Appendix D:
Geotechnical Engineering Investigation

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GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED IN-N-OUT BURGER RESTAURANT
18181 IMPERIAL
YORBA LINDA, CALIFORNIA

PROJECT NO. 112-18047
MAY 9, 2018

PREPARED FOR:

IN-N-OUT BURGER, A CALIFORNIA CORPORATION
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GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED IN-N-OUT BURGER RESTAURANT
18181 IMPERIAL HIGHWAY
YORBA LINDA, CALIFORNIA

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Krazan & ASSOCIATES, INC.

GEOTECHNICAL ENGINEERING • ENVIRONMENTAL ENGINEERING
CONSTRUCTION TESTING & INSPECTION

May 9, 2018

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GEOTECHNICAL ENGINEERING INVESTIGATION
PROPOSED IN-N-OUT BURGER RESTAURANT
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INTRODUCTION

This report presents the results of our Geotechnical Engineering Investigation for the proposed development that will include construction of an approximately 3,867 square foot In-N-Out Burger Restaurant. It is anticipated that the proposed construction will include a drive-thru area, patio area, trash enclosure, associated parking and drive areas, and localized landscaped areas. Discussions regarding site conditions are presented herein, together with conclusions and recommendations pertaining to site preparation, grading, utility trench backfill, drainage and landscaping, foundations, concrete floor slabs and exterior concrete flatwork, retaining walls, soil corrosivity, and pavement design.

A Vicinity Map showing the location of the site is presented on Figure 1. A Site Plan showing the approximate boring locations is presented on Figure 2. Descriptions of the field and laboratory investigations, boring log legend and boring logs are presented in Appendix A. Appendix A contains a description of the laboratory-testing phase of this study, along with the laboratory test results. Appendices B and C contain guide specifications for earthwork and flexible pavements, respectively. If conflicts in the text of the report occur with the general specifications in the appendices, the recommendations in the text of the report have precedence.

PURPOSE AND SCOPE OF SERVICES

This geotechnical investigation was conducted to evaluate subsurface soil and groundwater conditions at the project site. Engineering analysis of the field and laboratory data was performed for the purpose of developing and providing geotechnical recommendations for use in the design and construction of the earthwork, foundation and pavement aspects of the project.

Our scope of services was outlined in our proposal dated March 14, 2018 (KA Proposal No. G18041CAC) and included the following:

- A site reconnaissance by a member of our engineering staff to evaluate the surface conditions at the project site.

- Review of selected published geologic maps, reports and literature pertinent to the site and surrounding area.

- A field investigation consisting of drilling six (6) borings to depths ranging from approximately ten (10) to twenty (20) feet below the existing ground surface for evaluation of the subsurface conditions at the project site.

- Performance of two (2) infiltration tests at the subject site in order to determine an estimated infiltration rate for the near surface soil.

- Performance of laboratory tests on representative soil samples obtained from the borings to evaluate the physical and index properties of the subsurface soils.

- Evaluation of the data obtained from the investigation and engineering analyses of the data with respect to the geotechnical aspects of structural design, site grading and paving.

- Preparation of this report summarizing the findings, results, conclusions and recommendations of our investigation.

Environmental services, such as a chemical analysis of soil and groundwater for possible environmental contaminates, were not in our scope of services.

PROPOSED CONSTRUCTION

Based on our review of the site plan and our discussions with the project representative, we understand that the proposed development will include construction of an approximately 3,867 square foot In-N-Out Burger Restaurant. The proposed restaurant will be of wood frame/stucco construction with a slab-on-grade floor. The proposed development will include a drive-thru area, patio area, trash enclosure, associated parking and drive areas, and localized landscaped areas. It is anticipated that the proposed structure will be supported on a shallow foundation system.

In the event these structural or grading details are inconsistent with the final design criteria, we should be notified so that we can evaluate the potential impacts of the changes on the recommendations presented in this report and provide an updated report as necessary.

SITE LOCATION AND SITE DESCRIPTION

The site is a roughly triangular shaped parcel located along the northeast of Imperial Highway, in the city of Yorba Linda, California. The subject site is located at the physical address of 18181 Imperial Highway, Yorba Linda, California. Presently, the site is occupied by a three-story, wood framed Yorba Linda Public Library building and associated asphalt and concrete pavements, and localized landscape areas. The site is bound to the north by Lemon Drive and a mix of residential and commercial buildings beyond, to the east by Olinda Street and commercial buildings beyond, and to the west and south by Imperial Highway and commercial buildings beyond. The site is relatively flat and level, with no major changes in elevation with the exception of the eastern portion of the site which sits approximately 3 feet higher than the western side.

GEOLOGIC SETTING

The subject site is located within the Puente Hills with the San Gabriel Valley to the north and the Eastern Basin of the Los Angeles Coastal Plain to the south, within the Peninsular Ranges Geomorphic Province of California. The Eastern Basin of the Los Angeles Coastal Plain is situated between the Santa Monica Mountains to the northwest, the San Gabriel Valley and Mountains to the north, the Santa Ana Mountains to the southeast, and the Pacific Ocean to the west and south. The Los Angeles Basin and San Gabriel Valley are dominated by northwest-trending faults and adjacent anticlinal uplifts. The intervening deep synclinal troughs are filled with poorly consolidated Upper Pleistocene and unconsolidated Holocene sediments. Tectonism of the region is dominated by the interaction of the East Pacific Plate and the North American Plate along a transform boundary.

The near-surface deposits in the vicinity of the subject site are indicated to be comprised of recent alluvium consisting of unconsolidated sands, silt, and clays derived from erosion of the Puente Hills. Deposits encountered on the subject site during exploratory drilling are discussed in detail in this report.

The Puente Hills are composed of several Geologic Formations. The San Fernando formation is comprised of interbedded light brown fine to medium grained sandstone and dark brown to tan siltstone beds. The Diblee (1999) Geologic Map shows the site to be underlain by Qg – Holocene gravel and sand of major streams and Qoa-uplifted remnants of alluvial sand and gravel, north of hill areas. These surficial sediments are underlain by Tfps - the Pliocene Fernando Formation - "Pico" silty sandstone facies at the southwest end of Puente Hills, composed of very fine grained silty sandstone to siltstone, vaguely bedded.

Numerous moderate to large earthquakes have affected the area of the subject site within historic time. Based on the proximity of several dominant active faults and seismogenic structures, as well as the historic seismic record, the area of the subject site is considered subject to relatively moderate to high seismicity.

The Puente Hills, which includes the project site, are located, in the vicinity of the Elsinore, Puente Hills, and Chino Faults. These faults are significant seismic sources. The Elsinore, Puente Hills, and Chino Faults are located approximately 1.6, 3.1, and 8.0 miles from the subject site, respectively. Therefore, the proposed project should be designed in accordance with the seismic parameters and recommendation presented in this Geotechnical Engineering Investigation report.

SEISMIC HAZARDS ZONES

In 1990, the California State Legislature passed the Seismic Hazard Mapping Act to protect public safety from the effects of strong shaking, liquefaction, landslides, or other ground failure, and other hazards caused by earthquakes. The Act requires that the State Geologist delineate various seismic hazards zones on Seismic Hazards Zones Maps. Specifically, the maps identify areas where soil liquefaction and earthquake-induced landslides are most likely to occur. A site-specific geotechnical evaluation is required prior to permitting most urban developments within the mapped zones. The Act also requires sellers of real property within the zones to disclose this fact to potential buyers. The subject site is located on the State of California, Seismic Hazard Zones Map, Yorba Linda Quadrangle, dated August

11, 2005. The subject site is not located in and area designated by the State of California as a Liquefaction Hazard Zone.

SEISMICITY AND LIQUEFACTION POTENTIAL

Seismicity is a general term relating to the abrupt release of accumulated strain energy in the rock materials of the earth's crust in a given geographical area. The recurrence of accumulation and subsequent release of strain have resulted in faults and fault systems. Fault patterns and density reflect relative degrees of regional stress through time, but do not necessarily indicate recent seismic activity; therefore, the degree of seismic risk must be determined or estimated by the seismic record in any given region. The Puente Hills, Elsinore, and San Jose Faults are located approximately 1.5, 1.9, and 8.8 miles from the subject site, respectively.

Soil liquefaction is a state of soil particle suspension caused by a complete loss of strength when the effective stress drops to zero. Liquefaction normally occurs under saturated conditions in soils such as sand in which the strength is purely frictional. However, liquefaction has occurred in soils other than clean sand. Liquefaction usually occurs under vibratory conditions such as those induced by seismic events. To evaluate the liquefaction potential of the site, the following items were evaluated:

1) Soil type
2) Groundwater depth
3) Relative density
4) Initial confining pressure
5) Intensity and duration of ground shaking

The subject site is located on the State of California, Seismic Hazard Zones Map, Yorba Linda Quadrangle, dated August 11, 2005. The subject site is not located in and area designated as a liquefaction hazard zone. The subsurface soil conditions encountered at the site consist of medium dense to dense silty sand and hard clayey silt with varying fine sand content. Groundwater in the vicinity of the site was not encountered in any of the boring locations as part of this site investigation. Available groundwater depth mapping, as well as our experience in the area, indicates that historically groundwater has been located at depths in excess of fifty (50) feet below grade in the general vicinity of the site.

Based on the conditions encountered at the subject site, liquefaction is not considered a significant concern for the subject site. As such, mitigation measures associated with liquefaction are not considered warranted.

FAULT RUPTURE HAZARD ZONES

The Alquist-Priolo Geologic Hazards Zones Act went into effect in March, 1973. Since that time, the Act has been amended 11 times (Hart, 2007). The purpose of the Act, as provided in California Geologic Survey (CGS) Special Publication 42 (SP 42), is to prohibit the location of most structures for human occupancy across the traces of active faults and to mitigate thereby the hazard of fault-rupture". The Act was renamed the Alquist-Priolo Earthquake Fault Zoning Act in 1994, and at that time, the originally designated "Special Studies Zones" was renamed the "Earthquake Fault Zones."

The subject site is located on the State of California, Seismic Hazard Zones Map, Yorba Linda Quadrangle, dated November 1, 1991. The site is not within a Fault-Rupture Hazard Zone. The Elsinore, Puente Hills, and Chino Faults are located approximately 1.6, 3.1, and 8.0 miles from the subject site, respectively.

OTHER HAZARDS

Rockfall, Landslide, Slope Instability, Debris Flow: The subject site is relatively flat and level. It is our understanding that there are no significant slopes proposed as part of the proposed development. Provided the recommendations presented in this report are implemented into the design and construction of the anticipated development, rockfalls, landslides, slope instability, and debris flows are not anticipated to pose a hazard to the subject site.

Seiches: Seiches are large waves generated within enclosed bodies of water. The site is not located in close proximity to any lakes or reservoirs. As such, seiches are not anticipated to pose a hazard to the subject site.

Tsunamis: Tsunamis are tidal waves generated by fault displacement or major ground movement. The site is several miles from the ocean. As such, tsunamis are not anticipated to pose a hazard to the subject site.

Hydroconsolidation: The near surface soils encountered at the subject site were found to be medium dense to dense. Provided remedial grading recommendations presented in this report are incorporated in the design and construction, hydroconsolidation is not anticipated to be a significant concern for the subject site.

SITE COEFFICIENT

The site class, per Table 1613.5.2, 2016 CBC, is based upon the site soil conditions. It is our opinion that a Site Class D is appropriate for building design at this site. Site coordinates of 33.891099 and 117.815394 were used to determine the recommended seismic design values. For seismic design of the structures, in accordance with the seismic provisions of the 2016 CBC, we recommend the following parameters:

2016 CALIFORNIA BUILDING CODE		
Seismic Item	**Value**	**CBC Reference**
Site Class	D	Table 1613.5.2
Fa	1.000	Table 1613.5.3 (1)
Ss	1.981	Figure 1613.5 (3)
SMS	1.981	Section 1613.5.3
SDS	1.321	Section 1613.5.4
Fv	1.500	Table 1613.5.3 (2)
S1	0.733	Figure 1613.5 (4)
SM1	1.100	Section 1613.5.3
SD1	0.733	Section 1613.5.4
Peak Horizontal Acceleration	0.750 g	Figure 22.7

The seismic hazard most likely to impact the site is ground shaking due to a large earthquake on one of the major active regional faults. The Elsinore, Puente Hills, and Chino Faults are located approximately 1.6, 3.1, and 8.0 miles from the subject site, respectively. Because of the proximity to the subject site and the maximum probable events for these faults, it appears that a maximum probable event along these fault zones could produce a peak horizontal acceleration of approximately 0.750g when uncertainty is used. With respect to this hazard, the site is comparable to others in this general area within similar geologic settings.

FIELD AND LABORATORY INVESTIGATIONS

Subsurface soil conditions were explored by drilling six (6) borings using a truck-mounted drill rig to depths ranging from approximately ten (10) feet to twenty (20) feet below existing site grades. Bulk subgrade soil samples were also obtained for laboratory testing. The approximate boring and bulk sample locations are shown on the Site Plan, Figure 2. These approximate boring and sample locations were estimated in the field based on pacing and measuring from the limits of existing site features. During drilling operations, penetration tests were performed at regular intervals to evaluate the soil consistency and to obtain information regarding the engineering properties of the subsurface soils. Soil samples were retained for laboratory testing. The soils encountered were continuously examined and visually classified in accordance with the Unified Soil Classification System. A more detailed description of the field investigation is presented in Appendix A.

Laboratory tests were performed on selected soil samples to evaluate their physical characteristics and engineering properties. The laboratory-testing program was formulated with emphasis on the evaluation of natural in-situ moisture and density, gradation, R-Value, maximum dry density, resistivity, pH value, sulfate- and chloride-contents of the materials encountered. Details of the laboratory-testing program are discussed in Appendix A. The results of the laboratory tests are presented on the boring logs or on the test reports, which are also included in Appendix A. This information, along with the field observations, was used to prepare the final boring logs in Appendix A.

SOIL PROFILE AND SUBSURFACE CONDITIONS

Based on our findings, the subsurface conditions encountered appear typical of those found in the geologic region of the site. Ground surface at each of the boring locations consisted of approximately three (3) to (6) six inches of asphalt pavement underlain by approximately six (6) to seven (7) inches of discernable base material. The subsurface soil conditions encountered at the site generally consisted of fill soil to depths of up to ten (10) feet below existing site grades. The fill material appears to be uniform and consistent throughout the site. The fill material consisted of medium dense to dense silty sand. Below the near surface fill material, interbeded layers of medium dense to dense silty sands and hard clayey silts with varying sand content were encountered from depths of approximately 3 feet below site grades to the maximum depth explored, twenty (20) feet below site grades. Thicker fill materials may be present at the site between our boring locations. Verification of any fill material should be determined during site grading.

Field and laboratory tests suggest that the soils encountered are moderately strong and slightly compressible. Penetration resistance, measured by the number of blows required to drive a Modified California sampler or a Standard Penetration Test (SPT) sampler, ranged from 18 to 67 blows per foot. Dry densities ranged from approximately 107 to 127 pcf. Representative soil samples had angles of internal friction of 30 degrees.

The above is a general description of soil conditions encountered at the site in the borings drilled for this investigation. For a more detailed description of the soil conditions encountered, please refer to the boring logs in Appendix A.

GROUNDWATER

Test boring locations were checked for the presence of groundwater during and immediately following the drilling operations. Groundwater was not encountered in any of the boring locations as part of this site investigation. Based on a review of the Seismic Hazard Evaluation Report for the Yorba Linda Quadrangle, historic high groundwater depths for the vicinity of the subject site are estimated to be at depths in excess of fifty (50) feet below ground surface.

It should be recognized that water table elevation might fluctuate with time. The depth to groundwater can be expected to fluctuate both seasonally and from year to year. Fluctuations in the groundwater level may occur due to variations in precipitation, irrigation practices at the site and in the surrounding areas, climatic conditions, flow in adjacent or nearby canals, pumping from wells and possibly as the result of other factors that were not evident at the time of our investigation. Therefore, water level observations at the time of our field investigation may vary from those encountered during the construction phase of the project. The evaluation of such factors is beyond the scope of this report. Long-term monitoring in observation wells, sealed from the influence of surface water, is often required to more accurately define the potential range of groundwater conditions on a site.

SOIL CORROSIVITY

Corrosion tests were performed to evaluate the soil corrosivity to the buried structures. The tests consisted of minimum resistivity, sulfate content and chloride content, and the results of the tests are included as follows:

Parameter	Results	Test Method
Sulfate	197 ppm	CA 417
Min Resistivity	2,100 ohm-cm	CA 643
Chloride	29 ppm	CA 422
pH Value	7.5	EPA 9045C

INFILTRATION TESTING

Estimated infiltration rates were determined using the results of open borehole percolation testing performed at the subject site. Infiltration testing was performed in accordance with the Technical Guidance Document for Orange County. The percolation testing indicated that the near surface silty sand soil was found to have infiltration rates of approximately 0.21 and 0.28 inch per hour.

In order to perform the infiltration tests, two borings were drilled to approximately five feet below existing site grades. Infiltration testing was performed at each of the two boring locations. Infiltration testing has been performed using open borehole percolation testing in accordance with the County of Orange Best Management Guidance document. Prior to infiltration testing, approximately four inches of gravel was placed at the bottom of each borehole. The boreholes were pre-soaked prior to testing using clean water. The depth of each borehole was measured at each reading to verify the overall depth. The depth of water in the borehole was measured using a water level indicator or well sounder. Infiltration rates have been calculated using the Inverse Borehole procedures.

Based on the very low infiltration rates, the subsurface conditions encountered at the subject site are not considered conducive to infiltration. Detailed results of the infiltration testing are included in Appendix A in tabular format.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings of our field and laboratory investigations, along with previous geotechnical experience in the project area, the following is a summary of our evaluations, conclusions, and recommendations.

ADMINISTRATIVE SUMMARY

In brief, the subject site and soil conditions appear to be conducive to the development of the project. Based on the data collected during this investigation and from a geotechnical engineering standpoint, it is our opinion that the proposed improvements may be made as anticipated provided that the recommendations presented in this report are considered in the design and construction of the project.

To reduce post-construction soil movement, provide uniform support for the proposed building, and address anticipated disturbed material resulting from demolition activities, overexcavation and recompaction within the proposed building footprint area should be performed to a minimum depth of three (3) feet below existing grades or two (2) feet below the bottom of the proposed footings, whichever is deeper. The actual depth of the overexcavation and recompaction should be determined by our field representative during construction. The overexcavation and recompaction should also extend laterally five (5) feet beyond edges of the proposed footings or building limits. Any undocumented fill encountered during grading should be removed and replaced with Engineered Fill.

Within the proposed exterior flatwork and pavement areas, the overexcavation and recompaction should be performed to a depth of at least one (1) foot below existing grade or finish subgrade, whichever is deeper. This compaction effort should stabilize the surface soils and locate any unsuitable or pliant areas not found during our field investigation.

Fill material should be compacted to a minimum of 90 percent of the maximum dry density based on ASTM Test Method D1557. All fill material should be moisture-conditioned to at least 2 percent above optimum moisture-content.

The limit of grading and the proposed building footprint should be established in the field prior to construction. Additional remedial grading will be required if the building edges exceed the grading limit. The grading envelope should be at least 5 feet beyond the outer edges of the building footprint.

The proposed structures, including walls and other foundation elements may be supported on a shallow foundation system bearing on a minimum of one foot of newly placed Engineered Fill. Spread and continuous footings can be designed for a maximum allowable soil bearing pressure, dead plus live load, of 2,600 psf.

Infiltration rates were determined using the results of open borehole infiltration testing performed at the subject site. Infiltration testing performed on the near surface silty sand soil indicates infiltration rates of approximately 0.21 and 0.28 inch per hour. Based on the very low infiltration rates, the subsurface conditions encountered at the site are not considered conducive to infiltration.

GROUNDWATER INFLUENCE ON STRUCTURES/CONSTRUCTION

Based on our findings and historical records, it is not anticipated that groundwater will rise within the zone of structural influence or affect the construction of foundations and pavements for the project. However, if earthwork is performed during or soon after periods of precipitation, the subgrade soils may become saturated, "pump," or not respond to densification techniques. Typical remedial measures include: discing and aerating the soil during dry weather; mixing the soil with dryer materials; removing and replacing the soil with an approved fill material; or mixing the soil with an approved lime or cement product. Our firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

SEISMIC CONSIDERATIONS

Ground Shaking

Although ground rupture is not considered to be a major concern at the subject site, the site will likely be subject to at least one moderate to severe earthquake and associated seismic shaking during its lifetime, as well as periodic slight to moderate earthquakes. Some degree of structural damage due to stronger seismic shaking should be expected at the site, but the risk can be reduced through adherence to seismic design codes.

