The Earth Technology Corporation

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Geotechnical Report

letro Rail Project

Hollywood/Western Station

pared for

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Geotechnical Report

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1.0 EXECUTIVE SUMMARY

1.1 GENERAL

This report presents the results of a geotechnical investigation for the planned Hollywood/Western Station and its adjacent ancillary facilities. The primary objective of the geotechnical investigation was to evaluate subsurface soil and groundwater conditions to obtain geotechnical information for design of the station. The geotechnical investigation consisted of drilling and sampling seven borings, monitoring a piezometer installed during the 1988 investigation (Earth Technology, 1988), soil mechanics and chemical laboratory tests, and engineering evaluation.

1.2 SUBSURFACE STRATIGRAPHY AND CONDITIONS

The subsurface stratigraphy in the planned Hollywood/Western Station area, as encountered in this investigation, consists of a shallow fill zone and Holocene-aged Young Alluvium overlying Pleistocene-aged Old Alluvium. The Young and Old Alluvium in the station area are extremely heterogeneous and nonuniform. The Young Alluvium in the station area ranges from about 23 feet to 40 feet thick and consists predominantly of medium-dense to dense silty sand, sandy silt, and clayey sand interspersed with medium-stiff to stiff silty clay and clayey silt. Within the exploration depth range, the Old Alluvium consists of medium-dense to very dense silty sand, and clayey sand interspersed with very stiff to hard silty clay, sandy clay, and clayey silt. Localized pockets of gravel and gravelly sand up to about 10 feet thick are present in the Young and Old Alluvium.

In the site area and within the exploration depth range, the fine-grained materials approximately account for 25 percent and 50 percent of the Young and Old Alluvium, respectively. Granular materials approximately represent 75 percent and 50 percent of the Young and Old Alluvium, respectively.

The groundwater table in the station area was found at or a few feet below the planned station bottom slab elevation.

1.3 STATION CONSTRUCTION

The observed subsurface conditions in the planned Hollywood/Western Station area can provide excellent foundation support for the planned station structures. The required station excavation can be accomplished relatively rapidly using mechanical excavation techniques and readily available equipment. The geotechnical evaluation for various engineering aspects of station design and construction are summarized below:

1. Groundwater Control: The presence of the groundwater table at or a few feet below the excavation bottom elevation indicates that preconstruction dewatering is not necessary. However, the moist nature of the alluvial soils and the potential variation of the groundwater levels indicate that some groundwater seepage into the excavation opening may be possible during construction. The amounts of seepage flow are anticipated to be small and can be easily handled by a readily available drain/sump system.

2. Shoring: Due to the planned station's proximity to existing buildings and the limited construction space, shoring will be required for station excavation and construction. Based on subsurface conditions and cost considerations, the contractor will most likely use drilled soldier piles and lagging walls with tiebacks or internal bracing for lateral support. Accordingly, design input for these shoring types is presented in this report.

3. Underpinning: The need for underpinning the adjacent existing buildings depends on whether their foundations are adequate or whether the buildings can satisfactorily withstand the anticipated settlements due to excavation and shored wall-related construction. Each adjacent building should be evaluated on a case-by-case basis. However, guidelines and recommendations of various underpinning systems are provided in this report.

4. Foundation Design: The main station structure can be adequately supported on Old Alluvium using a relatively rigid slab/mat foundation. Spread footings can be used as supports for other structural components. Recommended earth pressures on walls, roof, and slabs of the structure are also presented in this report.

5. Settlement: Assuming a station loading of about 5,000 psf, immediate elastic settlement of the mat foundation is estimated to be about one inch. The consolidation settlement of a 10- to 15-foot-thick clay layer located immediately below the planned station bottom slab is estimated to be about 1.5 inches. The elastic settlement will take place almost immediately after construction, while consolidation settlement will take place over a period of about 2 months to 6 months. Due to the heterogeneous and nonuniform nature of the sub-

surface soils, some differential settlement of the mat foundation is expected.

1.4 MATERIAL HANDLING AND HEALTH AND SAFETY CONSIDERATIONS

In addition to the above-mentioned construction-related engineering aspects, the following aspects need careful consideration:

1. Material Handling: it is unlikely that excavated materials will require special cleanup or handling except at some localized areas. Extensive treatment of sumped groundwater, if any, prior to disposal is not anticipated. However, these issues may require further chemical testing and coordination with the California Regional Water Quality Control Board.

2. Health and Safety: the Hollywood/Western Station is about 7,000 feet and 10,000 feet from the Western Avenue and Los Angeles City Oil Fields, respectively. Due to this proximity, the potential for harmful concentrations of methane and hydrogen sulfide in the study area are likely to be minimal but cannot be completely eliminated. Methane and hydrogen sulfide should be continuously monitored during excavation and construction. Proper ventilation should be maintained continuously to prevent accumulation of these gases.

2.0 Introduction

2.0 INTRODUCTION

2.1 GENERAL

This report presents the results of a geotechnical investigation for the planned Hollywood/Western Station and its adjacent ancillary facilities. The station is part of the Metro Rail "Minimum Operable Segment-2" (MOS-2) alignment. The location of the Hollywood/Western Station with respect to the MOS-2 alignment is shown in Figure 2-1. This investigation was performed to evaluate subsurface soils and groundwater conditions at the station area. The results will be used for a detailed design of the station.

2.2 LOCATION/ALIGNMENT AND PLANNED CONSTRUCTION

Engineering efforts for planning and design of the planned Hollywood/Western Station have been initiated by Metro Rail Transit Consultants (MRTC). Figure 2-2 shows the location and alignment of the planned station, as they appear on the MRTC documents dated June 1989 (MRTC, 1989). As shown in this figure, the station will consist of two main components: the main structure (with ancillary facilities) and the entrance leading to the rail facilities. The station will be located underneath Hollywood Boulevard from about the east curb of the southbound Serrano Avenue to about 78 feet east of Western Avenue. The station entrance will be located about 60 feet south of Hollywood Boulevard.

The planned station is located in a developed commercial and residential area. The ground surface in the station area is paved, with no vegetative cover. Along the station alignment, the ground surface mildly slopes downward from about Elevation 401 feet at the eastern end to about Elevation 392 feet at the western end.

Several buildings are within 100 feet of the station. Most of these buildings are 1- to 2-story, except for the 4-story hotel building at the northeast corner of the Hollywood Boulevard/Western Avenue intersection.

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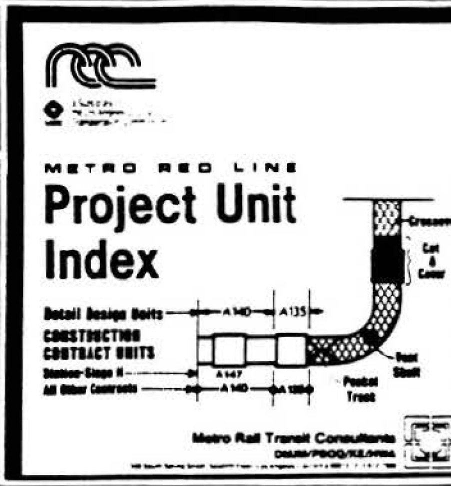

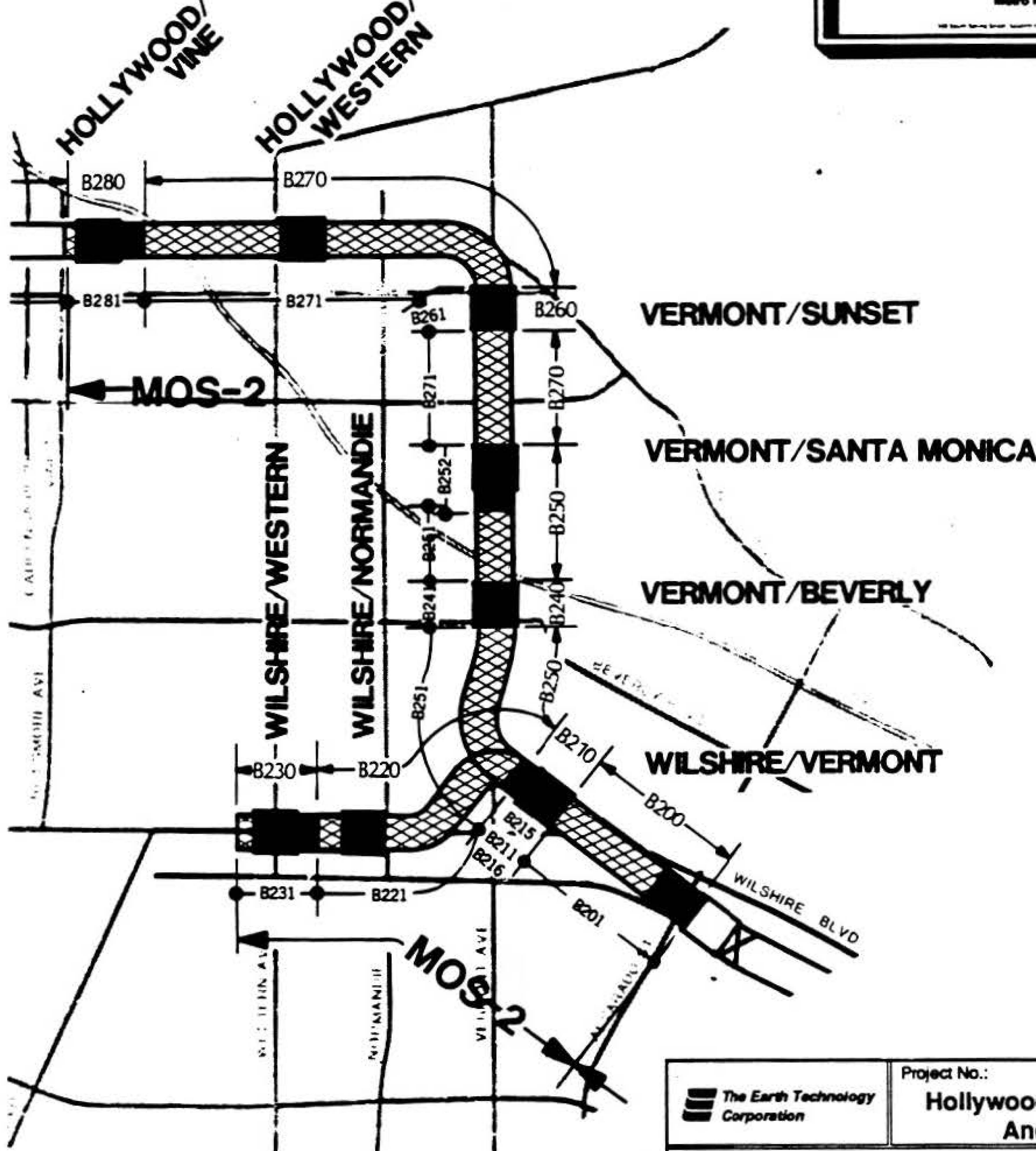

The Earth Technology Corporation	Project No.: 89-409 **Hollywood / Vine Station And Tunnel**

Mos-2 Alignment and Location of Hollywood / Western Station

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Figure 2-1

Cut-and-cover construction is planned for the station. The main structure, including ancillary facilities at both ends, is about 600 feet long, with an inside width of about 52 feet. The overall excavation width will be about 62 feet, assuming a 5-foot space for wall construction on each side. The planned bottom slab is at about Elevation 332 feet; this means that the excavation depth for the main structure will range from about 60 feet to 70 feet.

The surface elevation at the southern entrance leading to the mezzanine level is at about Elevation 393 feet. The planned mezzanine level is at about Elevation 360 feet. The platform level is planned at about Elevation 336 feet with an east-west gradient of about 0.3 percent.

2.3 OBJECTIVE AND SCOPE

The primary objective of the geotechnical investigation was to evaluate subsurface soil and groundwater conditions to obtain geotechnical information for design of the planned Hollywood/Western Station.

The scope of this investigation consisted of the following:

1. Reviewing available literature and reports.
2. Planning and coordinating field work, including:
   - Developing field procedures and manual
   - Planning the field investigation program
   - Obtaining permits from government agencies and private property owners
   - Coordinating with government agencies and utility companies prior to, during, and after the field work
   - Developing and implementing a project-specific Health and Safety Plan.
3. Performing a field exploration program, including:
   - Drilling and sampling seven test borings

- o Obtaining Organic Vapor Analyzer (OVA) readings on soil samples and background environments
- o Monitoring groundwater levels in an existing piezometer, LPE-11 (Earth Technology 1988).

4. Performing a laboratory testing program on selected representative soil and water samples to assess their index and engineering properties and to evaluate general chemical characteristics of the encountered subsurface materials.

5. Preparing this report documenting the findings, conclusions, and geotechnical recommendations.

2.4 ADDITIONAL INFORMATION

The geotechnical investigation for the planned Hollywood/Western Station is part of an overall geotechnical investigation for a major part of the Metro Rail alignment. The alignment starts at the Wilshire/Vermont Station, turns north along Vermont Avenue, and then curves west along Hollywood Boulevard. The subsurface conditions at the Hollywood/Western Station are similar to those found at the Metro Rail alignment portions along most of Hollywood Boulevard. Thus, applicable geotechnical data from Metro Rail alignment portions along Hollywood Boulevard have been incorporated in this report.

In addition to this report, pertinent project information for the Hollywood/Western Station is also included in the following reports:

- o "Geotechnical Report, Metro Rail Project, Vermont/Sunset Station and Adjacent Tunnel Segment," Report to Metro Rail Transit Consultants (MRTC) by The Earth Technology Corporation (1990).
- o "Geotechnical Report, Metro Rail Project, Hollywood/Vine Station and Adjacent Tunnel Segments," Report to Metro Rail Transit Consultants (MRTC) by The Earth Technology Corporation (1990).
- o "Geotechnical Report, Metro Rail Project, Hollywood/Highland Station," Report to Metro Rail Transit Consultants (MRTC) by The Earth Technology Corporation (1990).
- o "Report of Subsurface Gas Investigation - Southern California Rapid Transit District, Metro Rail Project, Phase II Alignment," Report prepared by Engineering Science Associates (ESA, 1990).

- "Geotechnical Investigation Report, Limited Preliminary Engineering Program, MOS-2 Alignment, Metro Rail Project," prepared for Metro Rail Transit Consultants (MRTC) by The Earth Technology Corporation (1988).
- "Geotechnical Investigation Report for Metro Rail Project," prepared for Southern California Rapid Transit District (SCRTD) by CWDD/ESA/GRC (1981).

2.5 REMARKS

For the Metro Rail Project, design procedures and criteria for underground structures under earthquake loading conditions are defined in the Southern California Rapid Transit District (SCRTD) report entitled "Supplemental Criteria for Seismic Design of Underground Structures," dated June 1984. Evaluations of the seismological conditions which may impact the project and the probable maximum earthquake which may be anticipated in the Los Angeles area are described in the SCRTD report entitled "Seismological Investigation and Design Criteria," dated May 1983.

3.0 Field Exploration and Laboratory Testing

3.0 FIELD EXPLORATION AND LABORATORY TESTING

This section provides a description of the subsurface exploration and laboratory testing work performed in this program. This field investigation program was part of a larger geotechnical program performed along the Metro Rail alignment. Results of the larger geotechnical investigation applicable to the Hollywood/Western Station, as well as available reports (Section 2.4), were also used in developing conclusions and recommendations presented in this report.

3.1 FIELD EXPLORATION

Field exploration consisted of drilling and sampling seven borings (PII-67 through PII-73) and monitoring groundwater levels in an existing piezometer (LPE-11, Earth Technology 1988). A plot plan showing boring locations is presented in Figure 2-2. Detailed locations and boring logs are presented in Appendix A.

3.1.1 Borings

Seven borings were drilled using rotary wash methods with a 4-7/8-inch-diameter bit which produces a nominal 5- to 6-inch-diameter borehole. A tri-cone bit was used in coarse-grained (granular) soils and a drag-bit was used in fine-grained soils. A bentonite drilling fluid was used. At the time of the field investigation, the penetration depths of the borings were about 55 feet below the planned station excavation depth (MRTC, 1988). After completion of these borings, the station excavation depth was increased about 15 feet (MRTC, 1989). Thus, the completed borings were about 40 feet or less below the currently planned station excavation depth. Penetration depths of the seven borings are shown in Table 3-1. Soil samples were obtained at five-foot-depth intervals by alternately using standard split-spoon samplers (Standard Penetration Test Method) and California-type drive samplers lined with one-inch-high brass rings.

TABLE 3-1. TOTAL PENETRATION DEPTHS FOR SOIL BORINGS

Boring #	Penetration Depth (Feet)
PII-67	91.0
PII-68	81.0
PII-69	91.0
PII-70	91.0
PII-71	101.0
PII-72	91.0
PII-73	101.0

Standard Penetration Tests (SPT) were performed according to the American Society for Testing Materials (ASTM) Standard Procedure D1586. This method consists of driving the standard split-spoon sampler 18 inches into the soil using a 140-pound hammer falling 30 inches. Blow counts were recorded for each 6-inch driving increment. The total blow count for the last 12 of 18 inches of driving is called the standard penetration resistance.

The driving was terminated when one of the following occurred:

- A total of 100 blows was reached for penetration of 12 inches or less
- No obvious sampler advance was observed during driving
- The sampler was advanced 18 inches.

Relatively undisturbed soil samples were obtained with the California-type drive samplers by driving the sampler with either a 265-, 295-, or 340-pound downhole hammer falling 18 inches. Hammer weight and corresponding drop heights used for driving the samplers are indicated in the boring logs (Appendix A). Blow counts were recorded for each six-inch driving increment. A Pitcher-barrel sampler was occasionally used when penetration or soil recovery with the drive samplers was difficult due to hard/dense subsurface conditions or when longer samples were required for laboratory testing.

The borings were continuously logged by an experienced geologist or soils engineer using the Unified Soil Classification System (USCS). The boring logs were prepared and/or reviewed by a certified engineering geologist (CEG).

3.1.2 Groundwater Level Monitoring

Groundwater levels were monitored in Piezometer LPE-11 (Earth Technology, 1988) using an electronic water-level indicator. Groundwater level readings were taken periodically and are summarized in Table 3-2.

TABLE 3-2. SUMMARY OF GROUNDWATER READINGS

Date of Reading	LPE-11 Ground Surface Elevation = 394.5 feet	
	Groundwater Level Depth (feet)	Groundwater Level Elevation (feet)
11/14/88	66.2	328.3
12/08/88	66.2	328.3
05/02/89	66.3	328.2
07/16/89	66.4	328.1
09/09/89	68.2	326.3
01/22/90	68.0	326.5

3.2 LABORATORY TESTING PROGRAM

A laboratory testing program was developed and performed on selected soil samples obtained in this investigation. The laboratory tests were intended to provide data for further refinement of subsurface conditions and associated engineering parameters, as well as to assess the extent of possible chemical contamination at the Hollywood/Western Station site area. In general, the laboratory testing program was developed to:

1. Aid in soil classification.
2. Obtain an initial assessment of engineering properties of the soils encountered in the investigation.
3. Provide a preliminary chemical characterization of selected soil samples.

It should be noted that test results on soil and water samples from Earth Technology's 1988 investigation were also incorporated in this study.

3.2.1 Soil Mechanics Laboratory Testing

A series of soil mechanics laboratory tests was performed on selected representative samples. All tests were performed in accordance with applicable standard test methods specified by the American Society for Testing Materials (ASTM), the U.S. Army Corps of Engineers, or the U.S. Environmental Protection Agency (EPA). The test program and procedures are summarized in Table 3-3.

The results of soil mechanics laboratory tests are presented in Appendix B. In addition, moisture content and dry density data are also presented in boring logs found in Appendix A. Results of the laboratory test data evaluation for the engineering properties of encountered subsurface materials are presented in Section 4.

TABLE 3-3. SUMMARY OF TESTS AND TEST PROCEDURES

Test Type	No. of Tests	Test Procedure
Visual Examination	Every sample	ASTM D 2488-84
Grain Size Distribution	16	ASTM D 422-63 and D 1140-54
Hydrometer Analysis	3	ASTM D 422-63
Unit Weight	22	ASTM D 2937-83
Moisture Content	22	ASTM D 2216-80
Specific Gravity	1	ASTM D 854-83
Atterberg limit	11	ASTM D 4318-84
Direct Shear Tests	18	ASTM D 3080-72
Permeability	3	ASTM D 2434-68 and EPA 9100
Consolidation Test	3	ASTM D 2435-80
Triaxial Compression	2	EM 110-2-1906[a] Appendix 10

Notes: (a) U.S. Army Corps of Engineers

3.2.2 Analytical (Chemical) Laboratory Testing

In addition to monitoring the background and headspace Organic Vapor Analyzer (OVA) readings of every soil sample, triple-meter monitoring was performed on samples with high OVA readings for an indication of hydrogen sulfide (H_2S) concentrations, explosivity levels, and carbon monoxide concentrations during the field work. A limited analytical (chemical) laboratory testing program was also performed on selected soil samples. No piezometers were installed during this investigation and, hence, no water samples were obtained. The analytical laboratory testing program performed for the investigation is summarized in Table 3-4. Analytical tests on water samples performed during the 1988 investigation (Earth Technology, 1988) are also included in this table.

The results of the analytical laboratory testing program are presented in Appendix C and summarized in Tables 3-5 through 3-11. An evaluation of the results and the potential impacts on design and construction are presented in Section 4.

TABLE 3-4. SUMMARY OF ANALYTICAL LABORATORY ANALYSES

Test Type	Sample Type	No. of Tests	Test Procedure
Total Recoverable Petroleum Hydrocarbons (TRPH)	soil	5	EPA 418.1
Aromatic Organic Compounds (BTEX)	soil	5	EPA 8020
Volatile Organic Compounds	soil	1	EPA 8240
Semivolatile Organic Compounds	soil	1	EPA 8270
CAM Metals	soil	1	California Metals[a]
Sulfide	soil	5	EPA 9030
Sulfate	soil	5	EPA 9038

Note: (a) California Code of Regulations, 1987

TABLE 3-5. RESULTS OF CHEMICAL TESTS FOR SULFATE CONCENTRATIONS

Location/ Sample No.	Sample Type	Sulfate Concentration (ppm)[a]	Detection Limit (ppm)	Potential Cement Type for Construction[b]
LPE-11 (Nov 88)	water	160	50	II
LPE-11/D-13 (Nov 88)	soil	P[c]	50	Regular
PII-69/D-6	soil	70	10	Regular
PII-69/D-14	soil	60	10	Regular
PII-70/D-16A	soil	70	10	Regular
PII-71/D-13	soil	50	10	Regular
PII-72/D-7A	soil	30	10	Regular

NOTES: (a) ppm = Parts per million.

(b) Cement types are based on recommendations specified in Uniform Building Code (UBC, 1988).

(c) P = Present in concentrations less than Detection Limit.

TABLE 3-6. RESULTS OF CHEMICAL TESTS FOR SULFIDE CONCENTRATIONS

Location/ Sample No.	Sample Type	Sulfide Concentration (ppm)[a]	Detection Limit (ppm)
LPE-11 (Nov 88)	water	P[b]	1
LPE-11/D-13 (Nov 88)	soil	P	3
PII-69/D-6	soil	2.0	1
PII-69/D-14	soil	ND[c]	1
PII-70/D-16A	soil	1.0	1
PII-71/D-13	soil	ND	1
PII-72/D-7A	soil	1.0	1

NOTES: (a) ppm = Parts per million.

(b) P = Present in concentrations less than Detection Limit.

(c) ND = Not detected.

TABLE 3-7. RESULTS OF CHEMICAL TESTS FOR AROMATIC ORGANIC COMPOUNDS (BTEX)

Location/ Sample No.	Sample Type	Concentration (ppb)[a] Benzene[b]	Toluene[b]	Ethylbenzene[b]	Xylenes[b]
LPE-11 (Nov 88)	water	ND[c]	ND	ND	ND
LPE-11/D-13(Nov 88)	soil	ND	ND	ND	ND
PII-69/D-6	soil	ND	ND	ND	ND
PII-69/D-14	soil	ND	ND	ND	ND
PII-70/D-16A	soil	ND	ND	ND	ND
PII-71/D-13	soil	ND	ND	ND	ND
PII-72/D-7A	soil	ND	ND	ND	ND

NOTES: (a) ppb = Parts per billion.

(b) Cleanup action levels for BTEX concentrations are 300 ppb, 300 ppb, 1,000 ppb and 1,000 ppb for benzene, toluene, ethylbenzene and xylenes, respectively, based on leaching potential analysis as per specification in Table 2-1, leaking Underground Fuel Tank (LUFT) Field Manual (State Water Resources Control Board 1987).

(c) ND = Not detected. Detection limits for benzene, toluene, ethylbenzene and xylenes are 0.5, 1.0, 1.0 and 1.0 ppb for water samples, respectively. Detection limits for BTEX are 5 ppb for soil samples.

TABLE 3-8. RESULTS OF CHEMICAL TESTS FOR TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (TRPH)[a] CONCENTRATIONS

Location/ Sample No.	Sample Type	Concentration (ppm)[b]	Detection Limit (ppm)
LPE-11 (Nov 88)	water	84	5
LPE-11/D-13 (Nov 88)	soil	110	5
PII-69/D-6	soil	ND[c]	5
PII-69/D-14	soil	ND	5
PII-70/D-16A	soil	ND	5
PII-71/D-13	soil	ND	5
PII-72/D-7A	soil	ND	5

NOTES: (a) Cleanup action level for TRPH concentration ranges from about 100 ppm to 1,000 ppm based on leaching potential analysis, as per specification in Table 2-1, Leaking Underground Fuel Tank (LUFT) Field Manual (State Water Resources Control Board, 1987)

(b) ppm = Parts per million.

(c) ND = Not detected.

