Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

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MCAS EL TORO
SSIC #5090.3

GEOTECHNICAL SLOPE STABILITY EVALUATION MARINE CORPS AIR STATION EL TORO, SITE 17 MCAS EL TORO EL TORO, CALIFORNIA

PREPARED FOR:
OHM Remediation Services Corporation
2031 Main Street
Irvine, California 90624

PREPARED BY:
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July 7, 1997
Project No. 201010-01

OHM Remediation Services Corp.
A Subsidiary of OHM Corporation

OHM TRANSMITTAL/DELIVERABLE RECEIPT

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Southwest Division
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Date: 23-Sep-97

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Location: MCAS EL TORO

FROM: James Franklin FOR
Stewart Bornhoft, Program Manager

Ginger James, Contracts Manager

DESCRIPTION OF ENCLOSURE: **Geotechnical Slope Stability Evaluation, Site 17, dated September 22, 1997.**

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OHM Remediation
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September 22, 1997

Mr. David Jesperson, Code 57CS1.DJ
Naval Facilities Engineering Command
Southwest Division
1220 Pacific Coast Highway
San Diego, California 92132
Attention: Ms. Lynn M. Hornecker, Code 56MC. LH

Subject: **Geotechnical Slope Stability Evaluation, IRP Site 17, Marine Corps Air Station (MCAS) El Toro, California, DO75, Contract N68711-93-D-1459**

Dear Ms. Hornecker:

It is our pleasure to submit the attached Geotechnical Slope Stability Evaluation for IRP Site 17, MCAS El Toro, California. The submittal includes both a report and an amendment.

The report was initially prepared for the original design, e.g. using gabion structure for the Surface Storm Water Diversion Channel assuming a 100-year storm. As you know, a number of design changes have occured since then. The amendment is included to address the changes such as project life span and structure materials. The amendment is inserted in the report.

We appreciate the opportunity to be of service to you on this project. If you have any questions, please contact me at (714)263-9124, extension 403.

Very truly yours,

Bill Sedlak

William L. Sedlak

Sr. Project Manager

cc: S. Kehe, ROICC 1C/1E
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Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

July 7, 1997
Project No. 201010-01

Mr. Hui Jun Hu
OHM Remediation Services Corporation
2031 Main Street
Irvine, California 90624

Subject: Geotechnical Slope Stability Evaluation
Marine Corps Air Station El Toro, Site 17
El Toro, California

Dear Mr. Hu:

In accordance with your request and authorization, please find enclosed our geotechnical report pertaining to our slope stability evaluation at Site 17 at the Marine Corps Air Station El Toro. Our study was conducted in accordance with the scope of services presented in our revised proposal for geotechnical slope stability analyses for Site 17 dated February 12, 1997.

The purpose of our study was to evaluate the subsurface conditions at the site and, based on our findings, to provide geotechnical recommendations regarding the stability of the proposed slopes. Accordingly, this report presents our findings, conclusions and recommendations regarding the geotechnical aspects of the project.

If you have any questions regarding our report, we will be pleased to meet with you at your convenience. We appreciate the opportunity to be of service on this project.

Respectfully submitted,
NINYO & MOORE

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1. INTRODUCTION

In accordance with your request and authorization, we have completed our geotechnical evaluation for the Site 17 improvements project located at the Marine Corps Air Station in El Toro, California (Figure 1). Based on discussions with you and review of the Communication Station Landfill, Site 17 improvements plan prepared by Montgomery Watson, dated March 25, 1997, we understand that the proposed project will consist of the design and construction of a gabion and concrete drainage ditch.

The purpose of our study was to evaluate the subsurface conditions in the areas chosen by OHM personnel and, based on our findings, to provide geotechnical recommendations regarding the earthwork and stability of the proposed slopes. This report presents our findings, conclusions, and recommendations relative to the project.

2. SCOPE OF SERVICES

The scope of our geotechnical services included the following:

- Project coordination and review of readily available geologic maps, published literature, stereoscopic aerial photographs, in-house information, and project plans.
- Drilling, sampling, and logging of three 8-inch-diameter borings to depths of approximately 61, 96 and 101 feet.
- Laboratory testing of representative soil samples to evaluate in-situ moisture and density, grain-size distribution, shear strength, hydroconsolidation, consolidation, corrosivity, and sulfate content.
- Data compilation and geotechnical analysis of field and laboratory data. Our analysis included evaluations of gross and surficial slope stability, erosion considerations, and construction considerations from a geotechnical perspective.
- Preparation of this report presenting our findings, conclusions, and recommendations pertaining to the proposed drainage structure.

3. SITE DESCRIPTION

The Communication Station Landfill, Site 17 is within the Marine Corps Air Station in El Toro near Irvine Boulevard and Magazine Drive. The hilly terrain was previously the site of mining operations. As a result, some of the ridgeline was mined and the waste soils were pushed downhill into the drainage channels of the hillside. The Communication Station Landfill is generally to the north and west of the proposed construction, although some landfill materials may be encountered during grading.

The Irvine Valley lies to the west of the subject site, and the Santa Ana Mountains lie to the east. Elevations at the site range from approximately 435 to 570 feet relative to mean sea level (MSL).

4. PROJECT DESCRIPTION

We understand the subject drainage structure is designed to provide drainage and erosion protection to the site for a 100-year flood event. Based on plans prepared by Montgomery Watson (1997), we understand that the proposed construction consists of a gabion-lined channel transitioning to a gabion drainage ditch with vertical walls. The proposed construction will also include culverts, a monitoring well, drainage swales, a rock berm, and a gravel paved roadway. The gabion-lined channel will consist of a geosynthetic membrane, compacted subgrade, and a 12-inch-thick gabion mattress. The gabion drainage ditch will be comprised of geotextile filter fabric, compacted subgrade, a reno mattress, a 4-inch-thick concrete section, and gabion bins.

The grading for the proposed construction will largely be excavations with conventional heavy earthmoving equipment. The excavation for the gabion-lined channel, between approximately Station 9+50 and Station 24+31, will be approximately 7 to 10 feet below existing grade with 3:1 (horizontal to vertical) side slopes. The excavation for the gabion drainage ditch, between approximately Station 0+87 and Station 5+40, will typically be approximately 12 feet below existing grade with nearly vertical side walls. From approximately Station 5+40 to Station 9+50, the excavation will be greater than 12 feet with the deepest cut up to approximately 40 feet below

existing ground surface. In this area, the plans indicate a cut slope of 3:1 (horizontal to vertical) from the top of the proposed drainage structure to join to existing grade.

5. SUBSURFACE EVALUATION AND LABORATORY TESTING

Our subsurface evaluation was conducted on April 28 and 29, 1997. Our evaluation included the excavation, logging, and sampling of three exploratory borings. The locations of the borings were selected by OHM personnel, and approximate locations are presented on Figures 2A, 2B and 2C. Borings B-1, B-2, and B-3 were excavated to depths of approximately 101, 96, and 61 feet, respectively, using a truck-mounted drill rig with 8-inch-diameter hollow-stem augers. The purpose of the borings was to evaluate the conditions of the subsurface soils, and to collect bulk and relatively undisturbed soil samples for laboratory testing. The boring logs are presented in Appendix A.

Laboratory testing of representative soil samples included tests to evaluate in-situ moisture and density, grain-size distribution, shear strength, hydroconsolidation, consolidation, corrosivity, and sulfate content. The results of our laboratory testing are presented on the boring logs in Appendix A and in the summary tables in Appendix B.

6. GEOLOGY AND SUBSURFACE CONDITIONS

6.1. Geologic Conditions

The project area is situated in the northern portion of the Peninsular Ranges geomorphic province of southern California (Norris and Webb, 1990). The geomorphic province encompasses an area that extends 125 miles from the Transverse Ranges and the Los Angeles Basin south to the United States-Mexico border and beyond another 775 miles to the tip of Baja California (Norris and Webb, 1990). The Peninsular Ranges vary in width from approximately 30 to 100 miles, most of which is characterized by northwest trending mountain ranges separated by subparallel fault zones. In general, the mountain ranges are

underlain by Jurassic-age metavolcanic and metasedimentary rocks and Cretaceous age igneous rocks of the southern California batholith.

The Peninsular Ranges are traversed by several major active faults. The Whittier-Elsinore, San Jacinto and the San Andreas faults are major active fault systems located northeast of the site. The Newport-Inglewood fault is located southwest of the site. Major tectonic activity associated with these and other faults within this regional tectonic framework is predominately right-lateral strike-slip movement.

Our review of geologic literature indicates that the site is underlain by the Tertiary-aged Topanga Formation (Morton and Miller, 1981). The site does not appear to be underlain by known or mapped landslides, but it has been mapped as having a high propensity for rockfall during periods of high rainfall or seismic shaking (Morton, 1976). However, small landslides have been mapped in the vicinity of the site (Fife, 1974). The soils at the site are mapped as having a low expansivity potential.

The results of our subsurface exploration indicate that the site is underlain by loose fill soils, the Topanga Formation and the Vaqueros/Sespe Formation. Generalized descriptions of the materials encountered are presented below. More detailed descriptions are provided in the boring logs in Appendix A.

6.2. Fill

Previously-placed fill soils were encountered in all of the borings, and generally consisted of light brown to reddish brown, damp to moist, very loose to loose, silty sand and sandy silt. The fill appeared to be derived from sandstone and siltstone exposed during the mining operations. As such, boulder-sized material should be anticipated in the fill. The fill was approximately 35 feet thick in borings B-1 and B-3, and approximately 20 feet thick in boring B-2.

6.3. Alluvium

Quaternary-age alluvium was encountered at a depth of approximately 35 feet in boring B-3. The alluvium generally consisted of light brown sand.

6.4. Topanga Formation

The Topanga Formation was encountered in borings B-1 and B-2 below depths of approximately 35 and 20 feet, respectively. The formation generally consisted of light orange-brown sandy siltstone and silty sandstone.

6.5. Vaqueros/Sespe Formation

The Vaqueros/Sespe Formation was encountered in borings B-1, B-2, and B-3 below depths of approximately 45, 74 and 43 feet, respectively. The formation generally consisted of gray to bluish-green sandy to clayey siltstone.

6.6. Groundwater

Groundwater was encountered in boring B-2 at a depth of approximately 79 feet. Fluctuations in the groundwater table due to precipitation, irrigation, surface drainage, topography, geology, and other factors not apparent during our evaluation are possible and should be anticipated.

7. FAULTING AND SEISMICITY

Based on our review of readily available geologic maps, the site is not underlain by known active or potentially active faults. The nearest known active or potentially active faults are the Peralta Hills and the Whittier-Elsinore Fault zone, located approximately 10 and 11 miles from the site, respectively (Jennings, 1994). Earthquakes generated from the Whittier-Elsinore fault zone and from other active faults in southern California could produce significant ground accelerations and shaking at the site. The following table lists the predicted horizontal ground accelerations that

could occur at the site as a result of the Maximum Probable Earthquakes (MPE) assigned to major active faults within approximately 60 miles of the site. The MPE is the largest earthquake event that has a 10 percent probability of exceedance in the next 50 years under the presently known tectonic framework.