Seismic Induced Settlement

One of the most common phenomena during seismic shaking accompanying any earthquake is the induced settlement of loose unconsolidated soils. Based on site subsurface conditions and the moderate to high seismicity of the region, any loose fill materials at the site could be vulnerable to this potential hazard. However, this hazard can be mitigated by following the design and construction recommendations of the Geotechnical Engineering Investigation Report.

EARTHWORK

Site Preparation – Clearing and Stripping

General site clearing should include removal of vegetation and existing utilities, structures (footings and slabs); existing pavements; trees and associated root systems; rubble; rubbish; and any loose and/or saturated materials. Site stripping should extend to a minimum depth of 2 to 4 inches, or until all organics in excess of 3 percent by volume are removed. Deeper stripping may be required in localized areas. These materials will not be suitable for reuse as Engineered Fill. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas.

Any excavations that result from clearing operations should be backfilled with Engineered Fill. Krazan & Associates' field staff should be present during site clearing operations to enable us to locate areas where depressions or disturbed soils are present and to allow our staff to observe and test the backfill as it is placed. If site clearing and backfilling operations occur without appropriate observation and testing by a qualified geotechnical consultant, there may be the need to over-excavate the building area to identify uncontrolled fills prior to mass grading of the building pad.

As with site clearing operations, any buried structures encountered during construction should be properly removed and backfilled. The resulting excavations should be backfilled with Engineered Fill.

Overexcavation and Recompaction

To reduce post-construction soil movement, provide uniform support for the proposed building, and address anticipated disturbed material resulting from demolition activities, overexcavation and recompaction within the proposed building footprint area should be performed to a minimum depth of three (3) feet below existing grades or two (2) feet below the bottom of the proposed footings, whichever is deeper. The actual depth of the overexcavation and recompaction should be determined by our field representative during construction. The overexcavation and recompaction should also extend laterally five (5) feet beyond edges of the proposed footings or building limits. Any undocumented fill encountered during grading should be removed and replaced with Engineered Fill.

Within the proposed exterior flatwork and pavement areas, the overexcavation and recompaction should be performed to a depth of at least one (1) foot below existing grade or finish subgrade, whichever is deeper. This compaction effort should stabilize the surface soils and locate any unsuitable or pliant areas not found during our field investigation.

The upper soils, during wet winter months, become very moist due to the absorptive characteristics of the soil. Earthwork operations performed during winter months may encounter very moist unstable soils which may require removal to grade a stable building foundation. Project site winterization consisting of placement of aggregate base and protecting exposed soils during the construction phase should be performed.

A representative of our firm should be present during all site clearing and grading operations to test and observe earthwork construction. This testing and observation is an integral part of our service as acceptance of earthwork construction is dependent upon compaction of the material and the stability of the material. The Soils Engineer may reject any material that does not meet compaction and stability requirements. Further recommendations of this report are predicated upon the assumption that earthwork construction will conform to recommendations set forth in this section and the Engineered Fill section.

Fill Placement

Prior to placement of fill soils, the upper 12 inches of native subgrade soils should be scarified, moisture-conditioned to at least 2 percent above optimum moisture-content, and recompacted to a minimum of 90 percent of the maximum dry density based on ASTM Test Method D1557. Fill material should be compacted to a minimum of 90 percent of the maximum dry density based on ASTM Test Method D1557.

The upper soils, during wet winter months, may become very moist due to the absorptive characteristics of the soil. Earthwork operations performed during winter months may encounter very moist unstable soils, which may require removal to grade a stable building foundation. Project site winterization consisting of placement of aggregate base and protecting exposed soils during the construction phase should be performed.

ENGINEERED FILL

The organic-free, on-site, native and fill soils are predominately silty sand with traces of clay content at some areas of the site. These soils will be suitable for reuse as Engineered Fill, provided they are cleansed of excessive organics and debris and have very minimal clay content.

The preferred materials specified for Engineered Fill are suitable for most applications with the exception of exposure to erosion. Project site winterization and protection of exposed soils during the construction phase should be the sole responsibility of the contractor, since they have complete control of the project site at that time.

Imported Fill material should be predominately non-expansive granular material. This material should be approved by the Geotechnical Engineer prior to use and should typically possess the following characteristics:

NON-EXPANSIVE FILL PROPERTIES	
Percent Passing No. 200 Sieve	10 to 50
Plasticity Index (PI)	12 maximum
Liquid Limit	35 maximum
UBC Standard 29-2 Expansion Index	20 maximum

Imported Fill should be free from rocks and clods greater than 4 inches in diameter. All Imported Fill material should be submitted to the Soils Engineer for approval at least 48 hours prior to delivery to the site. Fill soils should be placed in lifts approximately 6 inches thick, moisture-conditioned to at least optimum moisture-content, and compacted to achieve at least 90 percent of maximum dry density as determined by ASTM Test Method D1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable.

FOUNDATIONS

The proposed structures, including walls and other foundation elements may be supported on a shallow foundation system bearing on a minimum of two (2) feet of newly placed Engineered Fill. Spread and continuous footings can be designed for the following maximum allowable soil bearing pressures:

Load	Allowable Loading
Dead Load Only	2,000 psf
Dead-Plus-Live Load	2,600 psf
Total Load, including wind or seismic loads	3,500 psf

The footings should have a minimum depth of 18 inches below pad subgrade (soil grade) or adjacent exterior grade, whichever is deeper. Minimum footing widths should be 15 inches for continuous footings and 24 inches for isolated footings. The footing excavations should not be allowed to dry out any time prior to placement of concrete.

It is recommended that the foundation for the proposed structure be placed entirely within compacted fill materials or entirely within alluvium or bedrock. Footings shall not transition from one bearing material to another. It is recommended that all foundations contain steel reinforcement of at least two (2) number four (#4) bars, one (1) top and one (1) bottom.

It is recommended that all foundations be set back a minimum of five (5) feet from the top of all adjacent slopes or deepened to maintain at least five (5) feet between the bottom of the footing and the slope face. Additionally, all footing set back criteria, should conform to 2016 CBC Section 1805.3.2 and Figure 1805.3.1. It is recommended that all footings be cleared of all loose soil and construction debris prior to pouring concrete.

Settlement

Provided the site is prepared as recommended and that the foundations are designed and constructed in accordance with our recommendations, the total settlement due to foundation loads is not expected to exceed 1 inch. The differential settlement resulting from foundation loads is anticipated to be less than ½ inch in 30 feet. Most of the settlement is expected to occur during construction as the loads are applied. However, additional post-construction settlement may occur if the foundation soils are flooded or saturated.

Lateral Load Resistance

Resistance to lateral footing displacement can be computed using an allowable friction factor of 0.25 acting between the base of foundations and the supporting subgrade. Where a vapor barrier material is used below concrete slabs-on-grade, a coefficient of friction should be provided by the vapor barrier manufacturer. Lateral resistance for footings can alternatively be developed using an allowable equivalent fluid passive pressure of 200 pounds per cubic foot acting against the appropriate vertical footing faces. Where equivalent fluid pressure against the sides of the footings or embedded slab edge are to be used, the footing or slab edge must be cast directly against undisturbed soils or the soils surrounding the structure must be recompacted to the requirements for Engineered Fill presented above. The frictional and passive resistance of the soil may be combined without reduction in determining the total lateral resistance. A one-third increase in the value above may be used for short duration, wind, or seismic loads.

FLOOR SLABS AND EXTERIOR FLATWORK

The interior slabs-on-grade should be designed at least five inches (5") in thickness. It is recommended that the slabs be reinforced with number three (#3) bars, eighteen inches (18") on center in both directions.

Exterior slabs-on-grade should be designed at least five inches (5") in thickness. It is recommended that the slabs be reinforced with number three (#3) bars, eighteen inches (18") on center in both directions. The exterior floors should be poured separately in order to act independently of the walls and foundation system. All fills required to bring the building pads to grade should be Engineered Fills.

It is recommended that the slabs should be underlain by six inches (6") of compacted Class 2 Aggregate Base with a minimum 15 mil polyolefin membrane vapor barrier (i.e. Stego Wrap or equivalent) placed with two inches (2") of clean sand on top of the vapor barrier. As an alternative, well graded non-expansive compacted fill may be used directly below the slab on grade.

Moisture within the structure may be derived from water vapors, which were transformed from the moisture within the soils. This moisture vapor can travel through the vapor membrane and penetrate the slab-on-grade. This moisture vapor penetration can affect floor coverings and produce mold and mildew in the structure. To minimize moisture vapor intrusion, it is recommended that a vapor retarder be installed in accordance with ASTM guidelines. It is recommended that the utility trenches within the structure be compacted, as specified in our report, to minimize the transmission of moisture through the utility trench backfill. Special attention to the immediate drainage and irrigation around the building is recommended. Positive drainage should be established away from the structure and should be maintained throughout the life of the structure. Ponding of water should not be allowed adjacent to the structure. Over-irrigation within landscaped areas adjacent to the structure should not be performed. In addition, ventilation of the structure (i.e. ventilation fans) is recommended to reduce the accumulation of interior moisture.

RETAINING WALLS

For retaining walls with level ground surface behind the walls, we recommend that retaining walls capable of deflecting a minimum of 0.1 percent of its height at the top be designed using an equivalent fluid active pressure of 40 pounds per square foot per foot of depth. Walls that are incapable of this deflection or walls that are fully constrained against deflection may be designed for an equivalent fluid at-rest pressure of 60 pounds per square foot per foot of depth. This is anticipated to apply to the loading dock walls. A passive lateral pressure of 200 pounds per square foot may be used to calculate sliding resistance. If walls are to be constructed above descending slopes, our office should be contacted to discuss further reduction in allowable passive pressures for resistance of lateral forces, and for overall retaining wall foundation design.

The surcharge effect from loads adjacent to the walls should be included in the wall design. The surcharge load for walls capable of deflecting (cantilever walls), we recommend applying a uniform surcharge pressure equal to one-third of the applied load over the full height of the wall. Where walls are restrained the surcharge load should be based on one-half of the applied load above the wall, also distributed over the full height of the wall. For other surcharges, such as from adjacent foundations, point loads or line loads, Krazan & Associates should be consulted.

Expansive soils should not be used for backfill against walls. The zone of non-expansive backfill material should extend from the bottom of each retaining wall laterally back a distance equal to the height of the wall, to a maximum of five (5) feet.

The active and at-rest earth pressures do not include hydrostatic pressures. To reduce the build-up of hydrostatic pressures, drainage should be provided behind the retaining walls. Wall drain should consist of a minimum 12-inch wide zone of drainage material, such as ¾-inch by ½-inch drain rock wrapped in a non-woven polypropylene geotextile filter fabric such as Mirafi 140N or equivalent. Alternatively, drainage may be provided by the placement of a commercially produced composite drainage blanket, such as Miradrain, extending continuously up from the base of the wall. The drainage material should extend from the base of the wall to finished subgrade in paved areas and to within about 12 inches below the top of the wall in landscape areas. In landscape areas the top 12 inches should be backfilled with compacted native soil. A 4-inch minimum diameter, perforated, Schedule 40 PVC drain pipe should be placed with holes facing down in the lower portion of the wall drainage material, surrounded with drain rock wrapped in filter fabric. A solid drainpipe leading to a suitable discharge point should provide drainage outlet. As an alternative, weep holes may be used to provide drainage. If weep holes are used, the weep holes should be 3 inches in diameter and spaced about 8 feet on centers. The backside of the weep holes should be covered with a corrosion-resistant mesh to prevent loss of backfill and/or drainage material.

TEMPORARY EXCAVATION STABILITY

All excavations should comply with the current requirements of Occupational Safety and Health Administration (OSHA). All cuts greater than 5 feet in depth should be sloped or shored. Temporary excavations should be sloped at 1:1 (horizontal to vertical) or flatter, up to a maximum depth of 10 feet, and at 2:1 (horizontal to vertical) for cuts greater than 10 feet. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within five feet of the top (edge) of the excavation. Where sloped excavations are not feasible due to site constraints, the excavations may require shoring. The design of the shoring system is normally the responsibility of the contractor or shoring designer, and therefore, is outside the scope of this report. The design of the temporary shoring should take into account lateral pressures exerted by the adjacent soil, and, where anticipated, surcharge loads due to adjacent buildings and any construction equipment or traffic expected to operate alongside the excavation.

The excavation/shoring recommendations provided herein are based on soil characteristics derived from our test borings within the area. Variations in soil conditions will likely be encountered during the excavations. Krazan & Associates, Inc. should be afforded the opportunity to provide field review to evaluate the actual conditions and account for field condition variations, not otherwise anticipated in the preparation of this recommendation.

Local building codes may restrict vertical cuts or shoring types used during construction. This may include limitations adjacent to existing improvements or public right of ways.

UTILITY TRENCH LOCATION, CONSTRUCTION AND BACKFILL

To maintain the desired support for existing or new foundations, new utility trenches should be located such that the base of the trench excavation is located above an imaginary plane having an inclination of 1.0 horizontal to 1.0 vertical, extending downward from the bottom edge of the adjacent footing.

Utility trenches should be excavated according to accepted engineering practices following OSHA standards by a contractor experienced in such work. The responsibility for the safety of open trenches should be borne by the contractor. Traffic and vibration adjacent to trench walls should be kept to a minimum; cyclic wetting and drying of excavation side slopes should be avoided. Depending upon the location and depth of some utility trenches, groundwater flow into open excavations could be experienced, especially during or shortly following periods of precipitation. For purposes of this section of the report, backfill is defined as material placed in a trench starting one foot above the pipe; bedding and shading (also referred to as initial backfill) is all material placed in a trench below the backfill. With the exception of specific requirements of the local utility companies or building department, pipe bedding and shading should consist of clean medium-grained sand. The sand should be placed in a damp state and should be compacted by mechanical means prior to the placement of backfill soils. Above the pipe zone, underground utility trenches may be backfilled with either free-draining sand, on-site soil or imported soil. The trench backfill should be compacted to at least 90 percent relative compaction.

COMPACTED MATERIAL ACCEPTANCE

Compaction specifications are not the only criteria for acceptance of the site grading or other such activities. However, the compaction test is the most universally recognized test method for assessing the performance of the Grading Contractor. The numerical test results from the compaction test cannot be solely used to predict the engineering performance of the compacted material. Therefore, the acceptance of compacted materials will also be dependent on the moisture-content and the stability of that material. The Geotechnical Engineer has the option of rejecting any compacted material regardless of the degree of compaction if that material is considered to be too dry or excessively wet, unstable or if future instability is suspected. A specific example of rejection of fill material passing the required percent compaction is a fill which has been compacted with in-situ moisture-content significantly less than optimum moisture. Where expansive soils are present, heaving of the soils may occur with the introduction of water. Where the material is a lean clay or silt, this type of dry fill (brittle fill) is susceptible to future settlement if it becomes saturated or flooded.

SURFACE DRAINAGE AND LANDSCAPING

The ground surface should slope away from building and pavement areas toward appropriate drop inlets or other surface drainage devices. We recommended that adjacent paved exterior grades be sloped a minimum of 2 percent for a minimum distance of 5 feet away from structures. Ideally, asphalt concrete pavement areas should be sloped at a minimum of 2 percent, with Portland cement concrete sloped at a minimum of one percent toward drainage structures. These grades should be maintained for the life of the project. Roof drains should be designed to avoid discharging into landscape areas adjacent to the building. Downspouts should be directed to discharge directly onto paved surfaces to allow for surface drainage into the storm systems or should be connected directly to the on-site storm drain.

PAVEMENT DESIGN

Based on the established standard practice of designing flexible pavements in accordance with State of California Department of Transportation (Caltrans) for projects within California, we have developed pavement sections in accordance with the procedure presented in Caltrans Standard Test Method 301. This pavement design procedure is based on the volume of traffic (Traffic Index) and the soil resistance "R" value (R-Value).

Asphalt Concrete (Flexible) Pavements

One (1) near-surface soil sample was obtained from the soil borings at the project site for laboratory R-Value testing. The sample was tested in accordance with California Test 301. Results of the test are as follows:

R-VALUE TEST RESULTS			
Sample Number	**Sample Depth (ft)**	**Description**	**R-Value at Equilibrium**
RV #1	0-3'	Silty Sand	30

The Civil Engineer should consult with the client to confirm the truck count prior to assigning the Traffic Index and selecting the pavement sections for incorporation into the project plans.

Based on our understanding of the project specifications, a Traffic Index of 5.5 has been used for design of pavements for automobile parking lots and drive lanes.

Based on a review of the boring logs and the R-Value data presented above, the near surface soil of the site consists of silty sand with an R-Value of 30. If site grading exposes soil other than that assumed, we should perform additional tests to confirm or revise the recommended pavement sections for actual field conditions. Various alternative pavement sections based on the Caltrans Flexible Pavement Design Method are presented below:

ASPHALT CONCRETE (FLEXIBLE) PAVEMENTS Subgrade R-Value = 30				
Traffic / Pavement Designation	**Traffic Index**	**Asphalt Concrete (inches)**	**Class 2 Aggregate Base (inches)**	**Depth of Compacted Subgrade (in)**
STANDARD DUTY	**5.5**	4.0	6.0	12.0

We recommend that the subgrade soil be prepared as discussed in this report. The compacted subgrade should be non-yielding when proof-rolled with a loaded ten-wheel truck, such as a water truck or dump truck, prior to pavement construction. Subgrade preparation should extend a minimum of 2 feet laterally behind the edge of pavement or back of curbs.

Pavement areas should be sloped and drainage gradients maintained to carry all surface water off the site. A cross slope of 2 percent is recommended in asphalt concrete pavement areas to provide good surface drainage and to reduce the potential for water to penetrate into the pavement structure.

Unless otherwise required by local jurisdictions, paving materials should comply with the materials specifications presented in the Caltrans Standard Specifications Section. Class 2 aggregate should comply with the materials requirements for Class 2 base found in Section 26.

The mineral aggregate shall be Type B, ½-inch or ¾-inch maximum, medium grading, for the wearing course and ¾-inch maximum, medium grading for the base course, and shall conform to the requirements set forth in Section 39 of the Standard Specifications. The asphalt concrete materials should comply with and be placed in accordance with the specifications presented in Section 39 of the Caltrans Standard

Specifications, latest edition. Asphalt concrete should be compacted to a minimum of 96 percent of the maximum laboratory compacted (kneading compactor) unit weight.

ASTM Test procedures and should be used to assess the percent relative compaction of soils, aggregate base and asphalt concrete. Aggregate base and subbase, and the upper 12 inches of subgrade should be compacted to at least 95 percent based on the Modified Proctor maximum compacted unit weight obtained in accordance with ASTM Test Method D1557. Compacted aggregate base should also be stable and unyielding when proof-rolled with a loaded ten-wheel water truck or dump truck.

Portland Cement Concrete (Rigid) Pavement

A six-inch layer of compacted Class 2 Aggregate Base should be placed over the prepared subgrade prior to placement of the concrete. Based on soil conditions and project specifications, we recommend that the rigid pavement be a minimum of five (5) inches thick. The final rigid pavement design and section should be determined by the project Structural Engineer.

RIGID PAVEMENT			
Traffic/Pavement Designation	**Portland Cement Concrete (inches)**	**Class 2 Aggregate Base (inches)**	**Compacted Subgrade (inches)**
Standard Duty	5.0	6.0	12.0

Prior to the construction of any rigid pavement, we recommend that concrete mix histories with flexural strength data be obtained from the proposed supplier. In the absence of flexural strength history, we recommend that laboratory trial batching and testing be performed to allow for confirmation that the proposed concrete mix is capable of producing the required flexural strength.

The concrete pavements should be designed with both longitudinal and transverse joints. The saw-cut or formed joints should extend to a minimum depth on one-fourth of the pavement thickness plus ¼ inch. Joint spacing should not exceed 15 feet. Steel reinforcement of all rigid pavements is recommended to keep the joints tight and to control temperature cracking.

Keyed joints are recommended at all construction joints to transfer loads across the joints. Joints should be reinforced with a minimum of ½ inch diameter by 48-inch long deformed reinforcing steel placed at mid-slab depth on 18-inch center-to-center spacing to keep the joints tight for load transfer. The joints should be filled with a flexible sealer. Expansion joints should be constructed only where the pavements abut structures or fixed objects.