TABLE 3-9. RESULTS OF CHEMICAL TESTS FOR SEMIVOLATILE ORGANICS CONCENTRATIONS BY EPA METHOD-8270 IN SOIL SAMPLE NO. D-16A, BORING PII-70

Parameter	Concentration (ppm)[a]	Parameter	Concentration (ppm)
Phenol	ND[b] (0.1)[c]	Acenaphthene	ND (0.1)
Bis(2-chloroethyl)ether	ND (0.1)	2,4-dinitrophenol	ND (0.5)
2-chlorophenol	ND (0.1)	4-nitrophenol	ND (0.5)
1,3-dichlorobenzene	ND (0.1)	Dibenzofuran	ND (0.1)
1,4-dichlorobenzene	ND (0.1)	2,4-dinitrotoluene	ND (0.1)
Benzyl alcohol	ND (0.2)	2,6-dinitrotoluene	ND (0.1)
1,2-dichlorobenzene	ND (0.1)	Diethylphthalate	ND (0.1)
2-methylphenol	ND (0.1)	4-chlorophenyl-phenylether	ND (0.1)
Bis(2-chloroisopropyl)ether	ND (0.1)	Fluorene	ND (0.1)
4-methylphenol	ND (0.1)	4-Nitroaniline	ND (0.5)
N-nitroso-di-n-propylamine	ND (0.1)	4,6-dinitro-2-methylphenol	ND (0.5)
Hexachloroethane	ND (0.1)	N-nitrosodiphenylamine	ND (0.1)
Nitrobenzene	ND (0.1)	4-bromophenyl-phenylether	ND (0.1)
Isophorone	ND (0.1)	Hexachlorobenzene	ND (0.1)
2-nitrophenol	ND (0.1)	Pentachlorophenol	ND (0.5)
2,4-dimethylphenol	ND (0.1)	Phenanthrene	ND (0.1)
Benzoic Acid	ND (0.5)	Anthracene	ND (0.1)
Bis-(2-chloroethoxy)methane	ND (0.1)	Di-n-butylphthalate	ND (0.1)
2,4-dichlorophenol	ND (0.1)	Fluoranthene	ND (0.1)
1,2,4-trichlorobenzene	ND (0.1)	Pyrene	ND (0.1)
Naphthalene	ND (0.1)	Butylbenzylphthalate	ND (0.1)
4-chloroaniline	ND (0.2)	3,3'-dichlorobenzidine	ND (0.2)
Hexachlorobutadiene	ND (0.1)	Benzo(a)anthracene	ND (0.1)
4-chloro-3-methylphenol	ND (0.2)	Bis(2-ethylhexyl)phthalate	ND (0.1)
2-methylnaphthalene	ND (0.1)	Chrysene	ND (0.1)
Hexachlorocyclopentadiene	ND (0.1)	Di-n-octyl phthalate	ND (0.1)
2,4,6-trichlorophenol	ND (0.1)	Benzo(b)fluoranthene	ND (0.1)
2,4,5-trichlorophenol	ND (0.1)	Benzo(k)fluoranthene	ND (0.1)
2-chloronaphthalene	ND (0.1)	Benzo(a)pyrene	ND (0.1)
2-nitroaniline	ND (0.5)	Indeno(1,2,3-cd)pyrene	ND (0.1)
Dimethyl phthalate	ND (0.1)	Dibenz(a,h)anthracene	ND (0.1)
Acenaphthylene	ND (0.1)	Benzo(g,h,i)perylene	ND (0.1)
3-nitroaniline	ND (0.5)		
% Surrogate Recovery			
2-Fluorophenol	59	2-Fluorobiphenyl	66
Phenol-d_5	52	Terphenyl-d_{14}	115
Nitrobenzene-d_5	60		

NOTES: (a) ppm = Parts per million.
(b) ND = Not detected.
(c) ( ) = Detection Limit in ppm.

TABLE 3-10. RESULTS OF CHEMICAL TESTS FOR VOLATILE ORGANICS CONCENTRATIONS BY EPA METHOD - 8240 IN SOIL SAMPLE NO. D-16A, BORING PII-70

Parameters (8240)	Concentration (ppb)[a]	Detection Limit (ppb)
Acetone	ND[b]	100
Benzene[c]	ND	10
Bromodichloromethane	ND	10
Bromoform	ND	10
Bromomethane	ND	50
2-butanone (MEK)	ND	100
Carbon disulfide	ND	10
Carbon tetrachloride	ND	10
Chlorobenzene	ND	10
Chlorodibromomethane	ND	10
Chloroethane	ND	50
2-chloroethyl vinyl ether	ND	10
Chloroform	ND	10
Chloromethane	ND	50
1,1-dichloroethane	ND	10
1,2-dichloroethane	ND	10
1,1-dichloroethene	ND	10
1,2-dichloroethene (total)	ND	10
1,2-dichloropropane	ND	10
Cis-1,3-dichloropropene	ND	10
Trans-1,3-dichloropropene	ND	10
Ethylbenzene[c]	ND	10
2-hexanone	ND	100
Methylene chloride	ND	100
4-methyl-2-pentanone (MIBK)	ND	50
Styrene	ND	10
1,1,2,2-tetrachloroethane	ND	10
Tetrachloroethene	ND	10
Toluene[c]	ND	10
1,1,1-trichloroethane	ND	10
1,1,2-trichloroethane	ND	10
Trichloroethene	ND	10
Trichlorofluoromethane	ND	50
Vinyl acetate	ND	100
Vinyl chloride	ND	50
Xylenes (total)[c]	ND	10
% Surrogate Recovery		
1,2-dichloroethane d4	100	
Toluene-d8	98	
Bromofluorobenzene	94	

NOTES: (a) ppb = Parts per billion.
(b) ND = Not detected.
(c) Refer to Table 3-7 for action levels for benzene, toluene, ethylbenzene and xylenes concentrations.

TABLE 3-11. RESULTS OF CHEMICAL TESTS FOR CAM METALS CONCENTRATIONS IN SOIL SAMPLE NO. D-16A, BORING PII-70

Substances	Concentration (ppm)[a]		
	PII-70/D-16A	Detection Limit	Cleanup Action Level[b]
Antimony	6.0	5.0	500
Arsenic	12	1.0	500
Barium	69	5.0	10,000
Beryllium	ND[c]	1.0	75
Cadmium	4.5	1.0	100
Chromium - Total	39	1.0	500
Cobalt	16	1.0	8,000
Copper	25	1.0	2,500
Lead	20	1.0	1,000
Mercury	ND	0.05	20
Molybdenum	ND	1.0	3,500
Nickel	37	1.0	2,000
Selenium	ND	1.0	100
Silver	ND	1.0	500
Thallium	6.1	1.0	700
Vanadium	3.8	5.0	2,400
Zinc	70	1.0	5,000

NOTES: (a) ppm = Parts per million.
(b) California Code of Regulations, Title 22, Section 66699.
(c) ND = Not detected.

4.0 Geologic and Subsurface Conditions

4.0 GEOLOGIC AND SUBSURFACE CONDITIONS

4.1 GEOLOGIC SETTING AND CONDITIONS

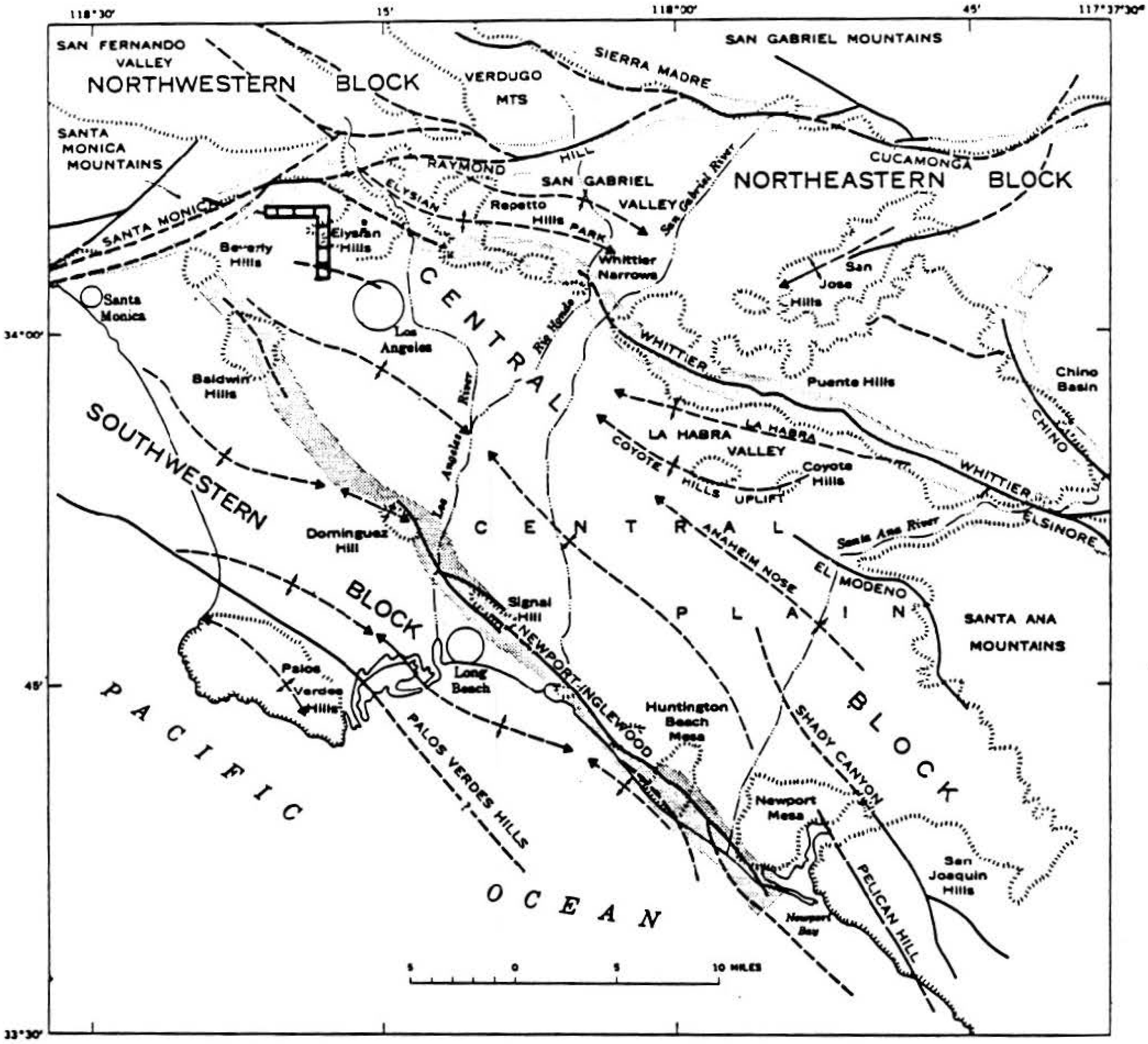
The planned Metro Rail alignment is located within the Los Angeles Basin, as defined by Yerkes et al., (1965), based on tectonic or structural blocks. As shown in Figure 4-1, the basin so defined can be further subdivided into four structural blocks including the Northwestern Block, the Northeastern Block, the Central Block, and the Southwestern Block. The Hollywood/Western Station is located in the Central Block and near the boundary between the Central Block and the Northwestern Block. The Central Block is bounded on the north by the Santa Monica-Raymond Hill Fault zones, on the northeast and east by the Whittier-Elsinore Fault zones, and on the west-southwest by the Newport-Inglewood Fault zones (Figure 4-1). The Northwestern Block of the Los Angeles Basin is bounded on the south by the Santa Monica-Raymond Hill Fault zones, on the east by the Sierra Madre Fault zone, on the north by the Santa Susana-Oak Ridge and San Gabriel Fault zones and on the west by the Pacific Ocean (Figure 4-1).

4.2 STRATIGRAPHY AND GEOLOGY

4.2.1 Regional Stratigraphy and Geology

The Central Block of the Los Angeles Basin in the area adjacent to the Northwestern Block is underlain by a deep structural depression filled with the following geologic units, in order of deposition:

- Puente Formation (Tp): The Upper Miocene bedrock underlying the area consists predominantly of stratified and weakly interbedded claystone, siltstone, and sandstone. The materials in the Puente Formation are generally low-strength (weak) rocks with a local presence of hard sandstone beds which may range from fractions of an inch to several feet or more in thickness. Up to the top 20 feet of the Puente Formation bedrock may be completely weathered (Tpw) and may exhibit soil-like characteristics with little or no cementation and without distinguishable bedding planes. This weathered zone is underlain by an approximate 10- to



EXPLANATION

WHITTIER			
Fault or fault zone *Dashed where approximately located; queried where doubtful*	**Anticline** *Dashed where approximately located*	**Syncline** *Dashed where approximately located*	**Boundary of structural block**

Approximate location of Metro Rail Alignment

Adopted from Yerkes et al. (1965)

The Earth Technology Corporation	Project No.: 89-409 Hollywood / Western Station
Major Structural Features in Los Angeles Basin	
06-90	Figure 4-1

50-foot-thick, moderately to slightly weathered or oxidized (Tpo) portion of the bedrock that is cemented to some extent and has distinguishable bedding planes that range from easily separable to intact. The lowest portion of the bedrock is unoxidized and fresh (Tpf), generally has well-defined bedding planes, and is generally moderately cemented.

- Fernando Formation (Tf): This Pliocene sediment consists of massive and well-bedded claystone, siltstone, and sandstone, overlying the Puente Formation. The contact is mostly gradational and difficult to locate. This formation was not encountered in the geotechnical investigation performed for the Metro Rail alignment.

- Old Alluvium (A3 and A4): These Pleistocene sediments consist of granular alluvium (A3) deposited in relatively "swift" water environments, and fine-grained alluvium (A4) deposited in relatively "quiet" water environments. The granular Old Alluvium consists primarily of medium-dense to very dense clean sand, silty sand, gravelly sand, sandy gravel, and gravel. The fine-grained Old Alluvium consists primarily of medium-stiff to very hard clay, silty clay, sandy clay, silt, clayey silt, and clayey sand.

- Young Alluvium (A1 and A2): These Holocene sediments consist of granular alluvium (A1) deposited in relatively "swift" water environments and fine-grained alluvium (A2) deposited in relatively "quiet" water environments. The granular Young Alluvium consists predominantly of loose to dense clean sand, silty sand, gravelly sand, and sandy gravel, with a potential local presence of cobbles and boulders. The fine-grained Young Alluvium consists of firm to hard clay, silty clay, silt, clayey silt, and clayey sand, with a local presence of traces of gravel.

The margins of the basin and its four blocks are formed by zones of folding and uplifting along basin/block-bounding faults, including the Santa Monica-Hollywood-Raymond Hill, Whittier, and Newport-Inglewood fault zones. In addition, there exist several major geologic features which are mostly inferred and not well delineated. Within the Central Block and adjacent to the Metro Rail alignment along Hollywood Boulevard, major geologic features include the Santa Monica Fault zone, the Los Angeles Anticline, the Hollywood Syncline, and the Hollywood Fault. The Hollywood Bowl Fault lies in the Northwestern Block adjacent to the end of the Metro Rail alignment portion along Hollywood Boulevard.

The Los Angeles Anticline is a gentle upfold in the Puente Formation and trends about N 70° W, which influences the dip of bedrock strata in the area.

This anticline acts as a trap for oil and gas within the Puente Formation. The Los Angeles City Oil Field and the Western Avenue Oil Field are within this anticline. For the most part, the Los Angeles City Oil Field has been abandoned except near the east end, where several producing wells exist. Known boundaries of the Los Angeles City Oil Field traverse Vermont Avenue between Second and Fourth streets along the Metro Rail alignment. The known production zones (150 feet or deeper below the ground surface) are deeper than the invert depths of the Metro Rail alignment (100 feet or less below the ground surface). The Western Avenue Oil Field is also located within the Los Angeles Anticline and appears to be a northwest extension of the Los Angeles City Oil Field. Little is known about this oil field. The closest known boundaries of the Western Avenue Oil Field and the Los Angeles City Oil Field are about 7,000 and 10,000 feet away from the Hollywood/Western Station, respectively. The relatively long distances from the site area to these two oil fields indicate that the likelihood of methane or other harmful gases migrating from these oil fields to the site area is minimal, but cannot be completely eliminated.

The Santa Monica-Hollywood-Raymond Hill Fault zones form the boundaries between the Central Block and the Northwestern Block of the Los Angeles Basin. The mappable segments of the Santa Monica Fault zone extend from the Santa Monica Bay eastward to Beverly Hills. This fault has been inferred to intersect the Metro Rail alignment at Hollywood Boulevard just east of Kingsley Drive (CWDD et al., 1981). However, the recent fault map compiled by the U.S Geological Survey (Ziony and Jones, 1989) indicates that the fault zone offsets the late Pleistocene deposits eastward to its intersection with the northwest trending Newport-Inglewood Fault zone (just south of the city of Beverly Hills) and is present in the subsurface further east and southeast without intersecting the Metro Rail alignment and apparently without disturbing the late Quaternary deposit.

A number of closely spaced borings for the tunnel alignment (Earth Technology, 1990a) along Hollywood Boulevard between Barnsdall Park and the Hollywood/Western Station were drilled in an attempt to shed some light on this contradictory information. No evidence of faulting was found within the boring depths (up to 110 feet). Thus, the exact surface and subsurface locations and inferred depths and the potential effects of the Santa Monica Fault zone on the planned alignment are not known.

The Hollywood Fault zone is located along the base of the Santa Monica Mountains as a scarp-like feature within Old and Young Alluvium (Weber et al., 1980). However, it is inferred since recent urban development has obscured any surface expression of the fault. The projected fault intersects Hollywood Boulevard just east of La Brea Avenue and then trends eastward along the mountain front (i.e., approximately parallel to the Metro Rail alignment portion along Hollywood Boulevard). Geomorphic features such as faceted and steeply inclined spurs along the mountain front near the fault trace suggest that the fault may have had Holocene movement (Weber et al., 1980).

The Hollywood Bowl Fault appears to be a branch of the Hollywood Fault zone, and is projected to cross the planned alignment about 1,200 feet northwest of the Hollywood Boulevard/La Brea Avenue intersection. This fault appears to be a normal fault with an inferred right-lateral offset and a steep dip of about 80 degrees (Weber et al., 1980). The fault is not known to be active. However, the age and amount of the last displacement are not known.

The Hollywood Syncline generally trends east-west and is bounded on the northwest by the Hollywood Fault. It is believed that the Hollywood Syncline was created by structural downwarping. The Hollywood Syncline is filled with Pleistocene- and Holocene-aged sediments derived from the San Gabriel and Santa Monica mountains. These sediments are generally categorized as "Old Alluvium" and "Young Alluvium" according to the time of deposition.

4.2.2 Site Stratigraphy and Geology

The results of this investigation and available data (Section 2.4) indicate that subsurface materials encountered in the Hollywood/Western Station site area consist mostly of Old Alluvium (A3 and A4) underlying a 25- to 40-foot-thick layer of Young Alluvium (A1 and A2). A more detailed description of these subsurface materials is provided in Section 4.3.

4.3 SUBSURFACE CONDITIONS

4.3.1 Subsurface Soils

The planned Hollywood/Western Station is located in a relatively well-developed area. Selection of borehole locations was restricted by the presence of existing buildings and underground utilities, as well as by the extent of cooperation given by private property owners. The borings performed for this investigation were located to be as close to the alignment as possible. At the time of the field investigation, the boring depth penetration was selected to be about 55 feet below the planned station bottom slab elevation. The field work for the seven borings was completed by May 3, 1989. Since then, the station bottom slab elevation was revised to be about 10 feet to 15 feet deeper than before. As can be seen from Figure 2-2 and Table 3-1, this depth revision results in the penetration depths of the borings performed for this alignment being 40 feet or less below the station bottom slab elevation.

In addition, a boring (LPE-11) from a previous investigation (Earth Technology, 1988) was also used to evaluate the subsurface conditions. The location and log of this boring is also included in Appendix A.

Based on the results of this investigation and other available data (Section 2.4), a generalized cross-sectional profile of the site area is shown in Figure 2-2. In general, the stratigraphy of the site area below the existing asphalt pavement consists of Young Alluvium (Units A1 and A2) overlying Old Alluvium (Units A3 and A4). In addition, rail and/or rail tie were encountered in borings performed for this investigation within about 5 feet below the ground surface.

The Old and Young Alluvium are extremely heterogeneous and nonuniform. In this investigation, no age-dating on the obtained alluvial samples was performed to differentiate Young and Old Alluvium. The contact between Young and Old Alluvium is difficult to delineate since the criteria for distinction are complex. The delineation shown in Figure 2-2 and boring logs (Appendix A) was based on color, density, consistency (as determined by SPT blow counts), the presence or absence of cementation, higher plasticity clays or coarse gravels, and engineering judgment.

As shown in Figure 2-2, the Young Alluvium in the station area varies from about 23 feet to about 40 feet thick. It consists of about 75 percent medium-dense to dense silty sand, sandy silt, and clayey sand (with a fines content of 35 percent or less), gravel and gravelly sand (granular Young Alluvium, Unit A1), interspersed with about 25 percent fine-grained Young Alluvium (Unit A2) consisting of medium-stiff to hard silty clay and clayey sand (with a fines content of about 35 percent or more).

Similarly, the Old Alluvium is extremely heterogeneous and nonuniform. As shown in Figure 2-2, the Old Alluvium within the exploration depth range of this investigation (up to about 96 feet below ground surface) consists predominantly of medium-dense to very dense silty sand and clayey sand (with a fines content of 35 percent or less) with traces of gravel and localized zones of clean or gravelly sand up to about 10 feet thick (granular Old Alluvium, Unit A3), interspersed with fine-grained Old Alluvium (Unit A4) consisting predominantly of very stiff to hard silty clay, sandy clay and clayey sand (with a fines content of 35 percent or more) with traces of gravel. Within the exploration depth range, the Old Alluvium consists of about 50 percent granular materials (Unit A3) and 50 percent fine-grained materials (Unit A4).

4.3.2 Groundwater Levels

Groundwater levels were monitored on Piezometer LPE-11 (Earth Technology, 1988) using an electronic water-level indicator. Groundwater level readings were taken periodically and are summarized in Table 3-2. The most recent groundwater level data observed in Piezometer LPE-11 and interpolated from other piezometers in adjacent tunnel alignments are presented in Figure 2.2.

Groundwater level readings summarized in Table 3-2 indicate a groundwater level drop of about 1.8 feet during an approximate 2-month period from July

16, 1989, to September 9, 1989. The most recent ground water level reading obtained on January 22, 1990, is consistent with the groundwater level reading obtained on September 9, 1989. These data suggest that seasonal variation in the groundwater level can be expected.

The most recent groundwater level readings indicate the groundwater table is at an elevation four feet to seven feet below the currently planned station bottom slab elevation. The water table appears to slope down westerly at an approximate gradient of about 0.01. Due to seasonal groundwater level variations in the area, there is a possibility that the groundwater may rise to an elevation at or a few feet above the planned bottom slab elevation.

4.3.3 Chemical Contamination and Construction Considerations

The results of chemical tests on selected soil and water samples are presented in Section 3.2.2, and in Appendix C. The Hollywood/Western Station is located in a well-developed area about 7,000 feet and 10,000 feet away from the Western Avenue and Los Angeles City Oil Fields, respectively. Chemical contamination of subsurface materials and groundwater in the alignment, if any, is most likely from the following sources:

1. Past and ongoing industrial and commercial facilities (especially gas stations) and activities in the station area and vicinity.
2. The presence of methane, hydrogen sulfide (H_2S) and residual petroleum (oil or tar) from natural sources.

Since the site area is some distance away from the existing oil fields, the potential contamination due to the second source mentioned above is likely to be limited but cannot be completely eliminated. The discussions presented in this section on chemical contamination levels in soil and groundwater samples, and their potential effects on disposal and work space environments during construction, are based solely on the results of a limited testing program performed for this investigation. They are presented to illustrate the potential chemical contamination extent in the Hollywood/Western Station site area.

In addition, cleanup action levels and exposure limits set or recommended by various regulatory agencies typically change as time passes. The action levels and exposure limits described in this section should be verified and modified, if necessary, to reflect up-to-date requirements at the time of station construction.

4.3.3.1 Chemical Contamination in Subsurface Materials. Headspace Organic Vapor Analyzer (OVA) readings were taken for most of the recovered samples to evaluate the possible presence and approximate concentration of volatile chemical compounds. Only one sample (PII-68/D-6) from this investigation indicated OVA reading of more than 10 ppm above the corresponding background OVA reading. The organic vapor type which generated high OVA readings on soil samples during this investigation is not known. Hence, an exposure limit of 10 ppm recommended for benzene (National Institute for Occupational Safety and Health, 1985) was conservatively selected for differentiating samples with high OVA readings.

The results of chemical tests performed on selected soil samples indicate that concentration levels of total recoverable petroleum hydrocarbons (TRPH) and four selected volatile (aromatic) organic compounds (BTEX, which includes benzene, toluene, ethylbenzene, and xylenes) are low, and except one sample, all are less than cleanup action levels as defined in the Leaking Underground Fuel Tank (LUFT) Field Manual (State Water Resources Control Board, 1987). TRPH level in sample LPE11/D-13 (Table 3-8) is slightly above the cleanup action level (110 ppm vs. 100 ppm). This indicates very localized contamination at the vicinity of Boring LPE-11.

It should be noted that the cleanup action levels in the LUFT Field Manual are specified only as guidelines. These action levels depend on various factors including the location of the groundwater table, the nature of groundwater usage, the possibility of groundwater contamination due to the presence of contaminants in subsurface soils, and other regulatory requirements. Most of these factors are decided on a case-by-case basis by the regulatory agencies. Hence, it is recommended that the requirements on cleanup action levels be determined in consultation with the California Regional Water Quality Control

Board (CRWQCB) and the Department of Health Services (DHS) before construction.