Table 1 – Seismic Parameters For Maximum Probable Earthquakes

Fault	Fault to Site Distrance (miles)	Maximum Probable Earthquake Magnitude[1]	Estimated Acceleration (g)	
			Peak Horizontal Bedrock[2]	Repeatable High Ground[3]
Agua Blanca-Coronado Bank	34	7.1	0.09	0.09
Cucamonga	30	6.6	0.08	0.08
El Modeno	11	6.0	0.15	0.10
Newport-Inglewood	14	6.5	0.16	0.10
Offshore Zone of Deformation	19	6.5	0.12	0.08
Palos Verdes	25	6.5	0.09	0.09
Peralta Hills	10	6.0	0.16	0.10
San Andreas (Central Mojave)	40	7.8	0.14	0.14
San Jacinto	33	7.0	0.09	0.09
Whittier-Elsinore	11	7.3	0.29	0.19

Notes:
[1] Wesnousky, 1986, Anderson et al., 1989, Everndon and Thomson, 1985, Wallace, 1990.
[2] Mualchin and Jones 1992
[3] Ploessel and Slosson 1974

Based on the indicated earthquake parameters for the faults listed, it is our opinion that the most significant probable event with respect to the project site would be an earthquake of magnitude 7.3 on the Whittier-Elsinore fault. Based on Mualchin and Jones (1992), the estimated peak horizontal bedrock acceleration produced at the site by such an event would be 0.29g. Because the epicenter would be within 20 miles of the site, a repeatable high ground acceleration (RHGA) of 65 percent of the peak, based on Ploessel and Slosson (1974), could be assigned to the site. Accordingly, the RHGA for the project site would be 0.19g, as shown in Table 1.

Seismic hazards at the site can be attributed to ground shaking caused by events on nearby and distant, active faults. The principal seismic hazard considerations in southern California are surface rupture, ground shaking, and seismically induced settlement. The probability of damage due to surface ground rupture appears to be relatively low due to the lack of active or potentially active faults crossing the site. Because of the loose, granular nature of the underlying soils, some seismically induced settlement is a possibility at the site.

8. CONCLUSIONS

Based on the results of our geotechnical evaluation, it is our opinion that construction of the proposed project is feasible from a geotechnical standpoint. Our review of published geologic data and our field observations do not indicate that the project site is underlain by landslides, although ancient landslides are present in close proximity to the site. In our opinion, the following geotechnical factors will be significant in the design and construction of the proposed improvements:

- The very loose and granular nature of the fill soils may result in significant erosion if not adequately addressed. It is important that surface drainage be directed away from the slope face and that the slopes are well vegetated to reduce the potential for erosion caused by surface runoff water over the slope face.
- We recommend that a stabilization fill be constructed on the proposed cut slopes over 10 feet high in existing fill to reduce the potential for erosion and surficial instability.
- Based on a review of background geologic documents, the bedding within the bedrock may be adversely oriented. The grading operations for the proposed cut slopes should be observed by the geotechnical consultant during construction.

9. RECOMMENDATIONS

The geotechnical recommendations presented in the following sections pertain to the proposed improvements associated with Site 17. These recommendations are limited to slope stability, erosion considerations, earthwork, cement type, and construction observation as they pertain to the proposed drainage structure. Other geotechnical aspects of the project were not addressed as

they were not within our limited scope of work. Considerations such as lateral loads on gabion walls, bearing capacity, settlement potential, and rippability of formational materials were not addressed, but are important aspects of the project.

9.1. Gross Stability of Slopes

Based on our review of project plans, we understand that the majority of the construction will consist of relatively shallow cuts, on the order of 10 feet deep, with the bottom of the excavation in loose fill. From approximately Station 5+40 to Station 9+00, the proposed gabion drainage structure will be up to approximately 40 feet below the existing ground surface. Based on our subsurface evaluation, the excavation will be through loose fill and into the underlying Topanga Formation over a portion of the alignment. Based on the project plans, a northwest-facing cut slope of up to 40 feet and a south-facing cut slope of up to 25 feet will be excavated at general inclinations of 3:1.

Stability analyses were performed on what is likely the critical sections of the proposed cut slopes using the PCSTABL5M computer program (Purdue University, 1988) assuming both static and seismic loading conditions. The stability under seismic loading conditions was evaluated using pseudo-static parameters assuming a repeatable seismic acceleration of 0.19g.

Shear strength parameters used in our analysis were obtained from laboratory test results and our experience with similar material types, as well as our engineering judgment. The shear strength parameters used in our analysis are summarized in Table 2.

Table 2 - Slope Stability Shear Strength Parameters

Geologic Unit	Moist Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
Fill	125	28	200
Topanga Formation:			
across bedding	125	31	800
along bedding	125	30	400

Our analyses indicate that the finished slopes constructed at a 3:1 (horizontal to vertical) inclination will be grossly stable. Our analysis indicated that the proposed slopes have factors of safety greater than 1.5 for static conditions and greater than 1.1 for pseudo-static conditions. The analysis assumes that adverse geologic conditions, such as out-of-slope dipping clay seams, significant fractures or other adversely oriented discontinuities are not exposed in the cut slope during slope excavation. This assumption should be checked during grading.

9.2. Temporary Stability of Slopes

Based on our review of the project plans, slopes will be excavated and left exposed until the drainage improvements are constructed. The loose fill may be able to stand at fairly steep inclinations for a short time because of some cohesive binder. However, if the material becomes saturated, the soil will have low shear strength, will be highly erodable, and may cave if excavated too steeply. Therefore, for worker safety, we recommend that all excavations in the fill be made in accordance with OSHA recommendations, with proper sloping or shoring.

9.3. Surficial Stability and Erosion Considerations

As observed in our subsurface borings, the fill overlying the bedrock is loose to very loose, and generally consists of fine sand and silt. In their present condition, the existing fill soils are highly erodable, and susceptible to surficial instability when saturated. To enhance surficial slope stability and reduce the potential for erosion, we recommend that where existing fill is exposed at the face of cut slopes less than 10 feet high, the fill be scarified, moisture conditioned, and compacted in place. Where fill is anticipated to be exposed on the larger cut slopes, between approximately Station 5+40 and Station 9+00, we recommend the existing fill at the slope face be removed and replaced by a stabilization fill (Figure 3). The stabilization fills should extend from the top of the slopes to the existing fill/bedrock contact, or toe of the 3:1 slope if bedrock is not encountered. An approximately equipment-width key, tilted 2 percent or more in towards the slope, should be excavated at the base of the stabilization fills. The location of stabilization fill keys should be selected by the geotechnical consultant during grading, after the 3:1 slopes have been cut to design grades. Fill material for the stabilization fill should be placed in lifts, and compacted to 90 percent or more relative compaction, in accordance with the earthwork recommendations presented in Section 9.4.

For the slope on the southeast side of the channel, we recommend a subdrain be installed along the heel of the key. This is intended to collect potential groundwater seepage perched along the fill/bedrock contact and discharge it to the gabion channel. The subdrain should be constructed in accordance with the details presented on Figure 3.

Provided the above recommendations are followed, the surficial stability of the proposed graded slopes should be adequate for the intended use. The calculated factor of safety against surficial instability will be greater than 1.5. Most man-made slopes will weather and erode over time as a result of runoff, wetting and drying cycles, biologic forces, and gravity. The degrading effects of these processes can be substantially reduced by appropriate protective and maintenance measures. To improve the future performance of graded slopes at the site, surface drainage should be controlled such that runoff does not flow over the tops of slopes.

This may be accomplished though the construction of brow ditches, graded berms, or other measures, as recommended by the project civil engineer. Slope planting should be accomplished as soon as practicable after the completion of grading. Vegetation should consist of a combination of shallow and deep-rooted, drought-tolerant plants. Native vegetation is generally desirable. A landscape architect should be consulted regarding the actual types of plants and planting configuration to be used, as well as other landscaping-related measures which may be implemented to reduce slope erosion.

9.4. Earthwork

The majority of the grading at the site will be excavations through loose fill soil and the underlying bedrock. We anticipate that most of the excavated material will be suitable for re-use as fill or backfill, if appropriately moisture conditioned. However, some cobbles and boulders will likely be encountered that should be processed or disposed of off site.

We recommend that the initial excavation of the cut slopes be performed at the proposed finished lines and grades under the observation of the geotechnical consultant. The location of the fill/bedrock contact can be noted, and then the earthwork for the stabilization fill can be accomplished. Additional remedial measures may become necessary during grading if out-of-slope dipping bedding or clay seams, significant fractures or other adversely oriented discontinuities are exposed in the cut slope during slope excavation.

Fill will be placed during remedial grading of the slope and for subgrade preparation. Further, backfilling may be necessary behind gabion bins. Fill should be placed in horizontal lifts of approximately 8 inches in loose thickness and compacted by appropriate mechanical methods. Fill material should be moisture conditioned as appropriate, and compacted to 90 percent or more relative compaction in accordance with ASTM D 1557-91. Fill should be generally free of material in excess of 6 inches in diameter.

9.5. Material Types

The corrosion potential of the on-site materials was analyzed to evaluate its effect on the proposed drainage structure. The resistivity and chloride content of representative soil samples indicate that the soil is very corrosive to ferrous metals. Therefore, we recommend that appropriate corrosion protection be applied to gabion bins, and other ferrous metals in contact with soil.

The water-soluble sulfate content of the sample tested for this evaluation was 0.05 percent by weight. Based on the American Concrete Institute Criteria (ACI, 318-89), this test result indicates a negligible sulfate exposure to concrete. Based on these laboratory test results, we recommend that Type II Modified cement be used in concrete structures, with 2 inches or more of concrete cover over steel reinforcement where in contact with soil.

9.6. Construction Observation

We did not perform a subsurface evaluation that would allow us to evaluate the site for the potential for massive bedrock landslides as this was not within our limited scope of work. Since the site is within an area with potential ancient landslides, we recommend that the geotechnical consultant observe the excavation where bedrock is exposed to map the exposed face, and provide remedial grading recommendations if necessary.

Further, the recommendations provided in this report are based on subsurface conditions disclosed by widely spaced exploratory borings. The assumed subsurface conditions should be checked by the geotechnical consultant in the field during construction. Observation and testing of the compacted fill at the site should be performed by the geotechnical consultant.

The recommendations provided in this report assume that Ninyo & Moore will be retained as the geotechnical consultant during the construction phase of the project. If another geotechnical consultant is selected, we request that the selected consultant provide a letter to the governing agency (with a copy to Ninyo & Moore) indicating that they fully understand

Ninyo & Moore's recommendations, and that they are in full agreement with the recommendations contained in this report.