Smooth bar dowels, with a diameter of d/8, where d equals the thickness of the concrete, at least 14 inches in length, placed at a spacing of 12 inches on centers, may also be considered for construction joints to transfer loads across the joints. The dowels should be centered across the joints with one side of the dowel lubricated to reduce the bond strength between the dowel and the concrete and fitted with a plastic cap to allow for bar expansion.

INFILTRATION TESTING

The shallow soil conditions present at the subject site were evaluated by drilling shallow borings in the vicinity of the infiltration tests. The borings drilled at the site indicated the subsurface soil conditions consisted of dense silty sand.

Infiltration rates were determined using the results of open borehole infiltration testing performed at the subject site. Infiltration testing performed on the near surface silty sand soil indicates infiltration rates of approximately 0.21 and 0.28 inch per hour. Based on the very low infiltration rates, the subsurface conditions encountered at the site are not considered conducive to infiltration. Detailed results of the percolation test and infiltration rate are attached in tabular format.

SOIL CORROSIVITY

Excessive sulfate in either the soil or native water may result in an adverse reaction between the cement in concrete (or stucco) and the soil. HUD/FHA and UBC have developed criteria for evaluation of sulfate levels and how they relate to cement reactivity with soil and/or water.

A soil sample was obtained from the site and tested in accordance with State of California Materials Manual Test Designation 417. The sulfate concentration detected in the soil sample indicated a moderate potential for exposure to sulfate based on allowable values established by HUD/FHA and UBC. Portland cement concrete in contact with soil should contain Type II cement and possess a compressive strength of at least 4,000 psi to compensate for sulfate reactivity with the cement.

Electrical resistivity testing of the soil indicates that the onsite soils may have a moderate potential for metal loss from electrochemical corrosion process. A qualified corrosion engineer should be consulted regarding the corrosion effects of the onsite soils on underground metal utilities.

ADDITIONAL SERVICES

Krazan & Associates should be retained to review your final foundation and grading plans, and specifications. It has been our experience that this review provides an opportunity to detect misinterpretation or misunderstandings with respect to the recommendations presented in this report prior to the start of construction.

Variations in soil types and conditions are possible and may be encountered during construction. In order to permit correlation between the soil data obtained during this investigation and the actual soil conditions encountered during construction, a representative of Krazan & Associates, Inc. should be present at the site during the earthwork and foundation construction activities to confirm that actual subsurface conditions are consistent with those contemplated in our development of this report. This will allow us the opportunity to compare actual conditions exposed during construction with those encountered in our investigation and to expedite supplemental recommendations if warranted by the exposed conditions. This activity is an integral part of our service, as acceptance of earthwork construction is dependent upon compaction testing and stability of the material. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor.

All earthworks should be performed in accordance with the recommendations presented in this report, or as recommended by Krazan & Associates during construction. Krazan & Associates should be notified at least five working days prior to the start of construction and at least two days prior to when observation and testing services are needed. Krazan & Associates, Inc. will not be responsible for grades or staking, since this is the responsibility of the Prime Contractor.

The review of plans and specifications, and the observation and testing of earthwork related construction activities by Krazan & Associates are important elements of our services if we are to remain in the role of Geotechnical Engineer-Of-Record. If Krazan & Associates is not retained for these services, the client and the consultants providing these services will be assuming our responsibility for any potential claims that may arise during or after construction.

LIMITATIONS

Geotechnical Engineering is one of the newest divisions of Civil Engineering. This branch of Civil Engineering is constantly improving as new technologies and understanding of earth sciences advance. Although your site was analyzed using appropriate and current techniques and methods, undoubtedly there will be substantial future improvements in this branch of engineering. In addition to advancements in the field of Geotechnical Engineering, physical changes in the site due to site clearing or grading activities, new agency regulations, or possible changes in the proposed structure or development after issuance of this report will result in the need for professional review of this report. Updating or revisions to the recommendations report, and possibly additional study of the site may be required at that time. In light of this, the Owner should be aware that there is a practical limit to the usefulness of this report without critical review. Although the time limit for this review is strictly arbitrary, it is suggested that two years be considered a reasonable time for the usefulness of this report.

Foundation and earthwork construction is characterized by the presence of a calculated risk that soil and groundwater conditions have been fully revealed by the original foundation investigation. This risk is derived from the practical necessity of basing interpretations and design conclusions on limited sampling of the earth. The recommendations made in this report are based on the assumption that soil conditions do not vary significantly from those disclosed during our field investigation. The logs of the exploratory borings do not provide a warranty as to the conditions that may exist beneath the entire site. The extent and nature of subsurface soil and groundwater variations may not become evident until construction begins. It is possible that variations in soil conditions and depth to groundwater could exist beyond the points of exploration that may require additional studies, consultation, and possible design revisions. If conditions are encountered in the field during construction, which differ from those described in this report, our firm should be contacted immediately to provide any necessary revisions to these recommendations.

This report presents the results of our Geotechnical Engineering Investigation, which was conducted for the purpose of evaluating the soil conditions in terms of foundation and retaining wall design, and grading and paving of the site. This report does not include reporting of any services related to environmental studies conducted to assessment the presence or absence of hazardous and/or toxic materials in the soil, groundwater, or atmosphere, or the presence of wetlands. Any statements in this report or on any boring log regarding odors, unusual or suspicious items, or conditions observed, are strictly for descriptive purposes and are not intended to convey professional judgment regarding the presence of potentially hazardous or toxic substances. Conversely, the absence of statements in this report or on any boring log regarding odors, unusual or suspicious items, or conditions observed, does not constitute our rendering professional judgment regarding the absence of potentially hazardous or toxic substances.

The conclusions of this report are based on the information provided regarding the proposed construction. We emphasize that this report is valid for the project as described in the text of this report and it should not be used for any other sites or projects. The geotechnical engineering information presented herein is based upon our understanding of the proposed project and professional interpretation of the data obtained in our studies of the site. It is not warranted that such information and interpretation cannot be superseded by future geotechnical engineering developments. The Geotechnical Engineer should be notified of any changes to the proposed project so the recommendations may be reviewed and re-evaluated. The work conducted through the course of this investigation, including the preparation of this report, has been performed in accordance with the generally accepted standards of geotechnical engineering practice, which existed in geographic area of the project at the time the report was written. No other warranty, express or implied, is made. This report is issued with the understanding that the owner chooses the risk they wish to bear by the expenditures involved with the construction alternatives and scheduling that are chosen. If you have any questions, or if we may be of further assistance, please do not hesitate to contact our office at (951) 273-1011.

Respectfully submitted,
KRAZAN & ASSOCIATES, INC.

Jim Kellogg

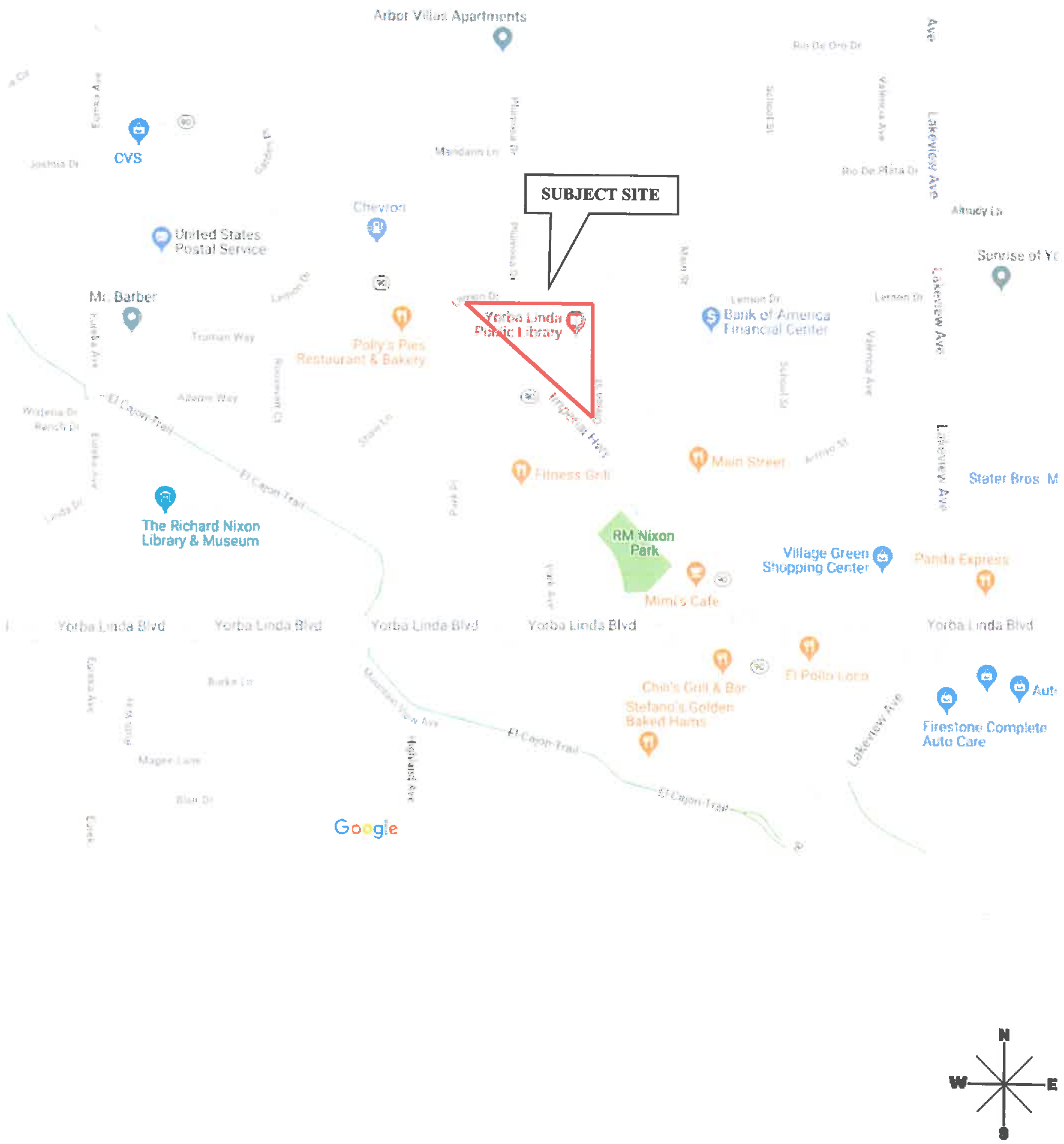
James M. Kellogg, PE, GE
Managing Engineer
RCE No. 65092 RGE No. 2902

REGISTERED PROFESSIONAL ENGINEER
JAMES M. KELLOGG
NO. 65092
EXP. 9/30/2019
CIVIL
STATE OF CALIFORNIA

Jorge A Pelayo

Jorge A. Pelayo. EIT
Staff Engineer

Figures



VICINITY MAP

PROPOSED IN-N-OUT BURGER RESTAURANT
18181 IMPERIAL HIGHWAY
YORBA LINDA, CALIFORNIA

Scale: NTS

Date: March 2018

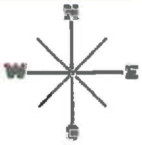
Drawn by: SK

Approved by: JK

Project No. 112-18047

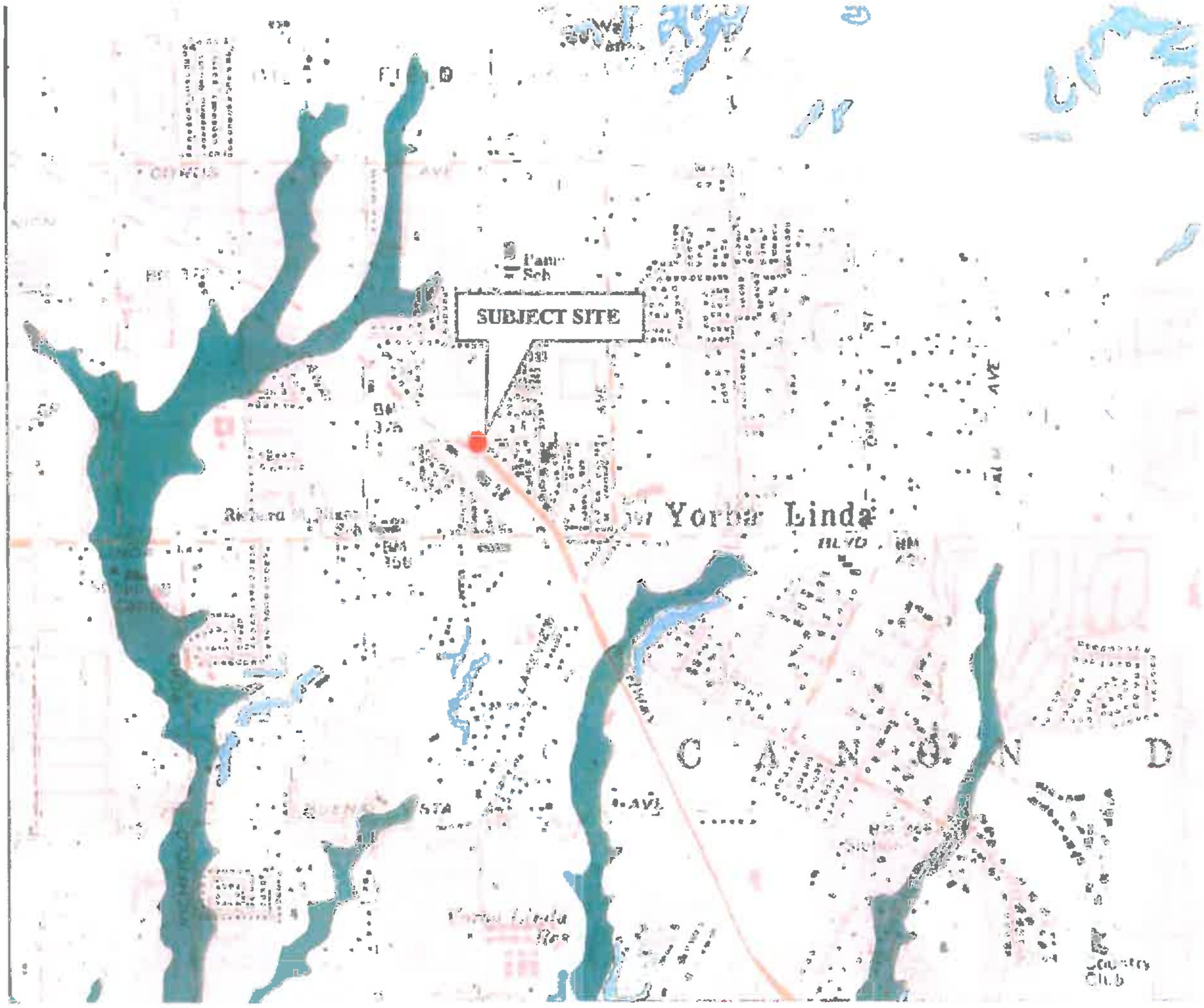
Figure No. 1

Krazan
GEOTECHNICAL ENGINEERING



▲ APPROXIMATE R-VALUE LOCATION
● APPROXIMATE BORING LOCATION
▲ APPROXIMATE INFILTRATION TEST LOCATION

SITE MAP	Scale: NTS	Date: May 2018	Krazan GEOTECHNICAL ENGINEERING
PROPOSED IN-N-OUT BURGER RESTAURANT **18181 IMPERIAL HIGHWAY** **YORBA LINDA, CALIFORNIA**	Drawn by: SK	Approved by: JK	
	Project No. 112-18047	Figure No. 2	



MAP EXPLANATION

ALQUIST-PRIOLO EARTHQUAKE FAULT ZONES

🟨 **Earthquake Fault Zones**
Zone boundaries are delineated by straight-line segments; the boundaries define the zone encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as described in Public Resources Code Section 2621.5(a) would be required.

Active Fault Traces
Faults considered to have been active during Holocene time and to have potential for surface rupture: Solid Line in Black or Red where Accurately Located; Long Dash in Black or Solid Line in Purple where Approximately Located; Short Dash in Black or Solid Line in Orange where Inferred; Dotted Line in Black or Solid Line in Rose where Concealed; Query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by fault creep.

SEISMIC HAZARD ZONES

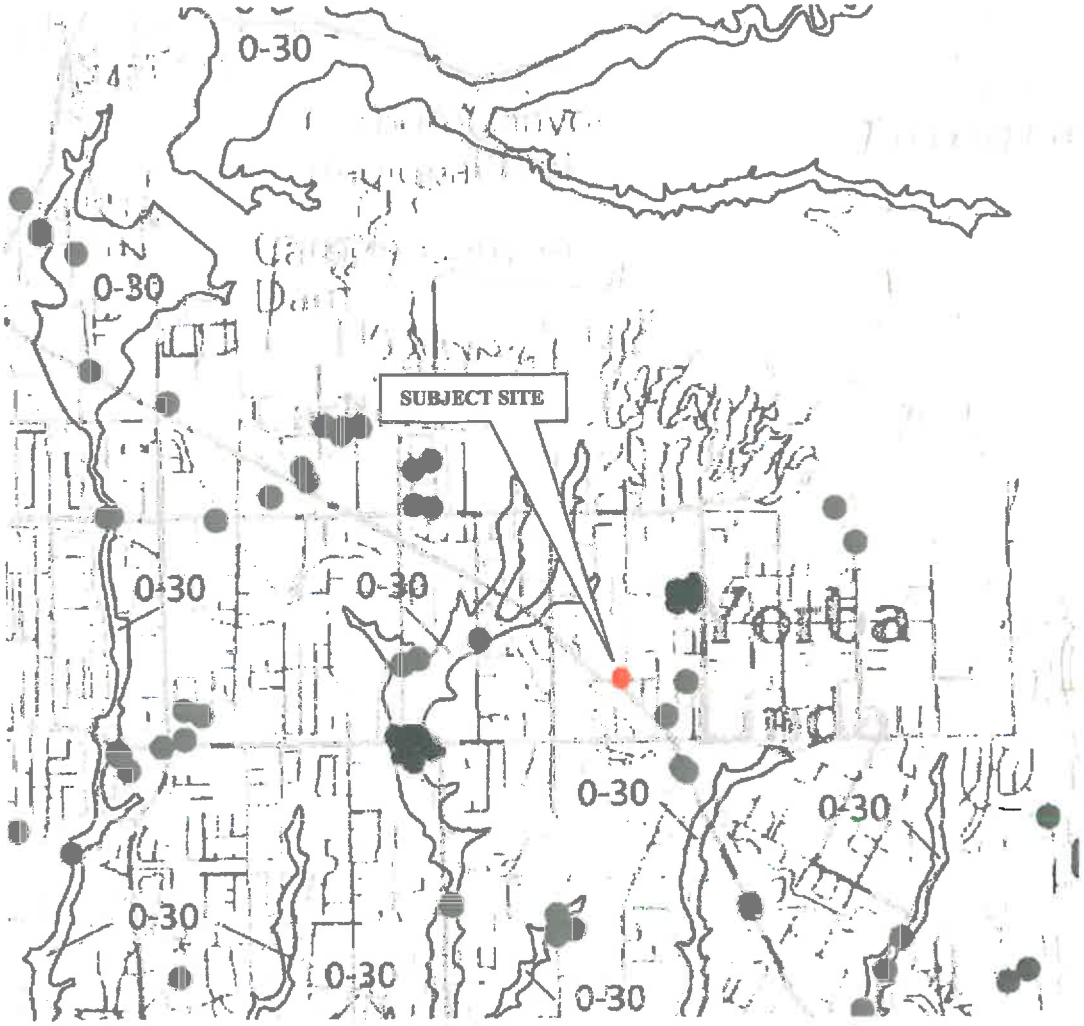
Liquefaction Zones
Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

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

N
W E
S

Source: State of California Seismic Hazards Map, Yorba Linda Quadrangle

EARTHQUAKE ZONES OF REQUIRED INVESTIGATION MAP	**Scale:** NTS	**Date:** May 2018	**Krazan** **GEOTECHNICAL ENGINEERING**
PROPOSED IN-N-OUT BURGER RESTAURANT **18181 IMPERIAL HIGHWAY** **YORBA LINDA, CALIFORNIA**	**Drawn by:** SK	**Approved by:** JK	
	Project No. 112-18047	**Figure No.** 3	