Chemical analyses results on selected samples to detect concentration levels of heavy metals also indicate the concentration levels of a suite of heavy metals (CAM Metals) in the subsurface materials are low and below cleanup action levels, as specified in the California Code of Regulations, Title 22, Section 66699.

Disposal of excavation spoils depends on the contamination level in the spoils. Excavation spoils will require special handling if they are classified as hazardous waste. The criteria to identify hazardous wastes are toxicity, ignitability, reactivity, and corrositivity as established in Title 22, Article II of the California Code of Regulations. Based on the ignitability characteristic of Total Recoverable Petroleum Hydrocarbons (TRPH) in "sandy soils," the Department of Health Services (DHS) has set a TRPH concentration of 1,000 ppm in soil as a criterion to classify hazardous waste (Appendix E, LUFT Field Manual). Soil samples collected from discrete locations and tested in this investigation did not indicate contamination levels which would classify subsurface soils as hazardous wastes. However, the potential for contamination exceeding hazardous criterion limits between boring locations cannot be eliminated. Therefore, monitoring is recommended during construction for contamination levels that may require special handling of excavation spoils (i.e., treatment or disposal at specific landfills that receive hazardous waste).

4.3.3.2 Chemical Contamination in Groundwater. Results of analytical testing on a water sample from Piezometer LPE-11, obtained and tested in the 1988 investigation (Earth Technology, 1988), are shown in Tables 3-5 through 3-10, and in Appendix C. Results indicate the concentration levels of TRPH, BTEX, and sulfide in the water are generally low or not detected. The results also indicate BTEX and TRPH concentrations in water samples are less than the cleanup action levels defined by the LUFT Field Manual.

Since the observed water level elevation is at or below the planned bottom slab elevation, the amount of groundwater collected during construction will be minimal. However, there will be some seepage into the excavation from saturated alluvium above the groundwater. Although the amount of water flow into the excavation is minimal, the disposal method for this water must be coordinated with California Regional Water Control Board (CRWQCB), the regulatory agency for related issues.

The CRWQCB requires chemical analyses of a suite of constituents in the groundwater for a National Pollutant Discharge Elimination System (NPDES) permit application to discharge wastewater. These include suspended solids, BOD_5 at 20°C, oil and grease, solids with the ability to settle, turbidity, sulfide, total petroleum hydrocarbons, volatile organic compounds (EPA Method 624), total dissolved solids, chlorides, sulfate and nitrate plus nitrate nitrogen. The CRWQCB action limits depend on discharge locations and the physical characteristics of specific groundwater aquifers and basins. These action limits are determined on a case-by-case basis. It is recommended that the issues and required data for permit application be discussed with the CRWQCB before taking further action.

The sulfate concentration level in the groundwater sample was relatively high and may require the use of Type II cement during construction (Table 3-5).

4.3.3.3 Hydrogen Sulfide and Methane. No sulfur odors were noticed during drilling and sampling of borings in this investigation (refer to boring logs in Appendix A). The results of available chemical tests show some concentrations of sulfate compounds in selected soil samples as well as moderate (70 ppm or less) concentrations of sulfate compounds in selected water samples. Sulfide and sulfate compounds may be potential sources for generating H_2S under certain chemical environments. Thus, the potential for H_2S concentration levels exceeding action levels cannot be completely eliminated. It is therefore prudent to continuously monitor H_2S concentrations during construction.

Some of the soil samples exhibited high headspace OVA readings during field investigation. Methane is one of the compounds which could produce high OVA readings in soil samples. The Hollywood/Western Station is in the general vicinity of the Western and Los Angeles City oil fields which may be the source of generating and propogating methane. Thus, the possibility of high methane concentrations in the site vicinity cannot be completely eliminated. Methane is combustible in air and can explode when the mixture in air is about 5 percent to 15 percent by volume. During construction, provisions to monitor the methane and oxygen concentrations and explosivity level, will be necessary. To ensure the safety of workers and to minimize shutdown, adequate ventilation should be maintained during construction to keep methane concentrations and explosivity levels in the work area within safety levels. The potential presence of high methane concentrations also require that station structures be tightly sealed to prevent accumulation of methane and to avoid combustion and explosion hazards.

4.4 ENGINEERING PROPERTIES OF SUBSURFACE MATERIALS

4.4.1 General

Engineering properties of subsurface materials based on the results of laboratory tests in this investigation are summarized in terms of ranges of variation, mean and standard deviation values. These are presented in Table B-8 in Appendix B. Similarly, shear wave velocity, static and dynamic modulus, and subgrade modulus based on available literature correlations with SPT blowcounts observed in the field exploration (Ohta and Goto, 1978; Schmertmann, 1970; and Terzaghi, 1955), are summarized and presented in Table B-9 in Appendix B. The results of laboratory tests and available correlations with SPT blowcounts (e.g., Mitchell, 1977), together with available data from project data files (Section 2.4), other published data in the engineering literature, and engineering judgement were used to develop relevant static and dynamic engineering properties for engineering design and evaluations for the Hollywood/Western Station. These engineering properties are presented in Tables 4-1 and 4-2.

Detailed descriptions of the static and dynamic properties presented in Tables 4-1 and 4-2 are provided in Section 4.4.2 and 4.4.3, respectively. It should be noted that although the ranges of variation and recommended values of

TABLE 4-1. ENGINEERING PROPERTIES FOR STATIC ANALYSES

MATERIAL PROPERTY	GEOLOGIC UNIT: GRANULAR YOUNG ALLUVIUM (A1)		FINE-GRAINED YOUNG ALLUVIUM (A2)		GRANULAR OLD ALLUVIUM (A3)		FINE-GRAINED OLD ALLUVIUM (A4)	
	RANGE OF VARIATION	RECOMMENDED VALUES	RANGE OF VARIATION	RECOMMENDED VALUES	RANGE OF VARIATION	RECOMMENDED VALUES	RANGE OF VARIATION	RECOMMENDED VALUES
DRY DENSITY (pcf)	93-105	100	90-113	105	98-122	112	93-121	110
MOIST UNIT WEIGHT ABOVE WATER (pcf)	111-121	120	113-130	125	109-142	130	106-140	130
SATURATED DENSITY (pcf)	---	---	---	---	110-138	130	120-140	130
EFFECTIVE SHEAR STRENGTH ϕ_e (degrees) C_e (psf)	 25-40 0-1,000	 34 0	 20-30 0-1,600	 25 600	 30-43 0-1,500	 37 0	 22-34 750-2,800	 27 1,000
UNDRAINED SHEAR STRENGTH S_u(psf)	---	---	500-2,000	1,300	---	---	1,000-4,000	1,500 (2,000)[b]
PERMEABILITY (cm/sec)	---	---	---	---	10^{-5} - 10^{-3}	10^{-4}	10^{-7} - 5×10^{-5}	5×10^{-6}
POISSON'S RATIO	---	0.35	---	0.4	0.3-0.4	0.35	0.35-0.45	0.4
YOUNG'S MODULUS (ksf)	100-750	300	50-300	150	200-2,000	700 (1,500)[a]	80-1,800	800 (1,500)[a]

Note: (a) Values presented in parentheses represent the best estimate in the depth range below 63 feet and were used for station settlement/heave estimates.

TABLE 4-2. ENGINEERING PROPERTIES FOR DYNAMIC ANALYSES

MATERIAL PROPERTY	GEOLOGIC UNIT: GRANULAR YOUNG ALLUVIUM (A1) RANGE	GRANULAR YOUNG ALLUVIUM (A1) RECOMMENDED VALUE	FINE-GRAINED YOUNG ALLUVIUM (A2) RANGE	FINE-GRAINED YOUNG ALLUVIUM (A2) RECOMMENDED VALUE	GRANULAR OLD ALLUVIUM (A3) RANGE	GRANULAR OLD ALLUVIUM (A3) RECOMMENDED VALUE	FINE-GRAINED OLD ALLUVIUM (A4) RANGE	FINE-GRAINED OLD ALLUVIUM (A4) RECOMMENDED VALUE
SHEAR WAVE VELOCITY (ft/s)	400-700	550	400-500	450	650-1,300	1,000	500-1,300	1,000
DYNAMIC SHEAR MODULUS (ksf)	500-1,900	1,100	500-1,100	750	1,400-6,400	3,500	1,100-6,500	3,500
POISSON'S RATIO	-	0.3	-	0.4	-	0.3	-	0.4
DAMPING[a] VALUES (%)		5-10		5-10		5-10		5-10

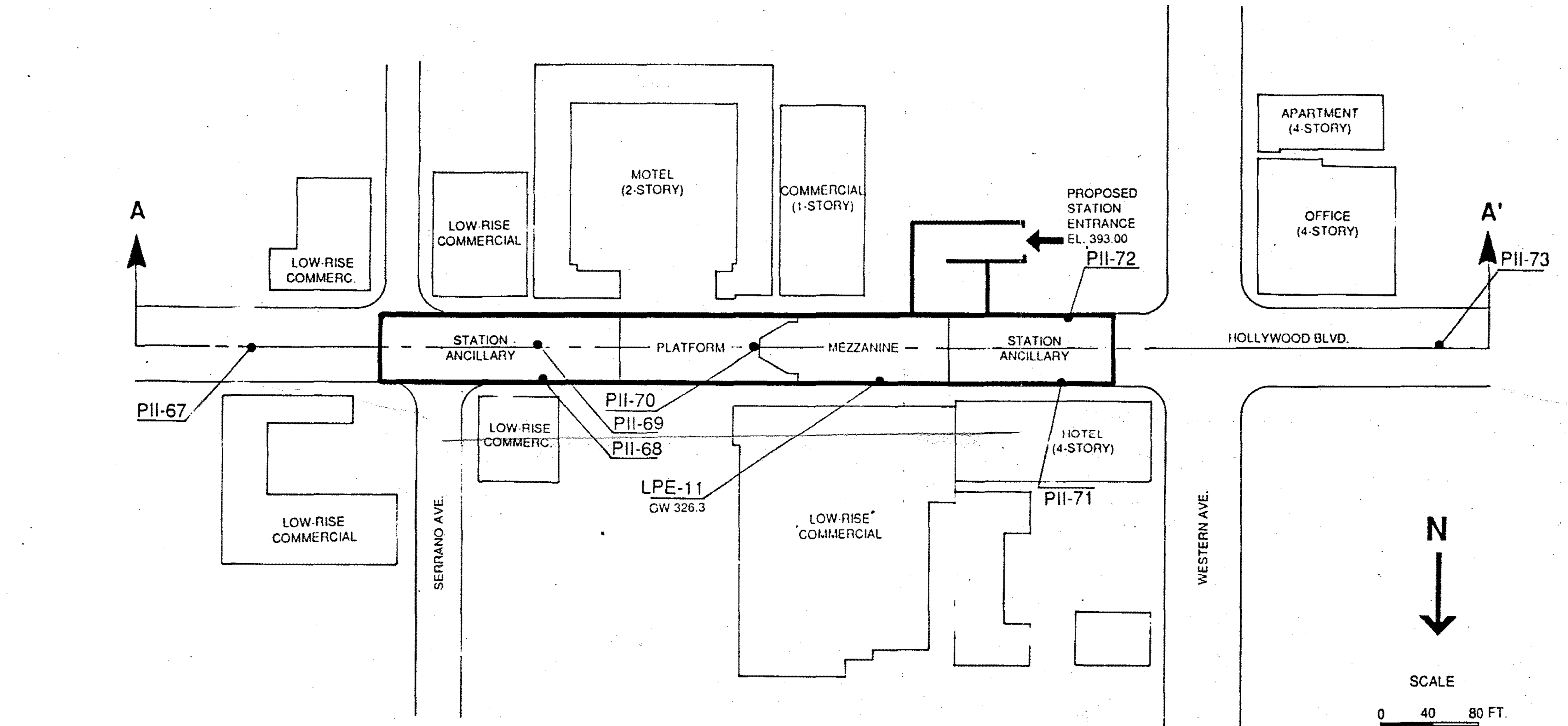
Note: (a) For small strains

various engineering properties presented in Tables 4-1 and 4-2 are considered reasonable for engineering evaluation purposes, they are not intended for the purpose of selecting construction machinery or equipment. The actual ranges of variation of various engineering properties for the subsurface materials are expected to be greater than those presented in Tables 4-1 and 4-2 because of the following reasons:

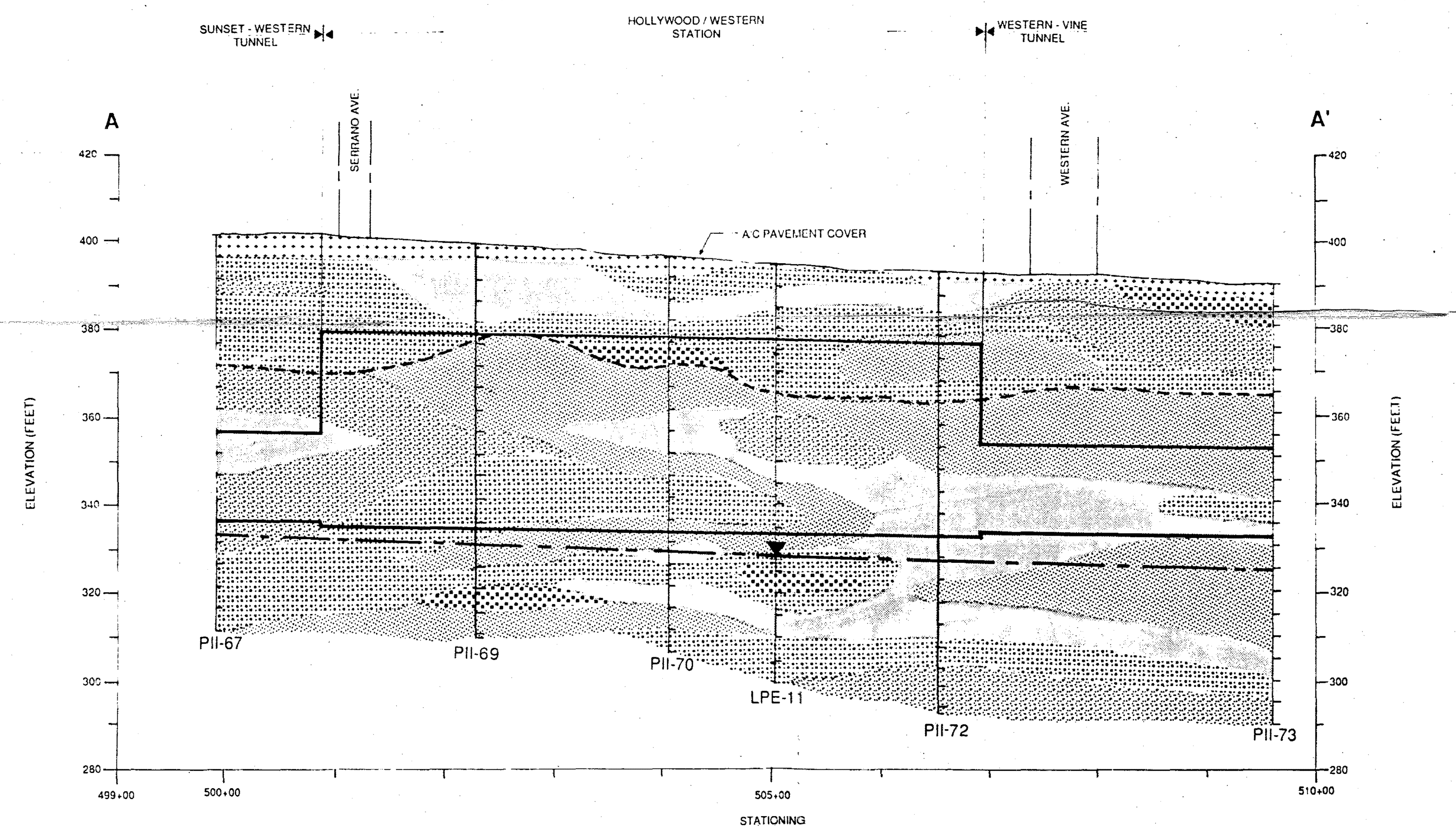
1. The ranges of variation in Tables 4-1 and 4-2 were obtained from field and laboratory data from discrete boring locations. The potential of engineering property variations for the subsurface materials between borings to be different from those in Tables 4-1 and 4-2 and cannot be eliminated.

2. Due to sample disturbance, the actual stiffness and strength characteristics of the subsurface soils will be higher than those exhibited by the laboratory testing on somewhat disturbed soil samples. Some sample disturbance is inevitable even under extreme care in the field exploration.

Strength and stiffness characteristics of the subsurface materials are an important considerations in selecting appropriate construction equipment and procedures. The above discussion indicates that although the exact extent is not known, the actual ranges of variations in subsurface materials' strength and stiffness characteristics will be higher than those summarized in Tables 4-1 and 4-2. It is advisable that the contractor select construction equipment and procedures based on stiffness and strength variation values that can appropriately cover potential variations in subsurface materials as well as sample disturbance effects. In addition, rail and/or rail tie from an old abandoned railway were encountered at various locations along Vermont Avenue and Hollywood Boulevard during the field exploration for the Metro Rail alignment. Their presence was detected within five feet below the ground surface in this investigation. The potential presence of these abandoned railway remains should be considered in the planning of the excavation.



PLAN



SCALE

HORIZONTAL 0 40 80 FT.

VERTICAL 0 10 20 FT.

PROFILE A-A'

EXPLANATION

- FILL (AND A/C PAVEMENT COVER IF PRESENT)
- FINE-GRAINED ALLUVIUM (CLAY OR CLAYEY SILT-CL, CH, ML, MH), UNIT A4/A2
- FINE-GRAINED ALLUVIUM (CLAYEY SAND WITH>35% FINES-SC) UNIT A4/A2
- GRANULAR ALLUVIUM (CLAYEY SAND WITH<35% FINES-SC UNIT A3/A1
- GRANULAR ALLUVIUM (SANDY SILT, SILTY SAND OR SILTY GRAVEL WITH>12% FINES-ML, SM, GM) UNIT A3/A1
- POORLY GRADED GRANULAR ALLUVIUM (SAND OR GRAVEL WITH<12% FINES-SP, GP, SP-SM, GP-GM) UNIT A3/A1
- GW 326.3 — APPROXIMATE GROUNDWATER LEVEL ELEVATION (PLAN)
- APPROXIMATE GROUNDWATER LEVEL ELEVATIONS (PROFILE) RECORDED IN THIS INVESTIGATION
- YOUNG ALLUVIUM / OLD ALLUVIUM CONTACT
- PII-70 — LOCATIONS AND NUMBERS OF BORINGS IN THIS INVESTIGATION
- LPE-11 — LOCATIONS AND NUMBERS OF MOS-2 BORING (EARTH TECHNOLOGY, 1988)
- PROPOSED STATION CONFIGURATION

NOTES

1. THIS PROFILE IS BASED ON ENGINEERING INTERPRETATION BETWEEN BORINGS AND AVAILABLE PIEZOMETRIC DATA, AND WAS DEVELOPED AS A VISUAL AID IN DEVELOPING A GENERAL UNDERSTANDING OF SUBSURFACE CONDITIONS AND ENGINEERING CONSIDERATIONS. ACTUAL CONDITIONS ENCOUNTERED DURING SUBSEQUENT INVESTIGATION OR CONSTRUCTION MAY BE DIFFERENT.
2. SUBSURFACE DATA AT BORING LOCATIONS PRESENTED HEREIN ARE SIMPLIFIED INTERPRETATIONS OF BOREHOLE DATA INCLUDED IN APPENDIX A.
3. GROUNDWATER LEVEL DATA ARE BASED ON MONITORING OF PIEZOMETERS FOR A LIMITED PERIOD OF TIME. SEASONAL AND SPATIAL VARIATIONS MUST BE EXPECTED.
4. YOUNG ALLUVIUM/OLD ALLUVIUM CONTACT LOCATION IS BASED ON SIMPLIFIED ENGINEERING INTERPRETATION OF BOREHOLE DATA. ACTUAL CONTACT LOCATION MAY BE DIFFERENT.
5. LOCATION AND CONFIGURATION OFSTATION ARE BASED ON"DESIGN DRAWINGS FOR SIX STATIONS & LINE SEGMENTS" PREPARED BY MRTC AND DATED JUNE 1989.
6. ELEVATIONS REFER TO LOS ANGELES CITY ENGINEER'S DATUM - 1975 ADJUSTMENT.
7. BOREHOLE DATA ARE PROJECTED HORIZONTALLY ON THE CROSS-SECTION LINE. GROUND ELEVATIONS AT BOREHOLE LOCATION AND AT CROSS-SECTION LINE LOCATION MAY BE DIFFERENT.
8. END POINTS OF LAYERS BETWEEN BORINGS ARE ILLUSTRATIVE ONLY. THEIR LOCATIONS AND GEOMETRY ARE NOT KNOWN.

The Earth Technology Corporation

100 West Broadway, Suite 5000, Long Beach, CA. 90802

REVISION DESCRIPTION

PLAN AND PROFILE HOLLYWOOD / WESTERN STATION

DRAWN BY: C.C.H.		SCALE: AS SHOWN
APPROVED BY: M.G.	CHECKED BY: M.H.	DATE: MAY 1990
DRAWING NUMBER SHEET 1 OF 1		FIGURE 2-2

4.4.2 Static Engineering Properties of Subsurface Materials

As described previously, relevant static engineering properties of the subsurface materials encountered in the site area are summarized in Table 4-1.

No engineering properties are presented for the localized presence of thin surficial fill, which has little or no effect on the planned design and construction of the station.

The following sections provide a description of the properties for the Young Alluvium and the Old Alluvium.

4.4.2.1 Granular Young Alluvium (Unit A1). Granular alluvium is present in considerable amounts in the planned Hollywood/Western Station area. Granular alluvium in this area consists mostly of dense to very dense sand, silty sand, and clayey sand, with a fines content ranging from about 10 percent to 35 percent. Occasional gravel pockets are also encountered in some of the borings. Properties of granular alluvium are expected to vary significantly, depending on the fines content.

Strength parameters for this stratum were derived based on direct shear test results on selected samples from this investigation, available data from the 1988 investigation (Earth Technology, 1988) and SPT correlations. Based on these results and engineering judgment, the use of a friction angle of 34 degrees and zero cohesion appears to be reasonably conservative to account for potential variability within the site area.

4.4.2.2 Fine-Grained Young Alluvium (Unit A2). The fine-grained Young Alluvium consists primarily of medium-stiff to hard silty clay, sandy clay, clayey silt, and clayey sand (with a fines content of 35 percent or more). The results of this investigation indicate these fine-grained alluvial materials are mostly confined to large pockets in localized areas (in Borings PII-69, PII-71, and marginally in PII-72 and LPE-11).

Shear strength parameters for this stratum were evaluated based on literature data, available correlations with SPT data, and engineering judgement. An

effective friction angle of 25 degrees and an effective cohesion of 600 psf are reasonably conservative to account for potential variability of fine-grained Young Alluvium in the Hollywood/Western Station site area.

4.4.2.3 Granular Old Alluvium (Unit A3). Granular materials account for about 40 percent of the Old Alluvium in the site area, and consists mostly of dense to very dense sand, silty sand, and clayey sand with a fines content ranging from about 10 percent to 35 percent, with occasional pockets of clean sand, gravelly sand, gravel, and sandy silt. Properties of granular Old Alluvium are expected to vary significantly, depending on the fines content.

Strength parameters for this stratum were derived based on direct shear test results on selected samples from this investigation, available data from the 1988 investigation (Earth Technology, 1988) and correlations with SPT data. Based on these results and engineering judgment, the use of a friction angle of 37 degrees and zero cohesion appears to be reasonably conservative to account for potential variability within the site area.

Elastic modulus (initial tangent modulus) and Poisson's ratio for this stratum were estimated based on literature data, available correlations with SPT data, and engineering judgement. Elastic modulus of granular soils is usually a function of soil density, confining stress, and past stress history. The modulus values shown in Table 4-1 for this stratum represent the estimated average values for use in the engineering evaluation.

Laboratory permeability tests performed on two samples (PII-69/D-20 and PII-70/D-20) from this investigation indicated permeability of 10^{-6} cm/sec to 10^{-7} cm/sec. This low permeability values are due to relatively high fines content in the tested samples (33 percent and 34 percent, respectively). However, results of field permeability tests (slug tests, pump tests), performed in earlier investigations (Earth Technology, 1990a) indicate field permeability of granular alluvium ranges between 1×10^{-4} cm/sec and 7×10^{-4} cm/sec. Available correlations of grain size data with permeability indicate permeability of granular Old Alluvium to range from 10^{-3} cm/sec to 10^{-5} cm/sec. Based on our experience, a permeability of 1×10^{-4} cm/sec is reasonable for this layer.

4.4.2.4 Fine-Grained Old Alluvium (Unit A4). The fine-grained Old Alluvium consists primarily of stiff to hard silty clay, sandy clay, clayey silt, and clayey sand (with a fines content of 35 percent or less). These materials are encountered at varying depths, deposited in 5- to 10-foot-thick layers extending across the whole site area. Properties of this material were determined based on test results on selected samples from this investigation, available data from the 1988 investigation (Earth Technology, 1988), correlations with SPT data, and engineering judgment. An effective friction angle of 27 degrees and an effective cohesion of 1,000 psf are reasonably conservative to account for the potential variability of fine-grained Old Alluvium in the Hollywood/Western Station site area.

Based on laboratory results, available correlations with SPT data, and engineering judgment, our best estimate for the undrained shear strength of the fine-grained Old Alluvium in the site area is about 1,500 psf. However, below the planned excavation bottom elevation, a value of 2,000 psf is considered reasonable to account for the increased effective stress.