10. LIMITATIONS

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

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

Our conclusions, recommendations and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. In the event of any changes in the nature, design, or locations of the proposed improvements, the conclusions and recommendations presented herein may not be valid unless the changes are evaluated by Ninyo & Moore and the conclusions of this report are modified in writing. It should be understood that the conditions of a site can change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition,

changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

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

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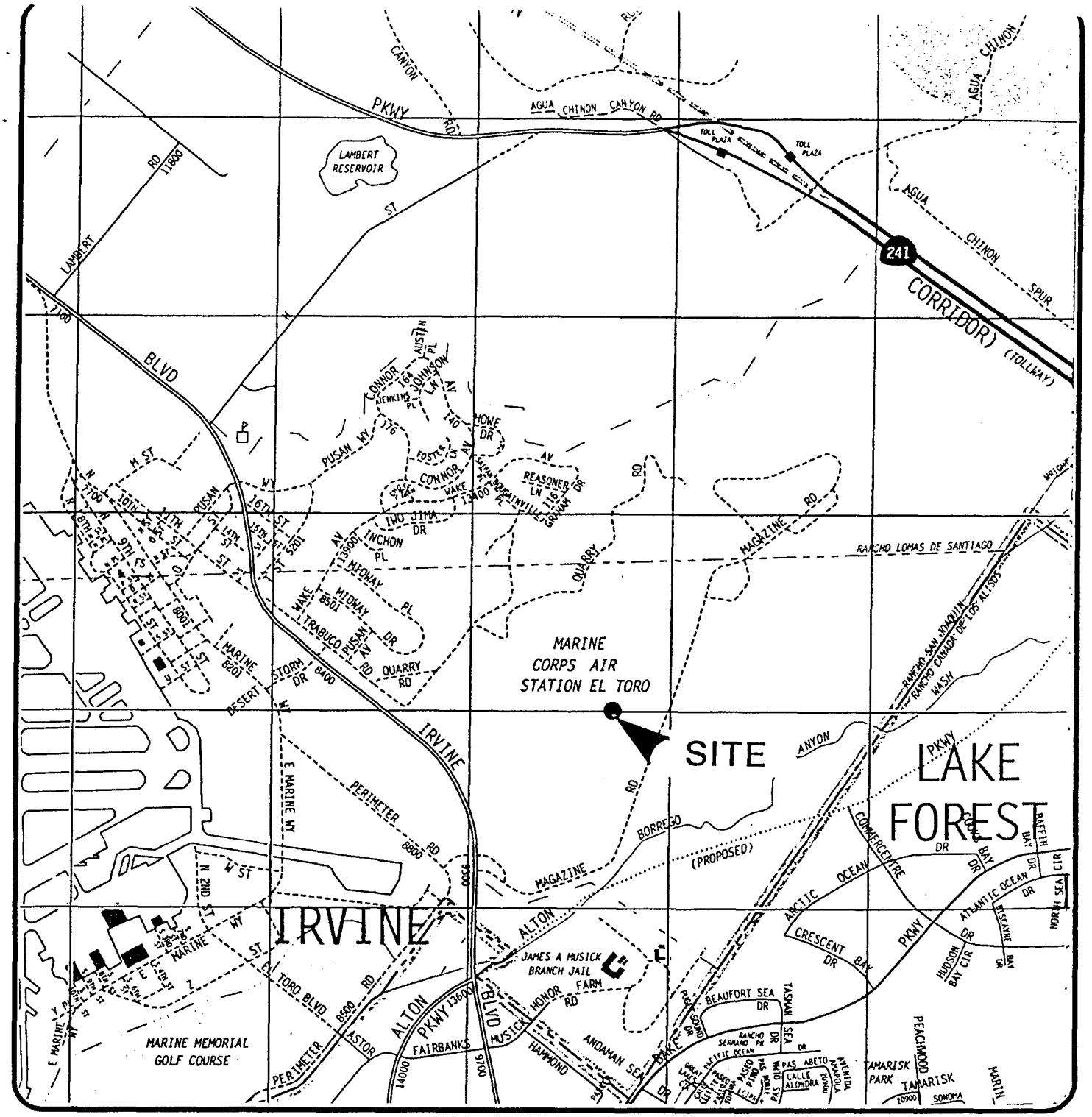
AERIAL PHOTOGRAPHS				
Source	**Scale**	**Date**	**Flight**	**Numbers**
USDA	1:20,000	12-12-52	AXK-3K	36 and 37



REFERENCE: 1996 Thomas Guide for Los Angeles and Orange Counties, Street Guide and Directory

NORTH

0 1900 3800

Approximate Scale in Feet

Ninyo & Moore

SITE LOCATION MAP

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	1

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

September 5, 1997
Project No. 201010-01

Mr. Guijun Hu
OHM Remediation Services Corporation
2031 Main Street
Irvine, California 90624

Subject: Addendum to Geotechnical Slope Stability Evaluation
Marine Corps Air Station El Toro, Site 17
El Toro, California

References: Ninyo & Moore, 1997, Geotechnical Slope Stability Evaluation, Marine Corps Air Station El Toro, Site 17, MCAS El Toro, El Toro, California: dated July 7.

Dear Mr. Hu:

As requested, we reviewed the changes in the channel design from gabions to a riprap-lined channel with respect to slope stability, and met on site with personnel from OHM Remediation Services Corporation and Montgomery Watson to review construction procedures. We are providing this addendum to our referenced report to present our findings and summarize our understanding of the project.

GROSS STABILITY OF SLOPES

In our referenced report, we evaluated the stability of proposed cut slopes based on project plans prepared by Montgomery Watson dated March 25, 1997. We concluded that the finished slopes constructed at a 3:1 (horizontal to vertical) inclination will be grossly stable assuming that adverse geologic conditions are not exposed during slope excavation. We evaluated the slope stability after the channel was redesigned using riprap in lieu of gabion walls and a reno mattress as presented in the as-builts in OHM's project files. The bottom approximately 5 feet of the cut slope was steepened to an inclination of approximately 2:1. The slopes are also grossly stable with this design change.

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14175 Telephone Avenue • Suite Q • Chino, California 91710 • Phone (909) 465-5125 • Fax (909) 465-5126

SURFICIAL STABILITY AND EROSION

The existing fill was observed in subsurface borings and during grading to generally consist of damp to moist, very loose to medium dense, silty sand. To reduce the likelihood of erosion and surficial failures on the 3:1 cut slopes, our report recommended the existing near-surface fill be removed and replaced as engineered fill compacted to 90 percent or more relative compaction as presented in Figure 3 of our referenced report. Based on our conversation on July 22, 1997 with personnel from OHM Remediation Services Corporation and Montgomery Watson, we understand that the drainage channel construction is intended as a temporary measure to mitigate the impact of surface runoff on the Communication Station Landfill. Because of the planned short design life of the channel and graded slopes, and the anticipated limited impact of surface failures or erosion on the drainage structure, the contractor has elected not to construct the stabilization fills, subsurface drains, and brow ditches to improve the surficial performance of the slopes. Surficial erosion of the slope face, and associated maintenance should be anticipated.

The geotechnical analysis presented in this addendum was conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in this area. We appreciate the opportunity to provide our geotechnical consulting services.

Respectfully submitted,
NINYO & MOORE

Deron J. van Hoff, P.E.
Project Engineer

Carol A. Price, C.E.G.
Chief Engineering Geologist

Jalal Vakili, Ph.D., P.E.
Principal Engineer

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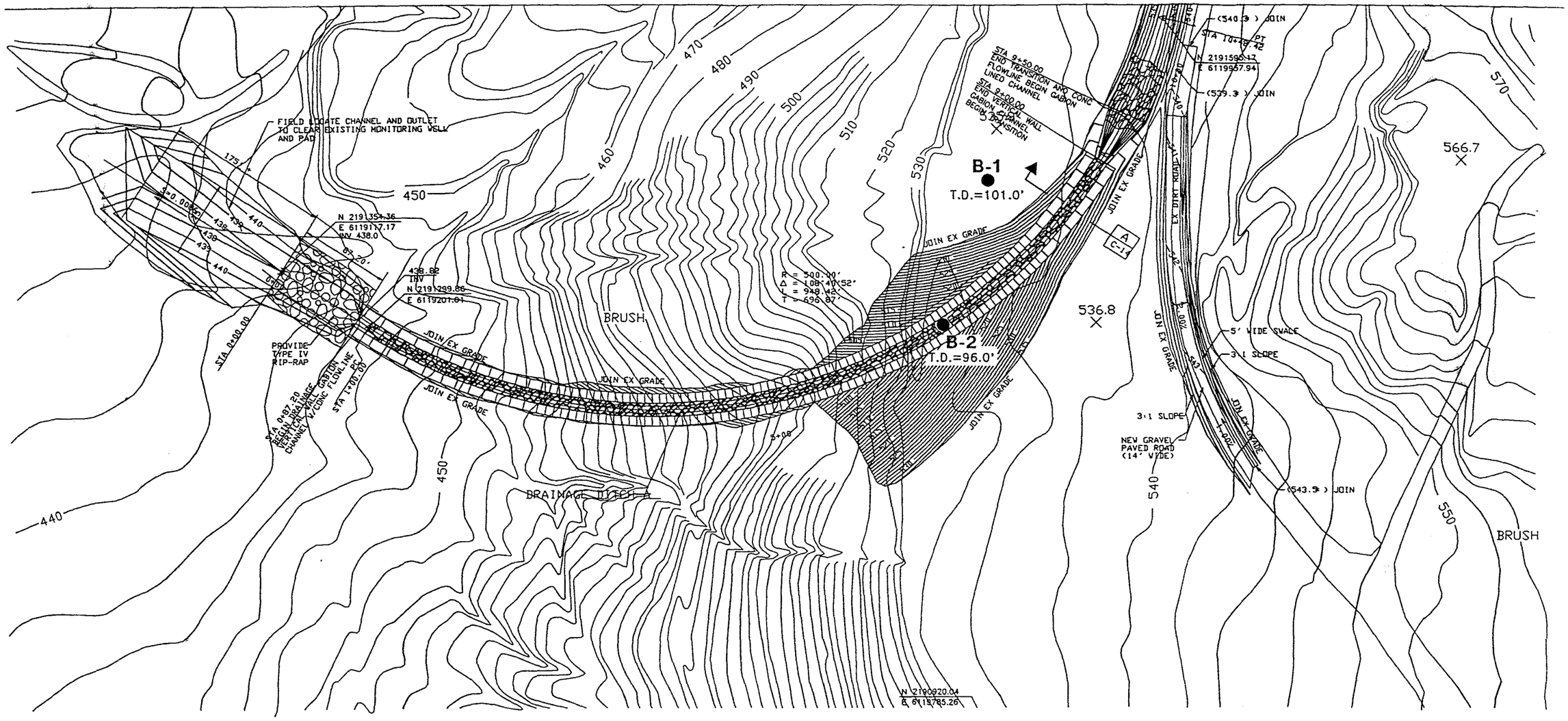
REGISTERED GEOLOGIST
Carol A. Price
No. 1774
Certified Engineering Geologist
Exp. 4/30/99
STATE OF CALIFORNIA

DV/CAP/JV/tw

Distribution: (3) Addressee

MATCH LINE – SEE SHEET 2B



0 100 200

Approximate Scale in Feet

LEGEND

B-3 ● T.D.=61.3' — Approximate location of exploratory boring, T.D.=total depth.

