u> OF <u>1</u>
								METHOD OF DRILLING <u>8" Hollow-Stem Auger (JDK Drilling)</u>
								DRIVE WEIGHT <u>140 lbs. (Cathead)</u> DROP <u>30"</u>
								SAMPLED BY <u>JRS</u> LOGGED BY <u>JRS</u> REVIEWED BY <u>LTJ</u>
								<b>DESCRIPTION/INTERPRETATION</b>
0								<u>ASPHALT CONCRETE:</u> Approximately 11 inches thick.
							SM	<u>FILL:</u> Medium brown, moist, medium dense, silty SAND; approximately 1 inch thick.
								<u>PORTLAND CEMENT CONCRETE:</u> Approximately 1 inch thick.
								Refusal. Total Depth = 1.1 feet (refusal). Groundwater was not encountered during drilling. Capped with rapid-set concrete on 9/12/13.
5								<u>Note:</u> Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
10								
15								
20								



**BORING LOG**

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FIGURE  
A-2

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>9/12/13</u> BORING NO. <u>B-3</u>	
	Bulk	Driven						GROUND ELEVATION <u>7.5'± (MSL)</u>	SHEET <u>1</u> OF <u>1</u>
								METHOD OF DRILLING <u>8" Hollow-Stem Auger (JDK Drilling)</u>	
								DRIVE WEIGHT <u>140 lbs. (Cathead)</u> DROP <u>30"</u>	
								SAMPLED BY <u>JRS</u> LOGGED BY <u>JRS</u> REVIEWED BY <u>LTJ</u>	
								<b>DESCRIPTION/INTERPRETATION</b>	
0							GP	<b>ASPHALT CONCRETE:</b> Approximately 4.5 inches thick.	
							SM	<b>AGGREGATE BASE:</b> Medium brown, moist, medium dense, poorly graded sandy GRAVEL; approximately 4 inches thick.	
								<b>FILL:</b> Medium brown, moist, medium dense, silty SAND; few gravel; trace pieces of metal and trash, trace shell fragments.	
5			25				SC	Medium brown, moist, medium dense, clayey SAND.	
							SM	@ 5': Groundwater was encountered during drilling.	
								<b>ALLUVIUM:</b> Grayish brown, saturated, medium dense, silty SAND; vegetation; pinhole voids.	
								Total Depth = 6.5 feet. Groundwater was encountered at 5 feet during drilling. Backfilled with on-site soils on 9/12/13.	
								<b>Note:</b> Groundwater may rise to a level higher than that measured in borehole due to seasonal variations in precipitation and several other factors as discussed in the report.	
10									
15									
20									



**BORING LOG**

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FIGURE  
A-3

DEPTH (feet)	BULK SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>9/12/13</u> BORING NO. <u>B-4</u>
							GROUND ELEVATION <u>7.5± (MSL)</u> SHEET <u>1</u> OF <u>1</u>
							METHOD OF DRILLING <u>8" Hollow-Stem Auger (JDK Drilling)</u>
							DRIVE WEIGHT <u>140 lbs. (Cathead)</u> DROP <u>30"</u>
							SAMPLED BY <u>JRS</u> LOGGED BY <u>JRS</u> REVIEWED BY <u>L TJ</u>
							<b>DESCRIPTION/INTERPRETATION</b>
0						GM	<u>ASPHALT CONCRETE:</u> Approximately 6 inches thick.
						SM	<u>AGGREGATE BASE:</u> Medium brown, moist, dense, poorly graded sandy GRAVEL; approximately 12 inches thick.
							<u>FILL:</u> Medium brown, moist, medium dense, silty SAND; few shell fragments.
						ML	@ 3.5': Groundwater was encountered during drilling. Gray; saturated.
						SM	Gray, saturated, loose, fine, sandy SILT and clayey SILT.
5		9					<u>ALLUVIUM:</u> Grayish brown, saturated, loose, silty SAND; vegetation.
							Total Depth = 6.5 feet. Groundwater was encountered at 3.5 feet. Backfilled with on-site soils and capped with rapid-set concrete on 9/12/13.
							<u>Note:</u> Groundwater may rise to a level higher than that measured in borehole due to seasonal variations in precipitation and several other factors as discussed in the report.
10							
15							
20							



