Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

GEOTECHNICAL EVALUATION
PROPOSED
RETAIL DEVELOPMENT
9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PREPARED FOR:
Imperial Beach Redevelopment Agency
825 Imperial Beach Boulevard
Imperial Beach, California 91932

PREPARED BY:
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5710 Ruffin Road
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July 13, 2009
Project No. 106609001

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Mr. Jerry Selby
Imperial Beach Redevelopment Agency
825 Imperial Beach Boulevard
Imperial Beach, California 91932

Subject: Geotechnical Evaluation
Proposed Retail Development
9th Street and Palm Avenue
Imperial Beach, California

Dear Mr. Selby:

In accordance with your request and authorization, we have performed a geotechnical evaluation for the proposed retail development to be constructed at the southwest corner of 9th Street and Palm Avenue in Imperial Beach, California. This report presents our geotechnical findings, conclusions, and recommendations regarding the proposed project. Our report was prepared in accordance with our proposal dated May 4, 2008.

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

Sincerely,
NINYO & MOORE

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1. INTRODUCTION

In accordance with your request and our proposal dated May 4, 2009, we have performed a geotechnical evaluation for the proposed retail development to be located at the southwest corner of 9th Street and Palm Avenue in Imperial Beach, California. This report presents the results of our field exploration and laboratory testing, our conclusions regarding the geotechnical conditions at the subject site, and our recommendations for the design and earthwork construction of this project.

2. SCOPE OF SERVICES

The scope of services for this study included the following:

- Review of readily available published and in-house geotechnical literature, topographic maps, geologic maps, fault maps, and stereoscopic aerial photographs.
- Performance of a field reconnaissance to observe site conditions and to locate and mark proposed exploratory borings.
- Notification of Underground Service Alert (USA) to clear proposed boring locations for the potential presence of underground utilities.
- Performance of a subsurface evaluation consisting of the drilling, logging, and sampling of nine exploratory borings with truck-mounted drilling equipment. Relatively undisturbed and bulk soil samples were obtained at selected intervals from the borings and returned to our offices for geotechnical laboratory analysis.
- Performance of percolation tests within three of the exploratory borings. The purpose of the percolation tests was to evaluate the infiltration rate of on-site soils.
- Performance of geotechnical laboratory testing on selected samples.
- Preparation of this report presenting our findings, conclusions, and recommendations regarding the geotechnical design and construction of the project.

3. SITE AND PROJECT DESCRIPTION

The proposed two-city-block retail development is located at the southwest corner of 9th Street and Palm Avenue in Imperial Beach, California (Figure 1). The rectangular-shaped site is bounded by

Delaware Street on the west, an unnamed alleyway to the south, 9th Street to the east, and Palm Avenue to the north. In addition, 8th Street runs north-south through the center of the site.

Existing improvements to the site include three, one-story buildings, asphalt concrete parking lots, and the associated utility improvements. We understand that the existing buildings will be demolished prior to the construction of the new retail development. Plans or detailed design information regarding future development was not made available to our offices. From our discussions with the owner, we anticipate that the proposed buildings will be similar lightly loaded structures, constructed of concrete block founded on conventional spread and perimeter foundations with a slab-on-grade floor.

The site slopes generally toward 8th Street. The ground elevations are approximately 25 feet above mean sea level (MSL) at the western end, 13 feet above MSL near the center, and 16 feet above MSL at the eastern end of the site (Nasland, 2009).

Although low-impact development (LID) structures are planned to be constructed at the site, at the time of our evaluation the locations of these structures were not known. However, we understand that the LID improvements may include pervious concrete and/or storm tanks (or similar) construction.

4. SUBSURFACE EXPLORATION AND LABORATORY TESTING

Our subsurface exploration was conducted on June 22, 2009, and consisted of drilling, logging, and sampling of nine small-diameter exploratory borings. Six of the borings were focused on obtaining subsurface data and were designated B-1 through B-6. The remaining three borings were converted for use in percolation testing and were designated PT-1 through PT-3. The borings were drilled to depths of up to approximately 20 feet below existing grades with a truck-mounted hollow-stem auger drill rig. Drive and bulk soil samples were obtained from the borings. The samples were then transported to our in-house geotechnical laboratory for testing. The approximate locations of the exploratory borings and percolation tests are shown on Figure 2. Logs of the borings are included in Appendix A.

Laboratory testing of representative soil samples included in-situ dry density and moisture content, gradation, direct shear, expansion index, corrosivity and R-value. The results of in-situ dry density and moisture content 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 findings regarding regional and local geology, including faulting and seismicity, landslides, rippability (excavatability), and groundwater conditions at the subject site are provided in the following sections.

5.1. Regional Geologic Setting

The project area is situated in the coastal foothill section 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; Harden, 1998). 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.

The Peninsular Ranges Province is traversed by a group of sub-parallel faults and fault zones trending approximately northwest. Several of these faults, shown on Figure 3, are considered active faults. The Elsinore, San Jacinto, and San Andreas faults are active fault systems located northeast of the project area, and the Rose Canyon, Agua Blanca-Coronado Bank, San Diego Trough, and San Clemente faults are active faults located west of the project area. The Rose Canyon Fault Zone, the nearest active fault system, has been mapped approximately 1.3 miles west of the project site. 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 fill materials and Old Paralic Deposits, (Kennedy and Tan, 2008). Generalized descriptions of the earth units encountered during our subsurface exploration are provided in the subsequent sections. More detailed descriptions of the subsurface units are provided on the boring logs in Appendix A. The geology of the site vicinity is shown on Figure 4.

5.2.1. Fill (Qaf)

Fill materials were encountered in several of our borings from beneath the surficial pavement sections to depths up to approximately 7 feet. As encountered, these materials generally consisted of brown, damp to moist, stiff to hard, sandy clay and medium dense silty sand with scattered gravel and cobbles. Documentation regarding these fills was not available.

5.2.2. Old Paralic Deposits (Qop_6)

Materials of the late Pleistocene-aged Old Paralic Deposits were encountered in our exploratory borings B-1 through B-6 and PT-3 underlying the surface fill to the total depths explored. As encountered, these materials generally consisted of brown, reddish brown and gray, damp to saturated, weakly to moderately cemented, silty sandstone and moderately to strongly indurated, sandy claystone. Although not encountered, these deposits are mapped as including conglomerates (Kennedy and Tan, 2008).

5.3. Excavation Characteristics

Based on our subsurface exploration of the site, excavation of the materials underlying the site will be feasible with heavy-duty excavation equipment in good working condition. Due to the existing structures on the site, underground utilities and concrete foundations should be anticipated to be encountered in excavations at the site. Cobbles and concrete, if encountered, will require special handling.

5.4. Groundwater

Groundwater was encountered in our exploratory borings B-1 through B-6 at depths between 13 and 17 feet below the existing ground surface. This corresponds to between elevations -2.5 and 4.0 feet above MSL. Fluctuations in the groundwater level and perched conditions may occur due to variations in ground surface topography, subsurface geologic conditions and structure, rainfall, irrigation, tidal fluctuations, and other factors.

5.5. Storm Water Infiltration

Percolation testing was performed on June 23, 2009 in general accordance with San Diego County Environmental Health Services guidelines for percolation testing. Approximately 2 inches of gravel was placed on the bottom of each hole. Varying lengths of 2-inch diameter, perforated pipe were installed in an upright position on top of the gravel layer and the outer area was backfilled with additional gravel. Presoaking was performed by filling each test hole with approximately 12 inches of clean water using a siphon and was carried out overnight. Once the presoak was finished, the water level within the boring was adjusted to 6 inches and testing was performed for an additional 3 hours, with readings taken every 30 minutes. The drop that occurred during the last 30 minutes of testing was used to calculate the infiltration rate in minutes per inch (mpi) for each location. Presented in Appendix C is the field percolation test data. Infiltration rates are shown in Table 1 below.

Table 1 – Infiltration Test Results

Test Number	Approximate Depth of Test (feet)	Earth Unit	Adjusted Infiltration Rate (min/inch)
PT-1	4.8	Fill (Sandy CLAY)	NA*
PT-2	4.6	Fill (Silty SAND/Sandy CLAY)	NA*
PT-3	10.6	Old Paralic Deposits (CLAYSTONE)	330.9

Notes:
*NA = Did not percolate

5.6. Faulting and Seismicity

Like much of Southern California, the subject site is considered to be in a seismically active area. Based on our review of readily available published geological maps and literature, as well as our geologic field mapping, the subject is not underlain by known active or potentially active faults (i.e., faults that exhibit evidence of ground displacement in the last 11,000 years and 2,000,000 years, respectively).