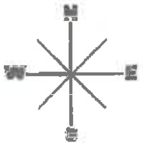


EXPLANATION

20 Contour interval depth (in feet) to historic high groundwater.

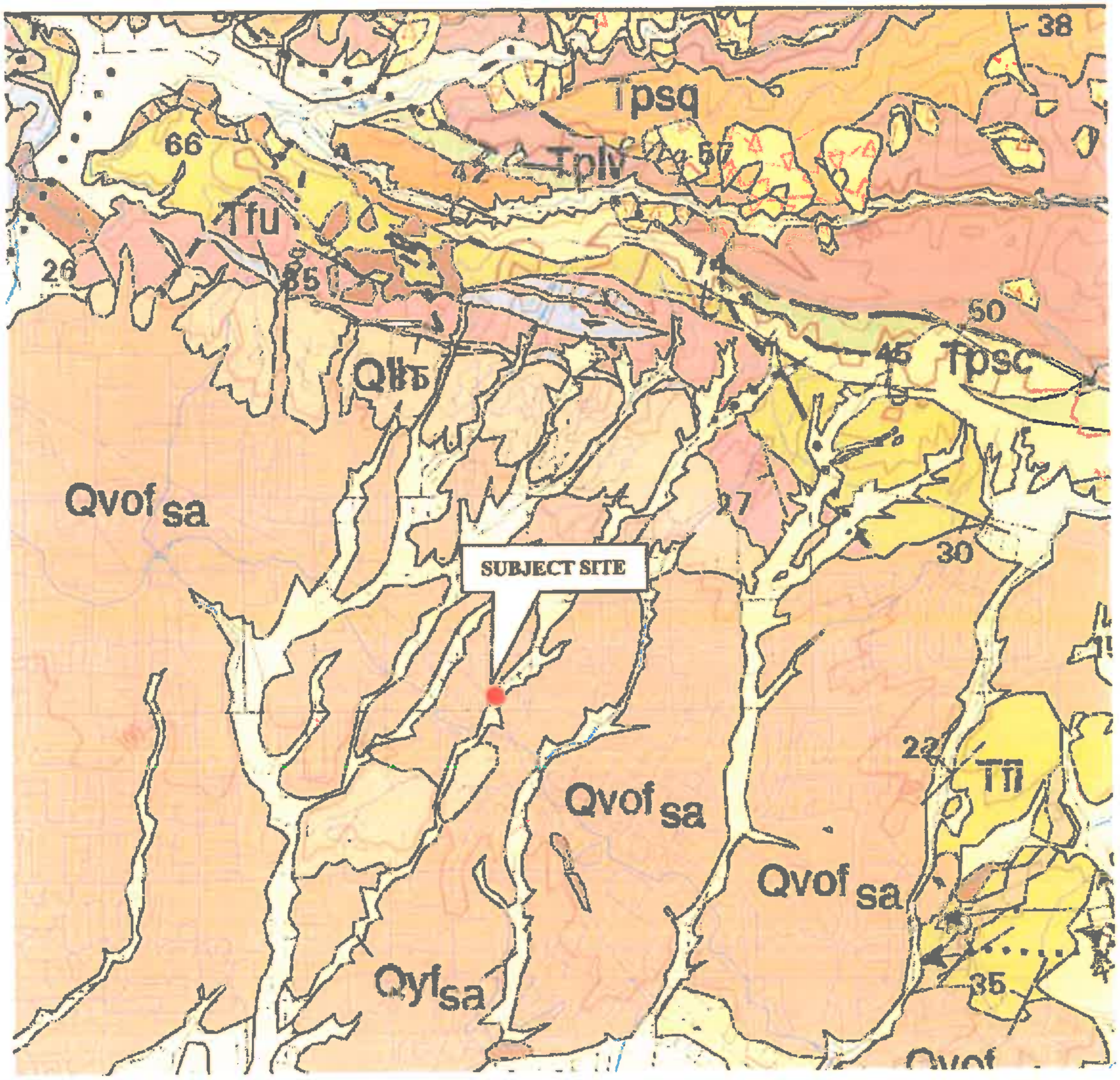
10 Depth (in feet) to historic high groundwater within defined area.

● Borehole Location

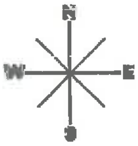


Source: State of California Seismic Hazards Map, Yorba Linda Quadrangle

HISTORICAL GROUNDWATER	**Scale:** NTS	**Date:** May, 2018	Krazan GEOTECHNICAL ENGINEERING
PROPOSED IN-N-OUT BURGER RESTAURANT **18181 IMPERIAL HIGHWAY** **YORBA LINDA, CALIFORNIA**	**Drawn by:** JP	**Approved by:** JK	
	Project No. 112-1804y	**Figure No.** 4	



Qvof	**Very old alluvial fan deposits (middle to early Pleistocene)**—Sandy alluvium; reddish-brown, well-indurated, fan surfaces well-dissected. Includes: [illegible]
Qyf	**Young alluvial fan deposits (Holocene and late Pleistocene)**—Gravel, sand, and silt. mixtures. some contain boulders; unconsolidated. Includes:



Source: USGS Geologic Map of the Santa Ana 60' Quadrangle, Southern California

GEOLOGIC MAP	Scale: NTS	Date: March 2018	Krazan GEOTECHNICAL ENGINEERING
PROPOSED IN-N-OUT BURGER RESTAURANT 18181 IMPERIAL HIGHWAY YORBA LINDA, CALIFORNIA	Drawn by: SK	Approved by: JK	
	Project No. 112-18047	Figure No. 5	

Appendix A

Log of Borings
&
Laboratory Testing

APPENDIX A

FIELD AND LABORATORY INVESTIGATIONS

Field Investigation

Our field investigation consisted of a surface reconnaissance and a subsurface exploration program consisted of drilling, logging and sampling a total of six (6) borings. The depth of exploration was approximately 10 to 20 feet below the existing site surface.

A member of our staff visually classified the soils in the field as the drilling progressed and recorded a continuous log of each boring. Visual classification of the soils encountered in our exploratory borings was made in general accordance with the Unified Soil Classification System (ASTM D2487). A key for the classification of the soil and the boring logs are presented in this Appendix.

During drilling operations, penetration tests were performed at regular intervals to evaluate the soil consistency and to obtain information regarding the engineering properties of the subsoils. Samples were obtained from the borings by driving either a 2.5-inch inside diameter Modified California tube sampler fitted with brass sleeves or a 2-inch outside diameter, 1-3/8-inch inside diameter Standard Penetration ("split-spoon") test (SPT) sampler without sleeves. Soil samples were retained for possible laboratory testing. The samplers were driven up to a depth of 18 inches into the underlying soil using a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler was recorded for each 6-inch penetration interval and the number of blows required to drive the sampler the last 12 inches are shown as blows per foot on the boring logs.

The approximate locations of our borings and bulk samples are shown on the Site Plan, Figure 2. These approximate locations were estimated in the field based on pacing and measuring from the limits of existing site features.

Laboratory Investigation

The laboratory investigation was programmed to determine the physical and mechanical properties of the soil underlying the site. The laboratory-testing program was formulated with emphasis on the evaluation of in-situ moisture, density, gradation, shear strength, consolidation potential, and R-Value of the materials encountered. In addition, chemical tests were performed to evaluate the soil/cement reactivity and corrosivity. Test results were used in our engineering analysis with respect to site and building pad preparation through mass grading activities, foundation and retaining wall design recommendations, pavement section design, evaluation of the materials as possible fill materials and for possible exclusion of some soils from use at the structures as fill or backfill.

Select laboratory test results are presented on the boring logs, with graphic or tabulated results of selected tests included in this Appendix. The laboratory test data, along with the field observations, was used to prepare the final boring logs presented in the Appendix.

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sands, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	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 silts
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

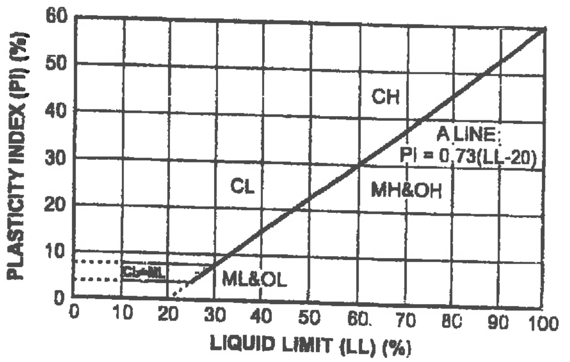
CONSISTENCY CLASSIFICATION

Description	Blows per Foot
Granular Soils	
Very Loose	< 5
Loose	5 – 15
Medium Dense	16 – 40
Dense	41 – 65
Very Dense	> 65
Cohesive Soils	
Very Soft	< 3
Soft	3 – 5
Firm	6 – 10
Stiff	11 – 20
Very Stiff	21 – 40
Hard	> 40

GRAIN SIZE CLASSIFICATION

Grain Type	*Standard Sieve Size*	*Grain Size in Millimeters*
Boulders	Above 12 inches	Above 305
Cobbles	3 to 12 inches	305 to 76.2
Gravel	3 inches to No. 4	76.2 to 4.76
Coarse-grained	3 to ¾ inches	76.2 to 19.1
Fine-grained	¾ inches to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.074
Coarse-grained	No. 4 to No. 10	4.76 to 2.00
Medium-grained	No. 10 to No. 40	2.00 to 0.042
Fine-grained	No. 40 to No. 200	0.042 to 0.074
Silt and Clay	Below No. 200	Below 0.074

PLASTICITY CHART



Log of Boring B1

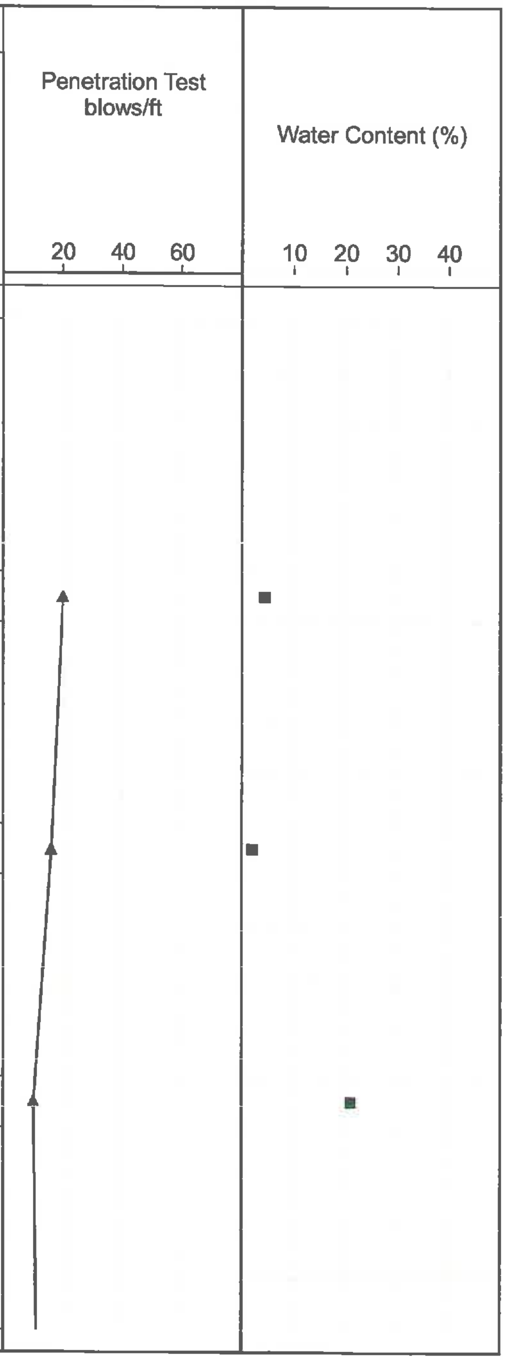
Project: In-N-Out Restaurant
Project No: 112-18042

Client: In-N-Out Burger
Figure No.: A-1

Location: 815 N. Bristol, Santa Ana, CA
Logged By: Jorge Pelayo

Depth to Water> Not Encountered
Initial: N/A
At Completion: N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
0	▥	***SILTY SAND (SM)*** Medium dense, fine-grained; dark brown, damp				
6	▥		102.5	4.5	◢	20
10	▩	***GRAVEL-SAND MIXTURES (GP)*** Medium dense, coarse- to medium-grained; brown, dry				
	▩		119.4	2.1	◢	16
14	▥	***CLAYEY SILT (ML)*** Stiff, fine-grained; dark brown, moist				
16	▥			21.1	■	10
20	▥				■	



Drill Method: Hollow Stem
Drill Date: 4-3-18

Drill Rig: CME 75
Hole Size: 5½ Inches

Krazan and Associates

Driller: Baja Exploration
Elevation: 50 Feet

Sheet: 1 of 3

Log of Boring B1

Project: In-N-Out Restaurant

Project No: 112-18042

Client: In-N-Out Burger

Figure No.: A-1

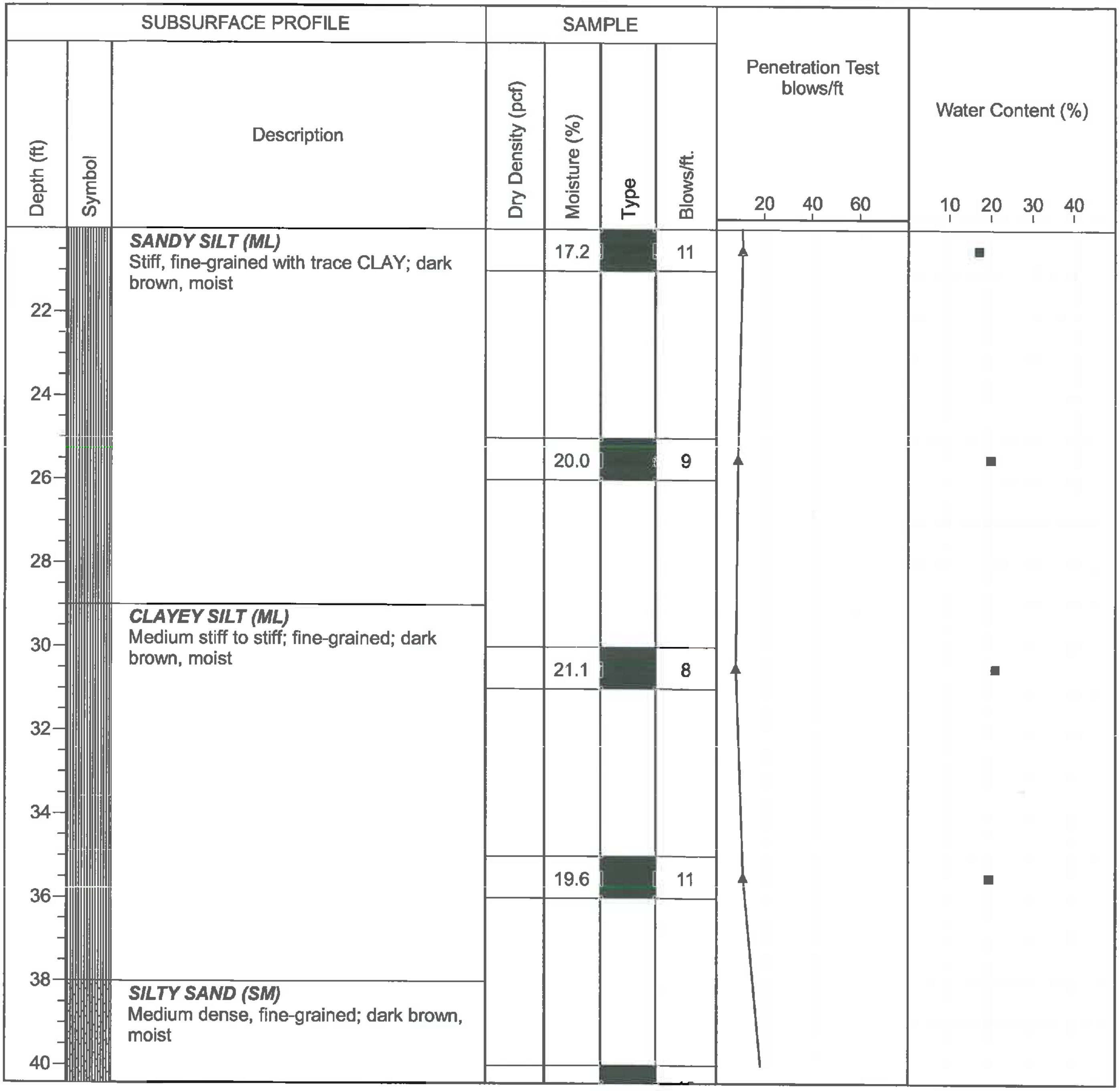
Location: 815 N. Bristol, Santa Ana, CA

Logged By: Jorge Pelayo

Depth to Water> Not Encountered

Initial: N/A

At Completion: N/A



SANDY SILT (ML)
Stiff, fine-grained with trace CLAY; dark brown, moist

CLAYEY SILT (ML)
Medium stiff to stiff; fine-grained; dark brown, moist

SILTY SAND (SM)
Medium dense, fine-grained; dark brown, moist

Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
	17.2	■	11
	20.0	■	9
	21.1	■	8
	19.6	■	11

Drill Method: Hollow Stem

Drill Date: 4-3-18

Drill Rig: CME 75

Krazan and Associates

Hole Size: 5½ Inches

Driller: Baja Exploration

Elevation: 50 Feet

Sheet: 2 of 3

Log of Boring B1

Project: In-N-Out Restaurant

Project No: 112-18042

Client: In-N-Out Burger

Figure No.: A-1

Location: 815 N. Bristol, Santa Ana, CA

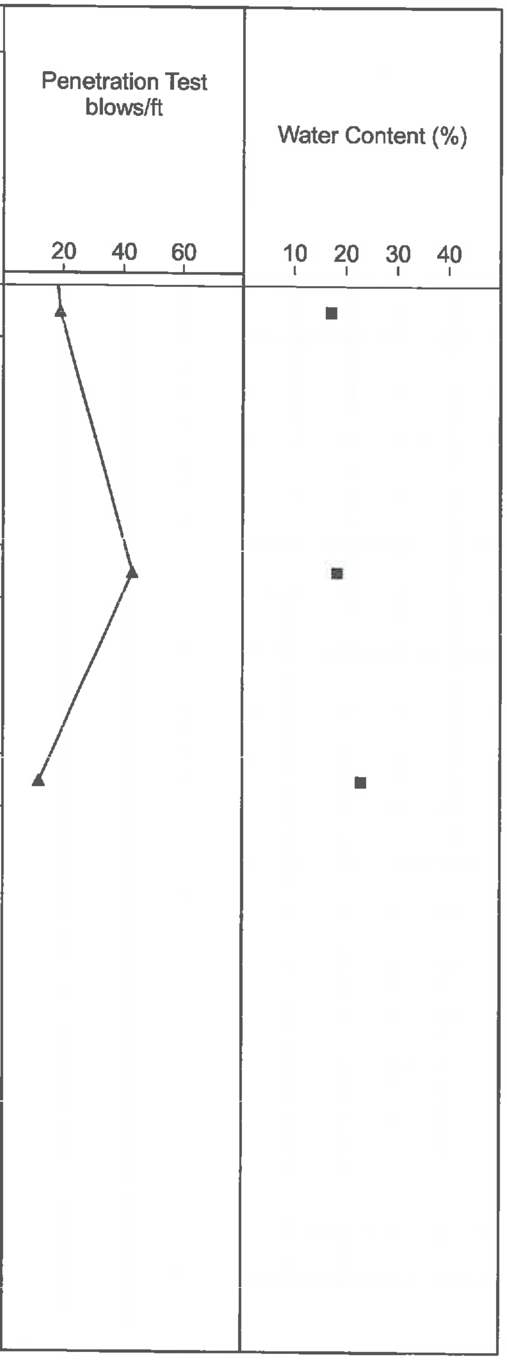
Logged By: Jorge Pelayo

Depth to Water> Not Encountered

Initial: N/A

At Completion: N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
	▥			17.2	■	19
42	▥					
44	▨	***SILTY CLAY (CL)*** Stiff, fine-grained with SAND; dark brown, very moist				
46	▨			18.4	■	43
48	▨					
50	▨			23.2	■	12
		End of Borehole				
52						
54						
56		No water encountered Boring backfilled with soil cuttings				
58						
60						