Ninyo & Moore

SITE PLAN

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	2A

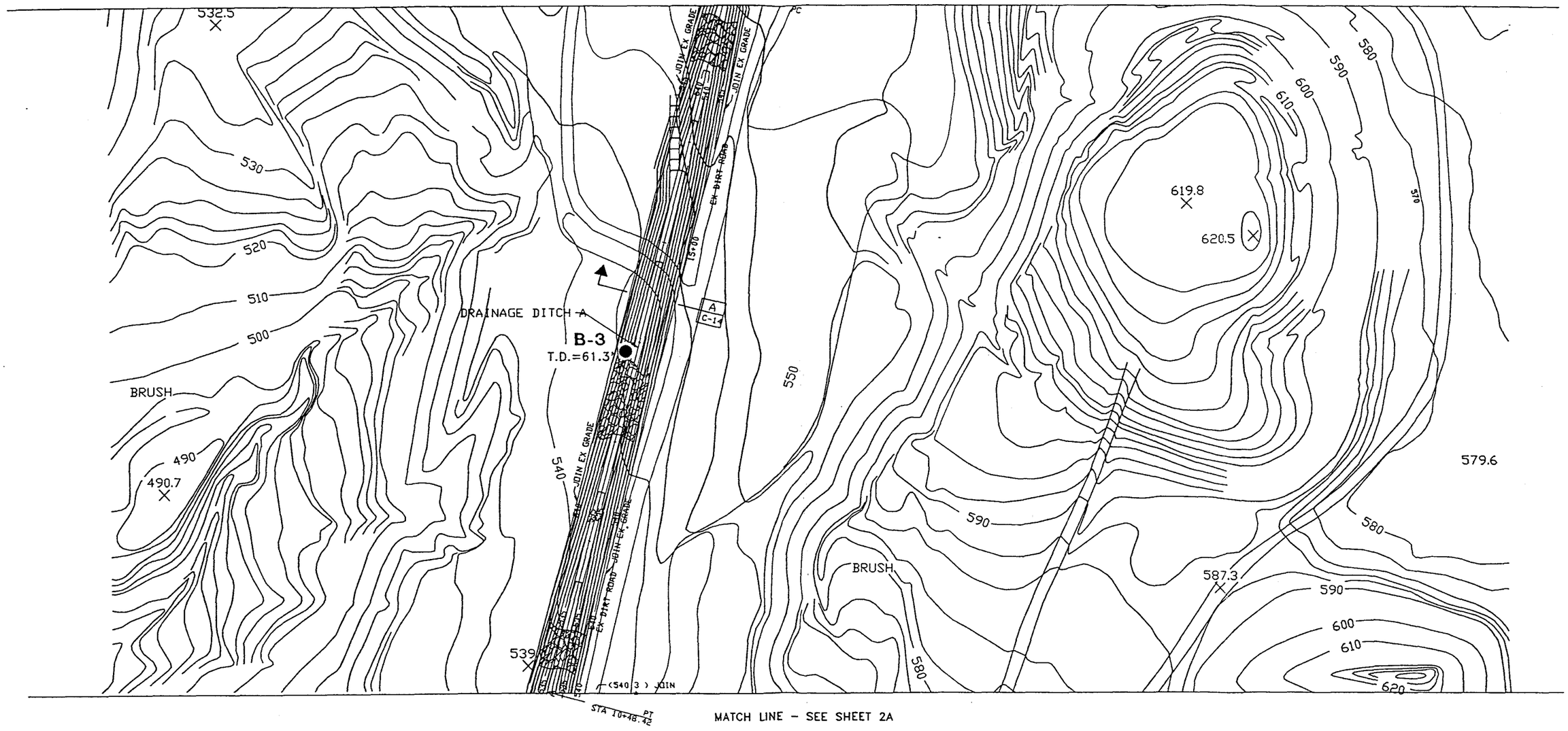
SOURCE: BASE MAP PROVIDED BY MONTGOMERY WATSON, 1997.

NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

1010f2a

3

MATCH LINE – SEE SHEET 2C



0 100 200
Approximate Scale in Feet

LEGEND

B-3 ● T.D.=61.3' — Approximate location of exploratory boring, T.D.=total depth.

Ninyo & Moore

SITE PLAN

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

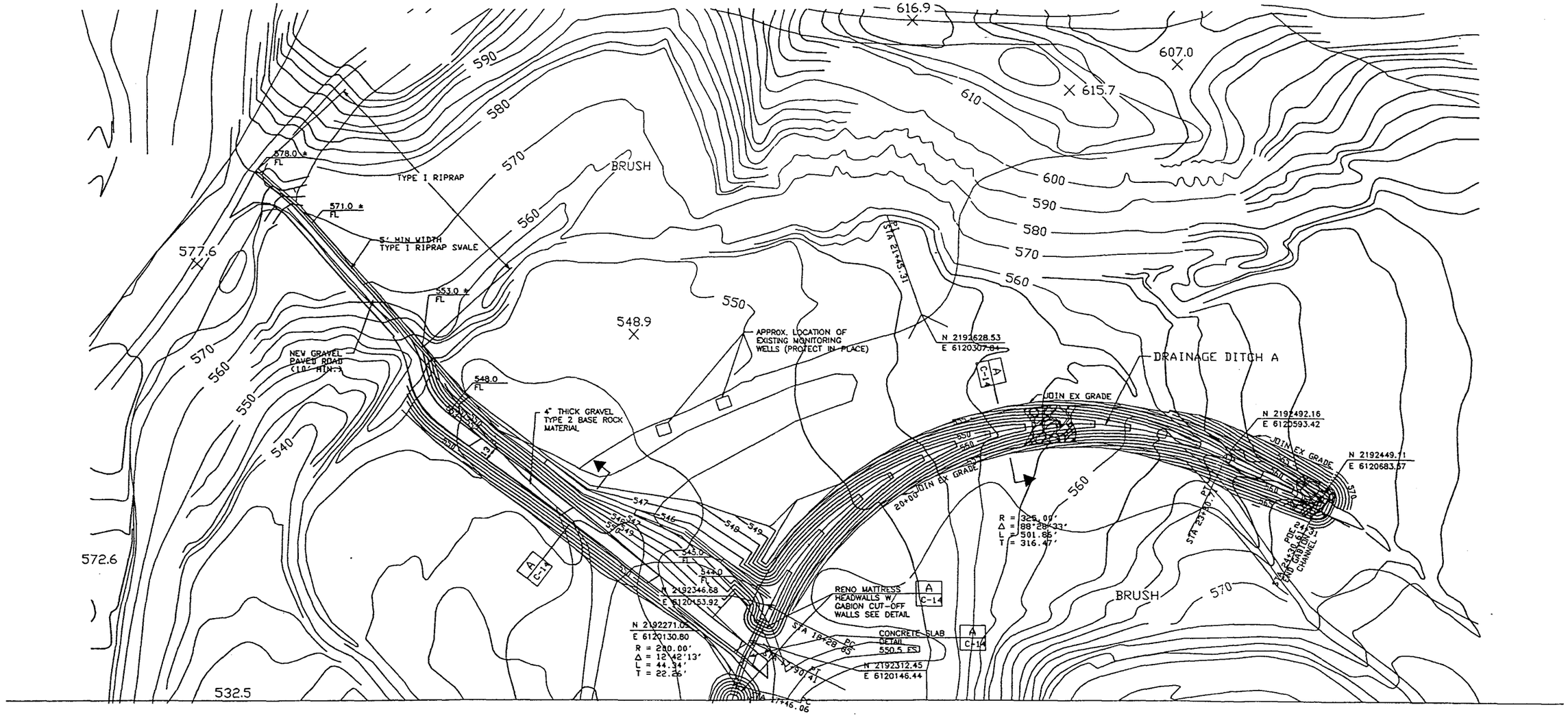
PROJECT NO.	DATE	FIGURE
201010-01	7/97	2B

SOURCE: BASE MAP PROVIDED BY MONTGOMERY WATSON, 1997.

NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

1010F2b

4



MATCH LINE – SEE SHEET 2B

0 100 200

Approximate Scale in Feet

LEGEND

B-3 ● T.D.=61.3' — Approximate location of exploratory boring, T.D.=total depth.

Ninyo & Moore

SITE PLAN

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	2C

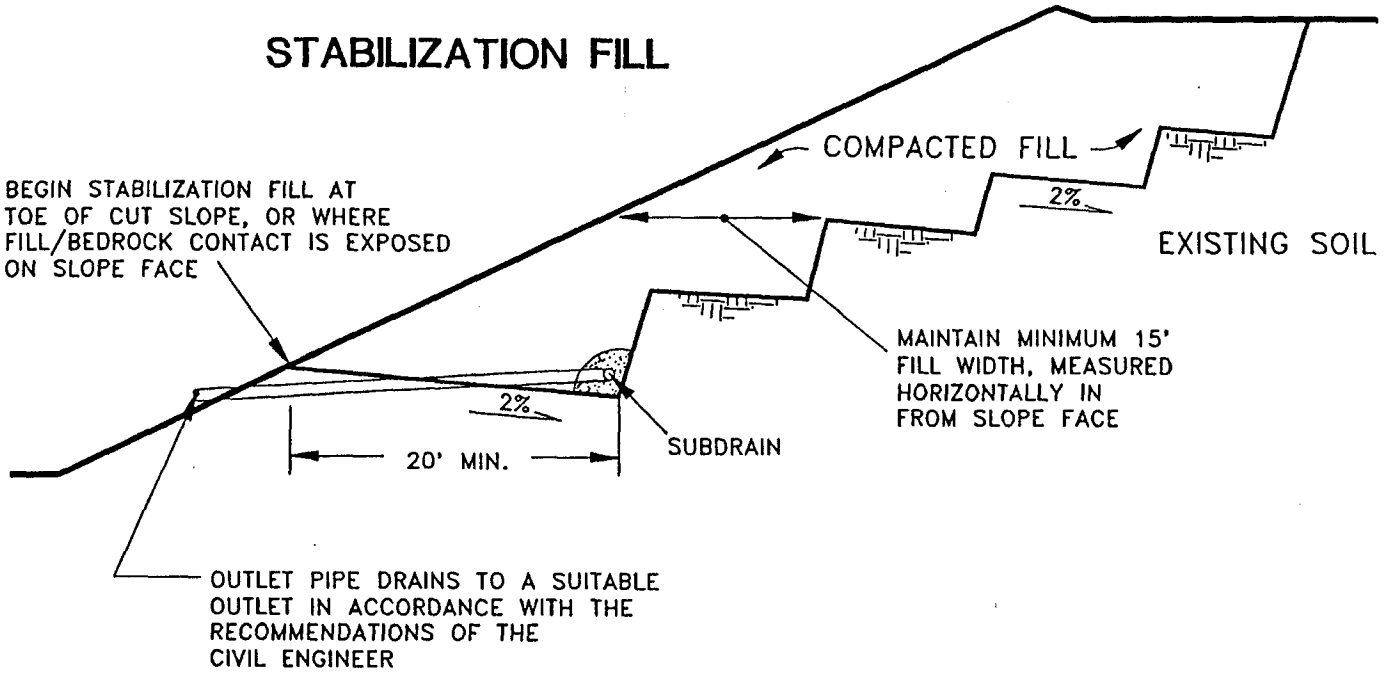
SOURCE: BASE MAP PROVIDED BY MONTGOMERY WATSON, 1997.