The site is not within a State of California Alquist-Priolo Fault Zone. The closest known active fault is the Rose Canyon Fault, which is capable of generating an earthquake magnitude of 7.2 (Cao, et al, 2003). As noted, the Rose Canyon Fault is located approximately 1.3 miles west of the site (Kennedy and Tan, 2008).

5.6.1. Strong Ground Motion

The 2007 California Building Code (CBC) recommends that the design of structures be based on the peak horizontal 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 probabilistic PGA_{MCE} for the site was calculated as 0.55g using the United States Geological Survey (USGS) web-based ground motion calculator (USGS, 2008). The design PGA was calculated to be 0.37g using the USGS ground motion calculator. These estimates of ground motion do not include near-source factors that may be applicable to the design of structures on site.

5.6.2. Ground Surface Rupture

Ground surface rupture due to active faulting is not considered a design issue due to the absence of any known active faults underlying the site. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

5.6.3. Liquefaction

Liquefaction of cohesionless soils can be caused by strong vibratory motion due to earthquakes. Based on the cemented, cohesive nature of the subsurface claystone and sandstone, it is our opinion that the potential for liquefaction at the site is not a design consideration.

5.7. Landsliding

Based on our review of referenced geologic maps, literature, topographic maps, and stereoscopic aerial photographs, no landslides or indications of deep-seated landsliding were noted underlying the project site. As such, the potential for significant large-scale slope instability at the site is not a design consideration.

6. LID DISCUSSION

Properly implemented and constructed, subsurface infiltration basins eliminate the possibilities of mud, mosquitoes and safety hazards sometimes perceived to be associated with ephemeral surface drainage. They also can provide for storage of large volumes of runoff, and can be incorporated with roof runoff collection systems (County of San Diego, 2007). However, sites with low permeability soils (type D) may require underdrains and/or lines to prevent seepage from damaging existing structures or pavements.

When used properly, pervious pavement can facilitate rainwater infiltration, decrease urban heating, replenish groundwater, allow tree roots to breathe, and reduce total runoff. Concrete unit pavers are designed to set on sand and form an interlocking surface that can bear heavy traffic loads. An aggregate base course can be added to increase total pavement thickness or hydraulic storage (County of San Diego, 2007).

7. CONCLUSIONS

Based on our review of the referenced background data, subsurface evaluation, and laboratory testing, it is our opinion that construction of the proposed project is feasible from a geotechnical standpoint provided the recommendations presented in this report are incorporated into the design and construction of the project. In general, the following conclusions were made:

- The project site is underlain by fill and Old Paralic Deposits. The existing fill is undocumented and not considered suitable for structural support in its current condition.

- Fill depths varied across the site. Remedial grading may be necessary depending on the location of the new structures within the site. The following recommendations should be re-evaluated once locations are determined for the structures.
- The underlying formational materials are considered suitable for support of structural fill or structural improvements provided recommendations presented in subsequent report sections are implemented.
- Based on our subsurface exploration, excavation of the subsurface materials should be feasible with heavy-duty excavation equipment in good working condition. Cobbles and cemented formational materials, if encountered, will require special handling.
- Groundwater was encountered at depths of between 13 and 17 feet. Therefore, it is anticipated to be a design consideration should excavations extend into saturated zones. Seepage should be anticipated in some areas.
- The active Rose Canyon fault zone is located approximately 1.3 miles west of the site. Accordingly, the potential for relatively strong seismic ground motions should be considered in the project design.
- Based on the results of our limited soil corrosivity tests during this study and Caltrans corrosion guidelines (2003), the site would be classified as corrosive.
- Soils with negligible percolation rates were encountered during our field evaluation. Shallow or perched ground water may affect performance of pavement if allowed to impound at pavement subgrade. Therefore, a subdrain system should be considered as part of the LID design.

8. RECOMMENDATIONS

Based on our understanding of the project, the following general recommendations are provided for the design and construction of the proposed development. These recommendations may change once specific development plans have been produced. The proposed site improvements should be constructed in accordance with the requirements of the applicable governing agencies.

8.1. Earthwork

In general, earthwork should be performed in accordance with the recommendations presented in this report. The geotechnical consultant should be contacted for questions regarding the recommendations or guidelines presented herein. In addition, Typical Earthwork Guidelines for the project are included as Appendix D. In the event of a conflict in recommendations, the recommendations presented below should supersede those in Appendix D.

8.1.1. Site Preparation

Site preparation should begin with the removal of existing foundations and improvements, vegetation, utility lines, asphalt, concrete, and other deleterious debris from areas to be graded. Tree stumps and roots should be removed to such a depth that organic material is generally not present. Clearing and grubbing should extend to the outside of the proposed excavation and fill areas. The debris and unsuitable material generated during clearing and grubbing should be removed from areas to be graded and disposed of at a legal dumpsite away from the project area. Underground utilities located within the proposed limits of the construction should be removed or abandoned, capped off or relocated so as not to interfere with earthwork operations.

8.1.2. Excavation Characteristics

The results of our field exploration program indicate that the project site, as presently proposed, is underlain by fill and Old Paralic Deposit materials. Excavation of the subsurface materials should be feasible with heavy-duty excavation equipment in good working condition. Cobbles and cemented formational materials, if encountered, will require special handling.

8.1.3. Remedial Grading

We recommend that the on-site existing fill be removed and replaced as compacted fill. The extent and depth of removals should be evaluated by Ninyo & Moore's representative in the field based on the material exposed. Additional remedial grading may be required depending on the configuration of the buildings and the exposed materials.

In proposed pavement and concrete flatwork areas we recommend that the on-site existing fill or Old Paralic Deposits be overexcavated to a depth of 2 feet below existing or planned grade, whichever is deeper. The resulting removal surface should then be scarified approximately 8 inches, moisture conditioned to near optimum moisture content, and recompacted to a relative compaction of 90 percent as evaluated by American Society for Testing and Materials (ASTM) Test Method D 1557. The resultant excavation should then be filled with compacted fill consisting of materials suitable for use as fill.

8.1.4. Materials for Fill

Very low to low expansion potential (i.e., an expansion index [EI] of 50 or less as evaluated by ASTM D 4829) on-site soils with an organic content of less than approximately 3 percent by volume (or 1 percent by weight) are suitable for use as fill. In general, fill material should not contain rocks or lumps over approximately 4 inches in diameter, and not more than approximately 40 percent larger than ¾ inch. Oversize materials should be separated from material to be used for fill and removed from the site.

Utility trench backfill material should not contain rocks or lumps over approximately 3 inches in general. Soils classified as silts or clays should not be used for backfill in the pipe zone. Larger chunks, if generated during excavation, may be broken into acceptably sized pieces or disposed of offsite.

Imported fill material, if needed for the project, should generally be granular soils with a very low to low expansion potential. Import material should also be non-corrosive in accordance with the Caltrans (2003) corrosion guidelines. Materials for use as fill should be evaluated by Ninyo & Moore's 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 Ninyo & Moore. 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 moisture contents generally above the optimum moisture content. The scarified materials should then be compacted to a relative compaction of 90 percent as evaluated in accordance with ASTM D 1557. The evaluation of compaction by the geotechnical consultant should not be considered to preclude any requirements for observation or approval by governing agencies. It is the contractor's responsibility to notify this office 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 generally above the laboratory 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 a moisture content generally above the laboratory optimum, 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 D 1557. Successive lifts should be treated in a like manner until the desired finished grades are achieved.

8.1.6. Temporary Excavations, Braced Excavations, and Shoring

For temporary excavations, we recommend that the following Occupational Safety and Health Administration (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 the geotechnical consultant in accordance with the OSHA regulations. Temporary excavations should be constructed in accordance with OSHA recommendations. For trench or other excavations, OSHA requirements regarding personnel safety should be met using appropriate shoring (including trench boxes) or by laying back the slopes to a slope ratio no steeper than 1.5:1 (horizontal:vertical) in fill and formational materials. Temporary excavations that encounter seepage may be shored or 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. On-site safety of personnel is the responsibility of the contractor.

8.1.7. Utility Trench Backfill

Based on our subsurface evaluation, the on-site earth materials should be generally suitable for re-use as trench backfill provided they are free of organic material, clay lumps, debris, and rocks greater than approximately 3 inches in diameter. We recommend that trench backfill materials be in conformance with the "Greenbook" (Standard Specifications for Public Works) specifications for structure backfill. Fill should be moisture-conditioned to generally above the laboratory optimum. Trench backfill should be compacted to a relative compaction of 90 percent as evaluated by ASTM D 1557 except for the upper 12 inches of the backfill beneath pavement areas. Materials in the upper 12 inches beneath the pavement section should be compacted to a relative compaction of 95 percent as evaluated by 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 the pipe during compaction of the backfill.