Elastic modulus (initial tangent modulus) and Poisson's ratio for this stratum were estimated based on literature data, available correlations, and engineering judgment. Elastic modulus is usually a function of the over-consolidation ratio, confining stress, and soil density. The values presented in Table 4-1 represent the estimated average values for use in engineering evaluation.

Laboratory permeability tests and grain size distribution correlations with permeability indicate permeability of this layer ranges from 5×10^{-5} cm/sec to 10^{-7} cm/sec. A permeability of 5×10^{-6} cm/sec is considered reasonable for these materials.

4.4.3 Dynamic Engineering Properties of Subsurface Materials

No laboratory tests were performed to determine dynamic engineering properties of subsurface material in Hollywood/Western Station site area. Blow counts observed during soil sampling are the only available data which could be used to estimate dynamic engineering properties of subsurface materials. There are two types of blow counts obtained during soil sampling, blow counts required to drive a standard split-spoon sampler, and blow counts for a California-type drive sampler. These sampling procedures were described in Section 3.1.1 of this report.

The number of blows required to drive a standard split-spoon sampler for the last 12 of 18 inches is called a standard penetration test blow count (SPT number). Blow counts required to drive a California-type drive sampler could be converted to approximate equivalent SPT numbers (De Mello, 1971; Bhushan et al., 1976). Our recommended dynamic engineering properties are based on available correlation with SPT numbers and engineering judgment. These properties are summarized in Table 4-2. No engineering properties are presented for the thin surficial fill which has little or no effect on the design.

5.0 Geotechnical Evaluation and Recommendations

5.0 GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

5.1 GENERAL

Cut and cover construction of the Hollywood/Western Station will involve about 60 feet to 70 feet of excavation from the ground surface (about Elevations 392 feet to 401 feet) to the station bottom slab elevation (about Elevation 333 ± 2 feet). The excavation will penetrate through surficial pavement, fill (if present), and about 55 feet to 65 feet of heterogenous and nonuniform alluvial soils which consist of about 20 feet to 35 feet of Young Alluvium (A1 and A2) and about 20 feet to 45 feet of Old Alluvium (A3 or A4).

Available data indicate that the groundwater levels in the site area are about four feet to seven feet below the planned station bottom slab elevation. Potential seasonal variation may result in a rise of the groundwater level to an elevation at or near the excavation bottom. No dewatering prior to station excavation is needed.

The moist nature of the alluvial soils and potential seasonal variation of the groundwater levels indicate that some groundwater seepage into the excavation opening may be possible during construction. The amounts of seepage flow are anticipated to be small and can be handled easily by a readily available drain/sump system.

Station construction will be very close (about 10 feet to 30 feet) to adjacent existing buildings. All of these building foundations may be located above the bottom of the station excavation. Thus, a means of protecting these existing buildings from damage due to station excavation will also require consideration. In addition to the proximity of these buildings to the planned station construction, the limited construction space and subsurface conditions indicate shoring will be required.

The above issues and other geotechnical considerations that require geotechnical engineering evaluation for design and construction purposes are summarized as follows:

- Construction effects on adjacent existing buildings and remedial needs

- Excavation-related shoring provisions and bottom stability/heave issues

- Foundation design of station structures

- Liquefaction potential and seismic-induced settlement.

5.2 STATION EXCAVATION

According to available design information (June 1989), the approximate elevations of excavation bottoms for various components are about Elevation 333 ± 2 feet, as described previously. Station excavations may be either shored or sloped back. Sloped excavations may not be feasible at the site due to the proximity of the excavation limits to existing structures. As an alternative to shored excavations, portions of the required excavation can be sloped back through the Young or Old Alluvium if sufficient easements can be obtained.

5.2.1 Sloped Excavation

Compared to shored excavations, sloped excavations will increase the volume of excavated materials. Sloped excavations can be used for the station's structural components that require shallower excavations, or can be used to reduce the height of shoring if sufficient easements can be obtained.

A series of slope stability analyses were performed assuming that no heavy loads are at or near the top of the slope. Our recommendations for temporary sloped excavations are as follows:

1. 1H:1V (one horizontal to one vertical) for the fine-grained Young and Old Alluvium (Units A2 and A4, respectively).
2. 1-1/2H:1V for the granular Young and Old Alluvium (Units A1 and A3, respectively).

The above recommendations for allowable slopes should be used as general guidelines. Actual slopes will depend on the subsurface conditions

encountered during excavation and construction. If heavy loads (stored materials, cranes, etc.) are anticipated at the top of the slopes, the slopes must be modified accordingly by taking into consideration the impact of these loads.

It should be noted that construction and proper maintenance of safe, stable slopes are the responsibility of the contractor, based on factors that must be determined in the field from actual construction conditions and the subsurface conditions encountered during construction.

5.2.2 Shored Excavation

The excavation for the cut-and-cover station will extend to a maximum depth of about 70 feet below the ground surface. The proximity of the excavation to adjacent buildings, limited construction space, and the subsurface conditions in the general area indicate shoring will be required.

Various shoring systems exist in engineering practice. These include sheet pile, structural slurry, or soldier pile and lagging walls with tiebacks or internal bracing. Based on local practice in the Los Angeles area with subsurface conditions similar to those encountered in the site area, soldier pile and lagging walls with tiebacks or internal bracing (struts and wales) are the most likely shoring systems. In this investigation the engineering evaluation and discussions provided in this section for the shoring support of the station excavation are related to the soldier pile and lagging walls with tiebacks or internal bracings. If a shoring system with combined tiebacks and internal bracings is selected, a complete soil-structure interaction study must be performed considering the difference in stiffness between the tiebacks and internal bracings. Results of such a study should be reviewed and approved by the owner agency or its authorized consultants.

It should be noted that appropriate shoring system selection, design, installation and maintenance will be the responsibilities of the contractor and subject to review and acceptance by the owner agency or its authorized consultants.

5.2.2.1 Assumptions. Shoring systems for deep excavations consist of soldier pile and lagging walls with tiebacks or internal bracing to resist lateral earth and water pressures exerted by the excavation and/or the lateral pressure resulting from the adjacent existing structures if they are not underpinned below the depth of the final excavation.

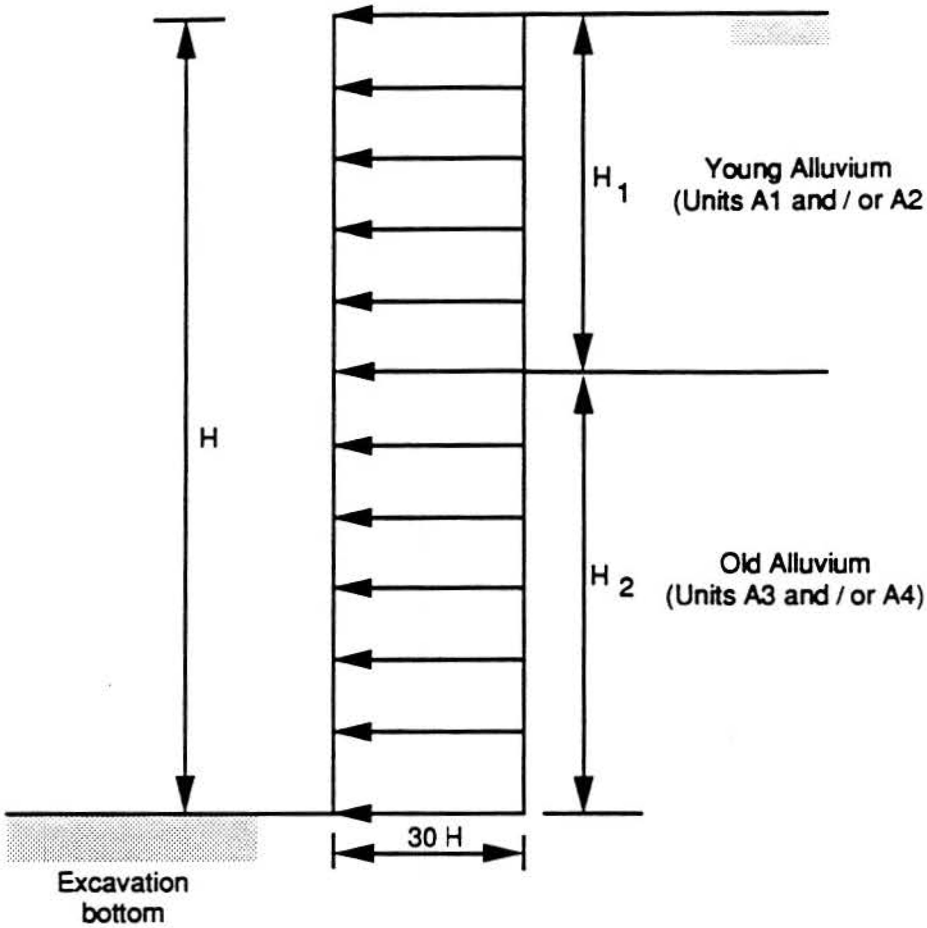
Both soldier pile and lagging walls with tiebacks or internal bracing were considered in the engineering evaluation. In the engineering evaluation provided in subsequent sections, it was assumed that the groundwater levels are below the planned bottom slab elevation of the station.

Based on this assumption, our engineering evaluation and recommendations, with respect to soldier pile and lagging walls with tiebacks or internal bracing, are described in the following sections.

5.2.2.2 Lateral Wall Pressure. Lateral pressure on the sheeting system depends on the type of shoring system, construction procedures, and subsurface and groundwater conditions. Based on the available results, anticipated shoring system, and construction procedures, as well as previously stated engineering assumptions, lateral earth pressures on the soldier pile and lagging walls for the following cases are shown in Figures 5-1 through 5-4:

- Braced sheeting above the excavation
- Cantilevered sheeting above the excavation
- Surcharges from a sloped excavation, existing buildings, construction loads, and earthquake-induced loads
- Active and passive earth pressures on soldier piles below the excavation.

The lateral loading diagrams presented in Figures 5-1 to 5-4 are for use in the design of soldier pile and lagging, tiebacks, or an internal bracing system. Various design considerations are described in the following sections.



Notes: (1) This pressure diagram is applicable to all sides of excavation
(2) Earth pressure in psf
(3) H_1, H_2, and H in feet

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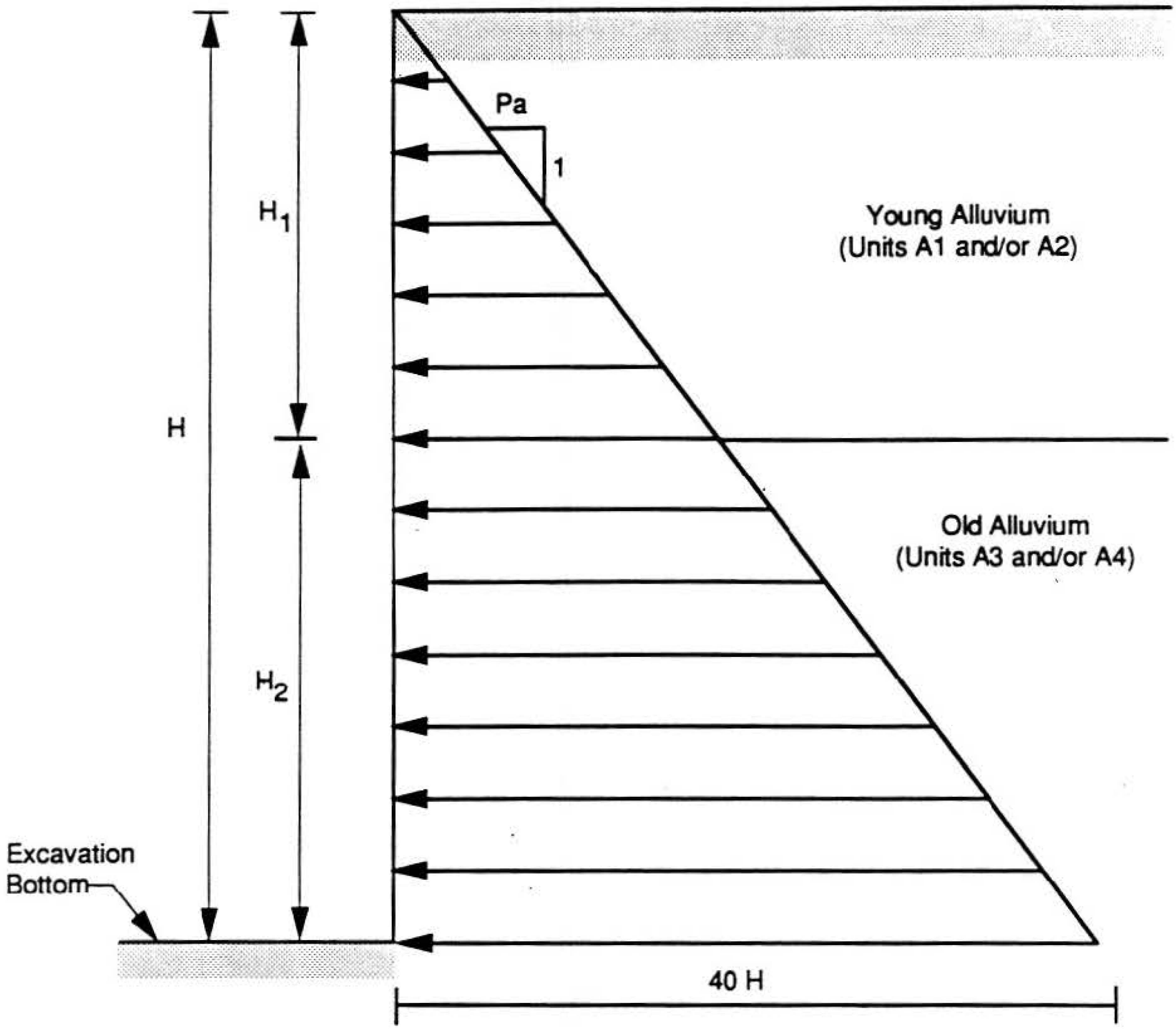
Lateral Earth Pressure On Braced Sheeting

03-90

Figure 5-1



Pa = 40 psf/ft

Notes: (1) All earth pressures in psf.
(2) H, H_1, and H_2 in feet.

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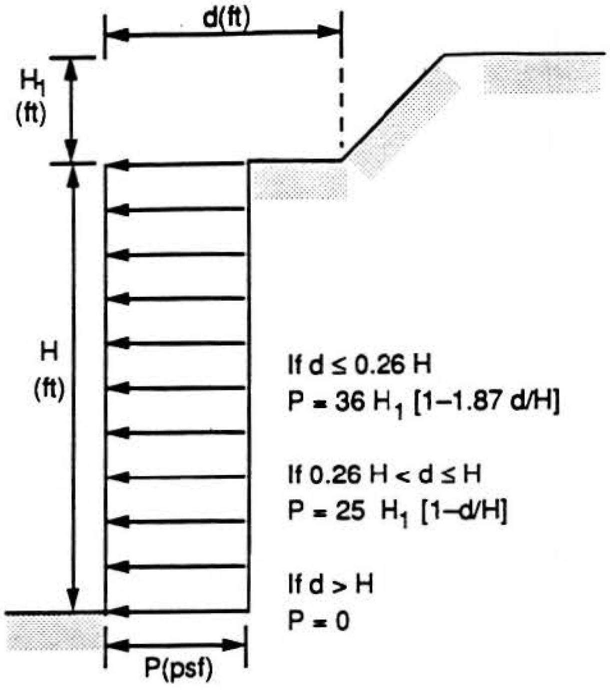
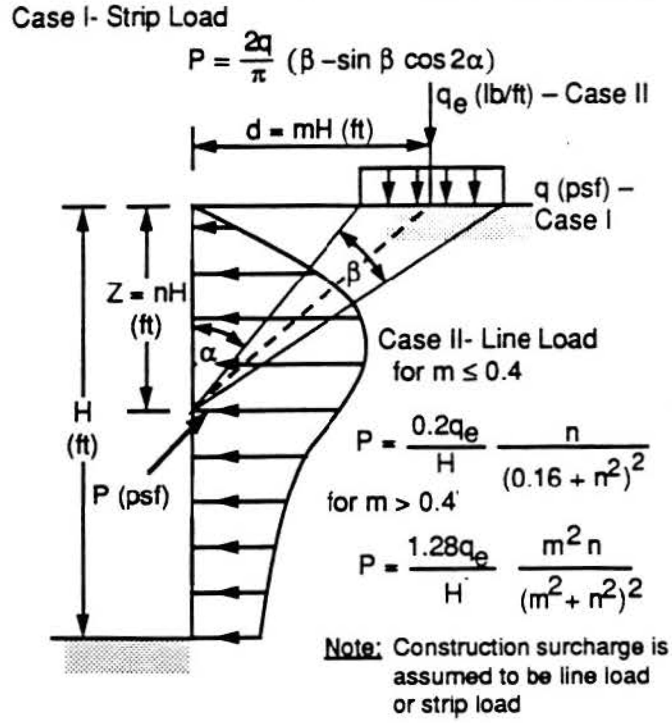
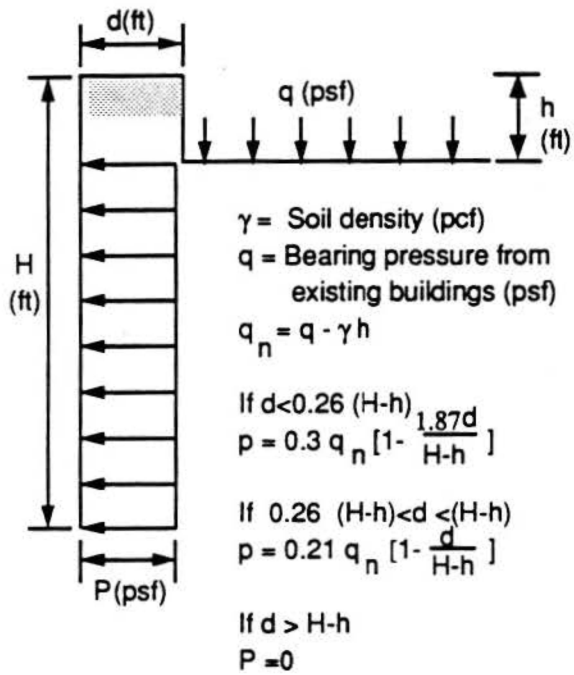
Lateral Earth Pressure on Cantilevered Sheeting	
03-90	Figure 5-2



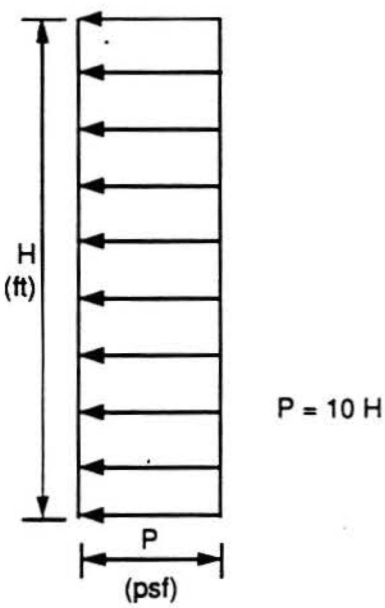
(a) Sloped Excavation Surcharge



(b) Construction Surcharge



(c) Building Surcharge



(d) Earthquake Surcharge

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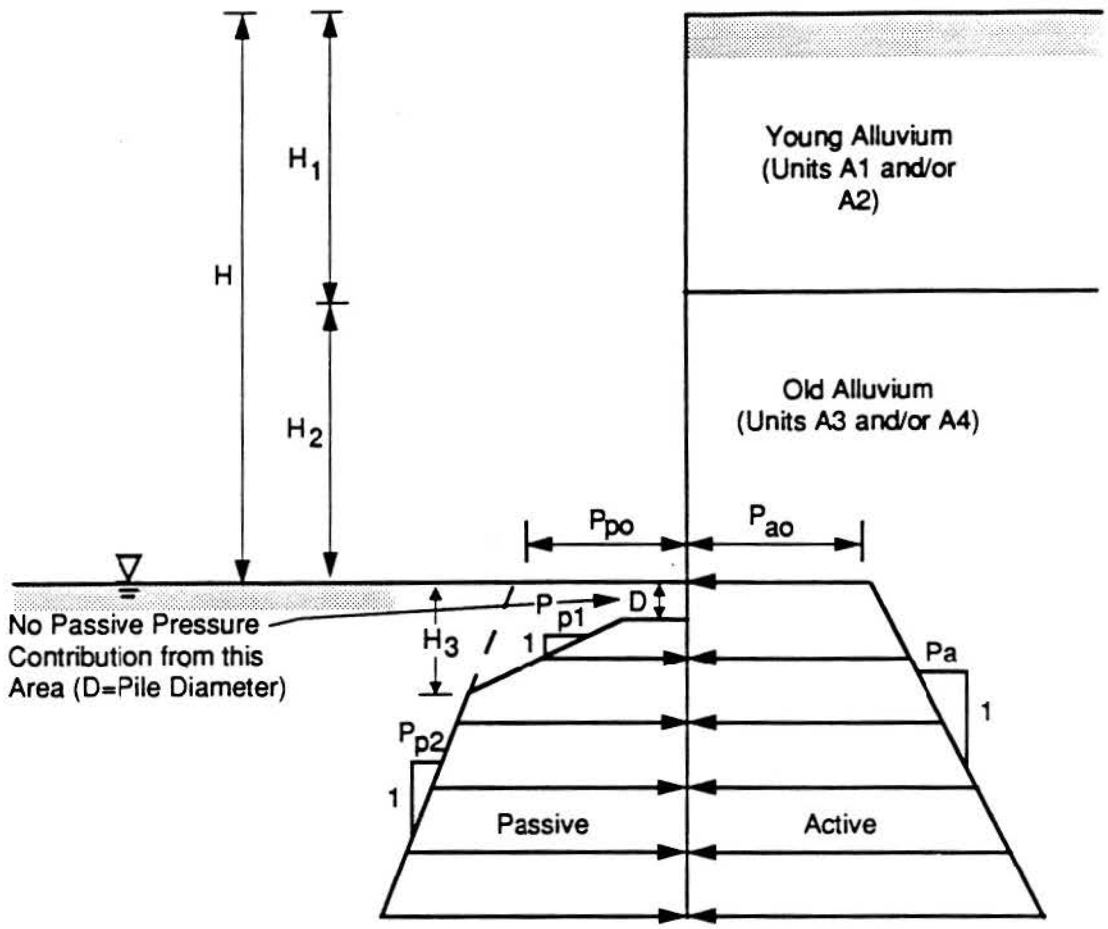
Additional Lateral Earth Pressure on Braced or Cantilevered Sheeting

03-90

Figure 5-3



P_a = 25 psf/ft
P_{po} = 1550 psf
P_{p1} = 134 psf/ft
P_{p2} = 77 psf/ft
P_{ao} = Active earth pressure at excavation bottom as obtained from Figure 5-1 or 5-2
$H_3 = P_{po} / (P_{p1} - P_{p2})$

Notes: (1) Alluvium below excavation bottom is assumed to be submerged.
(2) Factor of safety of 2.0 is included for passive pressure.
(3) All earth pressures in psf.
(4) H, H_1, H_2, and D in feet.

The Earth Technology Corporation	Project No.: 89-409 **Hollywood / Western Station**
06-90	**Lateral Earth Pressure On Soldier Piles Below Excavation** Figure 5-4

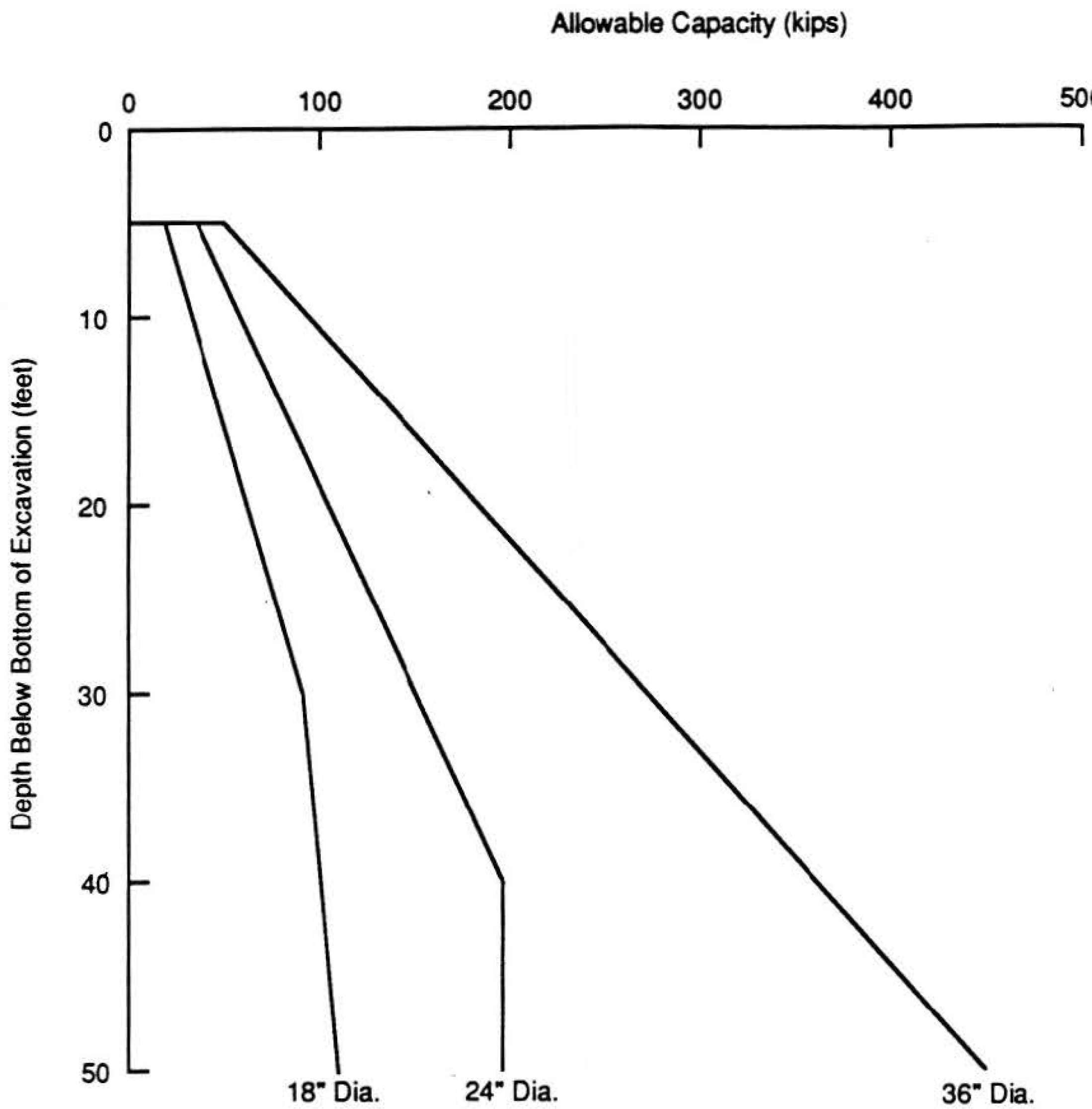
5.2.2.3 Design Considerations - Soldier Piles and Lagging. The soldier pile and lagging walls should be designed to safely resist lateral and vertical loads imposed by the excavation, existing structures, construction loading, environmental loading (such as earthquake loading), and the shoring system itself. Design considerations, which include pile sizing, embedment depth, spacing, installation, and lagging provisions, should be in compliance with appropriate building codes and city requirements.