NOTE: ALL DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

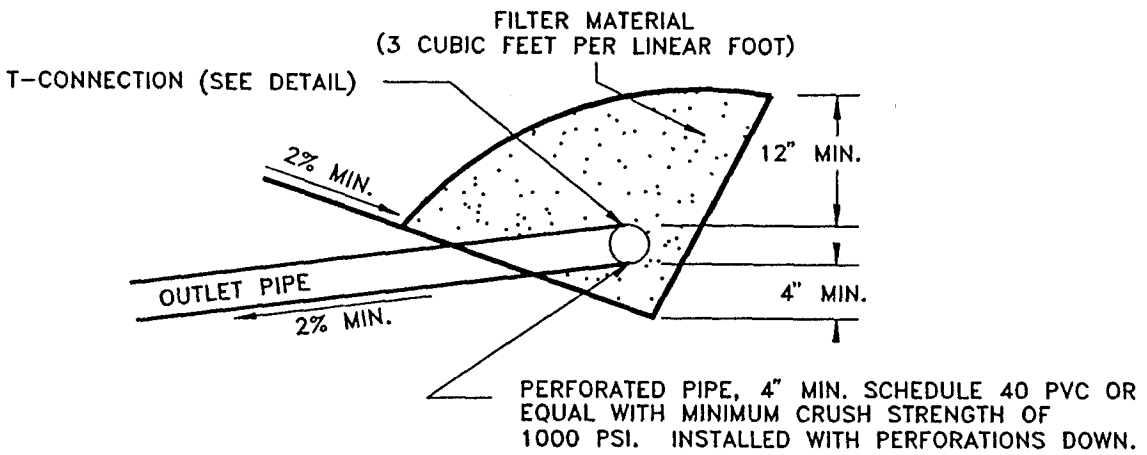
1010F2c

5

STABILIZATION FILL



SUBDRAIN DETAIL



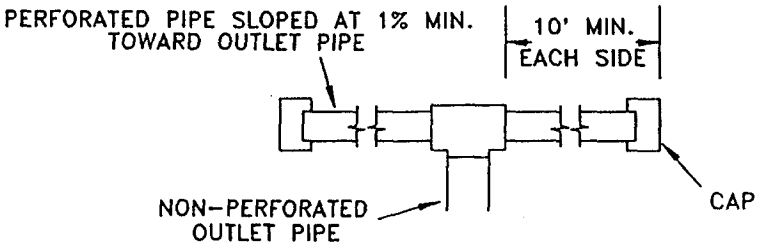
FILTER MATERIAL

FILTER MATERIAL SHALL BE CLASS II PERMEABLE MATERIAL PER STATE OF CALIFORNIA STANDARD SPECIFICATION OR APPROVED GRAVEL AND FILTER FABRIC WRAP ALTERNATIVE

CLASS II GRADATION

SIEVE SIZE	PERCENT PASSING
1"	100
3/4"	90–100
3/8"	40–100
No. 4	25–40
No. 8	18–33
No. 30	5–15
No. 50	0–7
No. 200	0–3

T-CONNECTION DETAIL



NOT TO SCALE

I:\1010F3_G

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SLOPE STABILIZATION FILL DETAIL

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	3

6

APPENDIX A

FIELD TESTING AND LOGS

Field Sampling Procedures

Disturbed Samples

Disturbed soil samples were obtained in the field using the methods described in the subsequent sections.

Bulk Samples

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

Relatively Undisturbed Samples

Undisturbed soil samples were obtained in the field using the methods described in the subsequent sections.

The Modified Split-Barrel Drive Sampler

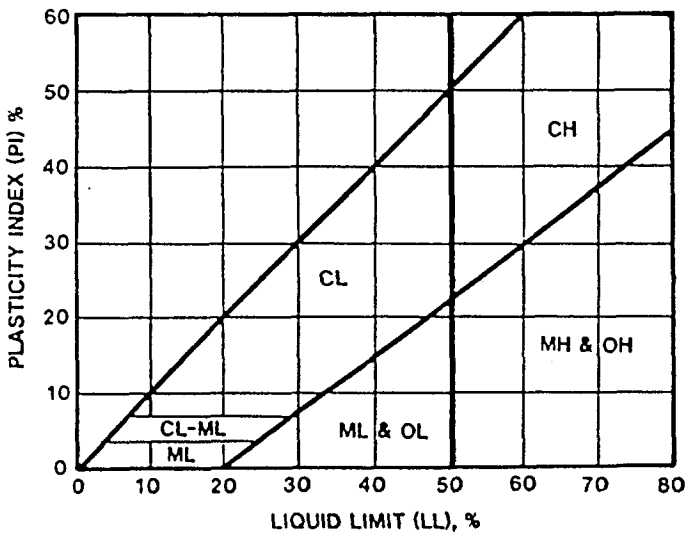
The sampler, with an external diameter of 3.0 inches, is lined with 1-inch long, thin, brass rings with inside diameters of approximately 2.4 inches. The sample barrel is driven into the ground with the weight of a hammer or the kelly bar of the drill rig in general accordance with ASTM D 3550-84. The driving weight is permitted to fall freely. The approximate length of the fall, the weight of the hammer or bar, and the number of blows per foot of driving, or as indicated, are presented on the boring logs as an index to the relative resistance of the sampled materials. The samples are removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

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

CLASSIFICATION CHART (Unified Soil Classification System)

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL	3" to No. 4	76.2 to 4.76
Coarse	3" to 3/4"	76.2 to 19.1
Fine	3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to No. 200	4.76 to 0.074
Coarse	No. 4 to No. 10	4.76 to 2.00
Medium	No. 10 to No. 40	2.00 to 0.420
Fine	No. 40 to No. 200	0.420 to 0.074
SILT & CLAY	Below No. 200	Below 0.074

GRAIN SIZE CHART



PLASTICITY CHART

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

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0								Auger (A)
								Solid line denotes formation change.
								Modified split-barrel drive sampler (C)
								No recovery with modified Split-Barrel Drive Sampler (B)
								Dutch cone test (D)
5								Seepage
								Rock Cores (E)
								Groundwater encountered during drilling.
								Groundwater measured after drilling.
								Piston (I)
								Dashed line denotes lithologic change
10								Standard Penetration Test (P)
								No recovery with a standard penetration test (T)
								Shelby tube sample (R)
			XX/XX					Distance pushed in inches/Length of sample recovered in inches.
								No recovery with Shelby tube sampler (X)
15								Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Sheared Bedding Surface
20								The total depth line is a solid line that is drawn at the level of the last entry.

DATE DRILLED _____ BORING NO. SAMPLE

GROUND ELEVATION _____ SHEET 1 OF 1

METHOD OF DRILLING _____

DRIVE WEIGHT _____ DROP _____

SAMPLED BY _____ LOGGED BY _____ REVIEWED BY _____

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BORING LOG

EXPLANATION OF BORING LOG

PROJECT NO. SAMPLE	DATE Rev.3/95	FIGURE

3

DATE DRILLED 4/28/97 BORING NO. B-1

GROUND ELEVATION 535.5' ±(MSL) SHEET 1 OF 6

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ML	FILL: Light olive brown, moist, very stiff, sandy SILT.
							SM	Light orange-brown, moist, medium dense, silty fine SAND; few gravel-sized chunks of weathered sandstone.
5			39					
10			9					Loose.
15			11	14.7	91.8			Iron oxide staining.
20								

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4

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-1

DATE DRILLED 4/28/97 BORING NO. [illegible]

GROUND ELEVATION 535.5' ±(MSL) SHEET 2 OF 6

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	9				SM	FILL: (Continued) Light orange-brown, moist, loose, silty SAND; few gravel-sized chunks of weathered sandstone.
25		■	11					Gray; Iron oxide staining.
30	■		8				ML	Dark brown, moist, firm, sandy SILT.
35		■	109/9"	17.4	102.4			TOPANGA FORMATION: Orange, moist, weakly cemented, fine sandy SILTSTONE.
40								

Ninyo & Moore

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-2

DATE DRILLED 4/28/97 BORING NO. B-1

GROUND ELEVATION 535.5' ±(MSL) SHEET 3 OF 6

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40		■	100/5"					TOPANGA FORMATION: (Continued) Orange, moist, weakly indurated, fine sandy SILTSTONE.
45		■	100/2"					VAQUEROS/SESPE FORMATION: Gray, moist, moderately cemented, sandy SILTSTONE; iron oxide staining.
50		■	100/5"					Light brown.
55								
60								

Ninyo & Moore

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-3

DATE DRILLED 4/28/97 BORING NO. B-1

GROUND ELEVATION 535.5' ±(MSL) SHEET 4 OF 6

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
60		■	70/6"					VAQUEROS/SESPE FORMATION: (Continued) Light brown, moist, moderately cemented, sandy SILTSTONE.
65								
70		■	100/6"					
75								
80								

Ninyo & Moore

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-4

DATE DRILLED 4/28/97 BORING NO. B-1

GROUND ELEVATION 535.5' ±(MSL) SHEET 5 OF 6

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
80		■	70/6"					VAQUEROS/SESPE FORMATION: (Continued) Dark gray, moist, moderately cemented, sandy SILTSTONE.
85								
90		■	100/6"					Moderately indurated; clayey siltstone.
95								
100								

Ninyo & Moore

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-5

DATE DRILLED 4/28/97 BORING NO. B-1

GROUND ELEVATION 535.5' ±(MSL) SHEET 6 OF 6

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
100		■	100/6"					VAQUEROS/SESPE FORMATION: (Continued) Dark gray, moist, moderately indurated, clayey SILTSTONE.
								Total Depth = 101.0 feet. No groundwater encountered. Backfilled on 4/28/97.
105								
110								
115								
120								

Ninyo & Moore

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-6

DATE DRILLED 4/29/97 BORING NO. B-2

GROUND ELEVATION 534' ±(MSL) SHEET 1 OF 5

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						SM	FILL: Light olive brown, moist, loose, silty fine SAND; few gravel-sized chunks of weathered sandstone.
5		14					
10		9	16.5	90.1			
						ML	Light orange-brown, moist, firm, sandy SILT; few gravel-sized chunks of weathered sandstone/siltstone.
15		7					
20							

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BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-7

DATE DRILLED 4/29/97 BORING NO. B-2

GROUND ELEVATION 534' ±(MSL) SHEET 2 OF 5

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	100/6"					TOPANGA FORMATION: Light orange-brown, damp, weakly cemented silty fine SANDSTONE.
								Reddish brown; fine to coarse sandstone.
25		■	88					Light brown; silty fine sandstone.
30		■	95	7.6	96.5			Orange.
35		■	101					Light orange-brown.
40								

Ninyo & Moore

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-8

DATE DRILLED 4/29/97 BORING NO. B-2

GROUND ELEVATION 534' ±(MSL) SHEET 3 OF 5

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLE Bulk	SAMPLE Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40		■	50/3"					TOPANGA FORMATION: (Continued) Light orange-brown, moist, weakly cemented, silty fine SANDSTONE.
45		■	60/6"					
50		■	100/6"					
55		■	100/5"					
60								

Ninyo & Moore

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-9

DATE DRILLED 4/29/97 BORING NO. B-2

GROUND ELEVATION 534' ±(MSL) SHEET 4 OF 5

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
60								TOPANGA FORMATION: (Continued) Light orange-brown, moist, weakly cemented, silty fine SANDSTONE.
65		■	100/4"					
70								
75		■	100/4"					VAQUEROS/SESPE FORMATION: Bluish-green, moist, moderately cemented, silty clayey SANDSTONE and sandy clayey SILTSTONE; moderately weathered.
80				▽				@ 79.0': Groundwater encountered during drilling. Saturated.