Drill Method: Hollow Stem

Drill Date: 4-3-18

Drill Rig: CME 75

Krazan and Associates

Hole Size: 5½ Inches

Driller: Baja Exploration

Elevation: 50 Feet

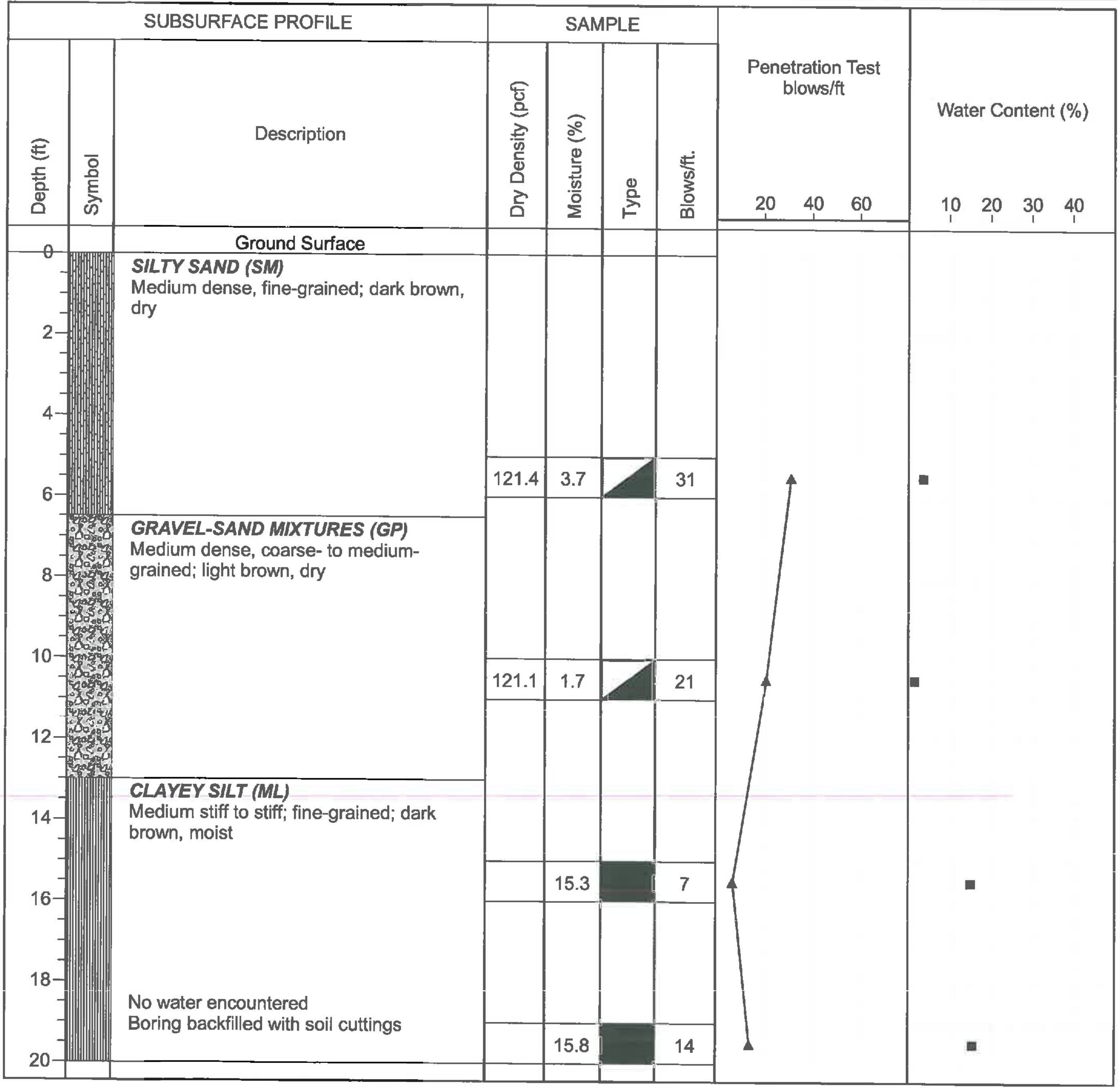
Sheet: 3 of 3

Log of Boring B2

Project: In-N-Out Restaurant
Client: In-N-Out Burger
Location: 815 N. Bristol, Santa Ana, CA
Depth to Water> Not Encountered

Initial: N/A

Project No: 112-18042
Figure No.: A-2
Logged By: Jorge Pelayo
At Completion: N/A



SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
		SILTY SAND (SM) Medium dense, fine-grained; dark brown, dry				
			121.4	3.7	◢	31
		GRAVEL-SAND MIXTURES (GP) Medium dense, coarse- to medium-grained; light brown, dry				
			121.1	1.7	◢	21
		CLAYEY SILT (ML) Medium stiff to stiff; fine-grained; dark brown, moist				
				15.3	■	7
		No water encountered Boring backfilled with soil cuttings				
20				15.8	■	14

Drill Method: Hollow Stem
Drill Rig: CME 75
Driller: Baja Exploration

Krazan and Associates

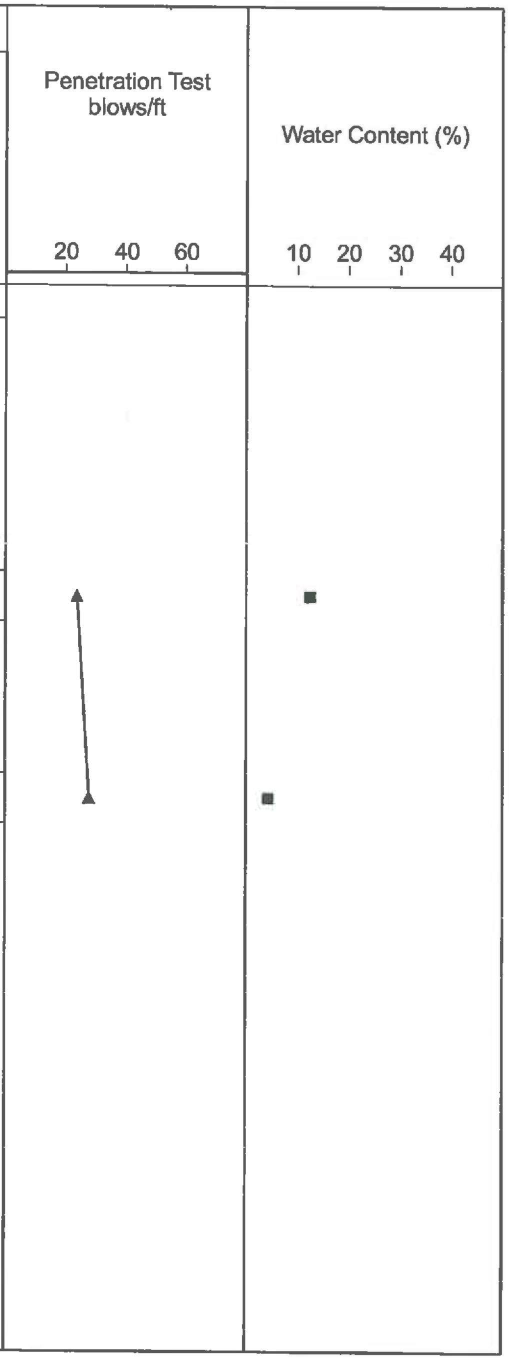
Drill Date: 4-3-18
Hole Size: 5½ Inches
Elevation: 20 Feet
Sheet: 1 of 1

Log of Boring B3

Project: In-N-Out Restaurant
Client: In-N-Out Burger
Location: 815 N. Bristol, Santa Ana, CA
Depth to Water> Not Encountered
Initial: N/A

Project No: 112-18042
Figure No.: A-3
Logged By: Jorge Pelayo
At Completion: N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0	▥	***CLAYEY SILT (ML)*** FILL - Very stiff; fine-grained; dark brown, moist				
2	▥					
4	▥					
6	▥		103.0	12.5	◢	24
8	▥	***SILTY SAND (SM)*** Medium dense, fine-grained; dark brown, damp				
10			101.2	4.4	◢	28
		End of Borehole				
12						
14						
16						
18		No water encountered Boring backfilled with soil cuttings				
20						



Drill Method: Hollow Stem
Drill Rig: CME 75
Driller: Baja Exploration

Krazan and Associates

Drill Date: 4-3-18
Hole Size: 5½ Inches
Elevation: 10 Feet
Sheet: 1 of 1

Log of Boring B4

Project: In-N-Out Restaurant

Client: In-N-Out Burger

Location: 815 N. Bristol, Santa Ana, CA

Depth to Water> Not Encountered

Initial: N/A

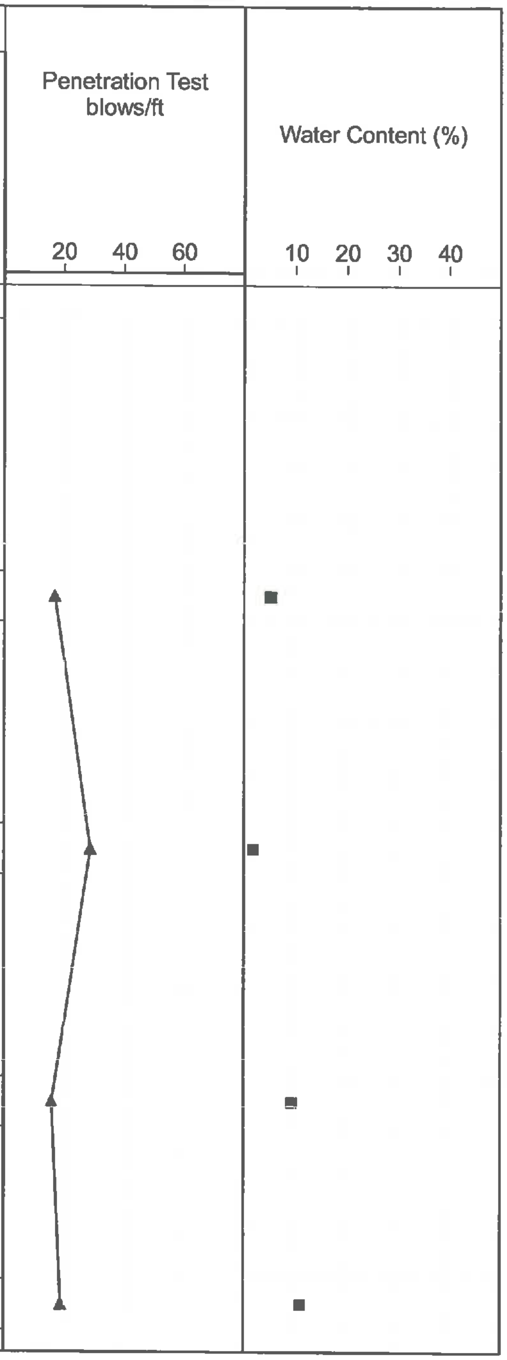
Project No: 112-18042

Figure No.: A-4

Logged By: Jorge Pelayo

At Completion: N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
		SILTY SAND (SM) Medium dense, fine-grained; dark brown to brown, damp				
2						
4						
			116.2	5.3	◢	17
6						
8						
		GRAVEL-SAND MIXTURES (GP) Medium dense, coarse- to medium-grained; light brown, dry				
10						
			107.9	1.9	◢	29
12						
14		***CLAYEY SILT (ML)*** Very stiff; fine-grained; brown, moist				
				9.4	■	16
16						
18						
		No water encountered Boring backfilled with soil cuttings				
				11.1	■	19
20						



Drill Method: Hollow Stem

Drill Rig: CME 75

Driller: Baja Exploration

Krazan and Associates

Drill Date: 4-3-18

Hole Size: 5½ Inches

Elevation: 20 Feet

Sheet: 1 of 1

Log of Boring B5

Project: In-N-Out Restaurant

Project No: 112-18042

Client: In-N-Out Burger

Figure No.: A-5

Location: 815 N. Bristol, Santa Ana, CA

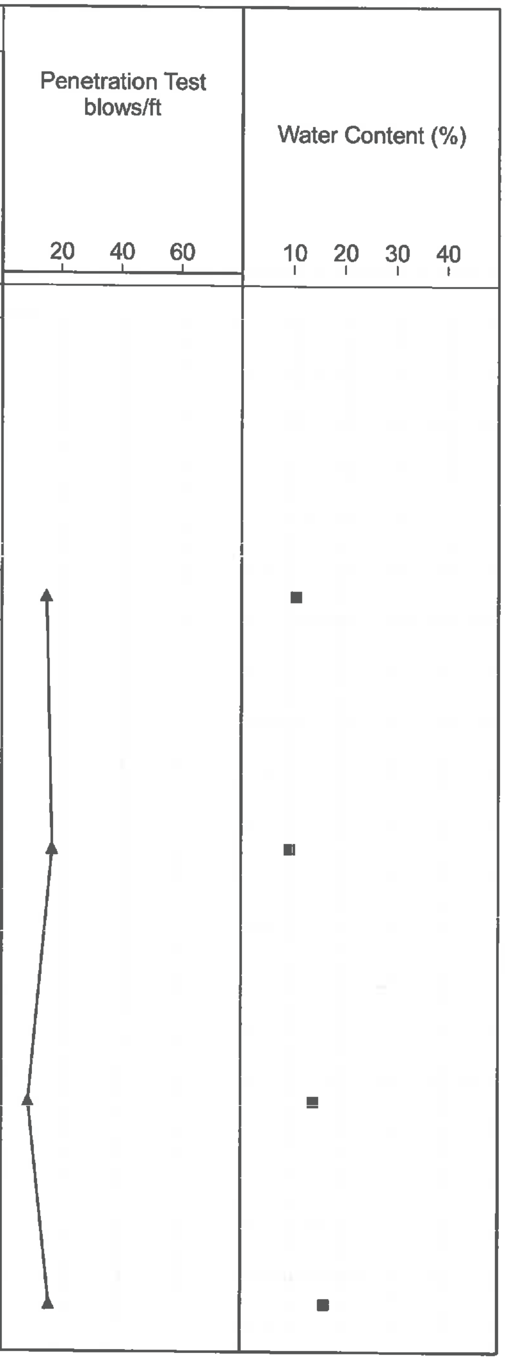
Logged By: Jorge Pelayo

Depth to Water> Not Encountered

Initial: N/A

At Completion: N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
0		Ground Surface				
		SILTY SAND (SM) Medium dense, fine-grained; dark brown, moist				
			114.7	10.6	◪	15
		GRAVEL-SAND MIXTURES (GP) Medium dense, coarse- to medium-grained; light brown, moist				
			107.8	9.5	◪	17
		CLAYEY SILT (ML) Stiff to very stiff; fine-grained; dark brown, moist				
				14.2	■	9
		No water encountered Boring backfilled with soil cuttings				
20				16.3	■	16



Drill Method: Hollow Stem

Drill Rig: CME 75

Driller: Baja Exploration

Krazan and Associates

Drill Date: 4-3-18

Hole Size: 5½ Inches

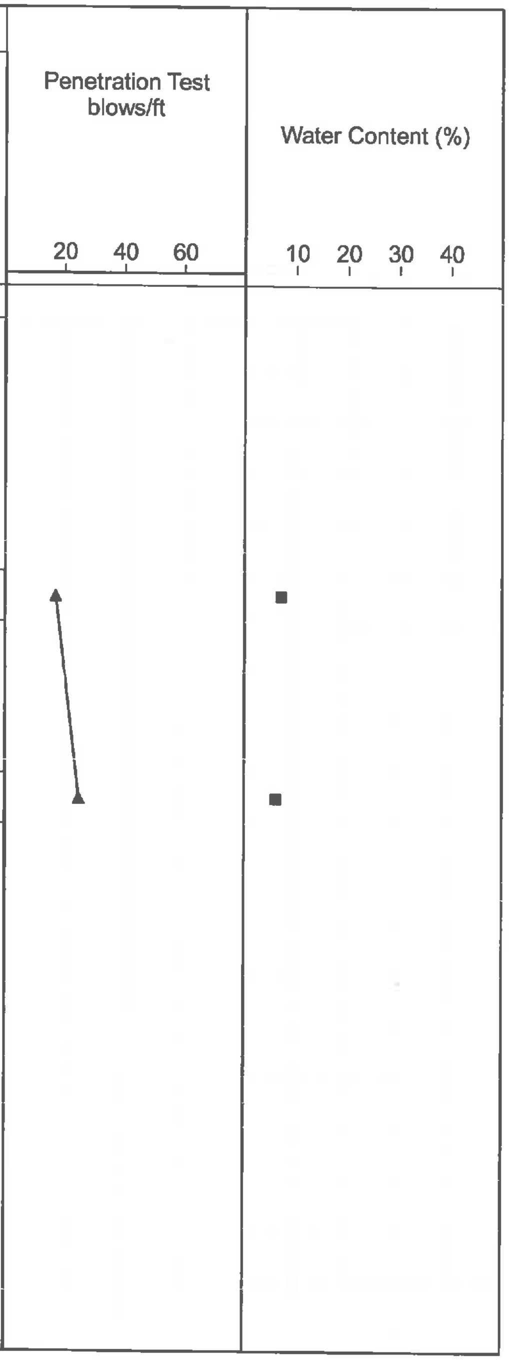
Elevation: 20 Feet

Sheet: 1 of 1

Log of Boring B6

Project: In-N-Out Restaurant
Client: In-N-Out Burger
Location: 815 N. Bristol, Santa Ana, CA
Depth to Water> Not Encountered
Initial: N/A
Project No: 112-18042
Figure No.: A-6
Logged By: Jorge Pelayo
At Completion: N/A

SUBSURFACE PROFILE			SAMPLE			
Depth (ft)	Symbol	Description	Dry Density (pcf)	Moisture (%)	Type	Blows/ft.
		Ground Surface				
0	▥	***SILTY SAND (SM)*** Medium dense, fine-grained; dark brown, moist				
6			105.3	7.2	◢	17
7	▨	***GRAVEL-SAND MIXTURES (GP)*** Medium dense, coarse- to medium-grained; light brown, damp				
10			116.7	6.3	◢	25
10		End of Borehole				
18		No water encountered Boring backfilled with soil cuttings				
20						



Drill Method: Hollow Stem
Drill Rig: CME 75
Driller: Baja Exploration

Krazan and Associates

Drill Date: 4-3-18
Hole Size: 5½ Inches
Elevation: 10 Feet
Sheet: 1 of 1

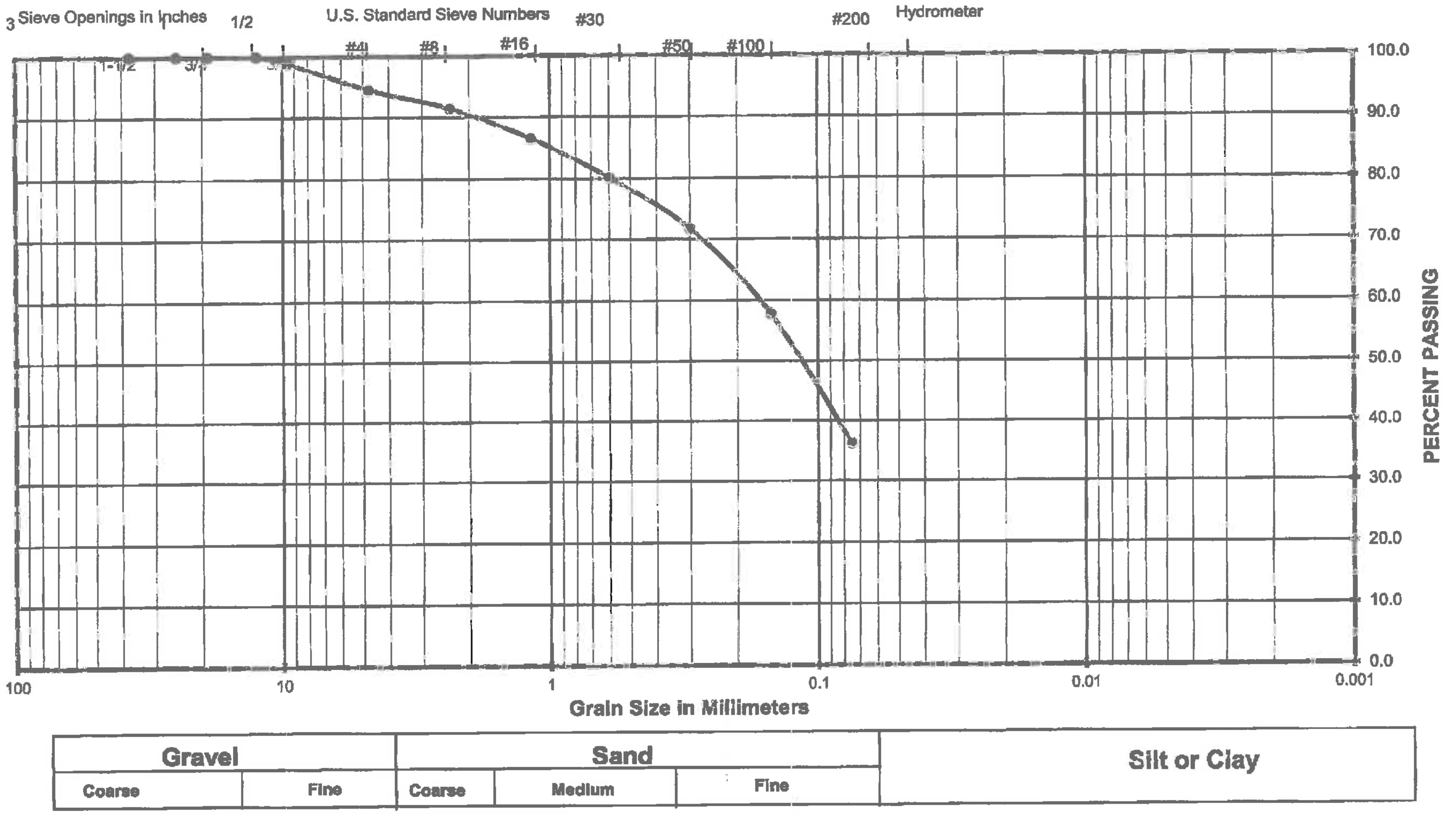
Sieve Analysis

Project Number : 11218047
Project Name : INO Yorba Linda
Date : 5/9/2018
Sample Location : B-2 @ 5'
Soil Classification : SM