Pile Sizing

Pile sizing includes a proper determination of pile size (diameter or cross section) and type (stiffness) so that stresses in the piles are within allowable limits. All anticipated lateral and vertical loads, as well as calculated loads from tiebacks or internal bracing, should be applied in calculating the pile stresses. The calculated stresses in the pile can be reduced by 20 percent to account for arching effects due to pile flexibility.

Embedment Depth

The soldier piles should be sufficiently embedded below the excavation depth to safely resist anticipated lateral and vertical loads. The passive resistance should be much more than the imposed lateral loads (active pressure in Figures 5-1 to 5-4, minus the resistance from tiebacks or internal bracing) with a reasonable factor of safety. The effective excavation width that each pile can support is about 1.5 times the soldier pile diameter or half of the pile spacing, whichever is less. For vertical load considerations, the allowable vertical pile capacity, shown in Figure 5-5, should be more than the vertical load components from tiebacks and the load from decking. It should be noted that piles may undergo some settlement before mobilizing the anticipated capacities. It is estimated these settlements may range from about 0.5 percent to 2 percent of the pile diameter. However, it is recommended that at least one or two pile load tests be performed to verify estimated capacities and to ensure that settlement under design load will be acceptable.



Note: Factor of safety of 3 is included.

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Allowable Vertical Capacity for Straight Shaft Soldier Piles

03-90

Figure 5-5

Pile Spacing

Optimal pile spacing depends on a number of factors, including subsurface conditions and engineering properties of subsurface materials, pile sizing, and construction procedures and cost. Considering the need for lagging to alleviate soil raveling and minimize ground loss, a pile spacing of eight feet or less would be reasonable.

Pile Installation

As in similar deep excavations in the Los Angeles area, soldier piles in the site area should be installed in predrilled holes to the design embedment depths. The presence of dense to very dense granular alluvium in the site area precludes the use of impact driving. Potential caving conditions exist in granular alluvium. Provisions such as the use of casings or slurry in the predrilled holes should be implemented to alleviate caving conditions, if they exist.

Lagging

Lagging between soldier piles will be needed to minimize soil raveling or ground loss, especially in the granular alluvial zones. It is the contractor's responsibility to control the temporary height of exposed soil prior to lagging placement to eliminate raveling and ground loss problems.

Tiebacks

Installing tiebacks in the site area will require permission from the owners of adjacent buildings and avoidance of below-grade obstructions such as basements or foundations in adjacent buildings. Many types of tieback anchors exist, including shaft anchors, belled anchors, anchor blocks, and high-pressure grout anchors. For this project, it is assumed that straight shaft anchors will be used in construction.

In general, the allowable capacity of the tieback anchor should be determined in the field based on anchor load tests. The following paragraphs describe

our anchor capacity estimates and recommendations for load testing and maintaining.

Effective friction of a tieback anchor can develop only beyond a no-load zone. Our recommendations for the no-load zones, considering depth of excavation and potential wedge failure planes, are shown in Figure 5-6. The allowable anchor capacity can be determined as follows:

$$P = q\ (\pi DL)$$

where:

P = allowable anchor load in kips
L = length of bonded anchor beyond the no-load zone in feet
D = anchor diameter in feet
q = soil friction in ksf, which can be determined as follows:

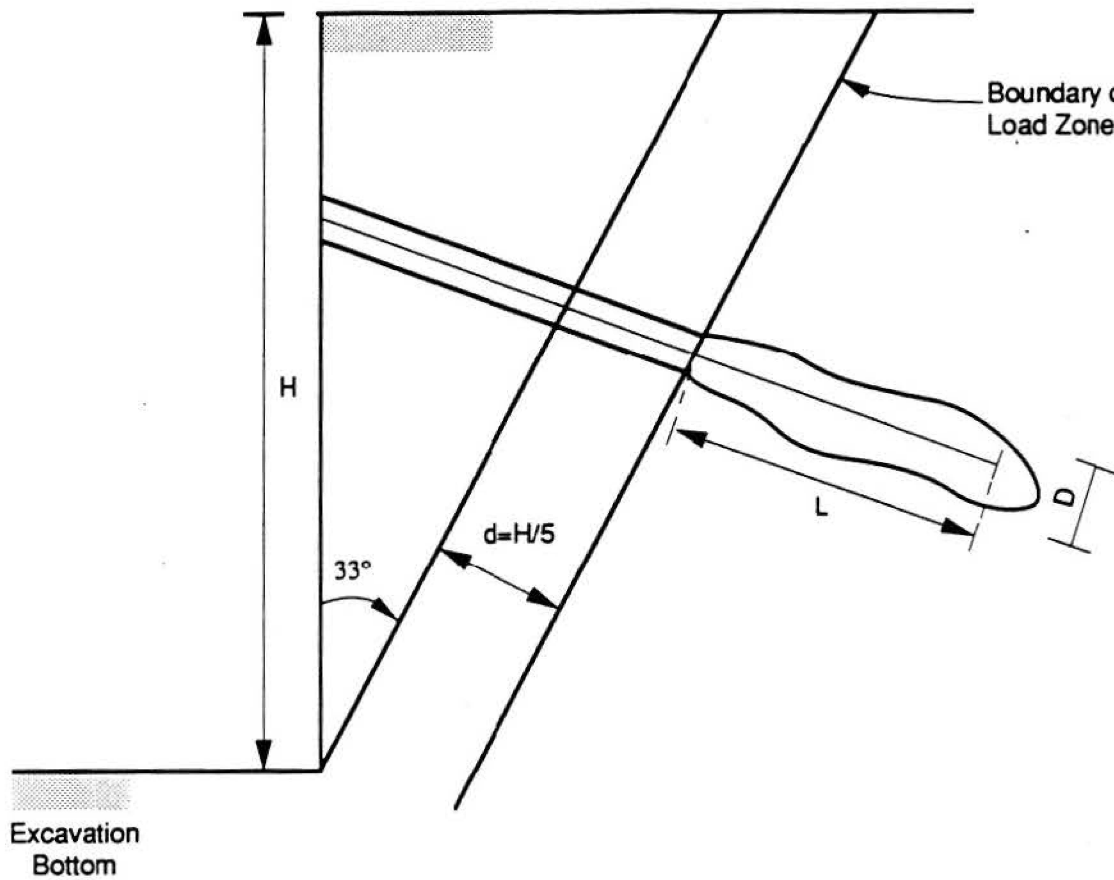
$q = 0.1 + 0.02z < 0.5$ ksf in fine-grained alluvium
$q = 0.015z < 1.5$ ksf in granular alluvium

where:

z = depth to the middle of bonded anchor in feet.

In addition, the allowable capacity of the anchors should not exceed 150 kips. The anchors may be installed at angles between 20 degrees to 50 degrees below the horizontal direction. Potential caving conditions in the granular alluvium are possible, so the contractor should use appropriate methods and measures to prevent caving to minimize ground loss.

Each tieback anchor should be load tested to 150 percent of the design load in accordance with standard acceptance criteria (FHWA-DP-68-IR, Nov. 1984; Winterkorn and Fang, 1975) or local site-specific experience of the contractor. The load in the tiebacks should be locked off at 100 percent of the design load. The load in a selected number of tiebacks should be periodically monitored and reloaded to 100 percent of the design load if the load decreases to less than 75 percent of the design load.



L = Bond length of anchor beyond no- load zone.

d, D, H, and L are in feet.

Reference: FHWA, Permanent Ground Anchors, 1984

The Earth Technology Corporation	Project No.: 89-409 **Hollywood / Western Station**
Anchor Locations For Tieback Walls	
03-90	Figure 5-6

Internal Bracing

If braced sheeting systems are employed, the strut loads should be determined using the full load diagrams shown in Figures 5-1 and 5-3. The vertical spacing between struts should be appropriately designed to minimize ground movements. All struts should be preloaded to eliminate slack and minimize ground movement. A preload of 25 percent of the design load is recommended. However, it should be noted that strut preloads may induce undue loading on basements, if any, of adjacent buildings. This possibility should be analyzed on a case-by-case basis. Procedures to compensate for the effects of temperature changes on the strut loads should be developed and implemented so proper strut load levels can be monitored and maintained during construction.

5.2.2.4 Ground Movement and Bottom Stability. Shored excavation will incur ground movements in terms of wall movement and ground heave. The magnitude of wall movement depends on many factors, including the design and construction of shoring systems, construction schedules, specifications, and subsurface conditions. In general, for a well-designed and constructed shoring system, the maximum horizontal wall deflection will be about 0.1 percent to 0.2 percent of the excavation depth. For the Hollywood/Western Station, the maximum horizontal wall movement may be about 3/4 inch to 1-1/2 inch. For a shoring system with tiebacks, this maximum horizontal deflection will occur near the surface, and the horizontal deflection will decrease with depth. For an internally braced system with struts and wales, the maximum horizontal deflection will probably occur near the bottom of the excavation and decrease to about 1/2 inch to 3/4 inch near the surface.

It is estimated that a maximum vertical settlement of about 1/2 inch to 1 inch will probably occur behind the wall to about 25 feet to 50 feet from the wall and will decrease as the distance from the maximum settlement location increases.

The excavation depth of the Hollywood/Western Station ranges from about 60 feet to 70 feet. This would mean a stress relief of about 7,200 psf to 8,750 psf at the bottom of the excavation, resulting in bottom heave due to elastic and consolidation rebounds. Because of design changes after the completion of

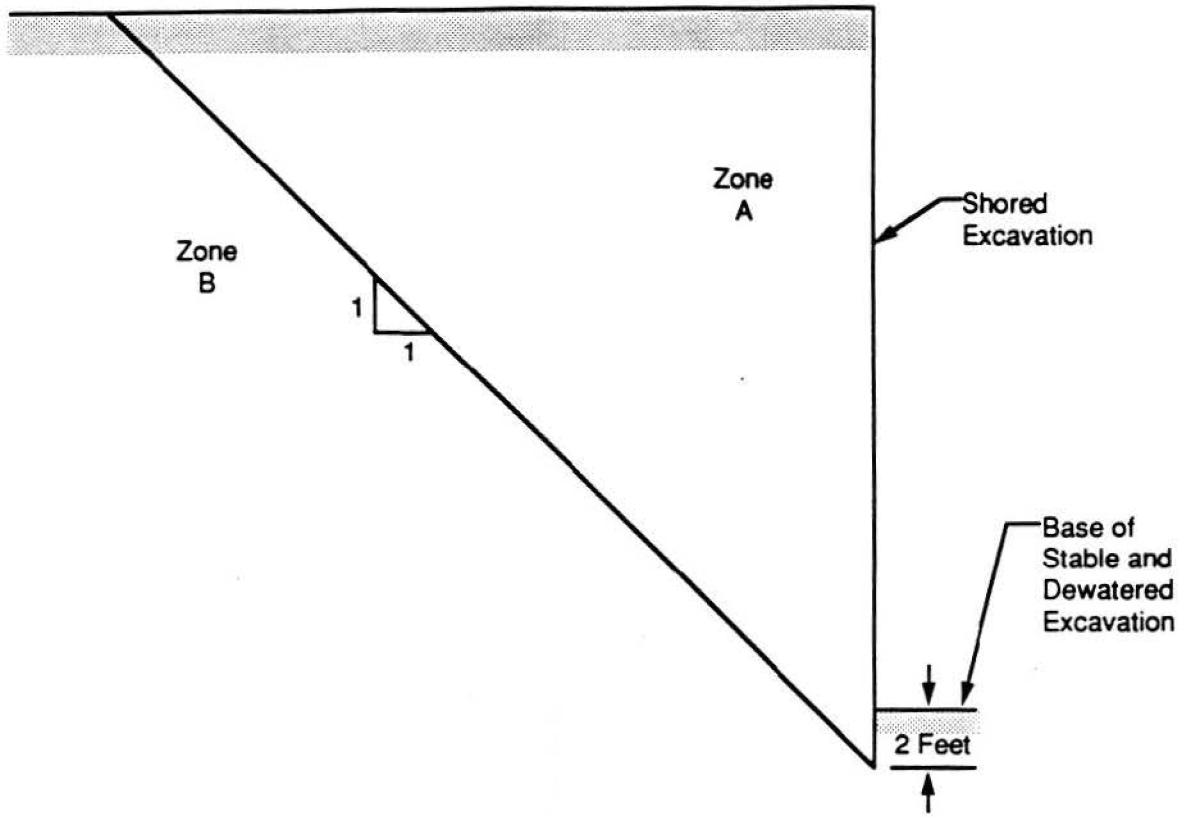
the field work (Section 4.3.1) the penetration depths of borings in this investigation were about 40 feet or less below the current station excavation depth (MRTC, 1989). For heave and settlement evaluation purposes, it was assumed that the subsurface conditions below the station bottom slab elevation consist of a 10- to 15-foot-thick layer of fine-grained Old Alluvium and very dense to dense granular Old Alluvium in the remaining portion within the influence zone of station construction (one to 1½ times the width of excavation). With this assumption, we estimate the heave at the center of the excavation bottom due to elastic rebound will be about 1½ inches and will occur mostly during excavation. The consolidation heave of 10 feet to 15 feet thick fine-grained alluvium located below the excavation bottom will be about 2 inches to 2½ inches and will occur within about 5 weeks to 10 weeks.

Assuming no surface surcharge along the side of the excavation, the stability against excessive heave and possible ground loss appears to be marginal. Therefore, before placing any surface surcharge further analyses for excavation stability should be performed and appropriate measures should be taken.

5.3 UNDERPINNING

The need to underpin adjacent existing buildings during station construction depends on many factors, including shoring design/construction, excavation dewatering effects, physical and foundation characteristics of existing buildings, cost, and the cooperation of private property owners. It is difficult to generalize such a need; each existing building has to be evaluated on a case-by-case basis. In general, the need for underpinning adjacent buildings will depend on whether their foundations are adequate and whether the buildings can satisfactorily resist anticipated settlement due to excavation. Figure 5-7 presents general guidelines for underpinning adjacent buildings.

There are several methods for underpinning, if needed. These may include, but are not limited to, jacked piles, drilled piers, and shafts/piers constructed



Notes: The following underpinning guidelines are for structure foundations in Zones A, and B.

Zone A: Foundations within this zone generally require underpinning.

Zone B: Underpinning may not be required.

The Earth Technology Corporation	Project No.: 89-409 **Hollywood / Western Station**
06-90	**General Guidelines For Underpinning** Figure 5-7

in pre-dug lagged pits to the bearing stratum. Our estimated allowable bearing capacity guidelines for jacked piles and drilled piers are presented in Figures 5-8 through 5-10. It should be noted that piles may experience a settlement of about 1/2 inch before mobilizing full friction resistance, and about 0.5 percent to 2 percent of pile diameter before mobilizing full tip resistance. It is recommended that at least one or two field pile load tests be performed at the site to verify recommended capabilities and to ensure that settlement under design load will be acceptable.

The settlements of underpinned buildings should be monitored on a regular basis during construction. If the settlement data indicate potential for settlements beyond the limits pre-set by the engineers, excavation work should be suspended temporarily and immediate remedial measures implemented.

5.4 STATION FOUNDATION SUPPORT AND CONSIDERATIONS

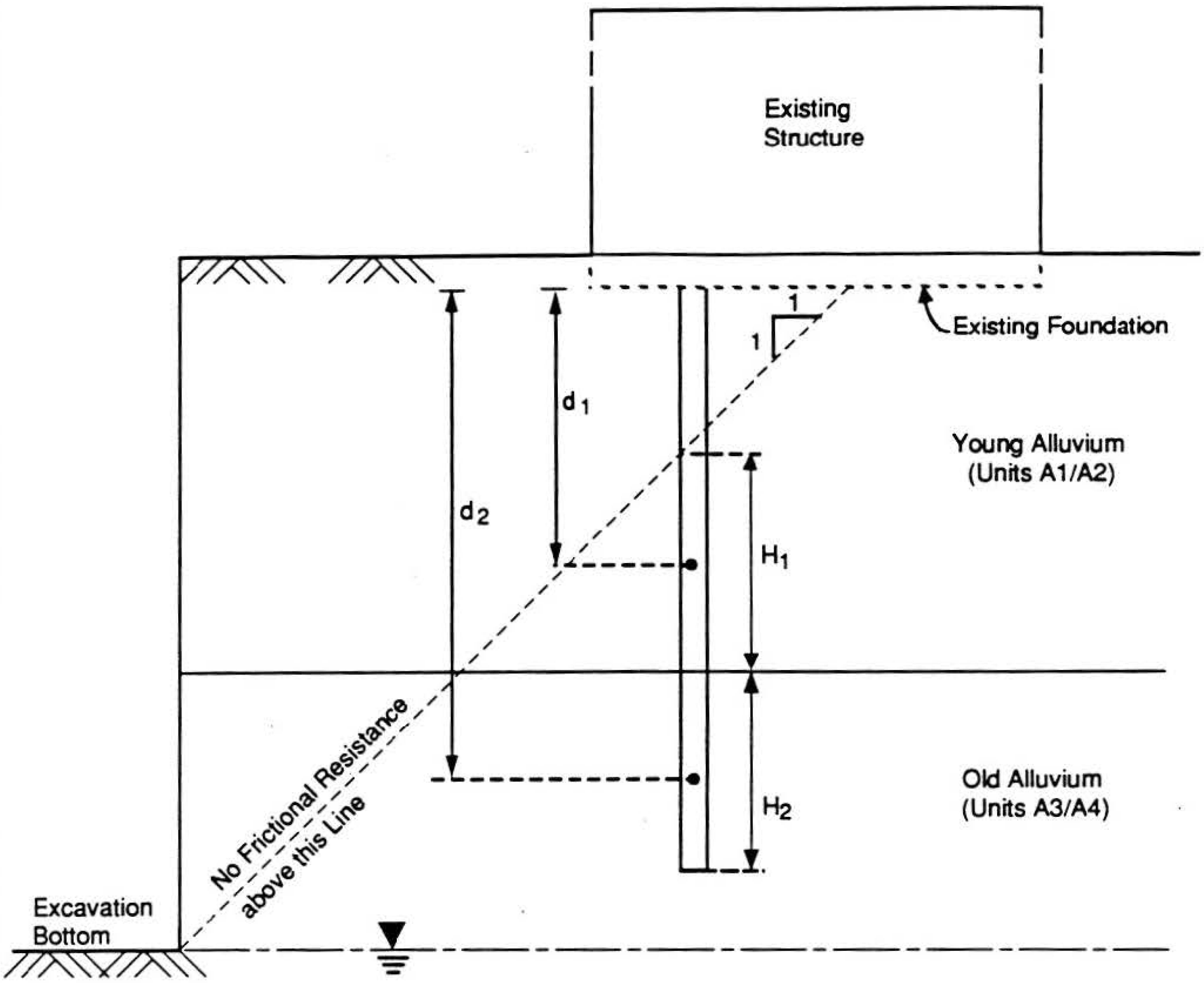
The subsurface material underlying the station is Old Alluvium which consists of either medium-dense to very dense granular sand or stiff to hard fine-grained soils. These soils will provide adequate foundation support for the planned station structures.

5.4.1 Main Station

We understand that the overall station will be designed and constructed as a relatively rigid box and the main station housing the rail facilities will be supported on wide, thick slabs that will function as relatively rigid mat foundations. These foundations will be supported on Old Alluvium.

Available information indicates that the average bearing pressure on the mat foundations from the station and backfill may be about 5,000 psf, which is less than the overburden removed by the excavation. This anticipated station load can be safely and adequately supported on the Old Alluvium.

As described in Section 5.2.2.4, it was assumed that the subsurface conditions below the planned station bottom slab elevation and within the influence zone



Allowable Capacity = $Q_T + (H_1 \times Q_{f1}) + (H_2 \times Q_{f2})$

Where Q_T = Allowable tip resistance at tip depth (Figure 5-9)

Q_{f1}, Q_{f2} = Allowable skin friction at depths d_1 and d_2, respectively (Figure 5-10)

Notes: (1) Allowable capacity and Q_T in Kips

(2) Q_{f1} and Q_{f2} in kips/ft.

(3) H_1, H_2, d_1, and d_2 in feet.

(4) Points located at depths d_1 and d_2 are at the middle of length segments H_1, and H_2 respectively.

(5) Groundwater level is assumed to be at or below excavation bottom elevation.

(6) Drawing is schematic.

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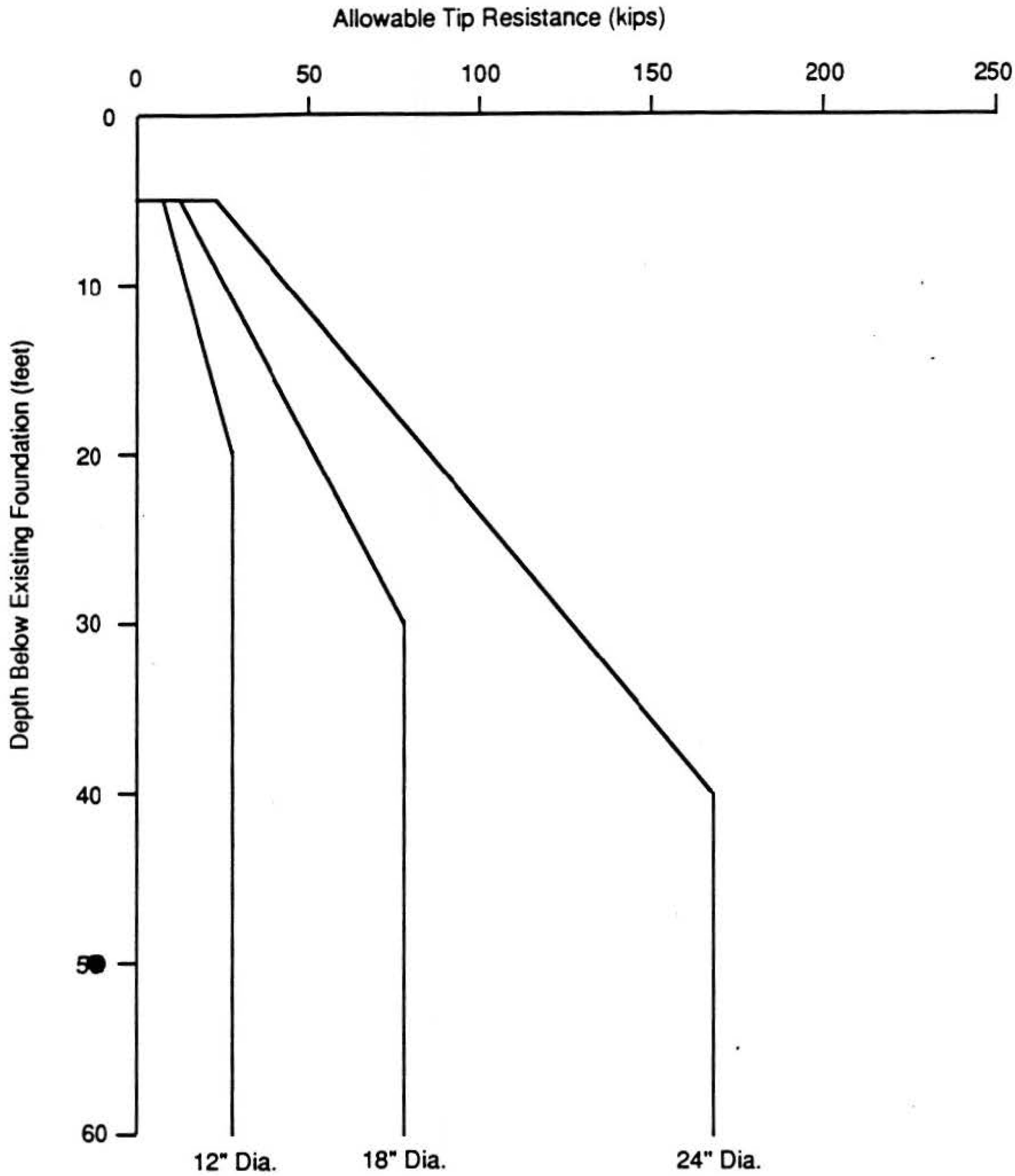
Design Capacity of Straight Shaft Piles for Underpinning Purposes

06-90

Figure 5-8



Note: Factor of safety of 3 is included.