Ninyo & Moore

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-10

DATE DRILLED 4/29/97 BORING NO. B-2

GROUND ELEVATION 534' ±(MSL) SHEET 5 OF 5

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
80								VAQUEROS/SESPE FORMATION: (Continued) Bluish-green, saturated, moderately cemented, silty clayey SANDSTONE and sandy clayey SILTSTONE.
85		■	100/5"					
90								
95		■	100/6"					Dark gray.
100								Total Depth = 96.0 feet. Groundwater encountered at approximately 79 feet during drilling. Backfilled on 4/29/97.

Ninyo & Moore

BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-11

DATE DRILLED 4/28/97 BORING NO. B-3

GROUND ELEVATION 540' ±(MSL) SHEET 1 OF 4

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							SM	FILL: Orange-brown, moist, loose, silty fine SAND.
5			15					Light olive gray; damp to moist; iron oxide staining; trace gravel-sized chunks of weathered sandstone.
10			30	12.1	96.4			Medium dense.
15			11					Gray; loose; iron oxide staining.
20								

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BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-12

DATE DRILLED 4/28/97 BORING NO. B-3

GROUND ELEVATION 540' ±(MSL) SHEET 2 OF 4

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLE Bulk	SAMPLE Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		■	9				SM	FILL: (Continued) Gray, damp to moist, loose, silty fine SAND; iron oxide staining; trace gravel-sized chunks of weathered sandstone.
25		X	41					Asphalt concrete and gravel in sampler.
30		■	7					Dark brown, moist, very loose, silty SAND; fine to medium sand; trace clay.
		■						Gravel layer.
35		■	82				SP	ALLUVIUM: Light brown, damp to moist, dense, fine to medium SAND.
40								

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BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-13

DATE DRILLED 4/28/97 BORING NO. B-3

GROUND ELEVATION 540' ±(MSL) SHEET 3 OF 4

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
40		X	100/6"				SP	ALLUVIUM: (Continued) Light brown, damp to moist, very dense, fine to medium SAND.
45		■	121					VAQUEROS/SESPE FORMATION: Dark green, moist, moderately indurated, clayey SILTSTONE; slightly weathered.
50		■	147					Iron oxide staining.
55		X	100/4"					
60								

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BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-14

DATE DRILLED 4/28/97 BORING NO. B-9

GROUND ELEVATION 540' ±(MSL) SHEET 4 OF 4

METHOD OF DRILLING 8" Hollow Stem Auger (A & R Drilling)

DRIVE WEIGHT 140 lbs. DROP 30"

SAMPLED BY EJA LOGGED BY EJA REVIEWED BY CAP

DEPTH (feet)	SAMPLE Bulk	SAMPLE Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
60		■	105/ 10"					VAQUEROS/SESPE FORMATION: (Continued) Dark green, moist, moderately cemented, sandy SILTSTONE.
								Total Depth = 61.3 feet. No groundwater encountered. Backfilled on 4/28/97.
65								
70								
75								
80								

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BORING LOG

Site 17/MCAS El Toro
El Toro, California

PROJECT NO.	DATE	FIGURE
201010-01	7/97	A-15

APPENDIX B

LABORATORY TESTING

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classification System. Soil classifications are indicated on the logs of the exploratory excavations in Appendix A.

In-Place Moisture and Density Tests

The moisture content and dry density of relatively undisturbed samples obtained from the exploratory excavations were evaluated in general accordance with ASTM D 2937-94. The test results are presented on the logs in Appendix A.

Gradation Analysis

Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422-63. The grain-size distribution curves are shown on Figures B-1 and B-2. These test results were utilized in evaluating the soil classifications in accordance with the Unified Soil Classification System.

Consolidation Tests

Consolidation tests were performed on selected relatively undisturbed soil samples in general accordance with ASTM D 4546-90. The samples were inundated during testing to represent adverse field conditions. The percent consolidation for each load cycle was recorded as a ratio of the amount of vertical compression to the original height of the sample. The results of the tests are summarized on Figures B-3 through B-5.

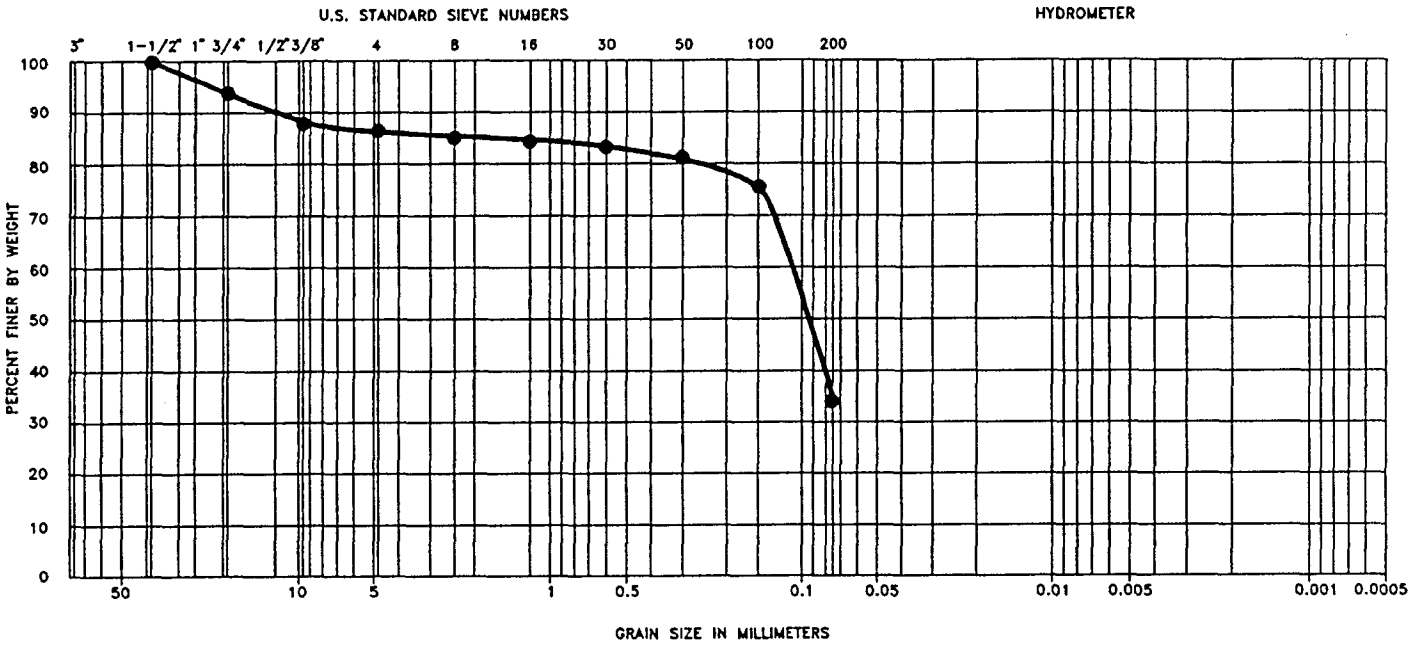
Direct Shear Tests

Direct shear tests were performed on undisturbed samples in general accordance with ASTM D 3080-90 to evaluate the shear strength characteristics of selected materials. The samples were inundated during shearing to represent adverse field conditions. The strain rate was0.01 inch per minute. Results are shown on Figures B-6 and B-7.

Soil Corrosivity Tests

Soil pH, water pH, and resistivity tests were performed on a representative soil sample in general accordance with California Test (CT) 643. The chloride content of a selected sample was evaluated in general accordance with CT 422. The sulfate content of a selected sample was evaluated in general accordance with CT 417. The test results are presented on Figure B-8.

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
●	B-1	5.0-6.5	-	-	-	SM

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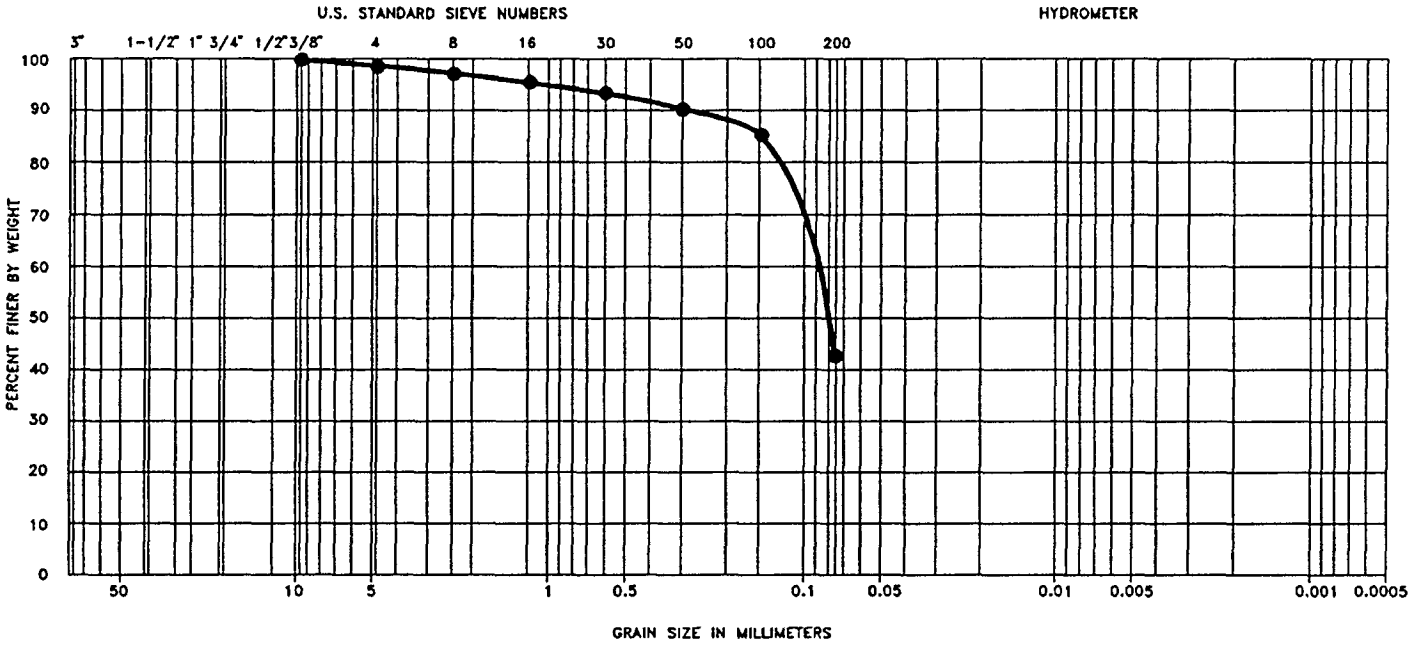
GRADATION TEST RESULTS