8.1.8. Drainage

Roof, pad, and slope drainage should be directed such that runoff water is 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 or more 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 final grading to preserve any berms, drainage terraces, interceptor swales or other drainage devices of a permanent nature on or adjacent to the property. Drainage patterns established at the time of final grading should be maintained for the life of the project. The property owner and the maintenance personnel should be made aware that altering drainage patterns might be detrimental to slope stability and foundation performance.

8.2. Seismic Design Parameters

The proposed improvements should be designed in accordance with the requirements of governing jurisdictions and applicable building codes. Table 2 presents the seismic design parameters for the site, according to the 2007 CBC and mapped spectral acceleration parameters (USGS, 2008).

Table 2 – Seismic Design Factors

Factors	Values
Site Class	D
Site Coefficient, F_a	1.0
Site Coefficient, F_v	1.5
Mapped Short Period Spectral Acceleration, S_S	1.367g
Mapped One-Second Period Spectral Acceleration, S_1	0.541g
Short Period Spectral Acceleration Adjusted For Site Class, S_{MS}	1.367g
One-Second Period Spectral Acceleration Adjusted For Site Class, S_{M1}	0.811g
Design Short Period Spectral Acceleration, S_{DS}	0.912g
Design One-Second Period Spectral Acceleration, S_{D1}	0. 541g

8.3. Foundations

Proposed lightly loaded structures may be supported on shallow, spread footings bearing on compacted fill in accordance with the recommendations presented in this report. Foundations should be designed in accordance with structural considerations and the following recommendations. In addition, requirements of the appropriate governing jurisdictions and applicable building codes should be considered in the design of the structures.

8.3.1. Shallow Footings

For anticipated one-story, lightly loaded structures, conventional spread footings should be at least 18 inches deep and bear on compacted fill. Continuous and isolated pad footings should be at least 18 and 30 inches wide, respectively. Continuous footings should be reinforced with four No. 4 steel reinforcing bars, two placed near the top and two placed near the bottom of the footings, and further detailed in accordance with the recommendations of the structural engineer.

Shallow, spread or continuous footings as described above, may be designed using a net allowable bearing capacity of 2,500 pounds per square foot (psf). The bearing capacity may be increased by 500 psf for every additional foot of depth or width up to a value of 3,500 psf. The allowable bearing capacities may be increased by one-third when considering loads of short duration such as wind or seismic forces.

8.3.2. Lateral Resistance

For resistance of footings to lateral loads, we recommend an allowable passive pressure of 250 psf of depth be used up to a value of 3,000 psf. These values assume that the ground is horizontal for a distance of 10 feet, 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 0.30 be used between soil and concrete. The allowable lateral resistance can be taken as the sum of the frictional resistance and passive resistance provided the passive resistance does not exceed one-half of the total allowable resistance. The passive resistance values may be increased by one-third when considering loads of short duration such as wind or seismic forces.

8.3.3. Static Settlement

We estimate that the anticipated structures, designed and constructed as recommended herein, will undergo total settlement on the order of 1 inch. Differential settlement on the order of ½ inch over a horizontal span of 40 feet should be expected.

8.4. Slabs-on-Grade

We recommend that conventional, slab-on-grade floors, underlain by compacted fill materials of generally very low to low expansion potential, be 5 inches in thickness and be reinforced with No. 3 reinforcing bars spaced 18 inches on center each way. The reinforcing bars should be placed near the middle of the slab. As a means to help reduce shrinkage cracks, we recommend that the slabs be provided with expansion joints at intervals of approximately 12 feet each way. The slab reinforcement and expansion joint spacing should be designed by the project structural engineer.

If moisture sensitive floor coverings are to be used, we recommend that slabs be underlain by a vapor retarder and capillary break system consisting of a 10-mil polyethylene (or equivalent) membrane placed over 4 inches of medium to coarse, clean sand or pea gravel and overlain by an additional 2 inches of sand to help protect the membrane from puncture during placement and to aid in concrete curing. The exposed subgrade should be moistened just prior to the placement of concrete.

8.5. Concrete Flatwork

Exterior concrete flatwork should be 4 inches in thickness and should be reinforced with No. 3 reinforcing bars placed at 24 inches on-center both ways. No vapor retarder is needed for exterior flatwork. To reduce the potential manifestation of distress to exterior concrete flatwork due to movement of the underlying soil, we recommend that such flatwork be installed with crack-control joints at appropriate spacing as designed by the structural engineer. Exterior slabs should be underlain by 4 inches of clean sand. The subgrade soils should be scarified to a depth of 12 inches, moisture conditioned to generally above the laboratory optimum moisture content, and compacted to a relative compaction of 90 percent as evaluated by ASTM D 1557. Positive drainage should be established and maintained adjacent to flatwork.

8.6. Preliminary Pavement Design

We understand that asphalt concrete pavements will be constructed on the site. For planning purposes, we are providing preliminary pavement designs. Laboratory testing was performed on a representative sample of the on-site soils to evaluate R-value in general accordance with

California Test (CT) Method 301 and the result is presented in Appendix B. The test result indicates an R-value of 25 for the sample tested. We have used this value for the preliminary design of flexible pavements at the project site. Actual pavement recommendations should be based on R-value tests performed on bulk samples of the soils that are exposed at the finished subgrade elevations in the areas to be paved once grading operations have been performed.

For design we have used Traffic Index (TI) of 4.0 and 5.0 for site pavements. The preliminary recommended pavement sections are as follows:

Table 3 – Recommended Pavement Sections

R-Value	Traffic Index	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
25	4.0	2.5	4.0
25	5.0	3.5	5.0

If traffic loads are different from those assumed, the pavement design should be reevaluated. In addition, we recommend that the upper 12 inches of the subgrade and the Class 2 aggregate base be compacted to a relative compaction of 95 percent as evaluated by ASTM D 1557.

8.7. Corrosion

Laboratory testing was performed on representative samples of the on-site earth materials to evaluate pH and electrical resistivity, as well as chloride and sulfate contents. The pH and electrical resistivity tests were performed in accordance with CT 643 and the sulfate and chloride content tests were performed in accordance with CT 417 and CT 422, respectively. These laboratory test results are presented in Appendix B.

The results of the corrosivity testing indicated an electrical resistivity of 450 to 980 ohm-cm, a soil pH of 7.6 to 8.8, a chloride content of 760 to 920 parts per million (ppm) and a sulfate content of 0.049 to 0.074 percent (i.e., 490 to 740 ppm). Based on the Caltrans corrosion (2003) criteria, the on-site soils would be classified as corrosive, which is defined as soils with more than 500 ppm chlorides, more than 0.2 percent sulfates, or a pH less than 5.5. A corrosion engineer should be contacted for additional recommendations.

8.8. Concrete

Concrete in contact with soil or water that contains high concentrations of water-soluble sulfates can be subject to premature chemical and/or physical deterioration. As stated above, the soil samples tested in this evaluation indicated a water-soluble sulfate content of 0.049 to 0.074 percent by weight (i.e., about 490 to 740 ppm). According to the American Concrete Institute (ACI) 318-05 building code, the potential for sulfate attack is moderate for water-soluble sulfate content (between 150 ppm and 1,500 ppm) in soils. Based on ACI criteria (ACI, 2005), Type II cement may be used for concrete construction. However, due to the potential variability of site soils and the use of recycled water, consideration should be given to using Type V cement and concrete with a water-cement ratio no higher than 0.45 by weight for normal weight aggregate concrete and a 28-day compressive strength of 4,500 pounds per square inch (psi) or more for the project.

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 required 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 be in accordance with section 1907.7 of the 2007 CBC. The structural engineer should be consulted for additional concrete specifications.

8.9. Pre-Construction Conference

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, Ninyo & Moore, and the contractor should attend to discuss the plans, the project, and the proposed construction schedule.

8.10. Plan Review and Construction Observation

The conclusions and recommendations presented in this report are based on analysis of observed conditions in widely spaced exploratory borings. If conditions are found to vary from those described in this report, Ninyo & Moore should be notified, and additional recommendations will be provided upon request. Ninyo & Moore should review the final project drawings and specifications prior to the commencement of construction. Ninyo & Moore should perform the needed observation and testing services during construction operations.

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 it is decided not to utilize the services of Ninyo & Moore during construction, we request that the selected consultant provide the client 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. 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 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. 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 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.