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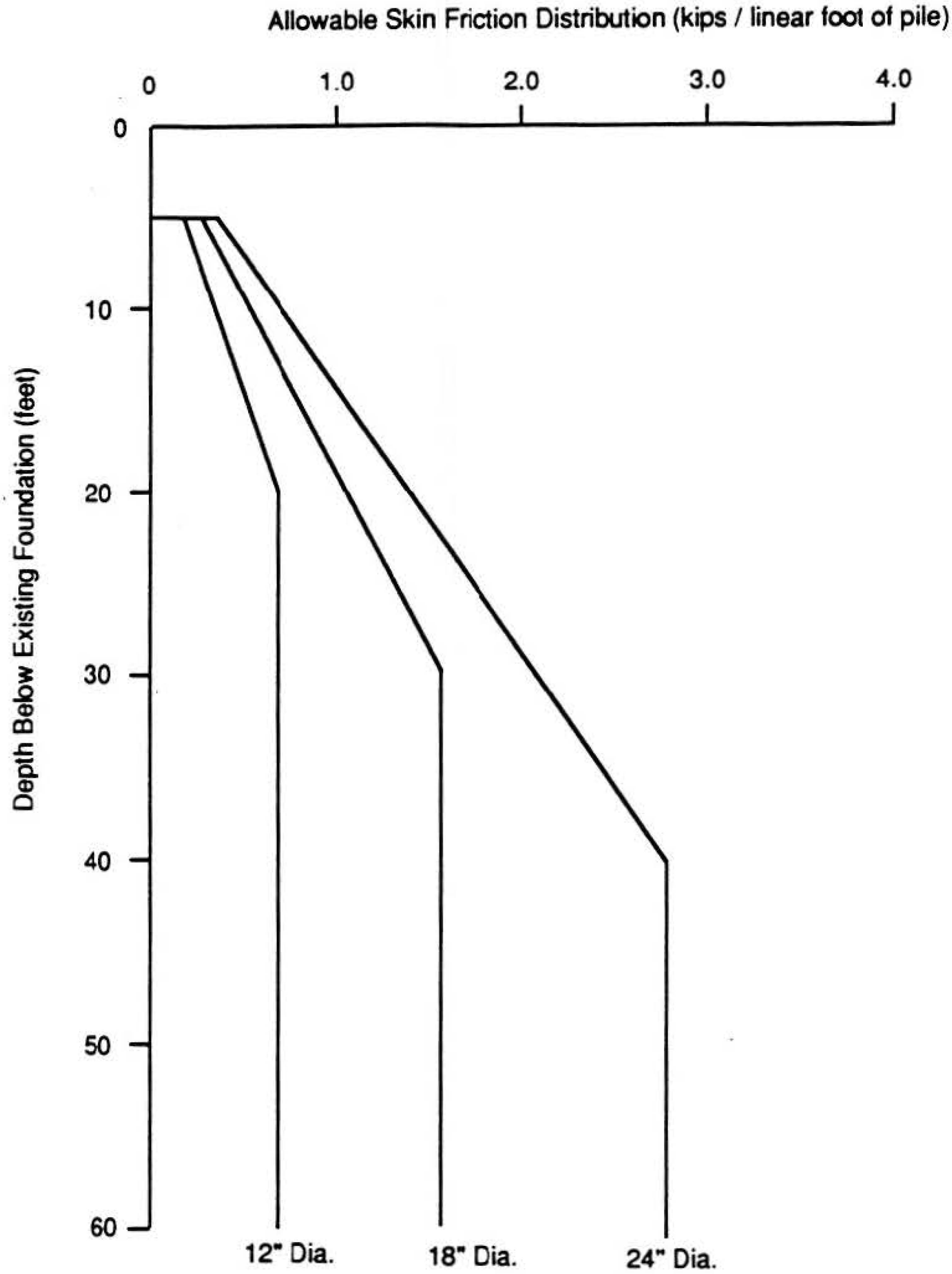
Allowable Tip Resistance For Straight Shaft Piles

03-90

Figure 5-9



Note: Factor of safety of 3 is included.

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Allowable Skin Friction Distribution Along Straight Shaft Piles

06-90

Figure 5-10

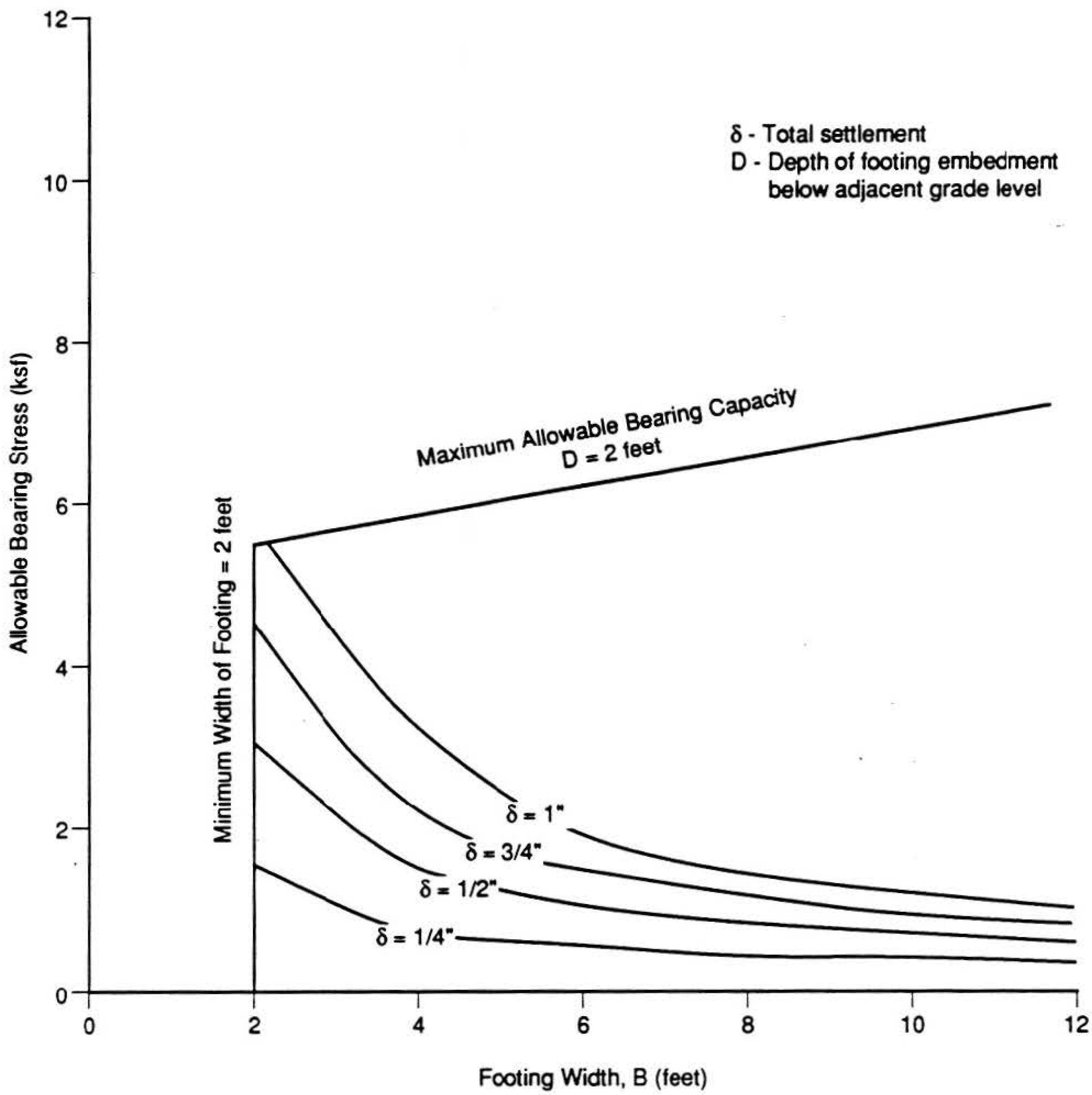
of station construction consists of a 10- to 15-foot-thick layer of fine-grained Old Alluvium and dense to very dense granular Old Alluvium for the purpose of settlement evaluation. With this asumption, it is estimated that elastic settlement due to a station load of 5,000 psf may be on the order of about one inch. This settlement would take place almost immediately during construction. Analyses also indicate consolidation settlement of 10 feet to 15 feet thick fine-grained alluvium located below the station bottom slab due to the imposed load will take place over a period of about 2 months to 6 months and will be about 1-1/2 inches. Thus, the maximum total settlement due to a station load of 5,000 psf is estimated to be about two inches to three inches. Due to the heterogeneous and nonuniform nature of the Old Alluvium, some differential settlement across the station width can be anticipated. It is estimated that the maximum differential settlement across the station width may be on the order of about one half of the maximum total settlement (i.e., a differential settlement of about 1-1/2 inches over the station width of about 60 feet).

5.4.2 Other Structures

The currently planned foundation level for the entrances and the stairways leading to the mezzanine level are located in the alluvium. These structures can be supported by conventional spread footings founded on the alluvium. All spread footings should be a minimum of two feet wide and at least two feet below the lowest adjacent grade. All in situ fill materials should be removed and should not be reused as compacted fill for spread footing support. Allowable bearing capacities and estimated total settlement in terms of footing width and bearing pressures for spread footings on alluvium are graphically presented in Figures 5-11 and 5-12.

5.4.3 Loads on Overall Station Walls and Slabs

The overall station will be constructed as a relatively rigid box. Our recommended permanent earth pressure diagrams for the walls and slabs of the station are shown in Figure 5-13. The following should be noted:

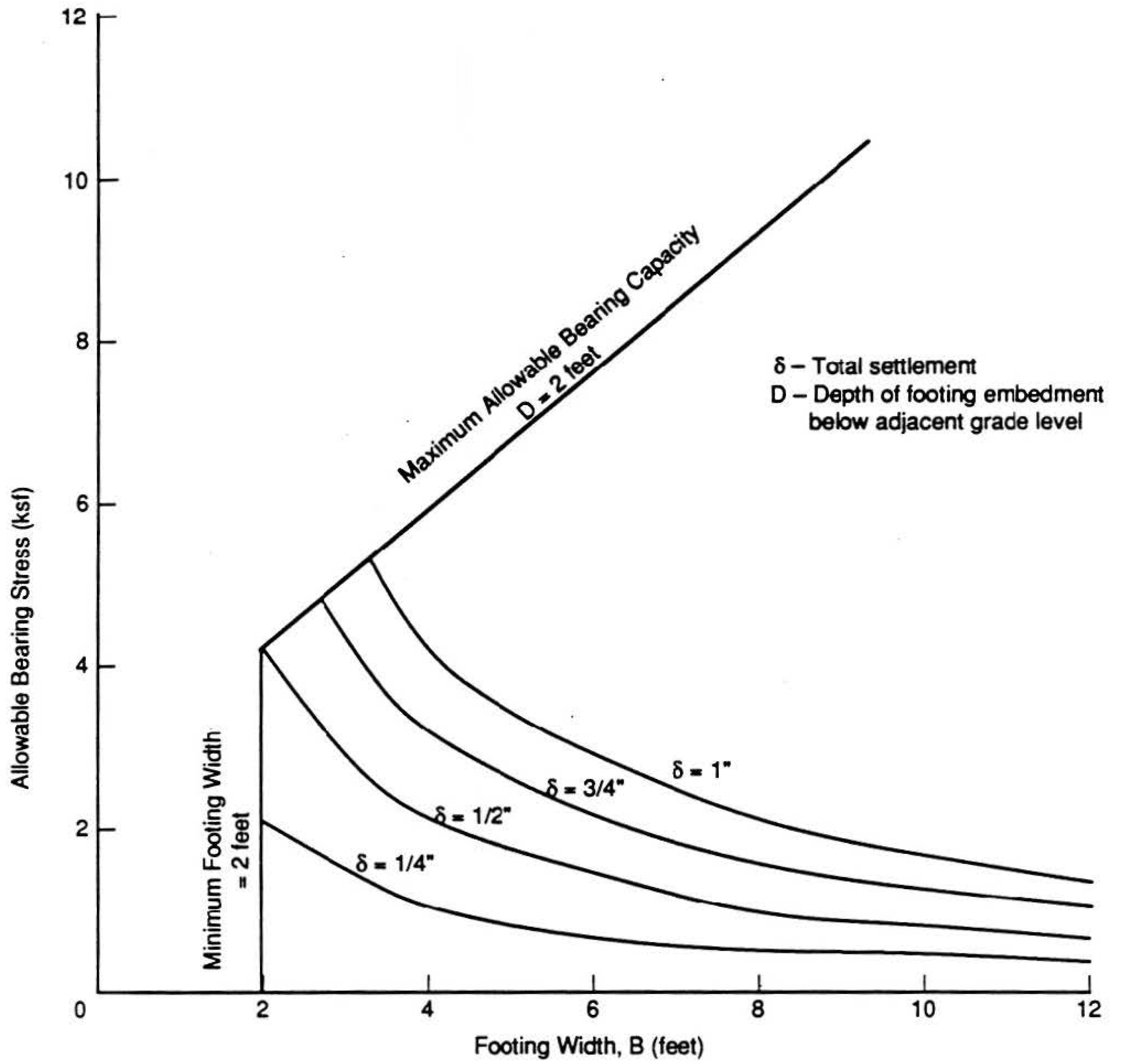


Note: Factor of safety of 3 is included.

The Earth Technology Corporation	Project No.: 89-409 **Hollywood / Western Station**

Bearing Capacity for Spread Footings in Fine-Grained Alluvium (Units A2 and / or A4)

04-90 Figure 5-11



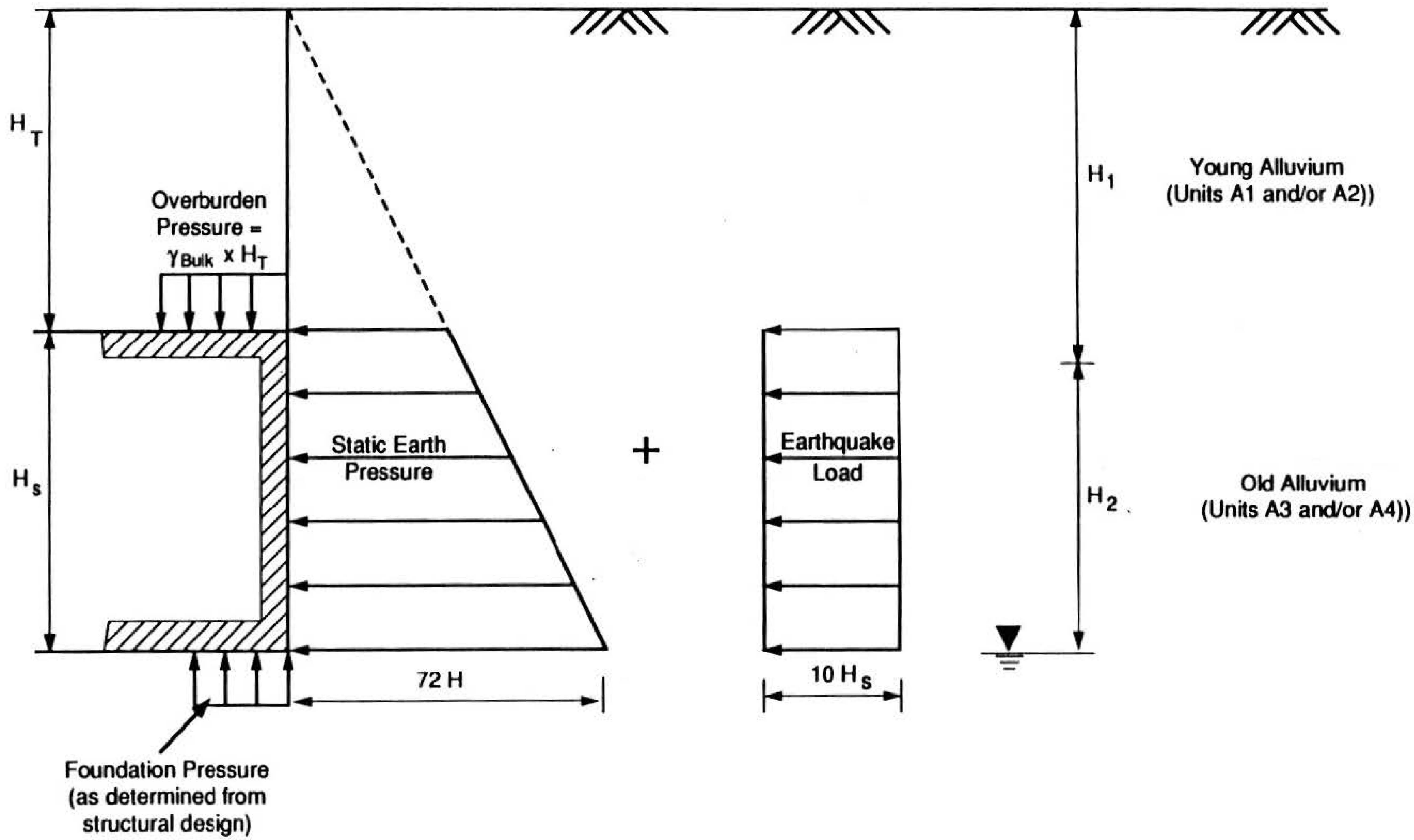
Note: Factor safety of 3 is included

The Earth Technology Corporation	Project No. 89-409 Hollywood / Western Station

Bearing Capacity for Spread Footings in Granular Alluvium (Units A1 and/or A3)

04-90

Figure 5-12



Notes:

(1) All pressures in psf

(2) Design groundwater elevations – 338 feet at eastern end and 330 feet at western end of the station. Use interpolated values between two ends.

(3) H_1, H_2, H_T, and H_S are in feet.

(4) γ_{bulk} - Bulk density of soils in pcf.

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Hollywood / Western Station

Earth Pressure on Below-Grade Permanent Structures

03-90

Figure 5-13

1. To account for potential seasonal variation and potential variations across the station, the groundwater level is set at Elevation 338 feet at the eastern end of the station and 330 feet at the western end of the station for design purposes.

2. Potential surcharge effects from adjacent existing buildings which are not underpinned should be considered in the wall pressure diagrams (Figure 5-3). Vertical loads from anticipated traffic and other live loads (car parking, etc.) should be determined and added to the roof loadings.

3. In Figure 5-13, a horizontal seismic coefficient, K_h, is used to calculate earthquake-induced lateral earth pressure. We recommend that a K_h value equal to two-thirds of the peak ground acceleration (in terms of gravity) be used. For the Metro Rail project, the peak horizontal ground acceleration of the Operating Design Earthquake (ODE) is 0.3g. Thus, a corresponding K_h value of 0.2 is recommended in earthquake-induced earth pressure determination. It should also be noted that the effect of vertical ground acceleration is ignored in earthquake-induced earth pressure consideration to avoid over-conservatism.

5.4.4 Groundwater Control

Permanent dewatering after completion of the station is unnecessary since only the bottom slab is at or slightly above the observed groundwater level elevation. Waterproofing provisions should be carried out at least to Elevation 340 feet across the station to account for potential seasonal variation and potential in situ variations that were not detected in this investigation.

5.5 EARTHWORK

Based on the subsurface conditions encountered in the investigation, the station excavation can be accomplished relatively rapidly by conventional and readily available excavation equipment. Earthwork and site preparation activities are expected to consist of excavation for subterranean structures, subgrade preparation for the floor of the station, foundation preparations for near-surface structures, excavation for utility trenches, subgrade preparation for pavements, and backfill placement for subterranean walls, footings and utility trenches. Major excavations will need to be provided with temporary

shoring according to the recommendations presented in Section 5.2.2 of this report. Other minor excavations, subgrade preparations and backfill placement should be done in accordance with the guidelines presented in Appendix D. All work should be in compliance with applicable city (Los Angeles), state, and federal (Occupational Safety and Health Act) requirements.

Available data indicate there is a considerable amount of granular alluvium present in the subsurface of the station area. Materials excavated from granular alluvium (sand, silty sand, gravelly sand, sandy gravel, and gravel) could be stockpiled to be reused as backfill material. The excavated fine-grained alluvium are not suitable as backfill material. If there is not sufficient material available for backfill, imported granular material could be used for fill, subject to approval of a geotechnical engineer.

5.6 LIQUEFACTION POTENTIAL

In the Hollywood/Western Station site area the subsurface materials below groundwater are either very stiff or dense Old Alluvium. Evaluation of liquefaction potential of subsurface soils using the method recommended by Seed and Idriss (1982) indicates that the liquefaction potential of these soils is of no concern under a 7.5 magnitude earthquake event with a peak horizontal ground acceleration of 0.3g, which is equivalent to the peak horizontal ground acceleration of the operating design earthquake (ODE) for the Metro Rail project. The potential amount of seismic-induced settlement under an earthquake equivalent to the ODE for the Metro Rail project was estimated to be about 1/2 inch or less, using the method recommended by Tokimatsu and Seed (1987).

5.7 CONSTRUCTION CONTROL AND MONITORING

Provisions for construction control and monitoring are necessary during and after construction. This section provides general recommendations that are considered prudent and reasonable. Detailed requirements and plans should be developed after the station design is finalized. In general, these requirements should include:

1. Monitoring structural integrity (crack survey, photography, etc.), lateral displacements, settlements of the adjacent existing buildings due to station construction before, during and after construction.

2. Monitoring the performance of shored excavation. This includes monitoring the movements of the excavation in and adjacent to the excavation by surveys, inclinometers and other instrumentation. If internally braced shoring systems are used, selected struts should be instrumented by strain gages to monitor the strut loads so timely remedial measures can be implemented if struts are overloaded. Similarly, a selected number of tiebacks, if used, should be preloaded and monitored to maintain sufficient locked-off load, as specified in Section 5.2.2.3.

3. Monitoring methane, hydrogen sulfide and explosivity level continuously during station construction.

6.0 Limitations

6.0 LIMITATIONS

The findings, recommendations, specifications, and professional opinions provided in this report are based on design information furnished by MRTC and on the subsurface conditions as disclosed by the field exploration program. Subsurface conditions described in this report were based on discretely located test borings drilled as part of the field exploration and on available geotechnical data. The borings may not reflect variations in subsurface conditions which are likely to exist in the unexplored areas. Thus, subsurface conditions should be monitored and verified in the field during construction. Should significant differences between the described and actual subsurface conditions be revealed during excavation, it may be necessary to re-evaluate the findings, recommendations, and specifications in this report based on onsite observation of the variations, additional field exploration or additional laboratory testing. Similarly, additional evaluation, field exploration or laboratory testing may be necessary if any design information such as location, orientation, site, configuration or nature of the planned facilities has been changed.

The findings, recommendations, specifications, and professional opinions presented in this report were developed within the limits prescribed by MRTC and in general accordance with applicable principles and practices of the geotechnical engineering profession at the time of this report preparation. There is no other warranty, either expressed or implied.

Submitted by:

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7.0 References

7.0 REFERENCES

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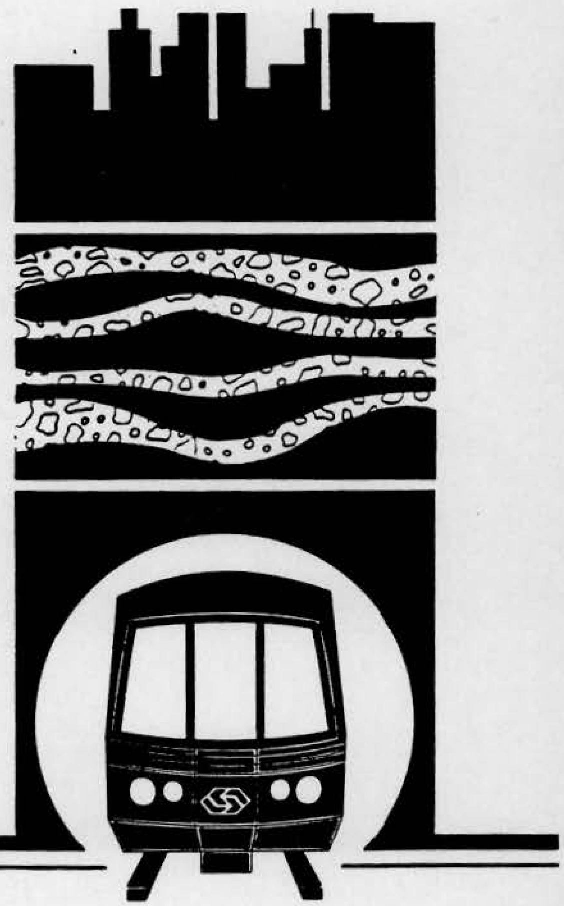
Appendix A

Boring Logs and Piezometer Diagrams



APPENDIX A

BORING LOGS AND PIEZOMETER DIAGRAMS

This appendix presents the logs and locations of borings and piezometer diagrams. This appendix includes the following figures:

Boring No.	Figure Number: Log	Figure Number: Location	Figure Number: Piezometer Diagram
PII-67	A-1	A-1A	--
PII-68	A-2	A-2A	--
PII-69	A-3	A-3A	--
PII-70	A-4	A-4A	--
PII-71	A-5	A-5A	--
PII-72	A-6	A-6A	--
PII-73	A-7	A-7A	--
LPE-11	A-8	A-8A	A-8B

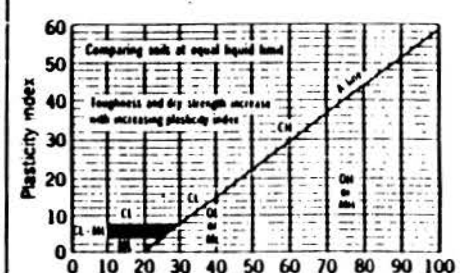
Explanations to the logs of borings are provided in Figures A-I through A-III.