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	B-1

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	Silt	Clay



Symbol	Hole Number	Depth (Feet)	Liquid Limit	Plastic Limit	Plasticity Index	Soil Type
●	B-3	15.0-16.5	–	–	–	SM

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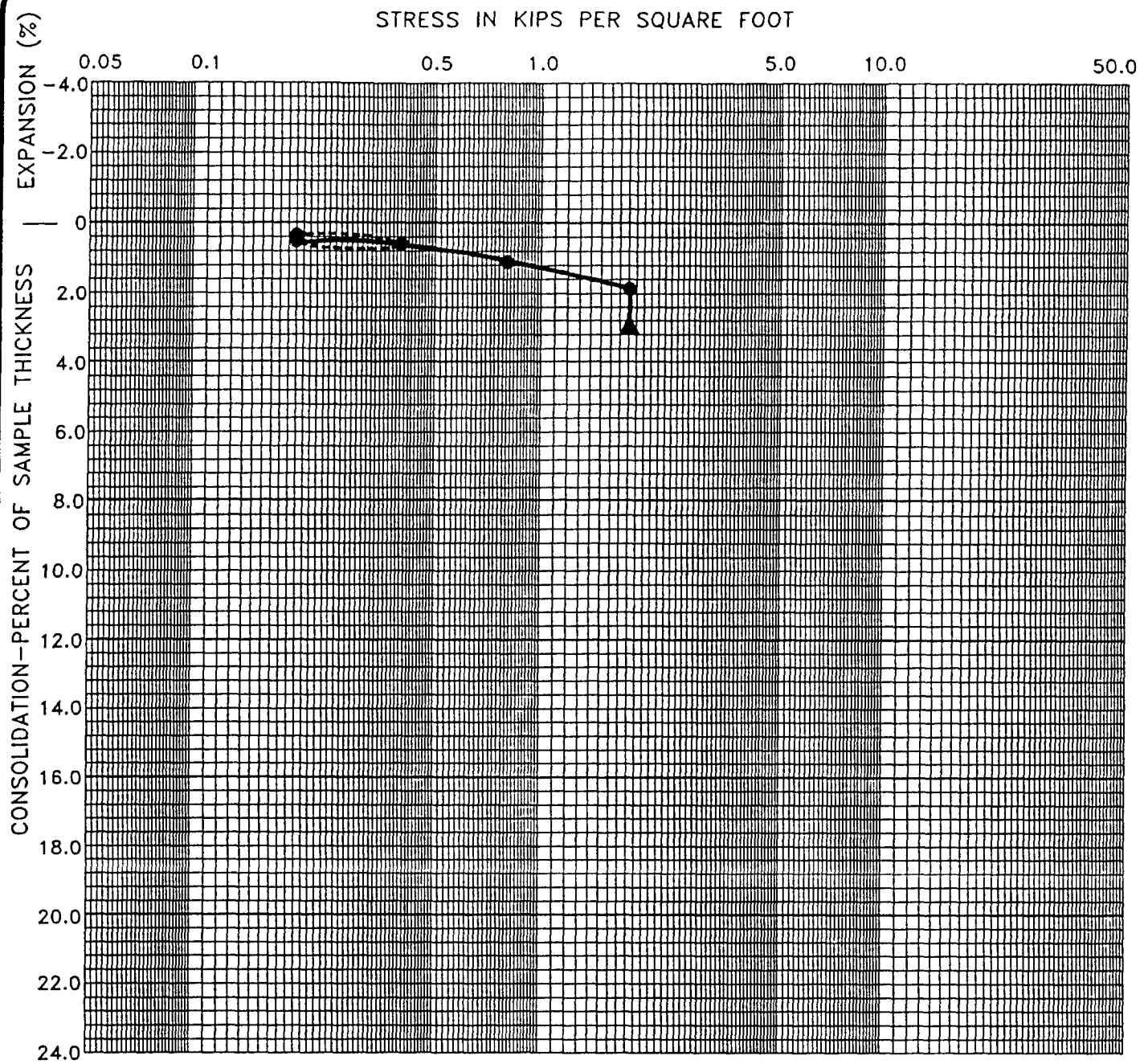
GRADATION TEST RESULTS

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	B-2

4



● Field Moisture	——— Loading	Boring No.	B–1
▲ Inundated	– – – Rebound	Depth (Ft.)	15.0–16.5
	-------- Seating Cycle	Soil Type	SM

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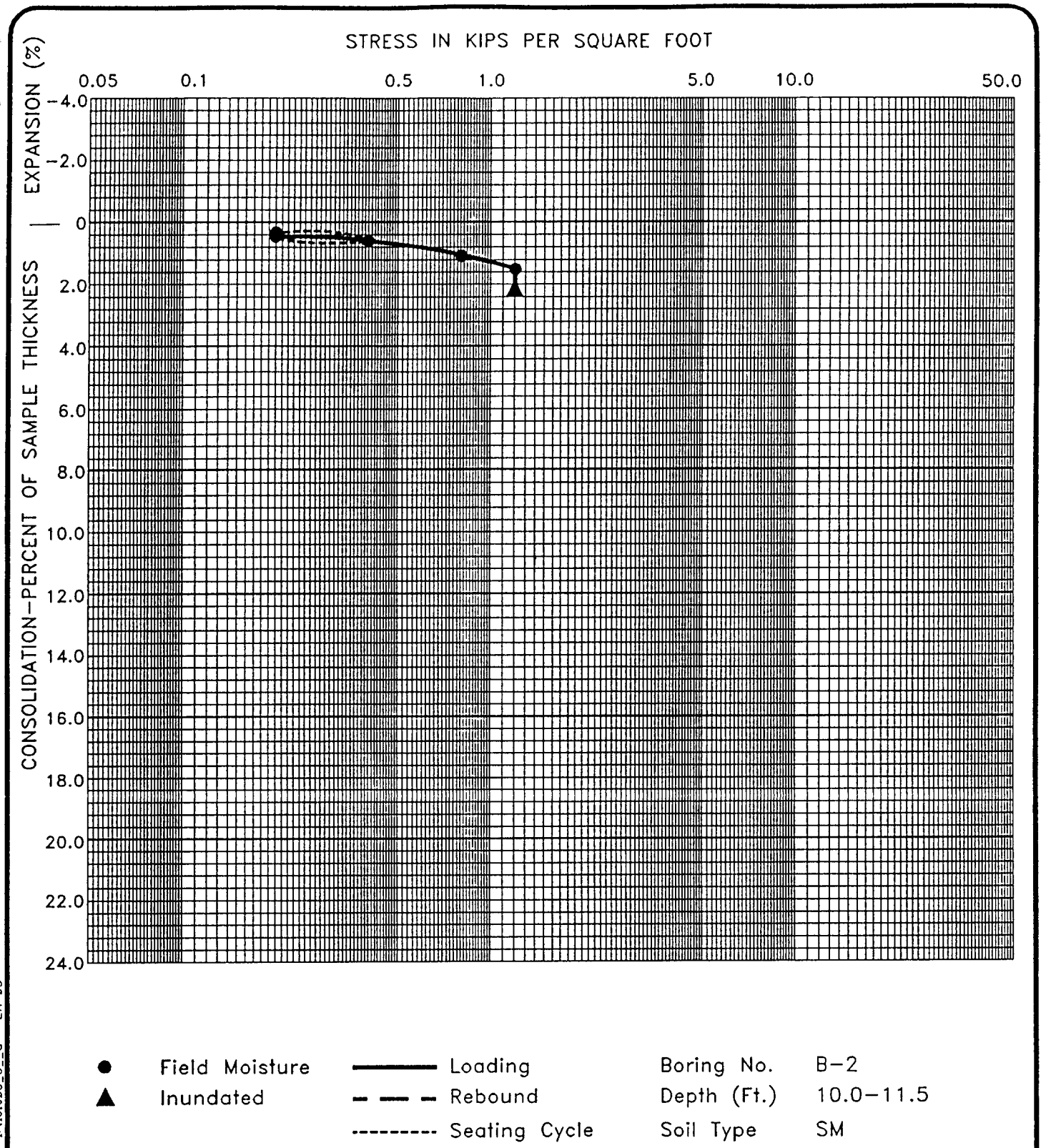
CONSOLIDATION TEST RESULTS