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AERIAL PHOTOGRAPHS				
Source	**Date**	**Flight**	**Numbers**	**Scale**
USDA	March 31, 1953	AXN-3M	41 and 42	1:20,000

REFERENCE: 2005 THOMAS GUIDE FOR SAN DIEGO COUNTY, STREET GUIDE AND DIRECTORY

0 2400 4800

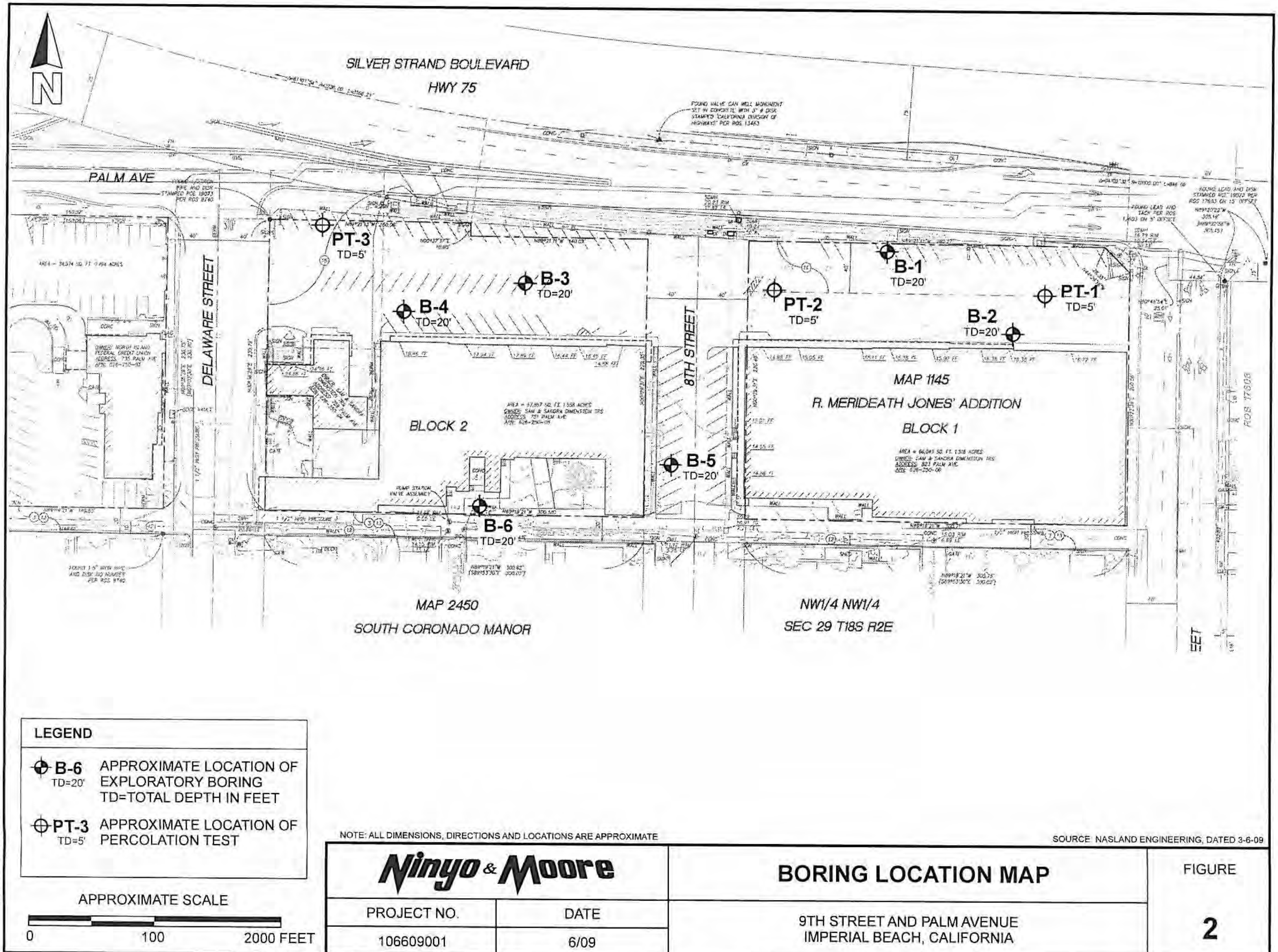
APPROXIMATE SCALE IN FEET

N

NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore		SITE LOCATION MAP	FIGURE
PROJECT NO.	DATE	9TH STREET AND PALM AVENUE IMPERIAL BEACH, CALIFORNIA	1
106609001	7/09		

fig 1 106609001 slm



NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE

SOURCE: NASLAND ENGINEERING, DATED 3-6-09

Ninyo & Moore		BORING LOCATION MAP	FIGURE
PROJECT NO.	DATE	9TH STREET AND PALM AVENUE IMPERIAL BEACH, CALIFORNIA	2
106609001	6/09		

fig 2 106609001 blm

SOURCE: FAULTS - CA DEPT OF CONSERVATION 2000 BASE - ESRI 2008

LEGEND

CALIFORNIA FAULT ACTIVITY

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY (POTENTIALLY ACTIVE)
- QUATERNARY (POTENTIALLY ACTIVE)
- STATE/COUNTY BOUNDARY

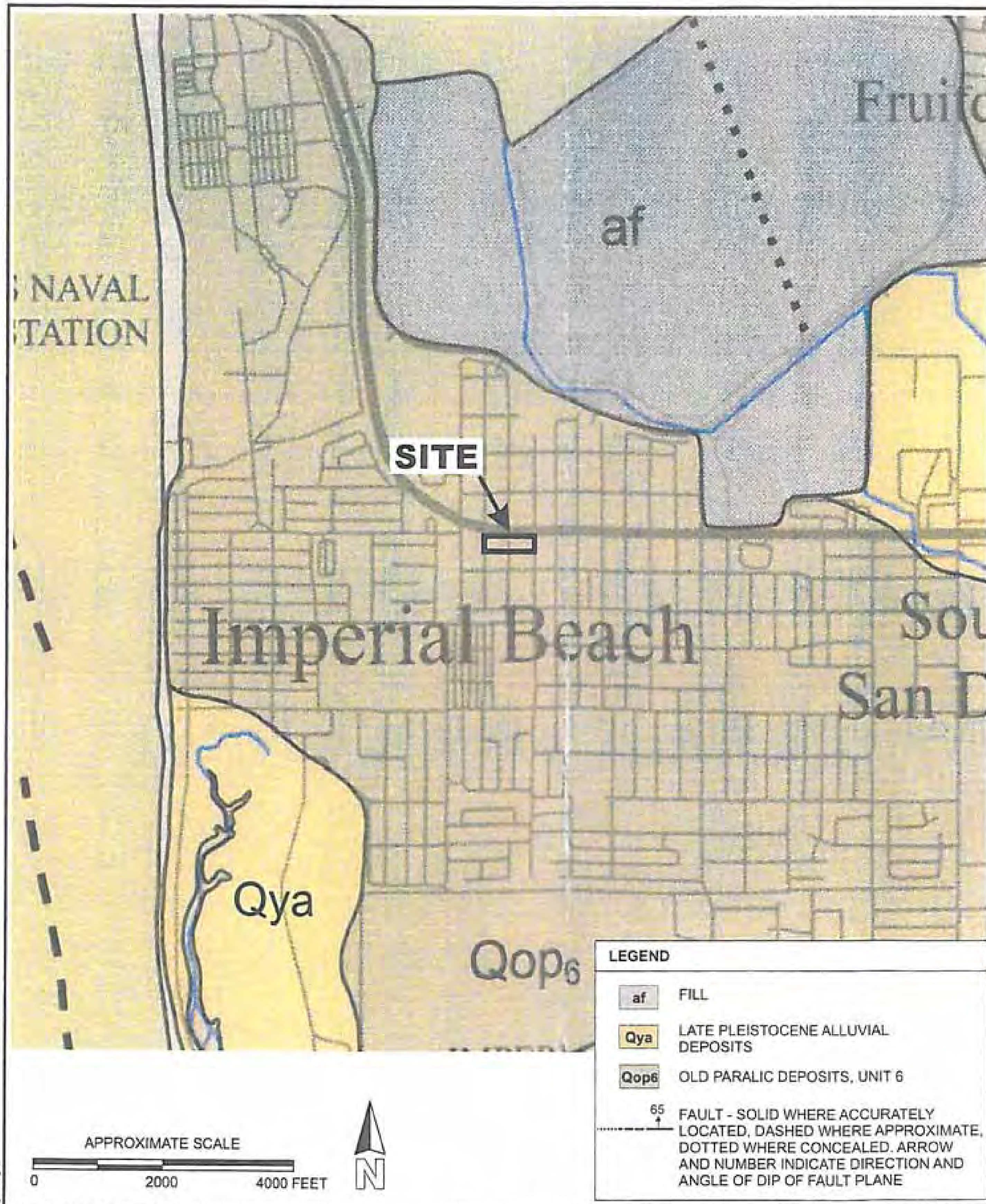
N

APPROXIMATE SCALE

0 12.5 25 50 MILES

NOTES: ALL DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore		FAULT LOCATION MAP	FIGURE
PROJECT NO.	DATE	9TH STREET AND PALM AVENUE IMPERIAL BEACH, CALIFORNIA	3
106609001	6/09		



NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE

REFERENCE: KENNEDY, M.P. AND TAN, S.S., 2008, GEOLOGIC MAP OF THE SAN DIEGO 30' X 60' QUADRANGLE, CALIFORNIA

Ninyo & Moore		REGIONAL GEOLOGIC MAP	FIGURE
PROJECT NO.	DATE	9TH STREET AND PALM AVENUE IMPERIAL BEACH, CALIFORNIA	4
106609001	7/09		

fig 4 106609001 geologic

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 borings. 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 SPT 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 EXPLANATION SHEET

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	
0								Bulk sample.
								Modified split-barrel drive sampler.
								No recovery with modified split-barrel drive sampler.
								Sample retained by others.
								Standard Penetration Test (SPT).
5								No recovery with a SPT.
			XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
								No recovery with Shelby tube sampler.
								Continuous Push Sample.
								Seepage.
10								Groundwater encountered during drilling.
								Groundwater measured after drilling.
							SM	ALLUVIUM: Solid line denotes unit change.
								Dashed line denotes material change.
15								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: Sheared Bedding Surface
20								The total depth line is a solid line that is drawn at the bottom of the boring.

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BORING LOG		
EXPLANATION OF BORING LOG SYMBOLS		
PROJECT NO.	DATE Rev. 01/03	FIGURE

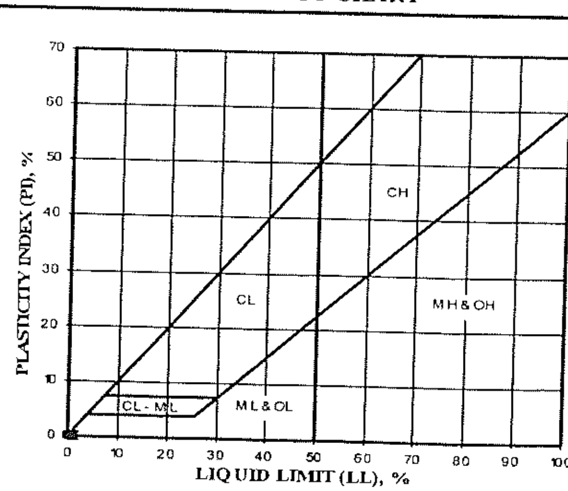
U.S.C.S. METHOD OF SOIL CLASSIFICATION

MAJOR DIVISIONS		SYMBOL	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil >No. 200 sieve size)	GRAVELS (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
	SANDS (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
FINE-GRAINED SOILS (More than 1/2 of soil <No. 200 sieve size)	SILTS & CLAYS Liquid Limit <50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS 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
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils

GRAIN SIZE CHART

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

PLASTICITY CHART



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

DATE DRILLED	6/22/09
BORING NO.	B-1
GROUND ELEVATION	13' ± (MSL)
SHEET	1 OF 2
METHOD OF DRILLING	6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)
DRIVE WEIGHT	140 lbs. (Auto-Trip)
DROP	30"
SAMPLED BY	BTM
LOGGED BY	BTM
REVIEWED BY	RI

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 6 inches thick.
							CL	FILL: Brown, damp, hard, fine sandy CLAY.
5			36	16.0	122.1			OLD PARALIC DEPOSITS: Brown, moist, weakly cemented, silty fine-grained SANDSTONE.
10			48					Clayey.
				▽				Saturated.
15			45					No clay.
20			41					

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BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-1

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.

DATE DRILLED 6/22/09 BORING NO. B-1

GROUND ELEVATION 13' ± (MSL) SHEET 2 OF 2

METHOD OF DRILLING 6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY RI

DESCRIPTION/INTERPRETATION

20

Total Depth = 20 feet.
Groundwater encountered at a depth of approximately 13.5 feet during drilling.
Backfilled with approximately 3.9 cubic feet of bentonite grout and capped with concrete shortly after drilling on 6/22/09.

Note: 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.

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Ninyo & Moore

BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-2

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 3 inches thick.
	X						CL	FILL: Brown, damp, stiff, sandy CLAY.
5		X	58	15.1	111.8			OLD PARALIC DEPOSITS: Brown, moist, weakly to moderately cemented, silty fine-grained SANDSTONE.
10		X	55					
				▽				Saturated.
15		X	43					Brown to gray; micaceous.
		X	26					
20								

DATE DRILLED 6/22/09 BORING NO. B-2

GROUND ELEVATION 16' ± (MSL) SHEET 1 OF 2

METHOD OF DRILLING 6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY RI

Ninyo & Moore

BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-3

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 6/22/09 BORING NO. B-2 GROUND ELEVATION 16' ± (MSL) SHEET 2 OF 2 METHOD OF DRILLING 6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations) DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30" SAMPLED BY BTM LOGGED BY BTM REVIEWED BY RI DESCRIPTION/INTERPRETATION
20								Total Depth = 20 feet. Groundwater encountered at a depth of approximately 14.5 feet during drilling. Backfilled with approximately 3.9 cubic feet of bentonite grout and capped with concrete shortly after drilling on 6/22/09. Note: 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.
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Ninyo & Moore

BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-4

DATE DRILLED 6/22/09	BORING NO. B-3
GROUND ELEVATION 16' ± (MSL)	SHEET 1 OF 2
METHOD OF DRILLING 6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)	
DRIVE WEIGHT 140 lbs. (Auto-Trip)	DROP 30"
SAMPLED BY BTM LOGGED BY BTM	REVIEWED BY RI

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 4 inches thick.
								OLD PARALIC DEPOSITS: Brown, damp, strongly indurated, fine sandy CLAYSTONE.
5		■	43	15.0	113.1			Reddish brown; moist.
10		■	28					
								Brown to gray, moist, weakly cemented, silty fine-grained SANDSTONE.
15		■	26					
				∇				Saturated.
20		■	25					

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BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-5

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 6/22/09 BORING NO. B-3 GROUND ELEVATION 16' ± (MSL) SHEET 2 OF 2 METHOD OF DRILLING 6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations) DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30" SAMPLED BY BTM LOGGED BY BTM REVIEWED BY RI DESCRIPTION/INTERPRETATION
20								Total Depth = 20 feet. Groundwater encountered at a depth of approximately 17 feet during drilling. Backfilled with approximately 3.9 cubic feet of bentonite grout and capped with concrete shortly after drilling on 6/22/09. Note: 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.
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BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-6

DATE DRILLED	6/22/09	BORING NO.	B-4
GROUND ELEVATION	19' ± (MSL)	SHEET	1 OF 2
METHOD OF DRILLING	6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)		
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"
SAMPLED BY	BTM	LOGGED BY	BTM
REVIEWED BY	RI		

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 4 inches thick.
	X							OLD PARALIC DEPOSITS: Reddish brown, damp, moderately cemented, silty fine-grained SANDSTONE.
5		X	65					Reddish brown.
10		X	52	3.7	124.3			Brown; weakly cemented; micaceous; friable.
15		X	75	▽				Saturated.
		X	40					Reddish brown; saturated; fine- to coarse-grained; scattered gravel.
20								

Ninyo & Moore

BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-7

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DATE DRILLED 6/22/09 BORING NO. B-4 GROUND ELEVATION 19' ± (MSL) SHEET 2 OF 2 METHOD OF DRILLING 6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations) DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30" SAMPLED BY BTM LOGGED BY BTM REVIEWED BY RI **DESCRIPTION/INTERPRETATION**
20								Total Depth = 20 feet. Groundwater encountered at a depth of approximately 15 feet during drilling. Backfilled with approximately 3.9 cubic feet of bentonite grout and capped with concrete shortly after drilling on 6/22/09. Note: 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.
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Ninyo & Moore

BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-8

DATE DRILLED	6/22/09	BORING NO.	B-5			
GROUND ELEVATION	12' ± (MSL)	SHEET	1	OF	2	
METHOD OF DRILLING	6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)					
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"			
SAMPLED BY	BTM	LOGGED BY	BTM	REVIEWED BY	RI	

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 8 inches thick.
	Bulk					CL	FILL: Brown, damp, very stiff, sandy CLAY.
5	Driven	22	13.2	118.3			OLD PARALIC DEPOSITS: Reddish brown, moist, weakly cemented, silty fine-grained SANDSTONE.
10	Driven	31					
							Brown, moist, moderately indurated, fine sandy CLAYSTONE.
			▽				Brown, saturated, weakly cemented, silty fine-grained SANDSTONE.
15	Driven	70					
20	Driven	38					

Ninyo & Moore

BORING LOG		
9TH STREET AND PALM AVENUE IMPERIAL BEACH, CALIFORNIA		
PROJECT NO.	DATE	FIGURE
106609001	7/09	A-9

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.
20							
25							
30							
35							
40							

DATE DRILLED 6/22/09 BORING NO. B-5

GROUND ELEVATION 12' ± (MSL) SHEET 2 OF 2

METHOD OF DRILLING 6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY RI

DESCRIPTION/INTERPRETATION

Total Depth = 20 feet.
Groundwater encountered at a depth of approximately 13 feet during drilling.
Backfilled with approximately 3.9 cubic feet of bentonite grout and capped with concrete shortly after drilling on 6/22/09.

Note: 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.

Ninyo & Moore

BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-10

DATE DRILLED	6/22/09
BORING NO.	B-6
GROUND ELEVATION	14' ± (MSL)
SHEET	1 OF 2
METHOD OF DRILLING	6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)
DRIVE WEIGHT	140 lbs. (Auto-Trip)
DROP	30"
SAMPLED BY	BTM
LOGGED BY	BTM
REVIEWED BY	RI

DEPTH (feet)	SAMPLES Bulk / Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						CL	FILL: Brown, damp, stiff, sandy CLAY.
5	Driven	20	18.0	108.5			Moist.
							OLD PARALIC DEPOSITS: Brown, damp, weakly cemented, silty fine-grained SANDSTONE; micaceous.
10	Driven	40					
							Reddish brown to gray, moist, moderately to strongly indurated, fine sandy CLAYSTONE.
15	Driven	50					
			▽				Saturated.
	Driven	37					
20							

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BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-11

DATE DRILLED	6/22/09	BORING NO.	B-6
GROUND ELEVATION	14' ± (MSL)	SHEET	2 OF 2
METHOD OF DRILLING	6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)		
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"
SAMPLED BY	BTM	LOGGED BY	BTM
REVIEWED BY	RI		

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20								Total Depth = 20 feet. Groundwater encountered at a depth of approximately 16.5 feet during drilling. Backfilled with approximately 3.9 cubic feet of bentonite grout shortly after drilling on 6/22/09. Note: 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.
25								
30								
35								
40								

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BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-12

DATE DRILLED	6/22/09	BORING NO.	PT-1
GROUND ELEVATION	15' ± (MSL)	SHEET 1 OF 1	
METHOD OF DRILLING	6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)		
DRIVE WEIGHT	140 lbs. (Auto-Trip)	DROP	30"
SAMPLED BY	BTM	LOGGED BY BTM	REVIEWED BY RI

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 6 inches thick.
							CL	FILL: Brown, damp, stiff, sandy CLAY.
5								Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled shortly after testing on 6/23/09. Note: 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								

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BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-13

DEPTH (feet)	SAMPLES: Bulk	SAMPLES: Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								ASPHALT CONCRETE: Approximately 4 inches thick.
							SM	FILL: Brown, damp, medium dense, silty SAND; scattered gravel and cobbles.
							CL	Brown, damp, stiff, sandy CLAY.
5								Total Depth = 5 feet. Groundwater not encountered during drilling. Backfilled shortly after testing on 6/23/09. Note: 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								

DATE DRILLED 6/22/09 BORING NO. PT-2

GROUND ELEVATION 14' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY RI

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BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-14

DEPTH (feet)	SAMPLES: Bulk	SAMPLES: Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.
0							
5							
10							
15							
20							

DATE DRILLED 6/22/09 BORING NO. PT-3

GROUND ELEVATION 22' ± (MSL) SHEET 1 OF 1

METHOD OF DRILLING 6" Diameter Hollow-Stem Auger (CME-75) (Baja Explorations)

DRIVE WEIGHT 140 lbs. (Auto-Trip) DROP 30"

SAMPLED BY BTM LOGGED BY BTM REVIEWED BY RI

DESCRIPTION/INTERPRETATION

ASPHALT CONCRETE:
Approximately 4 inches thick.

OLD PARALIC DEPOSITS:
Brown, damp, strongly indurated, fine sandy CLAYSTONE.

Total Depth = 5 feet.
Groundwater not encountered during drilling.
Backfilled shortly after testing on 6/23/09.

Note: 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.

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BORING LOG

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

PROJECT NO.	DATE	FIGURE
106609001	7/09	A-15

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.

In-Place Moisture and Density Tests

The moisture content and dry density of relatively undisturbed samples obtained from the exploratory borings were evaluated in general accordance with ASTM D 2937. The test results are presented on the logs of the exploratory borings in Appendix A.

Gradation Analysis

Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422. The grain-size distribution curve are shown on Figures B-1 and B-2. The test results were utilized in evaluating the soil classifications in accordance with the USCS.

Direct Shear Test

Direct shear tests were performed on relatively undisturbed samples in general accordance with ASTM D 3080-04 to evaluate the shear strength characteristics of the selected materials. The samples were inundated during shearing to represent adverse field conditions. The results are shown on Figures B-3 and B-4.

Expansion Index Tests

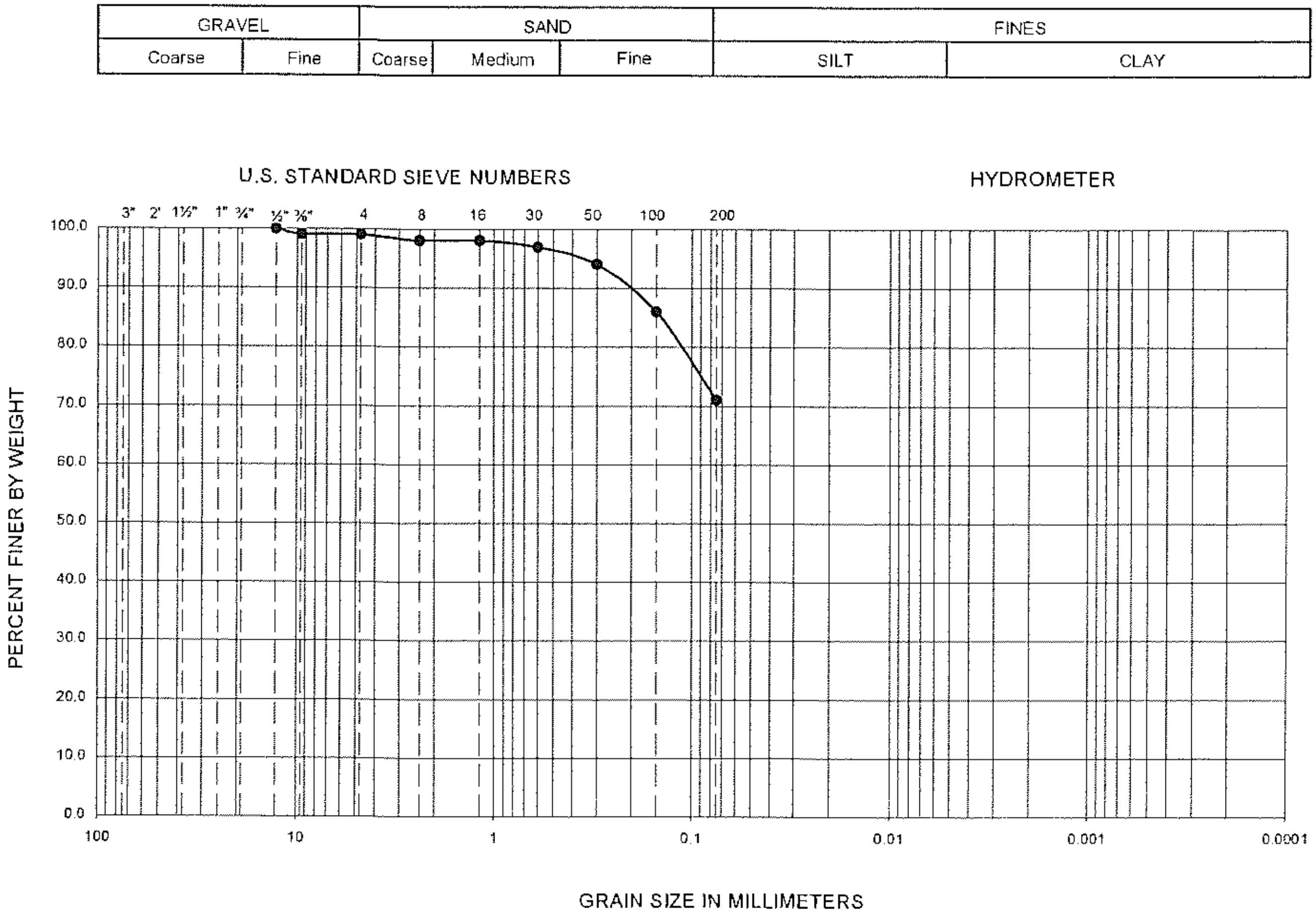
The expansion index of selected materials was evaluated in general accordance with Uniform Building Code (UBC) Standard No. 18-2 (ASTM D 4829). Specimens were molded under a specified compactive energy at approximately 50 percent saturation (plus or minus 1 percent). The prepared 1-inch thick by 4-inch 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-5.