Major divisions		Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights)	Group Symbols [a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria
Coarse-grained soils More than half of material is *larger* than No. 200 sieve size[b] (The No. 200 sieve size is about the smallest particle visible to naked eye) Gravels More than half of coarse fraction is larger than No. 4 sieve size (For visual classification, the ¼ in. size may be used as equivalent to the No. 4 sieve size)	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
		Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for *GW*
	Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics	Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
		Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures		Atterberg limits above "A" line, with *PI* greater than 7
Sands More than half of coarse fraction is smaller than No. 4 sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines	Example: *Silty sand, gravelly*; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
		Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for *SW*
	Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures		Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
		Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures		Atterberg limits below "A" line with *PI* greater than 7

Use grain size curve in identifying the fractions as given under field identification.

Determine percentages of gravel and sand from grain size curve.
Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows:
Less than 5% — *GW, GP, SW, SP*
More than 12% — *GM, GC, SM, SC*
5% to 12% — *Borderline* cases requiring use of dual symbols

Fine-grained soils — More than half of material is *smaller* than No. 200 sieve size	Identification Procedures on Fraction Smaller than No. 40 Sieve Size: Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses
	Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
	Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions
Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
	High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
	Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils	Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

[a] *Boundary classifications*. Soils possessing characteristics of two groups are designated by combinations of group symbols. For example *GW-GC*, well graded gravel-sand mixture with clay binder.
[b] All sieve sizes on this chart are U.S. standard.

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Unified Soil Classification System

06-90

Figure A1

ASPHALT

FILL

GRAVEL

SAND

SAND WITH GRAVEL

SAND-SILTY SAND

SAND-SILTY SAND WITH GRAVEL

SILTY SAND

SILTY SAND WITH GRAVEL

CLAYEY SAND

CLAYEY SAND WITH GRAVEL

CLAY

HIGHLY PLASTIC CLAY

SILTY CLAY

SANDY CLAY

SILT

CLAYEY SILT

SANDY SILT

GRAVELLY SILT

SANDSTONE

SILTSTONE

CLAYEY SILTSTONE

SILTSTONE WITH SANDSTONE INTERBEDDED

CLAYEY SILTSTONE WITH SANDSTONE INTERBEDDED

CLAYSTONE

SILTY CLAYSTONE

The Earth Technology Corporation	PROJECT NO.: 89-409 Hollywood / Western Station

Soil/Rock Symbols for Logs of Borings

06-90

Figure AII

SAMPLE TYPE

- **S** STANDARD SPLIT SPOON SAMPLE
- **D** 2½" DIA., 12" DRIVE SAMPLE
- **P** 2 7/8" DIA. PITCHER SAMPLE
- **NR** NO RECOVERY
- **B** BULK SAMPLE
- **C** CORE SAMPLE

EXPLANATIONS

PENETRATION RESISTANCE (BLOW COUNT)

–BLOW COUNTS FOR 6" INTERVALS EXCEPT AS NOTED

MOISTURE CONTENT (%)

–LABORATORY DETERMINED MOISTURE CONTENT

PPM –PARTS PER MILLION

PCF –POUNDS PER CUBIC FOOT

OVA–ORGANIC VAPOR ANALYZER

N/A –NOT APPLICABLE

/ –DENOTES ALTERNATING SOIL TYPES IN A LAYER (EXAMPLE: SP/SW i.e. ALTERNATING POORLY AND WELL GRADED SANDS IN A PREDOMINANTLY SANDY LAYER)

DEFINITION OF TERMS

DESCRIPTIVE TERM	PERCENT BY WEIGHT
TRACE	0-10
LITTLE	10-20
SOME	20-35
AND	35-50

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PROJECT NO.: 89-409
Hollywood / Western Station

Key for Logs of Boring

06-90

Figure AIII

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FIGURE A-1. LOG OF BORING PII-67

Project Name: METRO RAIL - PHASE II - LOS ANGELES			
Project Number: 89-409	Borehole Number: PII-67		sheet 1 of 3
Borehole Location: Hollywood Blvd, East of Serrano.		Elevation and Datum(feet): 402	
Health and Safety: Upgraded Level D		Date Started: 4/15/89	Date Finished: 4/15/89
Drilling Equipment: Mayhew 1500		Total Depth(feet): 91.0	Depth to: Bedrock(feet): --
Drilling Method: Rotary Wash		Borehole Diameter: 5-inch	
Drilling Fluid: Bentonite Mud		Piezometer Installation: NO	Depth(feet): --
Hammer Information: SPT Hammer: 140-lb and 30-inch drop. DOWNHOLE Hammer: 340-lb and 18-inch drop.		Logged By: Olu Odu-Falu	Checked By: Marshall C. Payne

Depth (feet)	Description	USCS Classification	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
	18-inch ASPHALT and CONCRETE.										
	CLAYEY SAND. SAND WITH GRAVEL at 4 feet.		FILL								
5	SILTY SAND; Dark brown, moist, loose, fine- to coarse-grained sand, nonplastic fines, micaceous. (Cuttings indicate gravel at 6-1/2 feet.) (Drill chatter at 9 feet. Cuttings indicate fine to medium, angular gravel.)	SM	A1	1	S	3 4 4	12"/18"	34			27
10	CLAYEY SAND; Dark brown, moist, medium dense, fine- to medium-grained sand with occasional coarse-grained, low plasticity fines, micaceous, void along side of the sample.	SC	A1	2	D	3 3	9"/12"	6	101	21	6
15	SILTY SAND; Olive brown, moist, medium dense, medium plasticity fines, fine- to medium-grained sand with occasional coarse-grained, trace clay and gravel, micaceous. (Cuttings indicate more subangular gravel at 17-1/2 feet.)	SM	A1	3	S	4 4 5	4"/18"	6			6
20	SILTY SAND; Dark brown, moist, medium dense, fine- to medium-grained, trace gravel at top of sample, 1- to 1-1/2- inch in size, nonplastic fines, micaceous.	SM	A1	4	D	6 10			112	11	
				4	D	8 5	5"/12"	7			6
	(Cuttings indicate more gravel at 24 feet.)										
25	SILTY SAND; Olive brown, loose, soft, low plasticity fines, very fine- to coarse-grained sand, gravel up to 1/2-inch size, micaceous.	SM	A1	5	S	5 5 6	12"/18"	7			6
30	(Cuttings indicate clayey soil at 29 feet.)										

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FIGURE A-1. LOG OF BORING PII-67

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-67 | Sheet 2 of 3

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		CLAYEY SAND; Dark yellowish brown, moist, medium dense, fine- to medium-grained sand with occasional coarse-grained and fine gravel, low plasticity fines, trace silt, micaceous.	SC	A3	6	D	7 7	6"/12"	7	103	19	6
35		CLAYEY SAND; Olive brown, moist, medium dense, fine- to coarse-grained sand with fine gravel, low plasticity fines, micaceous, trace clay at top of sample.	SC	A3	7	S	6 9 12	12"/18"	7			6
40		SILTY SAND; Dark brown, moist, medium dense, fine- to coarse-grained sand, low plasticity fines.	SM	A3	8	D	8 8	12"/12"	8			6
		SANDY CLAY; Dark brown, moist, soft, low plasticity, fine-grained sand, micaceous.	CL	A4	9	D	5 5		8			6
45		SANDY CLAY; Dark brown, moist, hard, medium to high plasticity, fine- to medium-grained sand, micaceous.	CH	A4	10	S	7 13 22	12"/18"	8			7
50		SANDY CLAY/CLAYEY SAND; Reddish brown, moist, very stiff, medium to high plasticity, fine- to medium-grained sand, micaceous. (Cuttings indicate some gravel at 54 feet.)	CL/SC	A4	11	D	15 19	9"/12"	7	109	20	6
55		CLAYEY SAND; Dark brown, moist, dense, fine- to coarse-grained sand, medium to high plasticity fines, micaceous.	SC	A3	12	S	9 15 25	12"/18"	10			7
60		CLAYEY SAND; Reddish brown, moist, dense to very dense, fine- to medium-grained sand with occasional coarse-grained, very low plasticity fines, micaceous. Sandy clay at bottom, dark brown, hard, medium plasticity, fine- to medium-grained sand. Pocket of silty sand.	SC	A4	13	D	18 21	12"/12"	9	109	21	6
65		CLAYEY SAND; Dark brown, moist, very dense, fine- to coarse-grained sand, medium plasticity fines, micaceous, trace silt.	SC	A3	14	S	21 32 42	12"/18"	8			7
70												

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FIGURE A-1. LOG OF BORING PII-67

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-67 | Sheet 3 of 3

Depth (feet)	Lith-ology	Description	USCS Classification	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		CLAYEY SAND; Dark yellowish brown, moist, very dense, low plasticity fines, fine- to medium-grained sand with fine gravel, micaceous.	SC	A4	15	D	17 26	9"/12"	7			6
75		SILTY SAND; Dark yellowish brown, moist, very dense, low plasticity fines, fine- to medium-grained sand, trace fine gravel, micaceous.	SM	A3	16	S	10 13 18	12"/18"	9			7
		(Cuttings indicate more sandy material at 79 feet.)										
80		SILTY SAND; Dark brown, moist, dense, fine to coarse sand, low plasticity fines, micaceous.	SM	A3	17	D	10 16	12"/12"	10			7
85		SILTY SAND; Dark yellowish brown, moist, dense, fine to coarse sand, low plasticity fines, micaceous.	SM	A3	18	S	14 19 24	18"/18"	11			8
90		Same as above.	SM	A3	19	D	17 ~~15~~	12"/12"	13	113	19	9
95		BORING TERMINATED AT 91 FEET. NOTE: This borehole log is based on field classification and visual soil description, and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with passage of time. The data presented is simplification of actual conditions encountered. The stratification lines represent the approximate boundary between subsurface material types and the transition may be gradual.										
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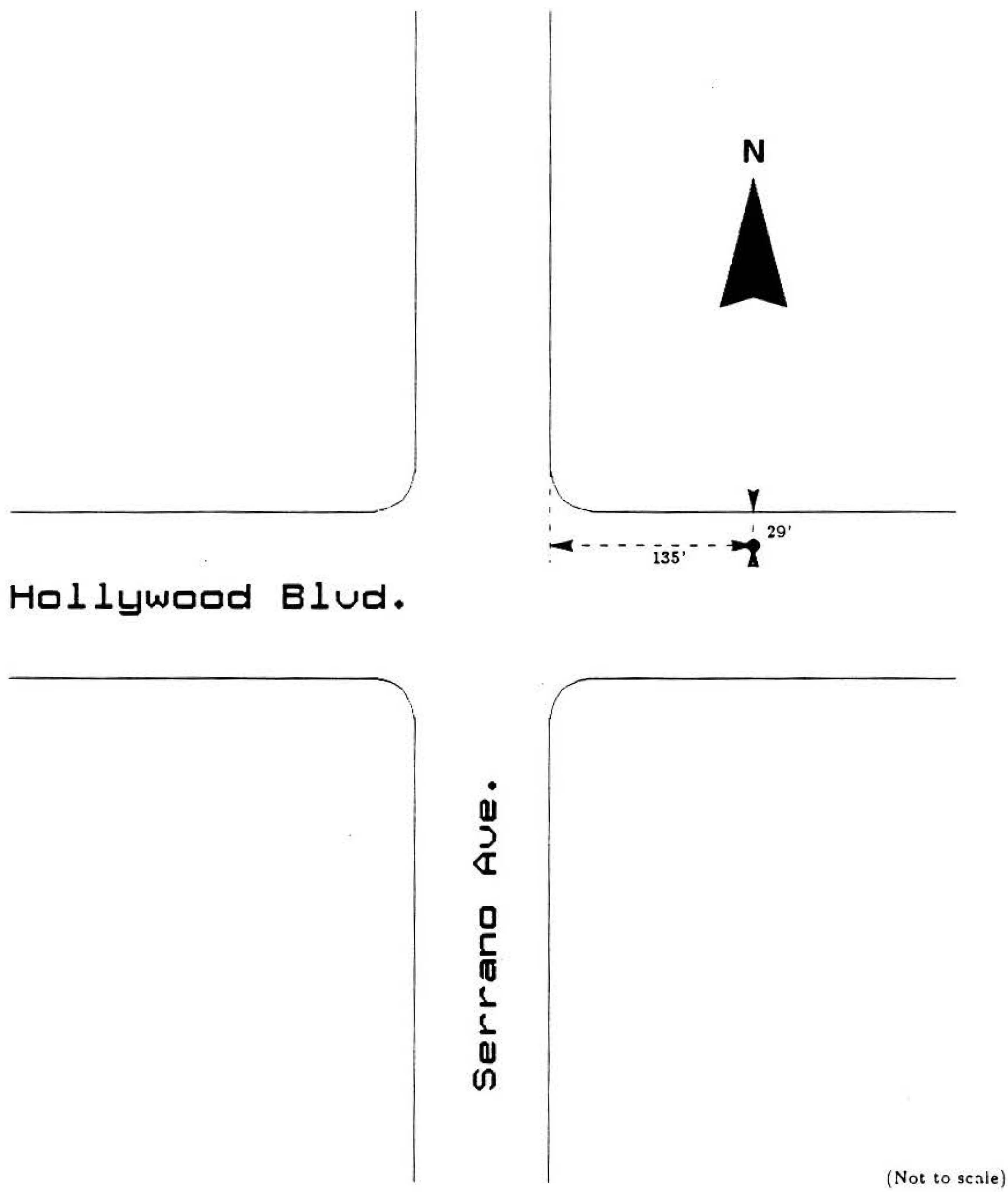

The Earth Technology Corporation	PROJECT NO.: 89-409 Hollywood / Western Station

Location of Borehole PII-67

06-90

Figure 1A

The Earth Technology Corporation

FIGURE A-2. LOG OF BORING PII-68

Project Name: METRO RAIL - PHASE II - LOS ANGELES			
Project Number: 89-409	Borehole Number: PII-68		sheet 1 of 3
Borehole location: Hollywood Blvd, West of Serrano		Elevation and Datum(feet): 399	
Health and Safety: Upgraded Level D		Date Started: 4/4/89	Date Finished: 4/4/89
Drilling Equipment: Failing 750		Total Depth(feet): 81.0	Depth to: Bedrock(feet): --
Drilling Method: Rotary Wash		Borehole Diameter: 5-inch	
Drilling Fluid: Bentonite Mud		Piezometer Installation: NO	Depth(feet): --
Hammer Information: SPT Hammer: 140-lb and 30-inch drop. DOWNHOLE Hammer: 295-lb and 18-inch drop.		Logged By: Pierre Charles	Checked By: Marshall C. Payne

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA(ppm)
		18-inch ASPHALT.										
		Base course material. SANDY CLAY at 2-1/2 feet.		FILL								
5		SANDY SILT; Dark reddish brown, damp, loose, medium plasticity fines, fine-grained sand with occasional coarse- grained, micaceous, trace clay.	ML	A1	1	S	2 3 5	18"/18"	6			6
10		Same as above. Medium to high plasticity fines.	ML	A1	2	D	3 5	6"/12"	6			6
		(Some coarse sand at 14-1/2 feet.)										
15		(No recovery. Cuttings indicate gravelly soil.)			3	S	5 9 13	0"/18"	6			6
20		SANDY SILT; Dark brown, moist, loose, medium plasticity, fine- to medium-grained sand, trace clay, micaceous.	ML	A1	4	D	4 7	6"/12"	5			5
		(Cuttings indicate some clay at 22-1/2 feet.)										
25		SANDY SILT; Dark brown, moist, dense, medium plasticity, fine- to medium-grained sand, micaceous, trace clay.	ML	A1	5	S	10 13 10		6			6
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FIGURE A-2. LOG OF BORING PII-68

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-68 | Sheet 2 of 3

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		SAND; Dark brown, moist, medium dense, trace gravel upto 1-inch size.	SP	A1	6	D	7 15	6"/12"	27			6
		(Heavy drill chatter at 32-1/2 feet.)										
		(Cuttings indicate sand and gravel at 34 feet.)										
35		CLAYEY SAND; Reddish brown, moist, dense, very fine- to medium-grained sand, medium plasticity fines, trace mica, carbonated.	SC	A4	7	S	7 17 21	12"/18"	6			6
		(Cuttings indicate more sand at 38 feet.)										
40		CLAYEY SAND; Reddish brown, moist, medium dense, medium plasticity fines, fine- to medium-grained sand, micaceous, trace clay.	SC	A4	8	D	8 19	6"/12"	10			6
45		CLAYEY SAND; Reddish brown, moist, very dense, very fine- to fine-grained sand, angular, medium plasticity fines, trace mica.	SC	A4	9	S	23 24 34	11"/18"	6			6
50		CLAYEY SAND; Reddish brown, moist, dense, fine- to medium-grained sand with occasional coarse-grained,low to medium plasticity fines, micaceous, trace silt.	SC	A3	10	D	20 30	6"/12"	6			6
55		SILTY SAND; Brown, moist, dense, fine- to coarse-grained sand with fine gravel, micaceous.	SM	A3	11	P	Push 200 psi	28"/30"	6	109	16	6
60		SILTY SAND; Dark yellowish brown, moist, dense, fine- to coarse-grained sand, trace fine gravel, low plasticity fines, micaceous.	SM	A3	12	D	16 25	6"/12"	6			6
65		CLAYEY SAND; Reddish brown, moist, very dense, fine- to coarse-grained sand, low to medium plasticity fines.	SC	A4	13	S	10 18 31	14"/18"	6			6
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FIGURE A-2. LOG OF BORING PII-68

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-68 | Sheet 3 of 3

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		CLAYEY SAND/SANDY CLAY; Reddish brown, moist, medium dense, medium plasticity fines, fine-grained sand, trace mica.	SC/CL	A4	14	D	23 50	6"/12"	6			6
75		SANDY CLAY; Dark yellowish brown, moist, very stiff, medium plasticity, fine-grained sand with occasional medium -grained, micaceous.	CL	A4	15	S	10 14 18	12"/18"	6			6
80		SANDY CLAY; Dark yellowish brown, moist, hard, low plasticity fines, micaceous. Clayey sand at bottom, predominantly fine-grained sand, trace medium to coarse- grained and fine gravel, micaceous.	CL	A4	16	D	31 46	6"/12"	6			6

BORING TERMINATED AT 81 FEET.

NOTE: This borehole log is based on field classification and visual soil description, and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with passage of time. The data presented is simplification of actual conditions encountered. The stratification lines represent the approximate boundary between subsurface material types and the transition may be gradual.

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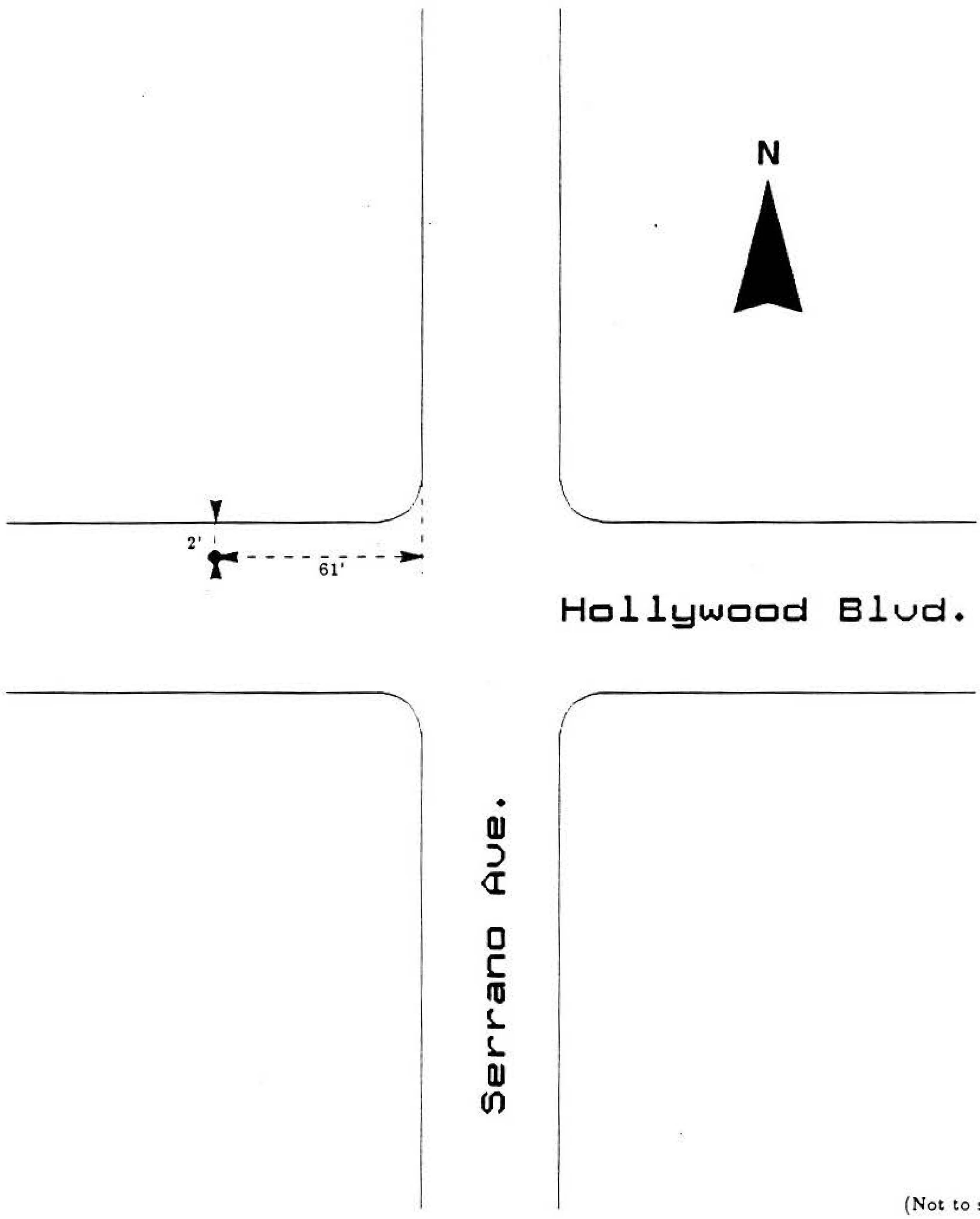

(Not to scale)

The Earth Technology Corporation	PROJECT NO.: 89-409 **Hollywood / Western Station**

Location of Borehole PII-68

06-90

Figure 2A

FIGURE A-3. LOG OF BORING PII-69

Project Name: METRO RAIL - PHASE II - LOS ANGELES			
Project Number: 89-409	Borehole Number: PII-69		sheet 1 of 3
Borehole Location: Hollywood Blvd. West of Serrano		Elevation and Datum(feet): 401	
Health and Safety: Upgraded Level D		Date Started: 4/22/89	Date Finished: 4/22/89
Drilling Equipment: Mayhew 1500		Total Depth(feet): 91.0	Depth to: Bedrock(feet): --
Drilling Method: Rotary Wash		Borehole Diameter: 5-inch	
Drilling Fluid: Bentonite Mud		Piezometer Installation: NO	Depth(feet): --
Hammer Information: SPT Hammer: 140-lb and 30-inch drop. DOWNHOLE Hammer: 265-lb and 18-inch drop.		Logged By: Curtis D. Cushman	Checked By: Marshall C. Payne

Depth (feet)	Description	USCS Classification	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
0	6-inch ASPHALT.										
	Fill material. Gravel.										
	Fill material. Silt and gravel.		FILL								
5	SANDY CLAY/CLAYEY SAND; Dark brown, moist, loose, fine- to medium-grained sand, low to medium plasticity fines, micaceous.	CL/SC	A2	3	S	3 3 3	8"/18"	8			8
10	Same as above.	CL/SC	A2	4	D	4 5	6"/12"	9	90	27	5
15	CLAYEY SILT; Dark brown, moist, soft to stiff, low plasticity fines, fine- to medium-grained sand, micaceous. (Drill chatter at 17 feet.)	ML	A2	5	S	4 5 6	14"/18"	8			5
20	SILTY SAND; Dark brown, moist, medium dense, fine- to medium-grained sand, low plasticity fines, micaceous.	SM	A1	6	D	11 12	6"/12"	8	99	16	5
25	CLAYEY SAND; Dark brown, moist, medium dense, fine- to medium-grained sand, low plasticity fines, micaceous.	SC	A4	7	S	5 6 10	12"/18"	8			5
30											

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FIGURE A-3. LOG OF BORING PII-69

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-69 | Sheet 2 of 3

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		CLAYEY SAND/SANDY CLAY; Some gravel.	SC/CL	A4	8	D	11 22	9"/12"	8	103	24	6
35		CLAYEY SAND; Brown, moist, medium dense, fine- to medium-grained sand with occasional coarse-grained, low to medium plasticity fines, micaceous.	SC	A4	9	S	5 7 12	17"/18"	8			6
40		CLAYEY SAND/SANDY CLAY; Brown, moist, very dense, fine- to medium-grained sand with occasional coarse-grained, medium plasticity fines, micaceous.	SC/CL	A4	10	D	25 45	6"/12"	8			6
					10	D	5 25	3"/12"				
45		CLAYEY SAND; Dark yellowish brown, moist, dense, fine- to coarse-grained sand, fine gravel, micaceous.	SC	A3	11	S	12 16 18	14"/18"	8			6
50		CLAYEY SAND; Dark yellowish brown, moist, very dense, fine to medium sand with occasional coarse-grained, fine gravel, low to medium plasticity fines, micaceous.	SC	A4	12	D	25 40	6"/12"	8			6
55		SILTY SAND; Brown, moist, dense, fine- to medium-grained sand with occasional coarse-grained, low plasticity fines, micaceous.	SM	A3	13	S	11 18 20	14"/18"	8			6
60		SILTY SAND; Dark yellowish brown, moist, very dense, fine- to medium-grained sand, low plasticity fines, micaceous. Some coarse-grained sand at bottom.	SM	A3	14	D	20 25		8	109	17	6
65		SILTY SAND; Dark yellowish brown, moist, very dense, fine- to coarse-grained sand, fine gravel, low plasticity fines, micaceous.	SM	A3	15	S	30 30/2"	6"/8"	9			6
70												