Wet Weight :	415.60
Dry Weight :	415.60
Moisture Content :	0%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50	5.0	1.2	1.2	98.8
#4	4.75	17.7	4.3	5.5	94.5
#8	2.36	13.0	3.1	8.6	91.4
#16	1.18	20.2	4.9	13.5	86.5
#30	0.60	26.7	6.4	19.9	80.1
#50	0.30	34.9	8.4	28.3	71.7
#100	0.15	57.8	13.9	42.2	57.8
#200	0.08	89.6	21.6	63.7	36.3

Grain Size Analysis



(Unified Soils Classification)

Project Name	INO Yorba Linda
Project Number	11218047
Soil Classification	SM
Sample Number	B-2 @ 5'

Krazan Testing Laboratory

Sieve Analysis

Project Number : 11218047
Project Name : INO Yorba Linda
Date : 5/9/2018
Sample Location : B-2 @ 10'
Soil Classification : SM / gravel

Wet Weight	:	485.40
Dry Weight	:	485.40
Moisture Content	:	0%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00	13.6	2.8	2.8	97.2
1/2"	12.50	0.1	0.0	2.8	97.2
3/8"	9.50	0.1	0.0	2.8	97.2
#4	4.75	0.1	0.0	2.9	97.1
#8	2.36	4.0	0.8	3.7	96.3
#16	1.18	14.3	2.9	6.6	93.4
#30	0.60	29.6	6.1	12.7	87.3
#50	0.30	59.3	12.2	24.9	75.1
#100	0.15	64.1	13.2	38.2	61.8
#200	0.08	96.1	19.8	58.0	42.0

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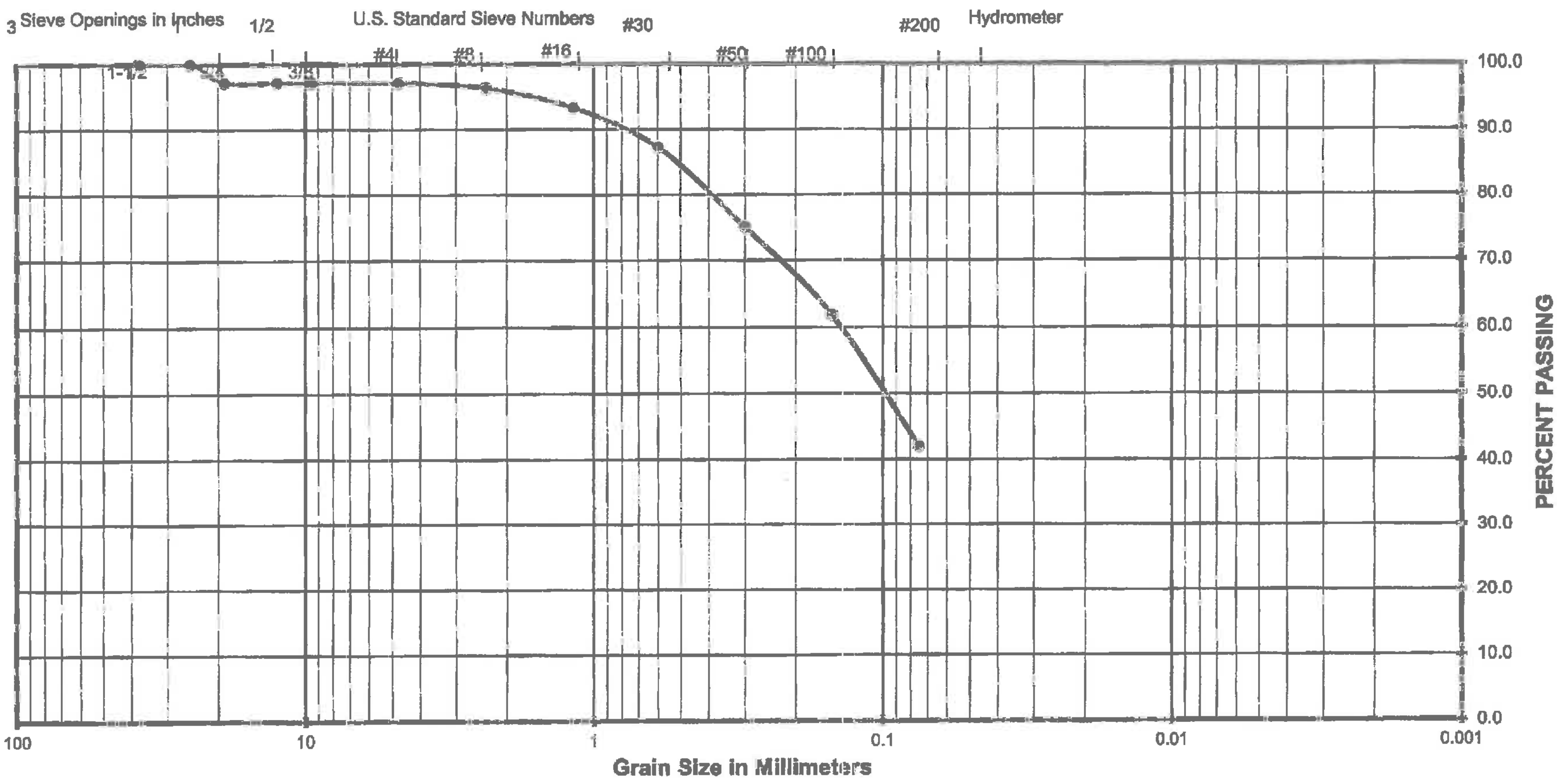
Grain Size Analysis



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	INO Yorba Linda
Project Number	11218047
Soil Classification	SM / gravel
Sample Number	B-2 @ 10'

Krazan Testing Laboratory

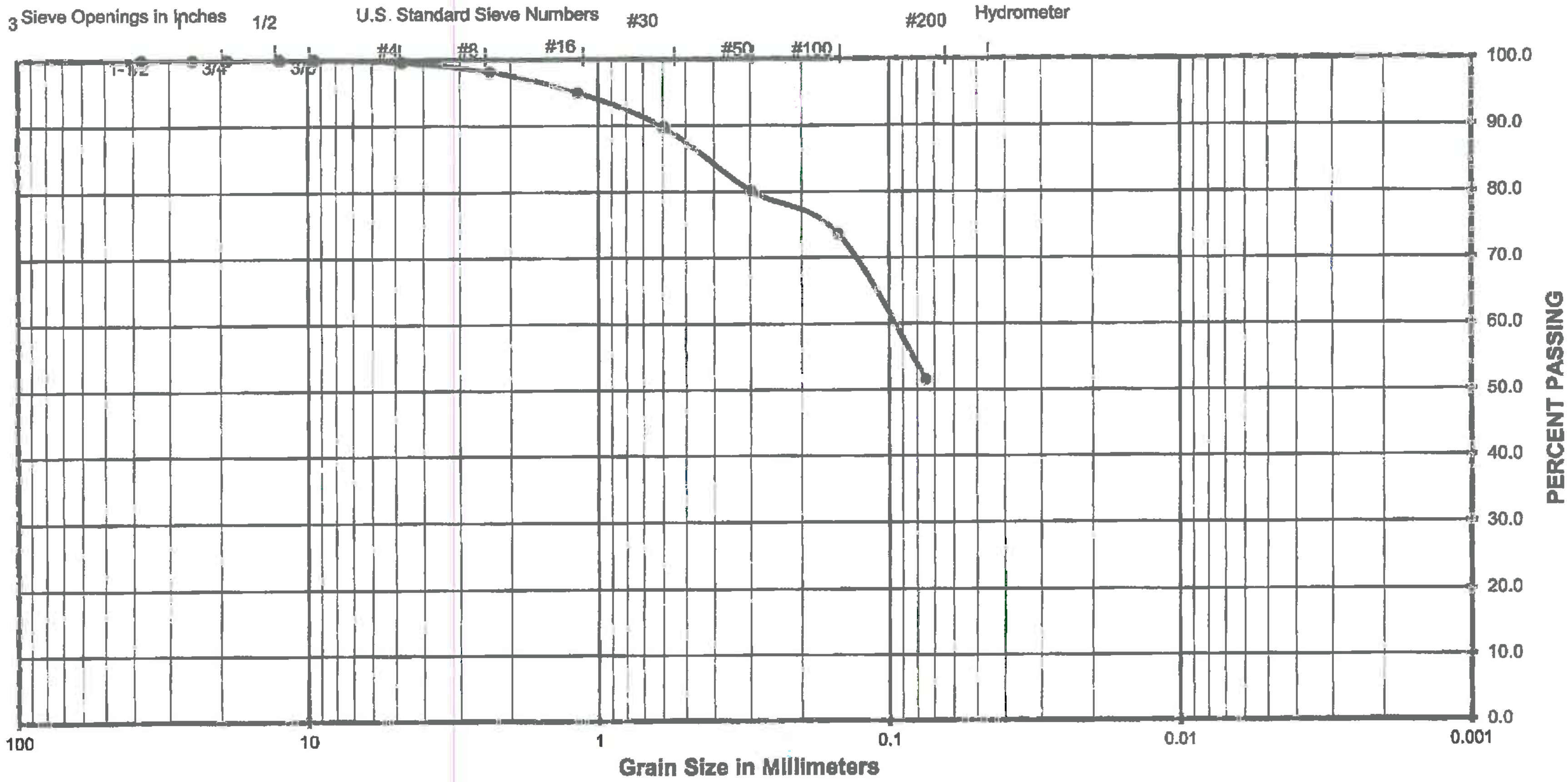
Sieve Analysis

Project Number : 11218047
Project Name : INO Yorba Linda
Date : 5/9/2018
Sample Location : B-2 @ 15'
Soil Classification : ML

Wet Weight	:	497.40
Dry Weight	:	497.40
Moisture Content	:	0%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50				100.0
#4	4.75	1.9	0.4	0.4	99.6
#8	2.36	7.5	1.5	1.9	98.1
#16	1.18	15.3	3.1	5.0	95.0
#30	0.60	26.1	5.2	10.2	89.8
#50	0.30	47.8	9.6	19.8	80.2
#100	0.15	32.3	6.5	26.3	73.7
#200	0.08	110.0	22.1	48.4	51.6

Grain Size Analysis



Gravel		Sand			Silt or Clay
Coarse	Fine	Coarse	Medium	Fine	

(Unified Soils Classification)

Project Name	INO Yorba Linda
Project Number	11218047
Soil Classification	ML
Sample Number	B-2 @ 15'

Krazan Testing Laboratory

Sieve Analysis

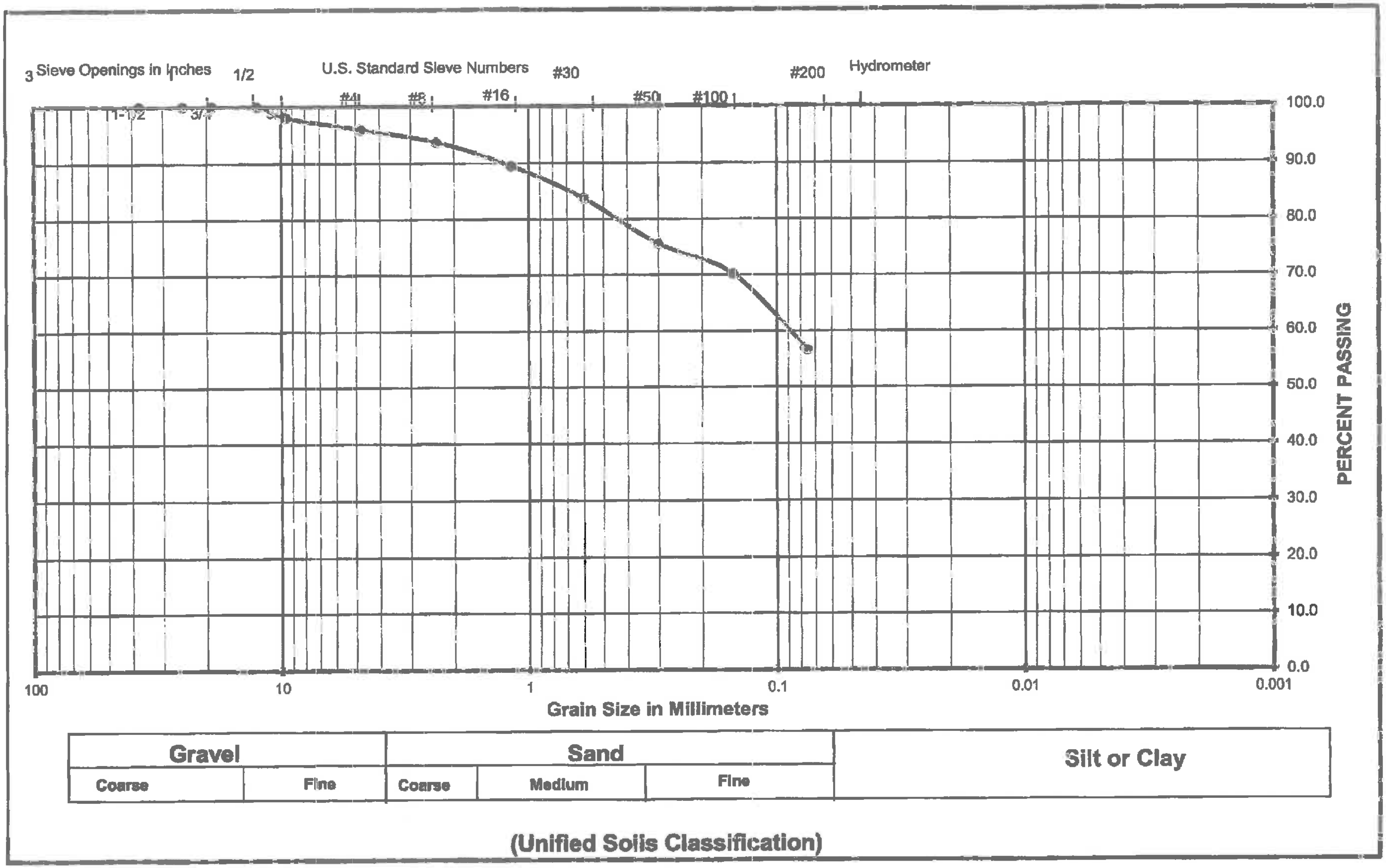
Project Number : 11218047
Project Name : INO Yorba Linda
Date : 5/9/2018
Sample Location : B-2 @ 20'
Soil Classification : ML

Wet Weight	:	491.20
Dry Weight	:	491.20
Moisture Content	:	0%

Sieves Size/Number	Sieve Size, mm	Retained Weight	Retained. %	Cum % Retained	Cum. % Passing.
1-1/2"	37.50				100.0
1"	25.00				100.0
3/4"	19.00				100.0
1/2"	12.50				100.0
3/8"	9.50	9.8	2.0	2.0	98.0
#4	4.75	10.1	2.1	4.1	95.9
#8	2.36	10.9	2.2	6.3	93.7
#16	1.18	20.7	4.2	10.5	89.5
#30	0.60	28.7	5.8	16.3	83.7
#50	0.30	39.8	8.1	24.4	75.6
#100	0.15	26.5	5.4	29.8	70.2
#200	0.08	66.5	13.5	43.4	56.6

Krazan Testing Laboratory

Grain Size Analysis



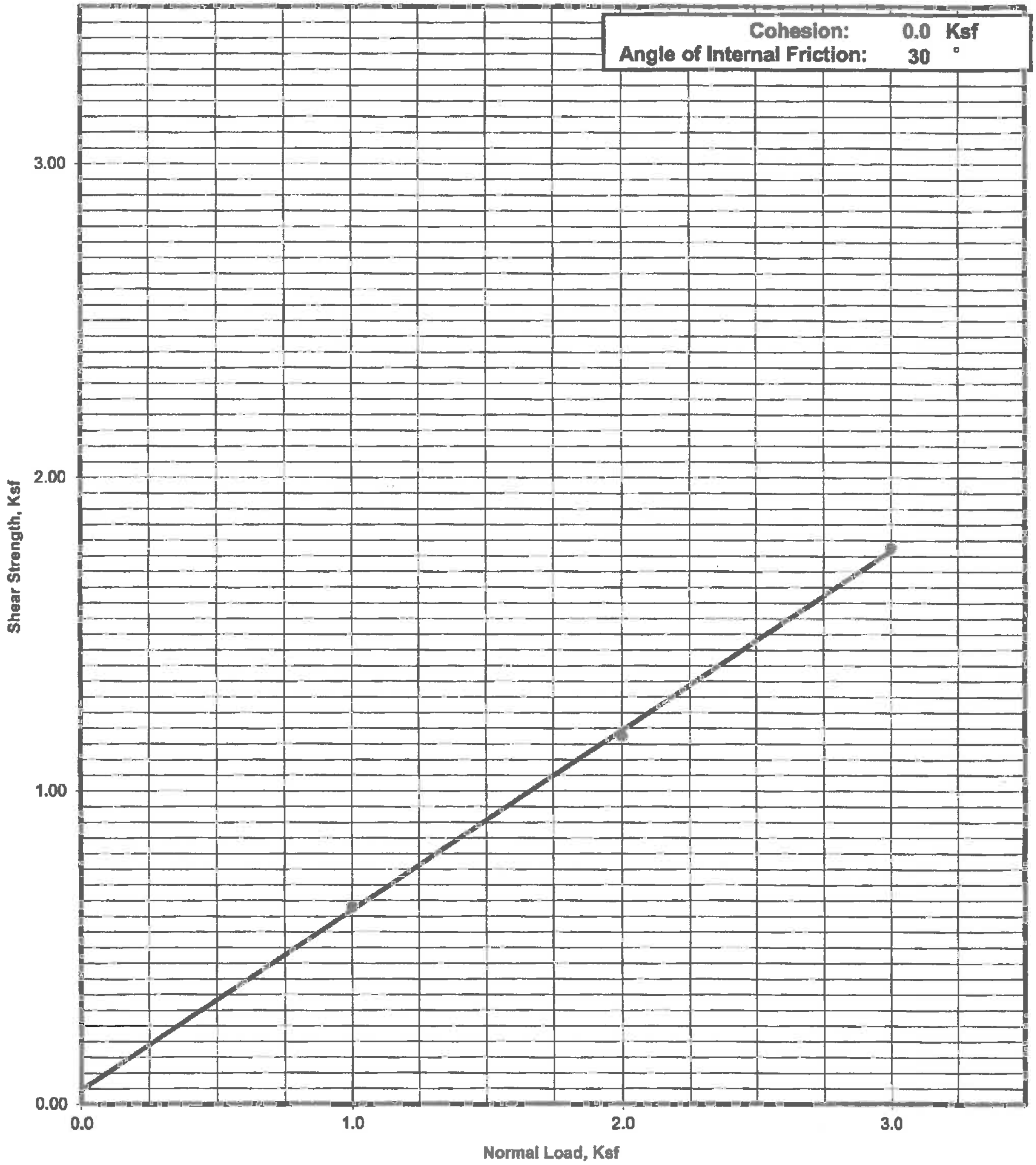
Project Name	INO Yorba Linda
Project Number	11218047
Soil Classification	ML
Sample Number	B-2 @ 20'