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FIGURE  
A-4

DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>9/12/13</u> BORING NO. <u>B-5</u>
	Bulk	Driven						GROUND ELEVATION <u>8± (MSL)</u> SHEET <u>1</u> OF <u>1</u>
								METHOD OF DRILLING <u>8" Hollow-Stem Auger (JDK Drilling)</u>
								DRIVE WEIGHT <u>140 lbs. (Cathead)</u> DROP <u>30"</u>
								SAMPLED BY <u>JRS</u> LOGGED BY <u>JRS</u> REVIEWED BY <u>L TJ</u>
								<b>DESCRIPTION/INTERPRETATION</b>
0								<p><u>ASPHALT CONCRETE:</u> Approximately 6 inches thick.</p> <p><u>PORTLAND CEMENT CONCRETE:</u> Approximately 3 inches thick.</p> <p>Refusal. Total Depth = 0.8 feet (refusal). Groundwater was not encountered during drilling. Capped with rapid-set concrete on 9/12/13.</p> <p><u>Note:</u> Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.</p>
5								
10								
15								
20								



**BORING LOG**

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DEPTH (feet)	SAMPLES		BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED <u>9/12/13</u> BORING NO. <u>B-6</u>	
	Bulk	Driven						GROUND ELEVATION <u>4± (MSL)</u>	SHEET <u>1</u> OF <u>1</u>
								METHOD OF DRILLING <u>8" Hollow-Stem Auger (JDK Drilling)</u>	
								DRIVE WEIGHT <u>140 lbs. (Cathead)</u> DROP <u>30"</u>	
								SAMPLED BY <u>JRS</u> LOGGED BY <u>JRS</u> REVIEWED BY <u>LTJ</u>	
								<b>DESCRIPTION/INTERPRETATION</b>	
0								<b>ASPHALT CONCRETE:</b> Approximately 6.5 inches thick.	
							GM	<b>AGGREGATE BASE:</b> Dark brownish gray, damp, dense, poorly graded gravel; approximately 5 inches thick.	
							SM	<b>FILL:</b> Medium brown, moist, medium dense, silty SAND; trace gravel.	
								@ 3': Groundwater was encountered during drilling. Saturated. Total Depth = 3.5 feet. Groundwater was encountered at 3 feet during drilling. Backfilled with on-site soils and capped with rapid-set concrete on 9/12/13.	
5								<b>Note:</b> Groundwater may rise to a level higher than that measured in borehole due to seasonal variations in precipitation and several other factors as discussed in the report.	
10									
15									
20									



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FIGURE  
 A-6

## **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 borings in Appendix A.

#### **R-Value**

The resistance value, or R-value, for site soils was evaluated in general accordance with California Test (CT) 301. Samples were prepared and evaluated for exudation pressure and expansion pressure. The equilibrium R-value is reported as the lesser or more conservative of the two calculated results. The test results are shown on Figure B-1.

#### **Soil Corrosivity Tests**

Soil pH, and resistivity tests were performed on representative samples in general accordance with CT 643. The soluble sulfate and chloride content of the selected samples were evaluated in general accordance with CT 417 and CT 422, respectively. The test results are presented on Figure B-2.

SAMPLE LOCATION	SAMPLE DEPTH (FT)	SOIL TYPE	R-VALUE
B-1	1.5-4.0	SM	72
B-4	1.5-3.5	SM	77
B-6	1.0-3.5	SM	71

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

<b><i>Ninyo &amp; Moore</i></b>		<b>R-VALUE TEST RESULTS</b> NEWPORT BOULEVARD AND 32ND STREET MODIFICATIONS NEWPORT BEACH, CALIFORNIA	FIGURE
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SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH <sup>1</sup>	RESISTIVITY <sup>1</sup> (Ohm-cm)	SULFATE CONTENT <sup>2</sup>		CHLORIDE CONTENT <sup>3</sup> (ppm)
				(ppm)	(%)	
B-4	1.5-3.5	8.8	5,505	40	0.004	80
B-6	1.0-3.5	8.5	2,390	25	0.003	260

<sup>1</sup> PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 643

<sup>2</sup> PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 417

<sup>3</sup> PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 422



### CORROSIVITY TEST RESULTS

FIGURE

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**B-2**