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	B-3



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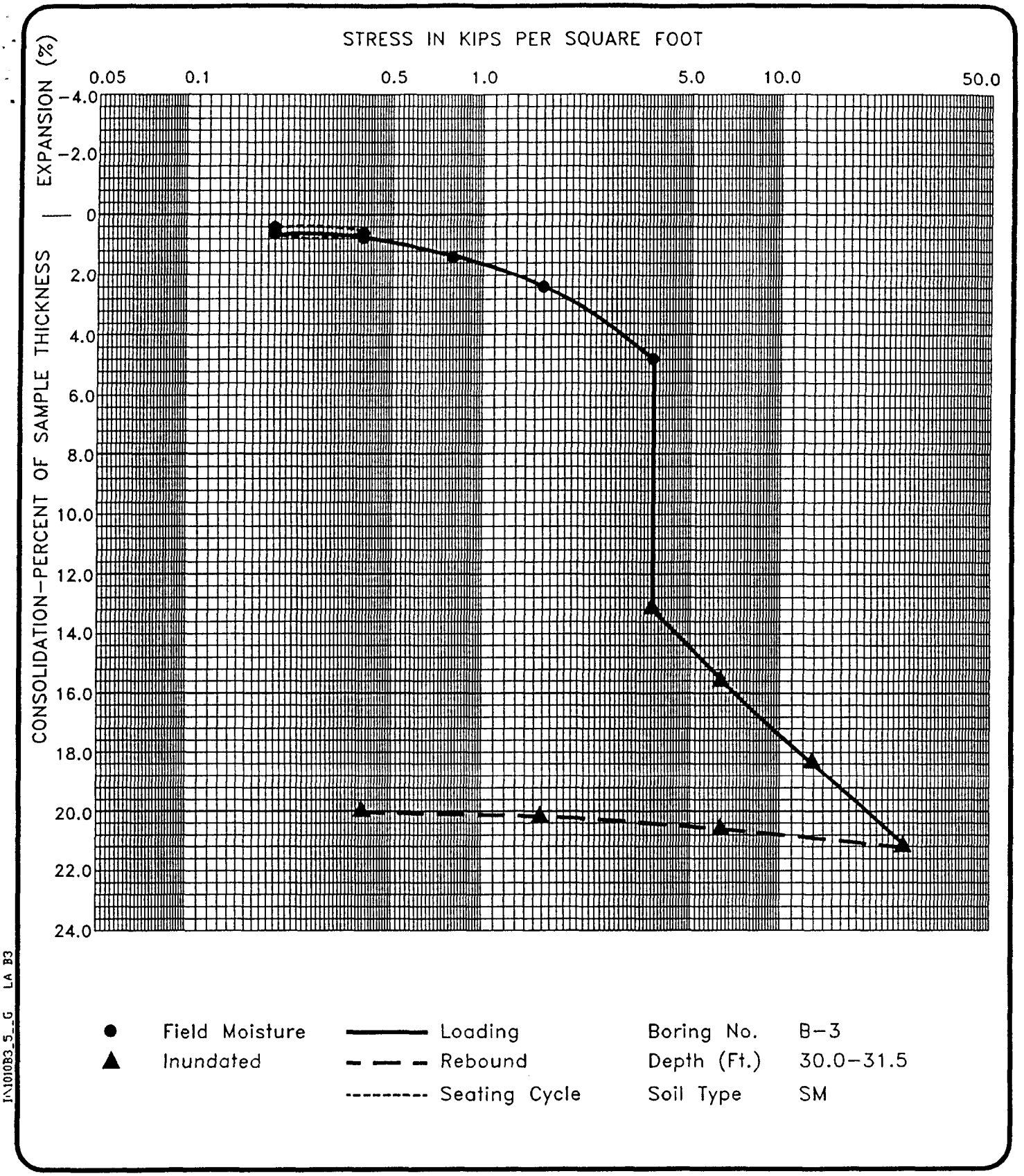
CONSOLIDATION TEST RESULTS

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	B-4

6



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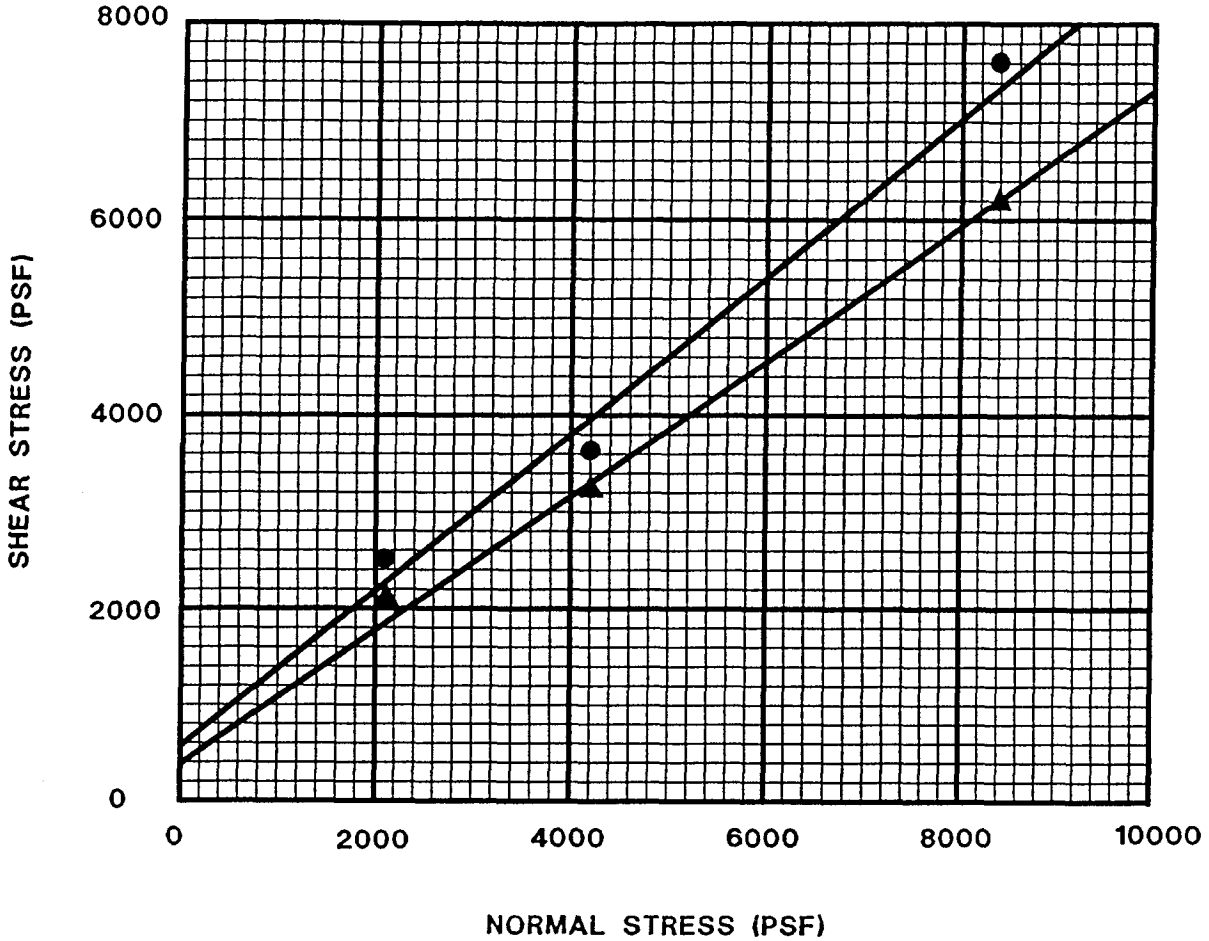
CONSOLIDATION TEST RESULTS

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	B-5



Description	Symbol	Boring Number	Shear Strength	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
Sandy SILTSTONE	●	B-1	Peak	35.0-36.3	600	39°	TOPANGA FORMATION
Sandy SILTSTONE	▲	B-1	Ultimate	35.0-36.3	400	35°	TOPANGA FORMATION

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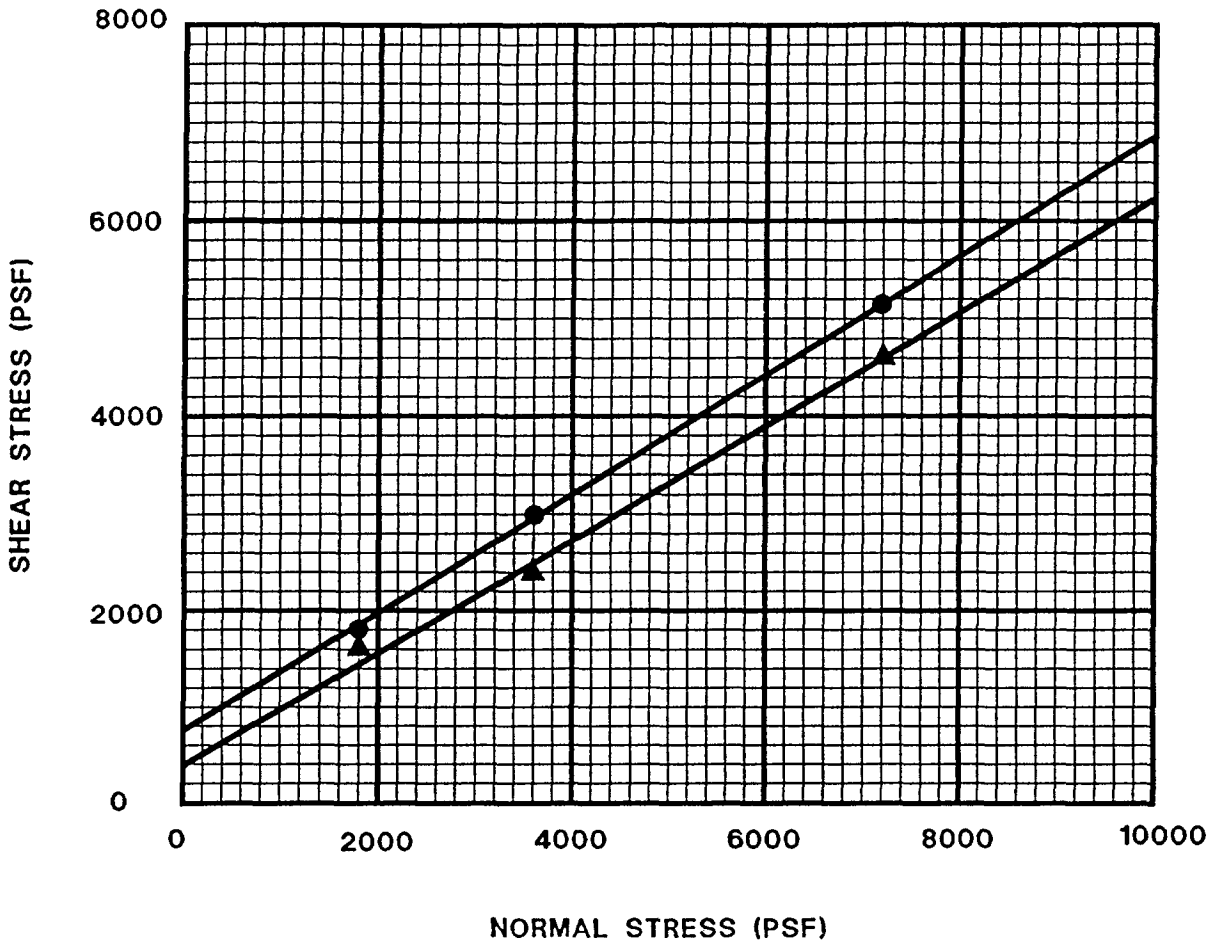
DIRECT SHEAR TEST RESULTS

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	B-6



Description	Symbol	Boring Number	Shear Strength	Depth (Feet)	Cohesion (PSF)	Friction Angle	Soil Type
Sandy SILTSTONE	●	B-2	Peak	30.0-31.5	800	31°	TOPANGA FORMATION
Sandy SILTSTONE	▲	B-2	Ultimate	30.0-31.5	400	30°	TOPANGA FORMATION

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DIRECT SHEAR TEST RESULTS

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE	FIGURE
201010-01	7/97	B-7

SAMPLE LOCATION	SAMPLE DEPTH (ft)	pH *	RESISTIVITY * (ohm-cm)	SULFATE CONTENT ** (ppm)	CHLORIDE CONTENT *** (ppm)
B-2	25.0-26.5 and 30.0-31.5	8.1	5870	50	40
B-3	1.0-5.0	8.9	1520	15	190

* California Test Method 643

** California Test Method 417

*** California Test Method 422

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CORROSIVITY TEST RESULTS

SITE 17
MCAS EL TORO
EL TORO, CALIFORNIA

PROJECT NO.	DATE
201010-01	7/97

FIGURE B-8