Krazan Testing Laboratory

Shear Strength Diagram (Direct Shear)

ASTM D - 3080 / AASHTO T - 236

Project Number	Boring No. & Depth	Soil Type	Date
11218047	B-3 @ 5'	SM	5/9/2018

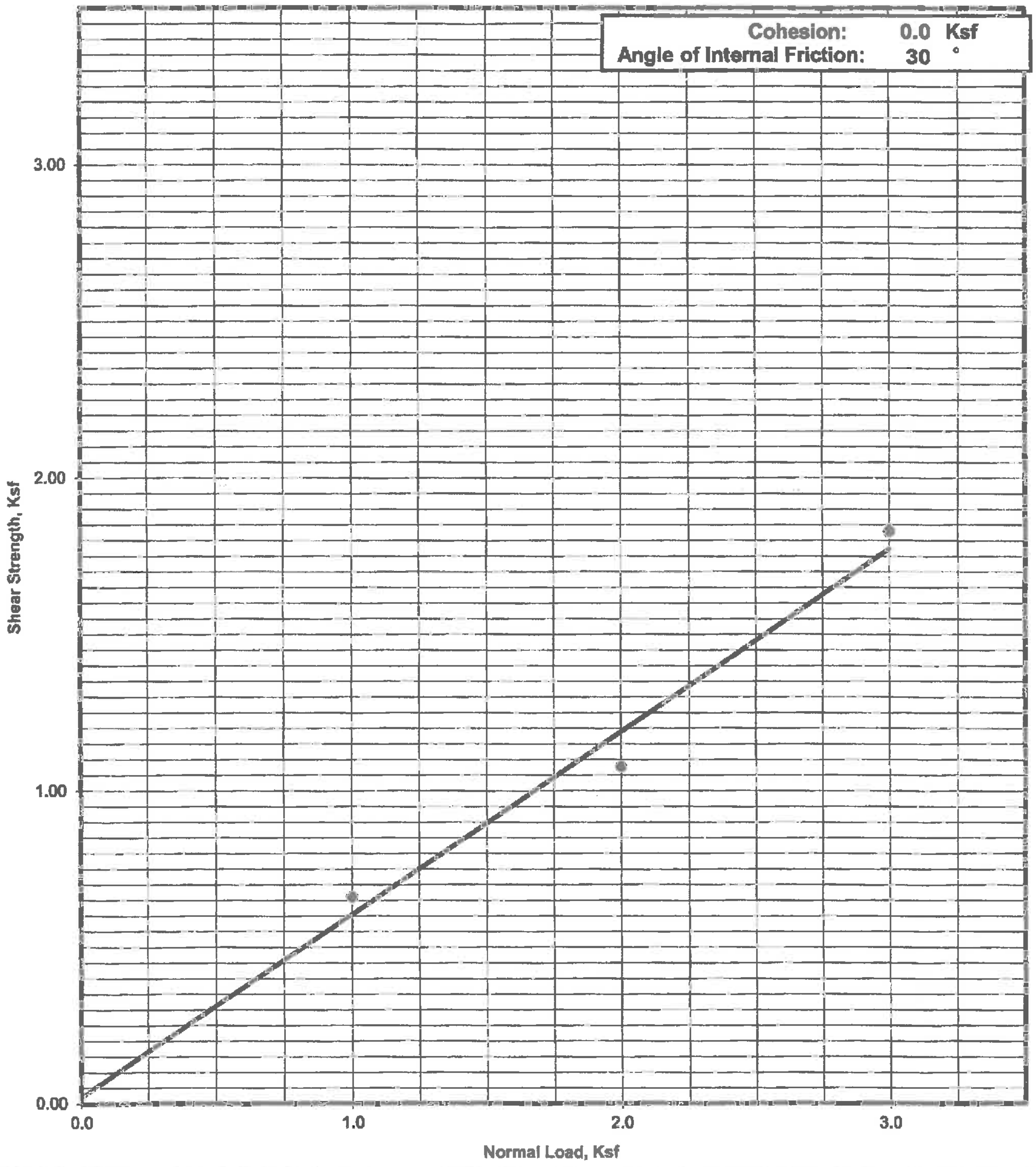


Krazan Testing Laboratory

Shear Strength Diagram (Direct Shear)

ASTM D - 3080 / AASHTO T - 236

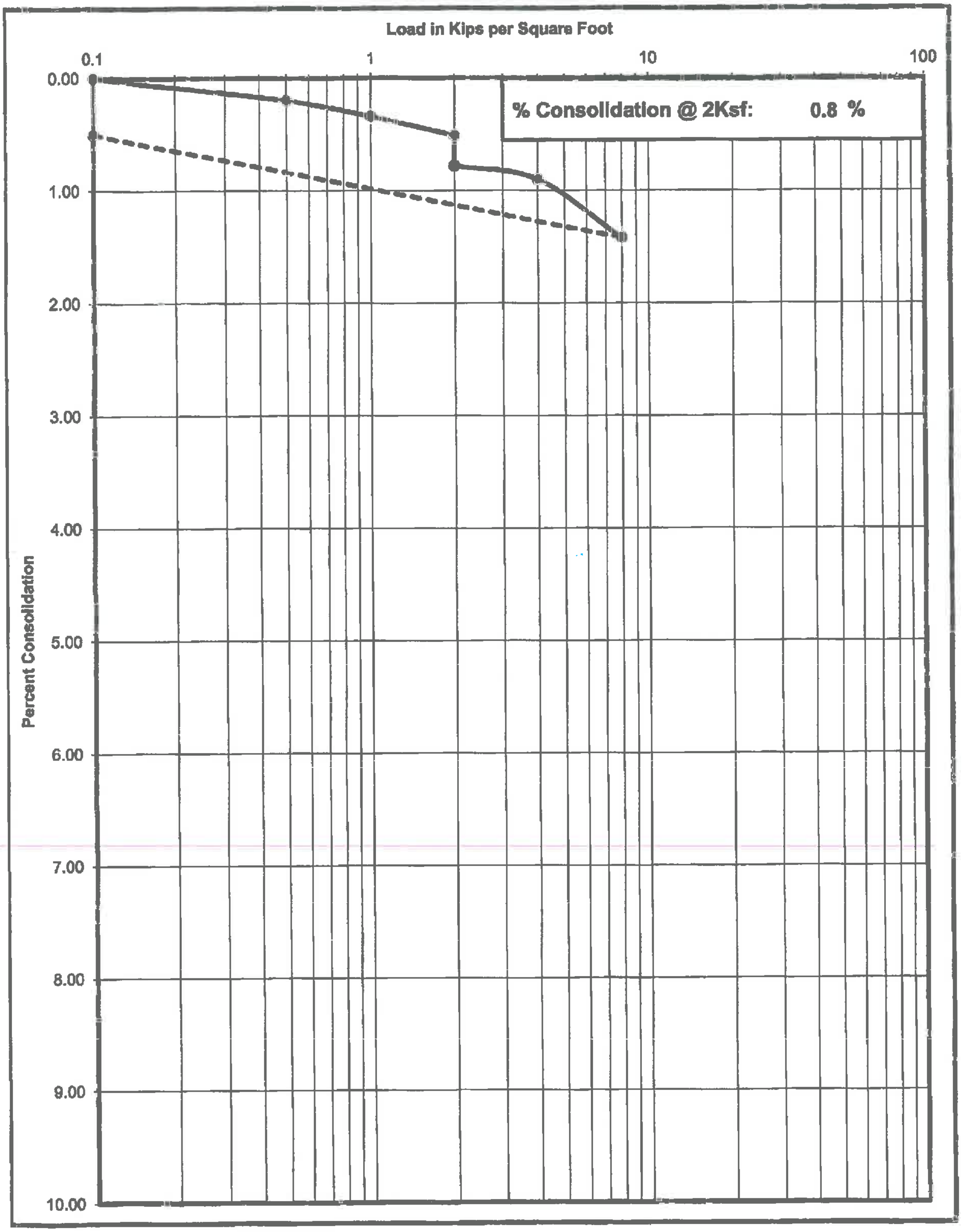
Project Number	Boring No. & Depth	Soil Type	Date
11218047	B-6 @ 5'	SM	5/9/2018



Krazan Testing Laboratory

Consolidation Test

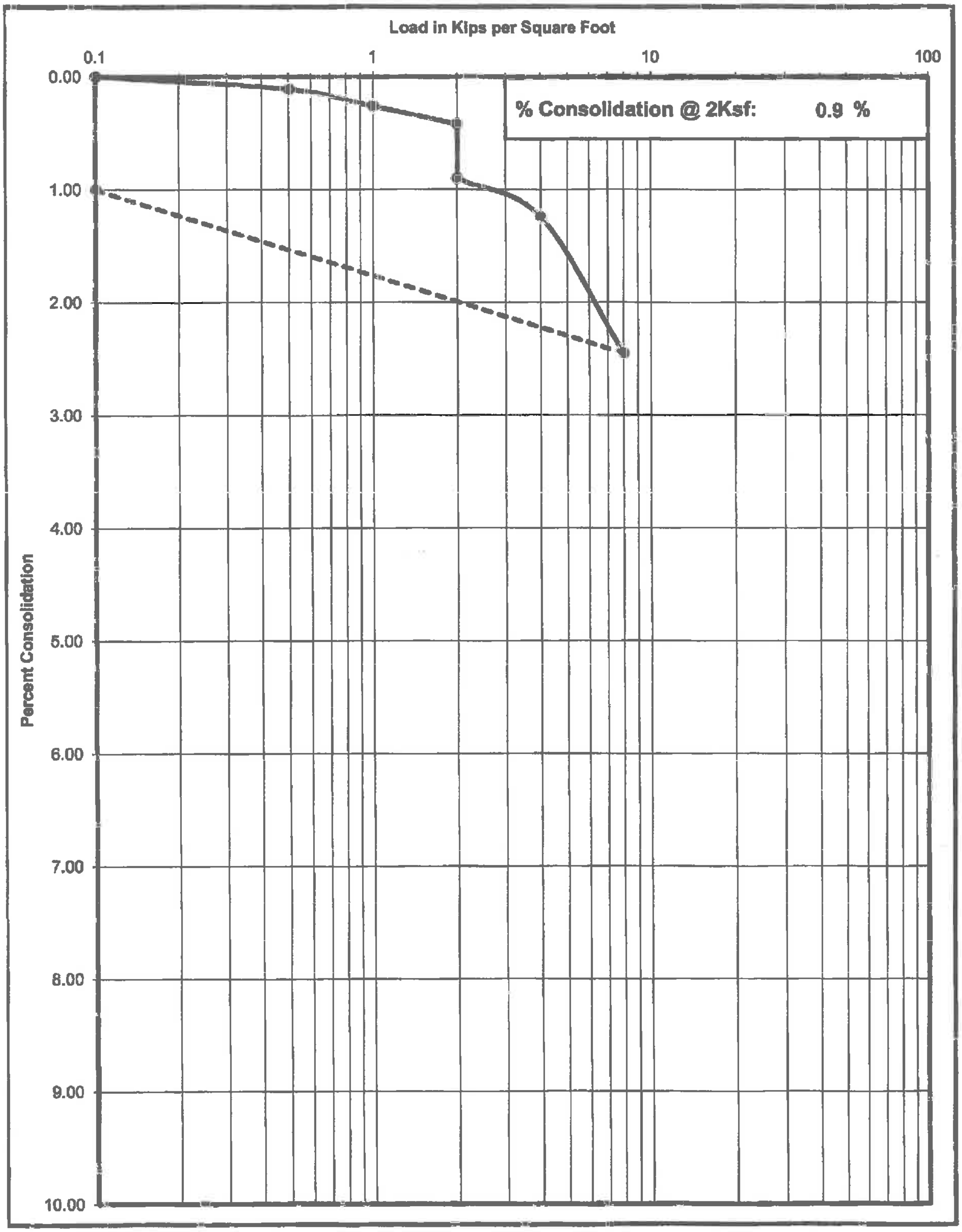
Project No	Boring No. & Depth	Date	Soil Classification
11218047	B-3 @ 5'	5/9/2018	SM



Krazan Testing Laboratory

Consolidation Test

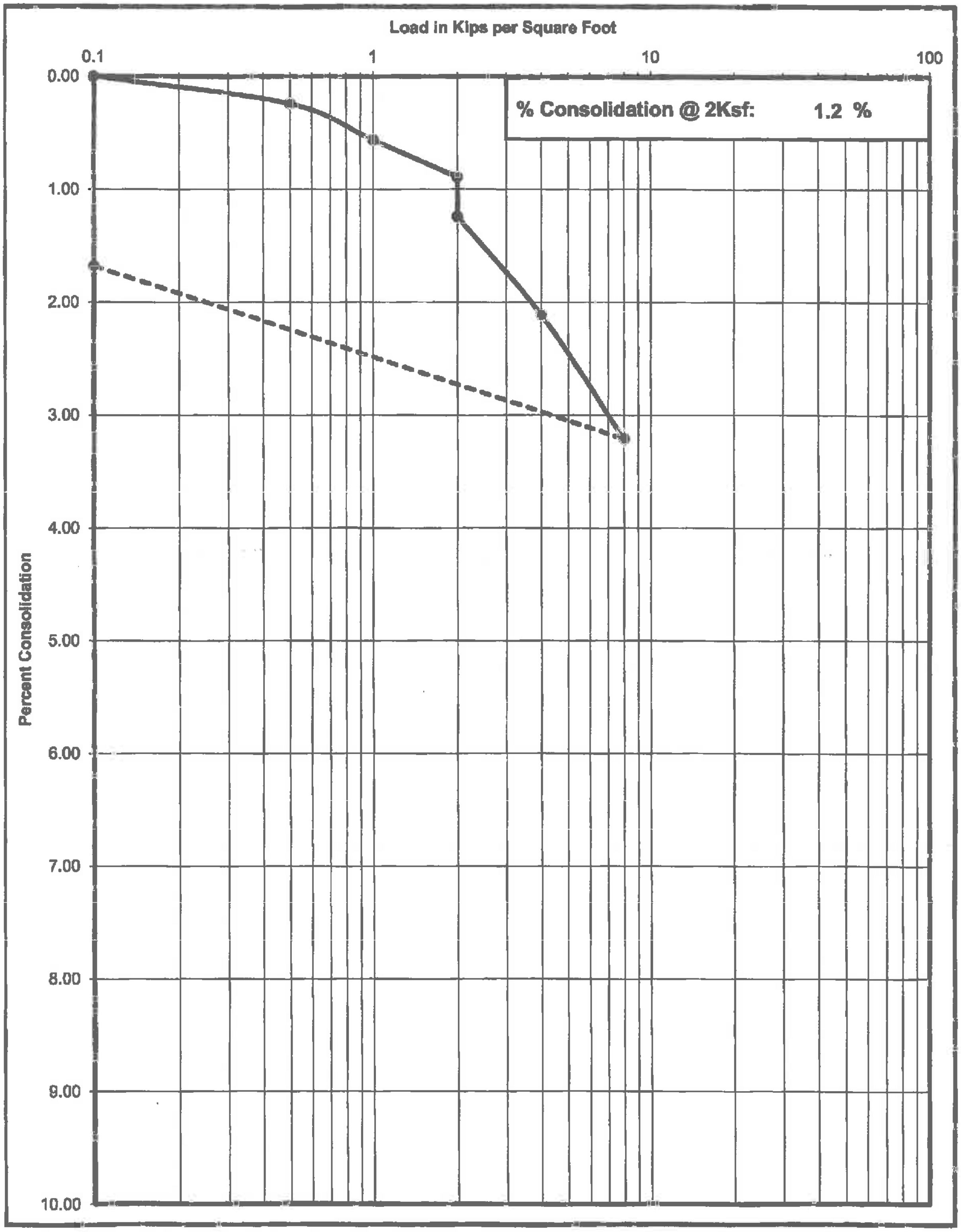
Project No	Boring No. & Depth	Date	Soil Classification
11218047	B-3 @ 10'	5/9/2018	SM



Krazan Testing Laboratory

Consolidation Test

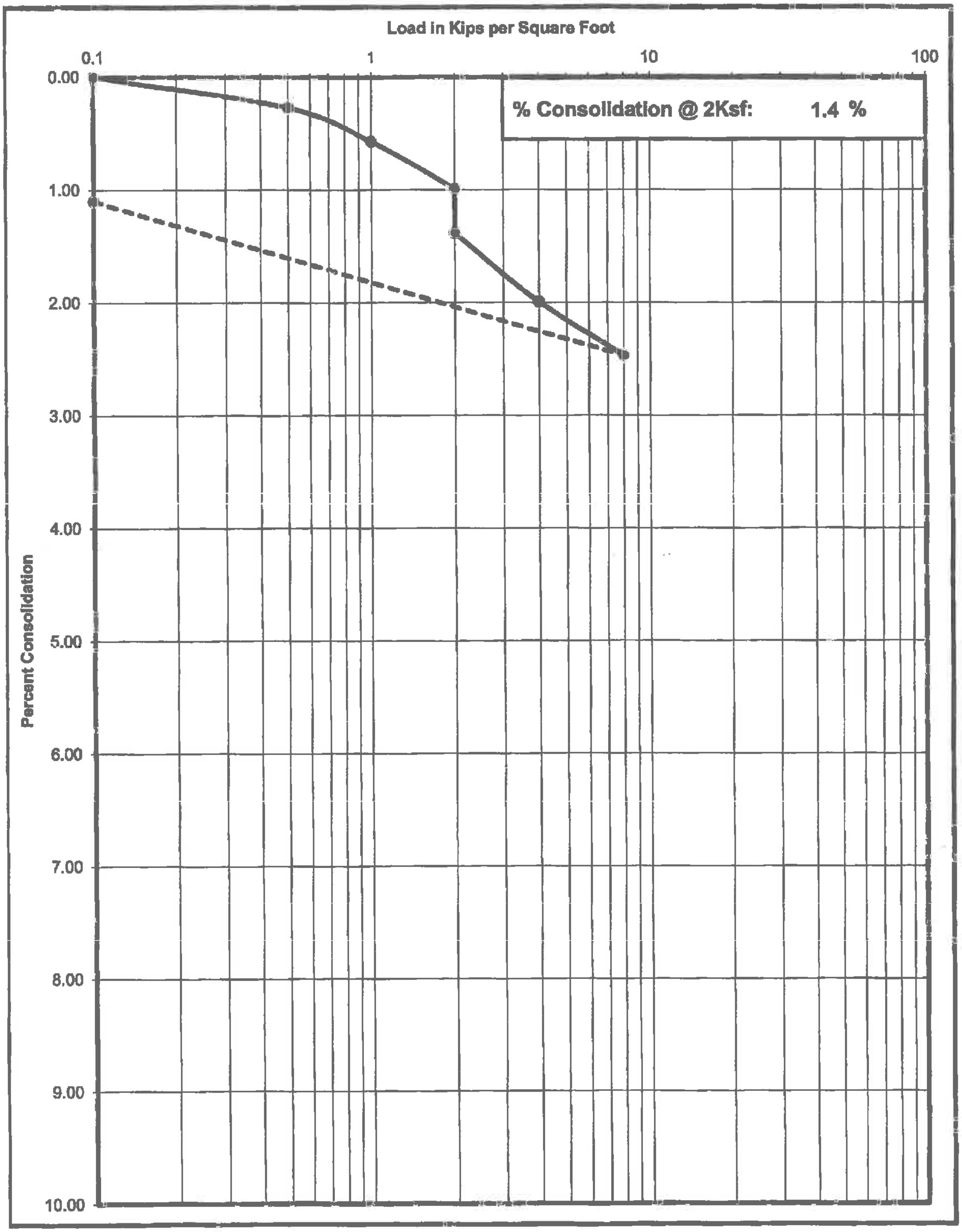
Project No	Boring No. & Depth	Date	Soil Classification
11218047	B-4 @ 5'	5/9/2018	SM



Krazan Testing Laboratory

Consolidation Test

Project No	Boring No. & Depth	Date	Soil Classification
11218047	B-4 @ 10'	5/9/2018	SM