Soil Corrosivity Tests

Soil pH, and minimum resistivity tests were performed on a representative sample in general accordance with CT 643. The sulfate and chloride content of the selected sample were evaluated in general accordance with CT 417 and CT 422, respectively. The test results are presented on Figure B-6.

R-Value Test

The resistance value, or R-value, for a sample of the site soils was evaluated in general accordance with California Test (CT) 301. The sample was 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-7.



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-1	1.0-5.0	--	--	--	--	--	--	--	--	71	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore

GRADATION TEST RESULTS

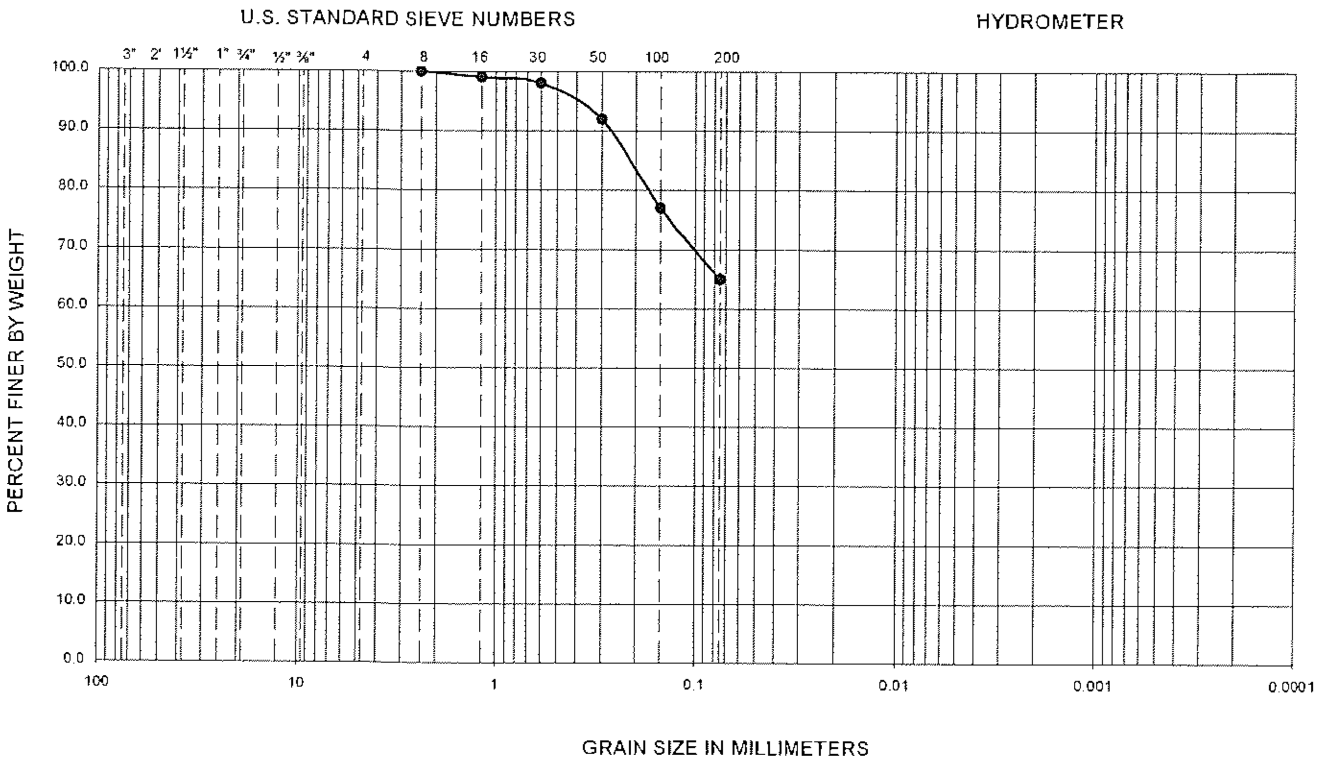
FIGURE **B-1**

PROJECT NO.	DATE
106609001	7/09

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

106609001 SIEVE B-1 @ 1.0-5.0.xls

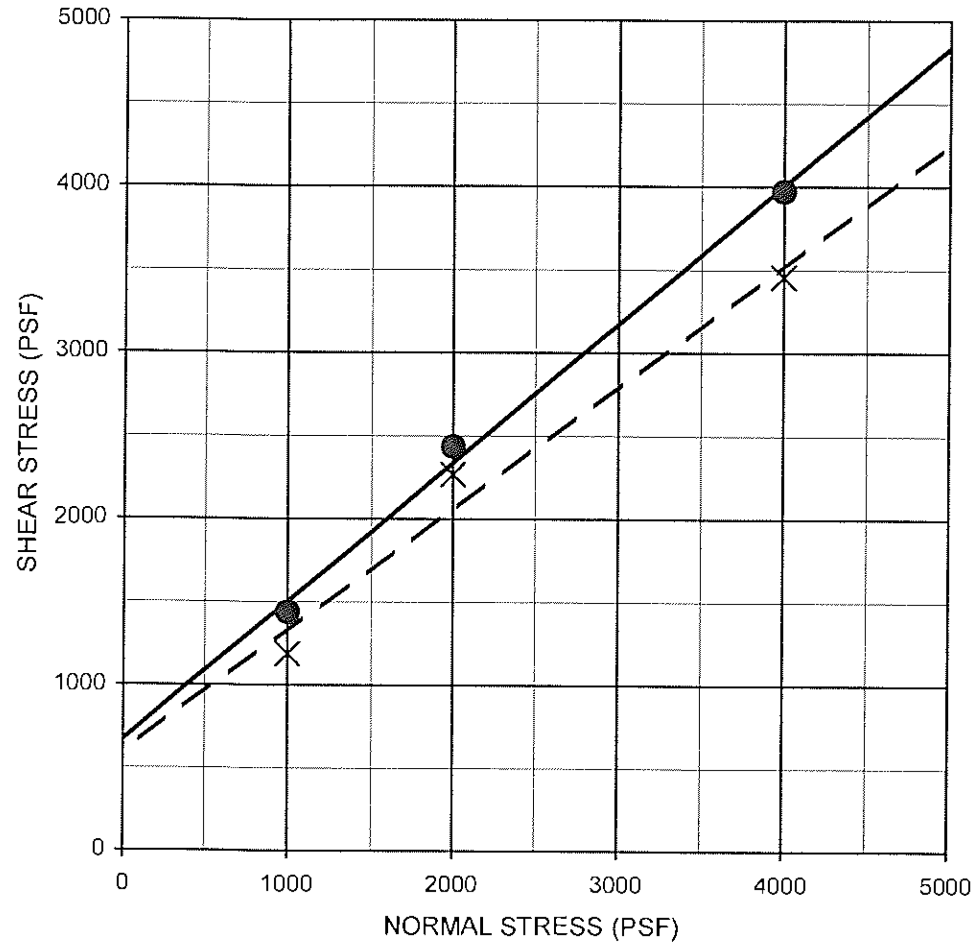
GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	USCS
●	B-5	1.0-5.0	--	--	--	--	--	--	--	--	65	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore		GRADATION TEST RESULTS	FIGURE
PROJECT NO.	DATE	9TH STREET AND PALM AVENUE IMPERIAL BEACH, CALIFORNIA	B-2
106609001	7/09		



Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion, c (psf)	Friction Angle, ϕ (degrees)	Soil Type
Silty SANDSTONE	——●——	B-2	5.0-6.5	Peak	670	40	Old Paralic Deposits
Silty SANDSTONE	- - X - -	B-2	5.0-6.5	Ultimate	600	36	

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

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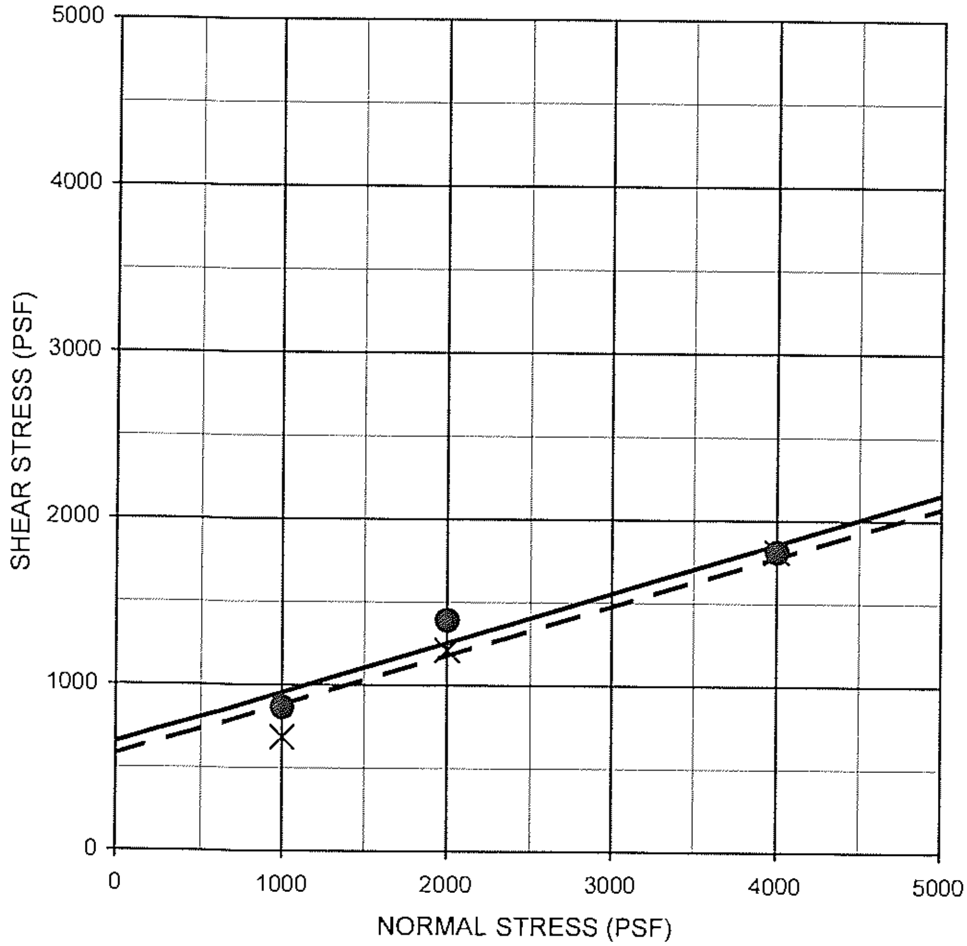
DIRECT SHEAR TEST RESULTS

FIGURE **B-3**

PROJECT NO.	DATE
106609001	7/09

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA



Description	Symbol	Sample Location	Depth (ft)	Shear Strength	Cohesion, c (psf)	Friction Angle, ϕ (degrees)	Soil Type
Sandy CLAY	—●—	B-6	5.0-6.5	Peak	650	17	CL
Sandy CLAY	- - X - -	B-6	5.0-6.5	Ultimate	580	17	CL

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 3080

Ninyo & Moore		DIRECT SHEAR TEST RESULTS	FIGURE
PROJECT NO.	DATE	9TH STREET AND PALM AVENUE IMPERIAL BEACH, CALIFORNIA	B-4
106609001	7/09		

SAMPLE LOCATION	SAMPLE DEPTH (FT)	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (PCF)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (IN)	EXPANSION INDEX	POTENTIAL EXPANSION
B-6	1.0-5.0	9.5	111.0	19.7	0.025	25	Low
PT-1	1.0-5.0	8.5	115.2	17.6	0.020	20	Very Low

PERFORMED IN GENERAL ACCORDANCE WITH ☐ UBC STANDARD 18-2 ☑ ASTM D 4829

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EXPANSION INDEX TEST RESULTS

FIGURE **B-5**

PROJECT NO.	DATE
106609001	7/09

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

SAMPLE LOCATION	SAMPLE DEPTH (FT)	pH[1]	RESISTIVITY[1] (Ohm-cm)	SULFATE CONTENT[2]		CHLORIDE CONTENT[3] (ppm)
				(ppm)	(%)	
B-2	1.0-5.0	8.8	980	490	0.049	760
B-5	1.0-5.0	7.6	450	740	0.074	920

[1] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 643
[2] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 417
[3] PERFORMED IN GENERAL ACCORDANCE WITH CALIFORNIA TEST METHOD 422

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CORROSIVITY TEST RESULTS

PROJECT NO.	DATE
106609001	7/09

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

FIGURE
B-6

SAMPLE LOCATION	SAMPLE DEPTH (FT)	SOIL TYPE	R-VALUE
B-1	1.0-5.0	Sandy CLAY (CL)	25

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 2844/CT 301

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R-VALUE TEST RESULTS

PROJECT NO.	DATE
106609001	7/09

9TH STREET AND PALM AVENUE
IMPERIAL BEACH, CALIFORNIA

FIGURE
B-7

APPENDIX C

FIELD PERCOLATION TEST DATA

PERCOLATION TEST RESULTS

Test Date - 6-23-09 **PT-1**

Boring Diameter - 6.0 in Boring Depth - 4.8 feet
Test performed and recorded by: BTM

t_1	d_1	t_2	d_2	Δt	Δd	$\Delta t/\Delta d$ MPI	Adjusted MPI
0	4.30	30	4.30	30	0.0	NA	NA
30	4.30	60	4.30	30	0.0	NA	NA
60	4.30	90	4.30	30	0.0	NA	NA
90	4.30	120	4.30	30	0.0	NA	NA
120	4.30	150	4.30	30	0.0	NA	NA
150	4.30	180	4.30	30	0.0	NA	NA

Test Date - 6-23-09 **PT-2**

Boring Diameter - 6.0 in Boring Depth - 4.6 feet
Test performed and recorded by: BTM

t_1	d_1	t_2	d_2	Δt	Δd	$\Delta t/\Delta d$ MPI	Adjusted MPI
0	4.05	30	4.07	30	0.0	125.0	330.9
30	4.07	60	4.07	30	0.0	NA	NA
60	4.07	90	4.07	30	0.0	NA	NA
90	4.07	120	4.07	30	0.0	NA	NA
120	4.07	150	4.07	30	0.0	NA	NA
150	4.07	180	4.07	30	0.0	NA	NA

t_1 = initial time when filling or refilling is completed in minutes

d_1 = initial depth to water in hole at t_1 in feet

t_2 = final time when incremental water level reading is taken in minutes

d_2 = final depth to water in hole at t_2 in feet

Δt = change in time between initial and final water level readings in minutes ($t_2 - t_1$)

Δd = change in depth to water in feet ($d_2 - d_1$)

MPI = minutes per inch

NA = did not percolate

PERCOLATION TEST RESULTS

Test Date - 6-23-09 **PT-3**

Boring Diameter - 8.0 in Boring Depth - 10.6 feet
Test performed and recorded by: BTM

t_1	d_1	t_2	d_2	Δt	Δd	$\Delta t/\Delta d$ MPI	Adjusted MPI
0	4.05	30	4.08	30	0.0	83.3	220.6
30	4.08	60	4.12	30	0.0	62.5	165.4
60	4.12	90	4.14	30	0.0	125.0	330.9
90	4.14	120	4.16	30	0.0	125.0	330.9
120	4.05	150	4.07	30	0.0	125.0	330.9
150	4.07	180	4.09	30	0.0	125.0	330.9

t_1 = initial time when filling or refilling is completed in minutes

d_1 = initial depth to water in hole at t_1 in feet

t_2 = final time when incremental water level reading is taken in minutes

d_2 = final depth to water in hole at t_2 in feet

Δt = change in time between initial and final water level readings in minutes ($t_2 - t_1$)

Δd = change in depth to water in feet ($d_2 - d_1$)

MPI = minutes per inch

NA = did not percolate