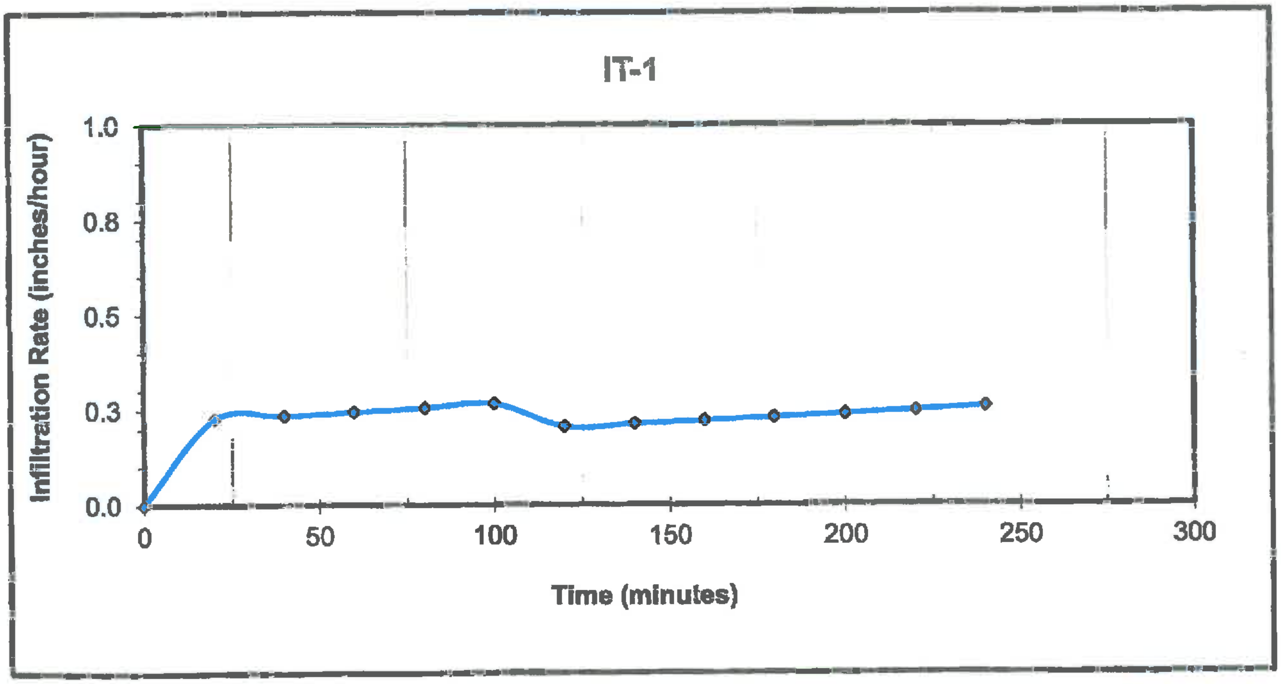


Krazan Testing Laboratory

RESULTS OF INFILTRATION TESTS - REVERSE BOREHOLE

Project #	11218047				**Date**	5/9/2018
Project Name	INO Yorba Linda					
Project Address	18181 Imperial Highway, Yorba Linda					
Test No:	IT-1	**Total Depth (in.)**		60	**Test Size (in)**	8
Depth To Water	>>50'	**Soil Classification**		SM		

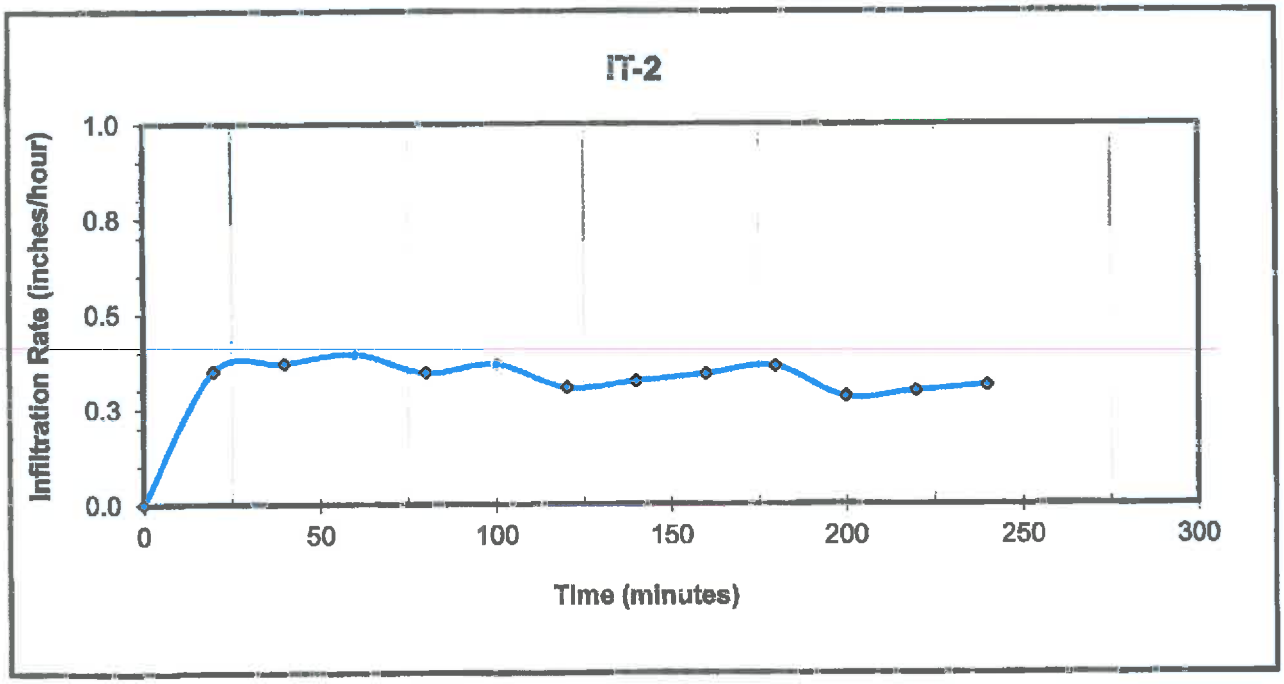
Reading	Elasped Time(min.)	Incremental Time (min.)	Initial Depth To Water(in.)	Final Depth To Water(in.)	Incremental Fall of Water(in.)	Incremental Infiltration Rate (in/hr)
Start	0	0.00		6.0	--	--
1	20.00	20.00	6.0	8.0	2.00	0.23
2	40.00	20.00	8.0	10.0	2.00	0.24
3	60.00	20.00	10.0	12.0	2.00	0.24
4	80.00	20.00	12.0	14.0	2.00	0.26
5	100.00	20.00	14.0	16.0	2.00	0.27
6	120.00	20.00	16.0	17.5	1.50	0.21
7	140.00	20.00	17.5	19.0	1.50	0.21
8	160.00	20.00	19.0	20.5	1.50	0.22
9	180.00	20.00	20.5	22.0	1.50	0.23
10	200.00	20.00	22.0	23.5	1.50	0.24
11	220.00	20.00	23.5	25.0	1.50	0.25
12	240.00	20.00	25.0	26.5	1.50	0.26
	Infiltration Rate in Inches per Hour					0.21



RESULTS OF INFILTRATION TESTS - REVERSE BOREHOLE

Project #	11218047				**Date**	5/9/2018
Project Name	INO Yorba Linda					
Project Address	18181 Imperial Highway, Yorba Linda					
Test No:	IT-2	**Total Depth (in.)**		60	**Test Size (in)**	8
Depth To Water	>>50'	**Soil Classification**		SM		

Reading	Elasped Time(min.)	Incremental Time (min.)	Initial Depth To Water(in.)	Final Depth To Water(in.)	Incremental Fall of Water(in.)	Incremental infiltration Rate (in/hr)
Start	0	0.00		6.0	–	–
1	20.00	20.00	6.0	9.0	3.00	0.35
2	40.00	20.00	9.0	12.0	3.00	0.37
3	60.00	20.00	12.0	15.0	3.00	0.40
4	80.00	20.00	15.0	17.5	2.50	0.35
5	100.00	20.00	17.5	20.0	2.50	0.37
6	120.00	20.00	20.0	22.0	2.00	0.31
7	140.00	20.00	22.0	24.0	2.00	0.32
8	160.00	20.00	24.0	26.0	2.00	0.34
9	180.00	20.00	26.0	28.0	2.00	0.36
10	200.00	20.00	28.0	29.5	1.50	0.28
11	220.00	20.00	29.5	31.0	1.50	0.30
12	240.00	20.00	31.0	32.5	1.50	0.31
	Infiltration Rate in Inches per Hour					0.28



ANAHEIM TEST LAB, INC
3008 ORANGE AVENUE
SANTA ANA, CALIFORNIA 92707
PHONE (714) 549-7267

DATE: 04/13/18

Krazan & Associates, Inc.
1100 Olympic Drive, Ste. 103
Corona, CA 92881

P.O. NO: Verbal

LAB NO: C-1757

SPECIFICATION: 417/422/643

MATERIAL: Soil

Project No: 11218047
INO Yorba Linda
B-1 @ 0-5'

ANALYTICAL REPORT
CORROSION SERIES
SUMMARY OF DATA

pH	SOLUBLE SULFATES per CA. 417 ppm	SOLUBLE CHLORIDES per CA. 422 ppm	MIN. RESISTIVITY per CA. 643 ohm-cm
7.5	197	29	2,100

RESPECTFULLY SUBMITTED

WES BRIDGER CHEMIST

General Earthwork Specifications

Appendix B

APPENDIX B

EARTHWORK SPECIFICATIONS

GENERAL

When the text of the report conflicts with the general specifications in this appendix, the recommendations in the report have precedence.

SCOPE OF WORK: These specifications and applicable plans pertain to and include all earthwork associated with the site rough grading, including, but not limited to, the furnishing of all labor, tools and equipment necessary for site clearing and grubbing, stripping, preparation of foundation materials for receiving fill, excavation, processing, placement and compaction of fill and backfill materials to the lines and grades shown on the project grading plans and disposal of excess materials.

PERFORMANCE: The Contractor shall be responsible for the satisfactory completion of all earthworks in accordance with the project plans and specifications. This work shall be inspected and tested by a representative of Krazan and Associates, Incorporated, hereinafter referred to as the Geotechnical Engineer and/or Testing Agency. Attainment of design grades, when achieved, shall be certified by the project Civil Engineer. Both the Geotechnical Engineer and the Civil Engineer are the Owner's representatives. If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary adjustments until all work is deemed satisfactory as determined by both the Geotechnical Engineer and the Civil Engineer. No deviation from these specifications shall be made except upon written approval of the Geotechnical Engineer, Civil Engineer, or project Architect.

No earthwork shall be performed without the physical presence or approval of the Geotechnical Engineer. The Contractor shall notify the Geotechnical Engineer at least 2 working days prior to the commencement of any aspect of the site earthwork.

The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of this project, including safety of all persons and property; that this requirement shall apply continuously and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold the Owner and the Engineers harmless from any and all liability, real or alleged, in connection with the performance of work on this project, except for liability arising from the sole negligence of the Owner or the Engineers.

TECHNICAL REQUIREMENTS: All compacted materials shall be densified to the minimum relative compaction of 95 percent. Soil moisture-content requirements presented in the Geotechnical Engineer's report shall also be complied with. The maximum laboratory compacted dry unit weight of each soil placed as fill shall be determined in accordance with ASTM Test Method D1557-00 (Modified Proctor). The optimum moisture-content shall also be determined in accordance with this test method. The terms “relative compaction” and “compaction” are defined as the in-place dry density of the compacted soil divided by the laboratory compacted maximum dry density as determined by ASTM Test Method D1557-00, expressed as a percentage as specified in the technical portion of the Geotechnical Engineer's report. The location and frequency of field density tests shall be as determined by the Geotechnical Engineer. The results of these tests and compliance with these specifications shall be the basis upon which the Geotechnical Engineer will judge satisfactory completion of work.

SOILS AND FOUNDATION CONDITIONS: The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the contents of the data presented in the Geotechnical Engineering Investigation report.

The Contractor shall make his own interpretation of the data contained in the Geotechnical Engineering Investigation report and the Contractor shall not be relieved of liability under the Contract for any loss sustained as a result of any variance between conditions indicated by or deduced from said report and the actual conditions encountered during the progress of the work.

DUST CONTROL: The work includes dust control as required for the alleviation or prevention of any dust nuisance on or about the site or the borrow area, or off-site if caused by the Contractor's operation either during the performance of the earthwork or resulting from the conditions in which the Contractor leaves the site. The Contractor shall assume all liability, including court costs of codefendants, for all claims related to dust or wind-blown materials attributable to his work.

SITE PREPARATION

Site preparation shall consist of site clearing and grubbing, over-excavation of the proposed building pad areas, preparation of foundation materials for receiving fill, construction of Engineered Fill including the placement of non-expansive fill where recommended by the Geotechnical Engineer.

CLEARING AND GRUBBING: The Contractor shall accept the site in this present condition and shall demolish and/or remove from the area of designated project earthwork all structures, both surface and subsurface, trees, brush, roots, debris, organic matter and all other matter determined by the Geotechnical Engineer to be deleterious. Site stripping to remove organic materials and organic-laden soils in landscaped areas shall extend to a minimum depth of 2 inches or until all organic-laden soil with organic matter in excess of 3 percent of the soils by volume are removed. Such materials shall become the property of the Contractor and shall be removed from the site.

Tree root systems in proposed building areas should be removed to a minimum depth of 3 feet and to such an extent that would permit removal of all roots greater than 1 inch in diameter. Tree roots removed in parking areas may be limited to the upper 1½ feet of the ground surface. Backfill of tree root excavation should not be permitted until all exposed surfaces have been inspected and the Geotechnical Engineer is present for the proper control of backfill placement and compaction. Burning in areas that are to receive fill materials shall not be permitted.

Excavations required to achieve design grades, depressions, soft or pliant areas, or areas disturbed by demolition activities extending below planned finished subgrade levels should be excavated down to firm, undisturbed soil and backfilled with Engineered Fill. The resulting excavations should be backfilled with Engineered Fill.

EXCAVATION: Following clearing and grubbing operations, the proposed building pad area shall be over-excavated to a depth of at least five feet below existing grades or three feet below the planned foundation bottom levels, whichever is deeper, and the remaining areas of the building and adjoining exterior concrete flatwork or pavements at the building perimeter shall be over-excavated to a depth of at least one foot below existing grade. The areas of over-excavation and recompaction beneath footings and slabs shall extend out laterally a minimum of five feet beyond the perimeter of these elements.

All excavation shall be accomplished to the tolerance normally defined by the Civil Engineer as shown on the project grading plans. All over-excavation below the grades specified shall be backfilled at the

Contractor's expense and shall be compacted in accordance with the applicable **TECHNICAL REQUIREMENTS**.

SUBGRADE PREPARATION: Surfaces to receive Engineered Fill or to support structures directly, shall be scarified to a depth of 8 inches, moisture-conditioned as necessary and compacted in accordance with the **TECHNICAL REQUIREMENTS**, above.

Loose soil areas and/or areas of disturbed soil shall be should be excavated down to firm, undisturbed soil, moisture-conditioned as necessary and backfilled with Engineered Fill. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill materials. All areas that are to receive fill materials shall be approved by the Geotechnical Engineer prior to the placement of any of the fill material.

FILL AND BACKFILL MATERIAL: No material shall be moved or compacted without the presence of the Geotechnical Engineer. Material from the required site excavation may be utilized for construction of site fills, with the limitations of their use presented in the Geotechnical Engineer's report, provided the Geotechnical Engineer gives prior approval. All materials utilized for constructing site fills shall be free from vegetation or other deleterious matter as determined by the Geotechnical Engineer, and shall comply with the requirements for non-expansive fill, aggregate base or aggregate subbase as applicable for its proposed used on the site as presented in the Geotechnical Engineer's report.

PLACEMENT, SPREADING AND COMPACTION: The placement and spreading of approved fill materials and the processing and compaction of approved fill and native materials shall be the responsibility of the Contractor. Fill materials should be placed and compacted in horizontal lifts, each not exceeding 8 inches in uncompacted thickness. Due to equipment limitations, thinner lifts may be necessary to achieve the recommended level of compaction. Compaction of fill materials by flooding, ponding, or jetting shall not be permitted unless specifically approved by local code, as well as the Geotechnical Engineer. Additional lifts should not be placed if the previous lift did not meet the required dry density (relative compaction) or if soil conditions are not stable. The compacted subgrade in pavement areas should be non-yielding when proof-rolled with a loaded ten-wheel truck, such as a water truck or dump truck, prior to pavement construction.

Both cut and fill shall be surface-compacted to the satisfaction of the Geotechnical Engineer prior to final acceptance.

SEASONAL LIMITS: No fill material shall be placed, spread, or rolled while it is frozen or thawing, or during unfavorable wet weather conditions. When the work is interrupted by heavy rains, fill operations shall not be resumed until the Geotechnical Engineer indicates that the moisture-content and density of previously placed fill is as specified.

Appendix C

General Paving Specifications

APPENDIX C

PAVEMENT SPECIFICATIONS

1. DEFINITIONS - The term "pavement" shall include asphalt concrete surfacing, untreated aggregate base, and aggregate subbase. The term "subgrade" is that portion of the area on which surfacing, base, or subbase is to be placed.

The term "Standard Specifications": hereinafter referred to is the January 1999 Standard Specifications of the State of California, Department of Transportation, and the "Materials Manual" is the Materials Manual of Testing and Control Procedures, State of California, Department of Public Works, Division of Highways. The term "relative compaction" refers to the field density expressed as a percentage of the maximum laboratory density as defined in the ASTM D1557-00.

2. SCOPE OF WORK - This portion of the work shall include all labor, materials, tools, and equipment necessary for, and reasonably incidental to the completion of the pavement shown on the plans and as herein specified, except work specifically notes as "Work Not Included."

3. PREPARATION OF THE SUBGRADE - The Contractor shall prepare the surface of the various subgrades receiving subsequent pavement courses to the lines, grades, and dimensions given on the plans. The upper 12 inches of the soil subgrade beneath the pavement section shall be compacted to a minimum relative compaction of 95 percent. The finished subgrades shall be tested and approved by the Geotechnical Engineer prior to the placement of additional pavement courses.

4. UNTREATED AGGREGATE BASE - The aggregate base material shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate base material shall conform to the requirements of Section 26 of the Standard Specifications for Class 2 material, ¾-inches maximum size. The aggregate base material shall be compacted to a minimum relative compaction of 95 percent. The aggregate base material shall be spread and compacted in accordance with Section 26 of the Standard Specifications. The aggregate base material shall be spread in layers not exceeding 6 inches and each layer of aggregate material course shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

5. AGGREGATE SUBBASE - The aggregate subbase shall be spread and compacted on the prepared subgrade in conformity with the lines, grades, and dimensions shown on the plans. The aggregate subbase material shall conform to the requirements of Section 25 of the Standard Specifications for Class II material. The aggregate subbase material shall be compacted to a minimum relative compaction of 95 percent, and it shall be spread and compacted in accordance with Section 25 of the Standard Specifications. Each layer of aggregate subbase shall be tested and approved by the Geotechnical Engineer prior to the placement of successive layers.

6. ASPHALT CONCRETE SURFACING - Asphalt concrete surfacing shall consist of a mixture of mineral aggregate and paving grade asphalt, mixed at a central mixing plant and spread and compacted on a prepared base in conformity with the lines, grades, and dimensions shown on the plans. The viscosity grade of the asphalt shall be AR-8000. The mineral aggregate shall be Type B, ½-inch or ¾-inch maximum, medium grading, for the wearing course and ¾-inch maximum, medium grading for the base course, and shall conform to the requirements set forth in Section 39 of the Standard Specifications. The drying, proportioning, and mixing of the materials shall conform to Section 39.

The prime coat, spreading and compacting equipment, and spreading and compacting the mixture shall conform to the applicable chapters of Section 39, with the exception that no surface course shall be placed when the atmospheric temperature is below 50 degrees F. The surfacing shall be rolled with a combination steel-wheel and pneumatic rollers, as described in Section 39-6. The surface course shall be placed with an approved self-propelled mechanical spreading and finishing machine.

7. FOG SEAL COAT - The fog seal (mixing type asphalt emulsion) shall conform to and be applied in accordance with the requirements of Section 37.

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