FIGURE A-3. LOG OF BORING PII-69

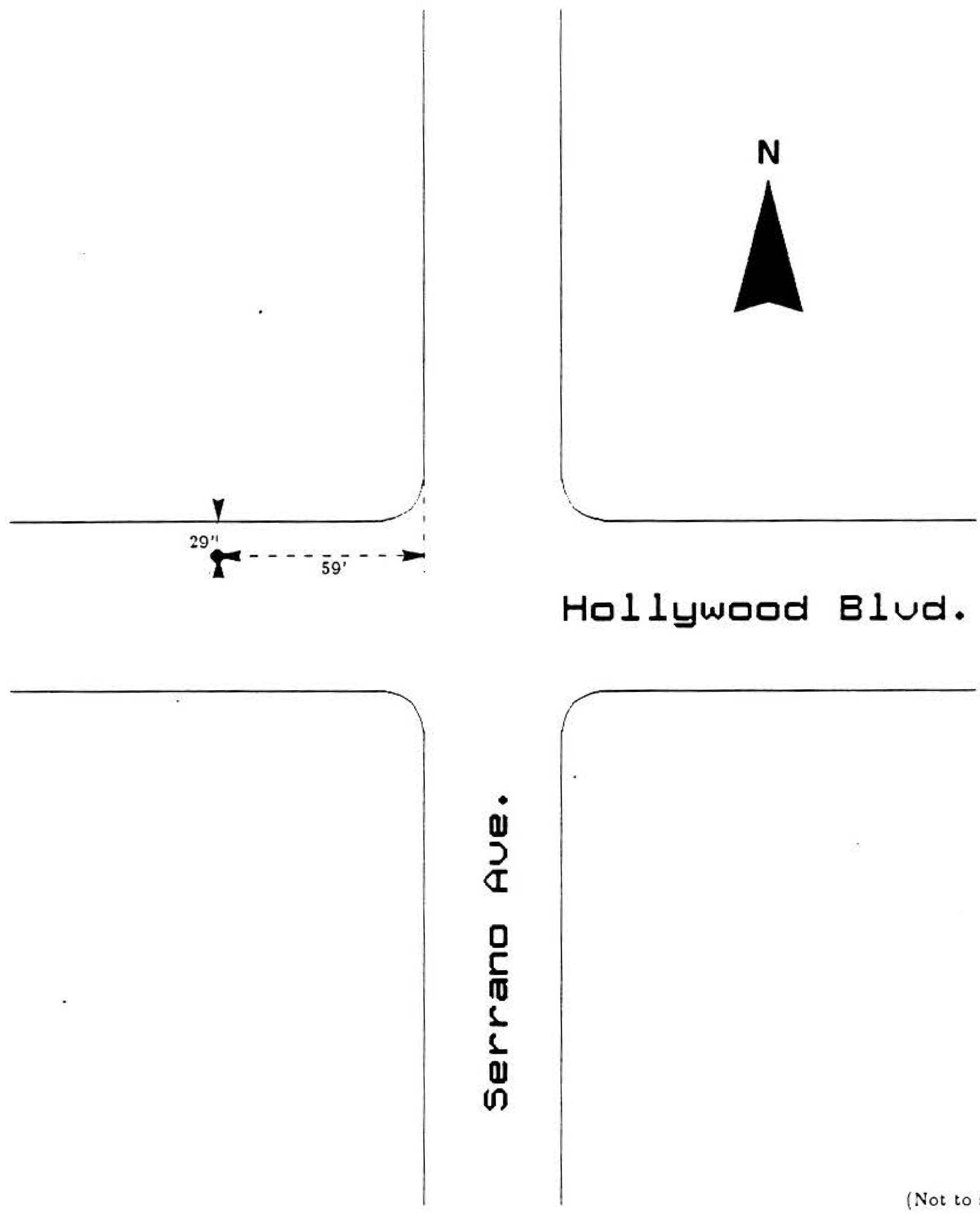
Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-69 | Sheet 3 of 3

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		CLAYEY SAND; Reddish brown, moist, very dense, fine- to medium-grained sand, medium plasticity fines, micaceous. Sandy silt at bottom; dark yellowish brown, hard, low to medium plasticity fines, fine- to medium-grained sand, micaceous.	SC	A4	16	D	20 30	9"/12"	9	114	18	7
75		SILTY SAND; Dark brown, moist, dense, fine- to coarse-grained sand, fine-grained gravel, nonplastic to low plasticity fines, micaceous.	SM	A3	17	S	12 14 21	16"/18"	8			7
80		SAND; Dark brown, damp, very dense, fine- to coarse-grained sand, some gravel upto 1-inch size, micaceous.	SP	A3	18	D	50	3"/6"				7
85		CLAYEY SAND; Dark yellowish brown, moist, very dense, fine- to coarse-grained sand, medium plasticity fines, micaceous.	SC	A4	19	S	12 26 32	18"/18"				7
90		SILTY SAND; Dark brown, moist, very dense, fine- to medium-grained sand with occasional coarse-grained, trace gravel, low plasticity fines, micaceous.	SM	A3	20	D	15 35	6"/12"		110	19	7
95												
100												
105												
110												

BORING TERMINATED AT 91 FEET.

NOTE: This borehole log is based on field classification and visual soil description, and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with passage of time. The data presented is simplification of actual conditions encountered. The stratification lines represent the approximate boundary between subsurface material types and the transition may be gradual.



(Not to scale)

The Earth Technology Corporation

PROJECT NO.: 89-409

Hollywood / Western Station

Location of Borehole PII-69

06-90

Figure 3A

The Earth Technology Corporation

FIGURE A-4. LOG OF BORING PII-70

Project Name: METRO RAIL - PHASE II - LOS ANGELES			
Project Number: -89-409	Borehole Number: PII-70		sheet 1 of 3
Borehole location: Hollywood Blvd, West of Serrano		Elevation and Datum(feet): 397	
Health and Safety: Upgraded Level D		Date Started: 4/23/89	Date Finished: 4/23/89
Drilling Equipment: Mayhew 1500		Total Depth(feet): 91.0	Depth to: Bedrock(feet): --
Drilling Method: Rotary Wash		Borehole Diameter: 5-inch	
Drilling Fluid: Bentonite Mud		Piezometer Installation: NO	Depth(feet): --
Hammer Information: SPT Hammer: 140-lb and 30-inch drop. DOWNHOLE Hammer: 265-lb and 18-inch drop.		Logged By: Curtis D. Cushman	Checked By: Marshall C. Payne

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA(ppm)
0		6-inch ASPHALT.										
		FILL MATERIAL.		FILL								
5		SILTY SAND; Dark brown, moist, medium dense, fine- to medium-grained sand, friable, micaceous, low plasticity fines.	SM	A1	3	S	3 4 4	11"/18"	8			5
10		SANDY CLAY; Dark brown, moist, soft to stiff, fine- to medium-grained sand, trace fine gravel, medium plasticity fines, micaceous.	CL	A2	4	D	5 5	6"/12"	7			5
15		SILTY SAND; Dark brown, moist, medium dense, fine- to coarse-grained sand, occasionally fine gravel, micaceous.	SM	A1	5	S	3 4 5	11"/18"	8			5
20		SAND-SILTY SAND; Dark brown, damp, medium dense, fine- to coarse-grained sand, gravel upto 1/2-inch size, micaceous.	SP-SM	A1	6	D	12 15	6"/12"	7	93	21	6
25		CLAYEY SAND; Brown, moist, medium dense, fine- to coarse-grained sand, friable, trace fine gravel, low plasticity fines, micaceous.	SC	A4	7	S	5 6 9	12"/18"	7			6
30												

FIGURE A-4. LOG OF BORING PII-70

The Earth Technology Corporation

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-70 | Sheet 2 of 3

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		CLAYEY SAND; Dark brown, moist, medium dense, fine- to medium-grained sand, trace clayey sand and fine gravel, low plasticity fines, micaceous.	SC	A4	8	D	8 10	6"/12"	7	107	19	6
35		CLAYEY SILT; Reddish brown, moist, stiff, medium plasticity, trace medium- to coarse-grained sand, micaceous.	ML	A4	9	S	9 14 18	16"/18"	7			6
40		SANDY CLAY/SANDY SILT; Dark yellowish brown, moist, stiff, medium plasticity, very fine- to fine-grained sand, trace clay, micaceous. Silty sand at bottom, dark brown, dense, fine to coarse, trace gravel, micaceous.	CL/ML	A4	10 10	D D	10 22 7 32	7"/12"	6	98	27	6
45		CLAYEY SAND; Reddish brown, moist, dense, fine- to coarse-grained sand, trace fine gravel, medium plasticity fines, micaceous, trace silt.	SC	A4	11	S	9 16 16	16"/18"	6			6
50		SILTY SAND; Reddish brown, moist, very dense, low to medium plasticity fines, fine- to medium-grained sand, micaceous, trace clay.	SM	A3	12	D	25 40	6"/12"	6	111	17	6
55		SILTY SAND; Brown, moist, very dense, fine- to coarse-grained sand, trace fine gravel, low plasticity fines, micaceous.	SM	A3	13	S	11 32 47	14"/18"	8			6
60		SANDY CLAY/CLAYEY SAND; Reddish brown, moist, hard, high plasticity, fine-grained sand with occasional coarse-grained, trace mica.	CH/SC	A4	14	D	20 35	6"/12"	7	111	17	6
65		SANDY SILT; Reddish brown, moist, dense, medium plasticity, fine-grained sand, micaceous.	ML	A4	15	S	16 25 50/5"	14"/17"	8			6
70												

The Earth Technology Corporation

FIGURE A-4. LOG OF BORING PII-70

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-70 | Sheet 3 of 3

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		SILTY SAND; Dark brown, moist, very dense, fine to medium sand, low plasticity fines, micaceous.	SM	A3	16	D	20 35	9"/12"	7			6
75		SANDY SILT; Reddish brown, moist, very stiff, medium plasticity, fine-grained sand, micaceous, trace clay.	ML	A4	17	S	20 33 37/3"	14"/15"	7			6
80		CLAYEY SAND; Dark yellowish brown, moist, dense, fine- to medium-grained sand, low plasticity fines, micaceous, trace clay. Sandy silt at bottom, very stiff, low plasticity, fine sand, micaceous.	SC	A4	18	D	12 21	6"/12"	7	102	24	6
85		SILTY SAND; Dark yellowish brown, moist, very dense, fine- to medium-grained sand, trace fine gravel, low plasticity fines, micaceous.	SM	A3	19	S	14 16 41	16"/18"	7			6
90		SILTY SAND; Brown, moist, dense, fine- to coarse-grained sand, trace fine gravel, micaceous, pocket of clay.	SM	A3	20	D	18 ~~35~~			112	18	6

BORING TERMINATED AT 91 FEET.

NOTE: This borehole log is based on field classification and visual soil description, and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with passage of time. The data presented is simplification of actual conditions encountered. The stratification lines represent the approximate boundary between subsurface material types and the transition may be gradual.

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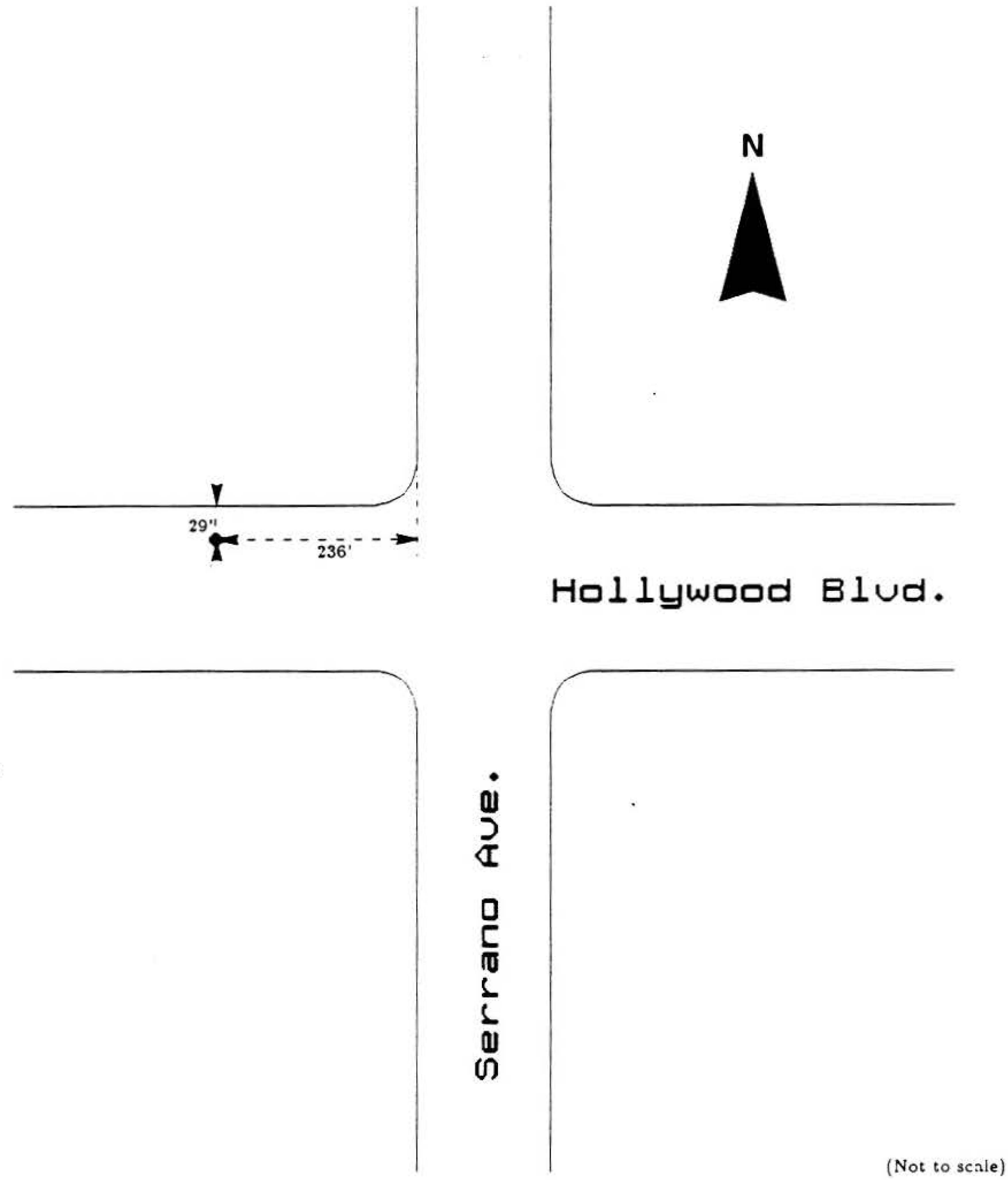


The Earth Technology Corporation

PROJECT NO.: 89-409

Hollywood / Western Station

Location of Borehole PII-70

06-90

Figure 4A

The Earth Technology Corporation

FIGURE A-5. LOG OF BORING PII-71

Project Name: METRO RAIL - PHASE II - LOS ANGELES			
Project Number: 89-409	Borehole Number: PII-71		sheet 1 of 3
Borehole location: Hollywood Blvd., East of Western Ave.		Elevation and Datum(feet): 394	
Health and Safety: Upgraded Level D		Date Started: 4/14/89	Date Finished: 4/14/89
Drilling Equipment: Mayhew 1500		Total Depth(feet): 91.0	Depth to: Bedrock(feet): --
Drilling Method: Rotary Wash		Borehole Diameter: 5-inch	
Drilling Fluid: Bentonite Mud		Piezometer Installation: NO	Depth(feet): --
Hammer Information: SPT Hammer: 140-lb and 30-inch drop. DOWNHOLE Hammer: 340-lb and 18-inch drop.		Logged By: Olu Odu-Falu	Checked By: Marshall C. Payne

Depth (feet)	Description	USCS Classification	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
	12-inch asphalt.										
	SAND with Gravel; Coarse-grained sand, fine gravel.		FILL								
	SILTY SAND.		FILL								
5	CLAYEY SAND; Dark brown, moist, loose, medium plasticity fines, fine- to medium-grained sand, micaceous, gasoline odor.	SC	A2	1	S	2 3 3	4"/18"				7
	(Cuttings indicate coarser material at 9-1/2 feet.)										
10	CLAYEY SAND; Dark brown, moist, loose, low plasticity fines, fine- to medium-grained sand, and trace coarse-grained sand, micaceous.	SC	A2	2	D	2 3	6"/12"				7
15	CLAYEY SAND; Dark brown, moist, loose to medium dense, low to medium plasticity fines, fine- to medium-grained sand, micaceous, trace fine gravel.	SC	A2	3	S	3 4 6	15"/18"				7
20	CLAYEY SAND; Dark brown, moist, loose, medium plasticity fines, trace fine- to medium-grained sand, micaceous, trace fine gravel.	SC	A2	4	D	2 3	8"/12"	6			6
	(Drill chatter at 23 feet. Cuttings indicate gravel.)										
25	SILTY SAND; Brown, wet, dense, low plasticity fines, fine- to coarse-grained sand, micaceous, trace fine gravel.	SM	A1	5	S	12 19 28	12"/18"	8			6
30											

The Earth Technology Corporation

FIGURE A-5. LOG OF BORING PII-71

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-71 | Sheet 2 of 3

Depth (feet)	Description	USCS Classification	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
	SILTY SAND; Dark brown, damp, dense, low plasticity fines, fine-grained sand, micaceous, trace fine gravel.	SM	A1	6	D	13 25	12"/12"	6			6
				7	D	15 16	8"/12"	6			6
35	SAND-SILTY SAND; Dark brown, moist, dense, fine- to coarse-grained sand, micaceous, trace fine gravel, friable.	SP-SM	A1	8	S	12 18 18	15"/18"	6			5
40	CLAYEY SAND; Dark brown, damp, dense, low plasticity fines, fine- to medium-grained sand, occasionally coarse-grained sand, trace fine gravel, trace mica.	SC	A4	9	D	11 14	9"/12"	6			5
	(Cuttings indicate gravel at 43 feet.)										
45	CLAYEY SAND with gravel; Dark brown, damp, dense to very dense, nonplastic fines, fine- to coarse-grained sand, friable, little gravel up to 1/2-inch size.	SC	A4	10	S	11 16 22	14"/18"	6			5
50	SILTY SAND; Dark brown, damp, dense, nonplastic fines, fine- to medium-grained sand with occasional coarse-grained sand, trace fine gravel, trace mica.	SM	A3	11	D	12 19	9"/12"	6			5
55	CLAYEY SAND; dark brown, moist, dense, low plasticity fines, fine- to coarse-grained sand, micaceous, trace gravel. (Cuttings indicate more gravel at 57 feet.)	SC	A4	12	S	10 14 16	18"/18"	6			5
60	SILTY SAND; Dark brown, damp, dense, low plasticity fines, fine- to coarse-grained sand, micaceous, trace subangular gravel up to 1-inch size.	SM	A3	13	D	11 20	9"/12"	6			5
65	SAND-SILTY SAND with gravel; Dark yellowish brown, damp, very dense, coarse-grained sand, micaceous, little gravel up to 1-inch size. (Drill chatter at 67 feet. Cuttings indicate gravel.)	SP-SM	A3	14	S	19 34 35	12"/18"	6			5
70											

The Earth Technology Corporation

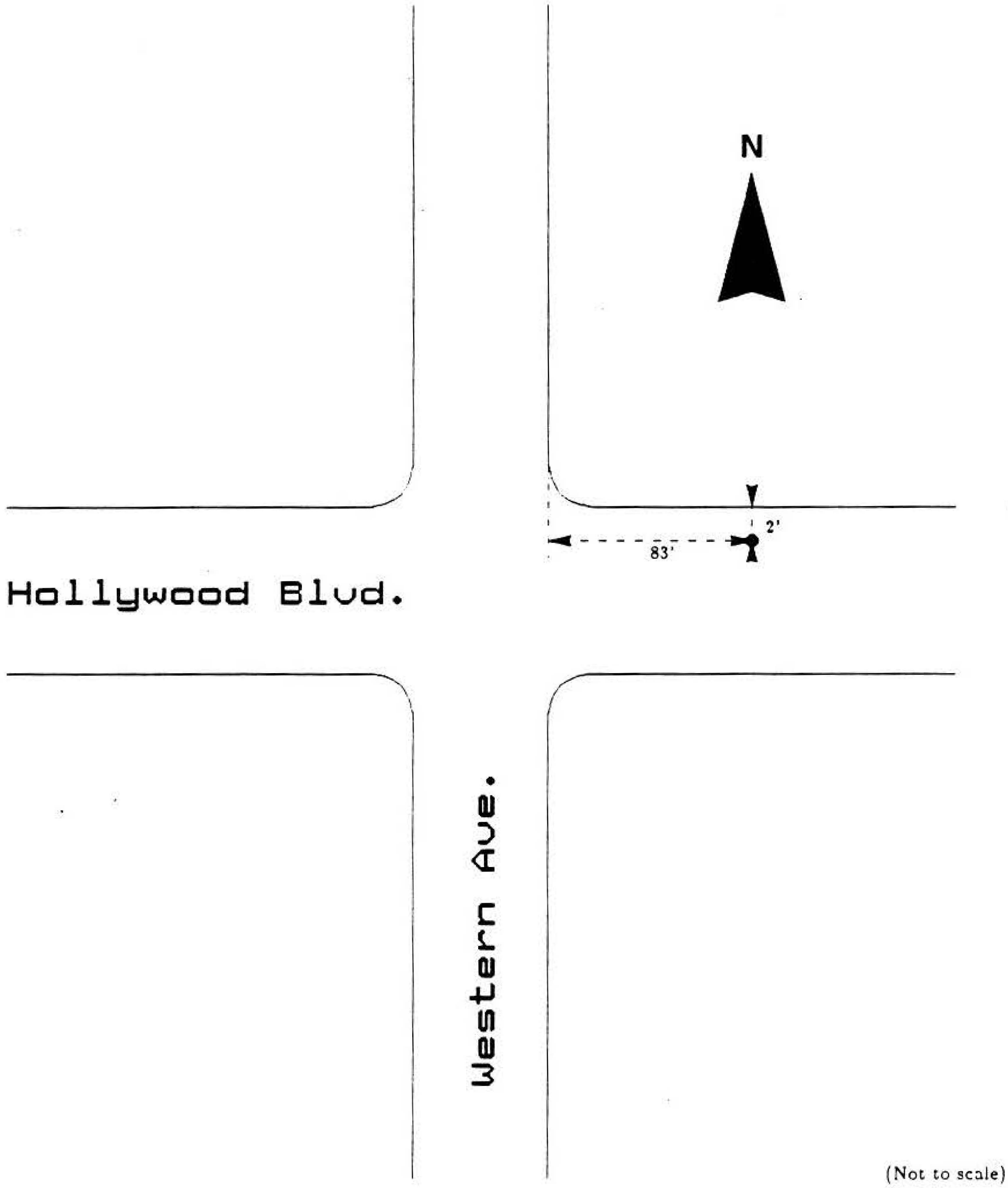
FIGURE A-5. LOG OF BORING PII-71

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-71 | Sheet 3 of 3

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		Same as above.	SP-SM	A3	15	D	28 37	7"/12"	6			5
75		Same as above. Less gravel. Clayey sand at bottom; low plasticity fines, fine- to medium-grained sand.	SP-SM	A3	16	S	17 24 40	14"/18"	6			5
80		SANDY CLAY; Dark yellowish brown, moist, very stiff, low plasticity fines, fine- to medium-grained sand, trace subangular gravel.	CL	A4	17	D	23 27	12"/12"	6			5
85		CLAYEY SAND; Dark yellowish brown, damp, very dense, trace fine gravel, micaceous, trace silt, clay.	SC	A3	18	S	23 44	8"/12"	14			5
90		CLAYEY SAND; Brown, moist, very dense, low plasticity fines, fine- to coarse-grained sand, trace subangular gravel up to 1-1/2 inch size.	SC	A3	19	D	16 22	12"/12"	6			5
95		BORING TERMINATED AT 91 FEET.										
100												
105												
110												

NOTE: This borehole log is based on field classification and visual soil description, and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with passage of time. The data presented is simplification of actual conditions encountered. The stratification lines represent the approximate boundary between subsurface material types and the transition may be gradual.



The Earth Technology Corporation	PROJECT NO.: 89-409 Hollywood / Western Station

Location of Borehole PII-71

06-90

Figure 5A

The Earth Technology Corporation

FIGURE A-6. LOG OF BORING PII-72

Project Name: METRO RAIL - PHASE II - LOS ANGELES			
Project Number: 89-409	Borehole Number: PII-72		sheet 1 of 3
Borehole location: Hollywood Blvd., East of Western Ave.		Elevation and Datum(feet): 395	
Health and Safety: Upgraded Level D		Date Started: 5/3/89	Date Finished: 5/3/89
Drilling Equipment: Mayhew 1500		Total Depth(feet): 101.0	Depth to: Bedrock(feet): --
Drilling Method: Rotary Wash		Borehole Diameter: 5-inch	
Drilling Fluid: Bentonite Mud		Piezometer Installation: NO	Depth(feet): --
Hammer Information: SPT Hammer: 140-lb and 30-inch drop. DOWNHOLE Hammer: 340-lb and 18-inch drop.		Logged By: Olu Odu-Falu	Checked By: Marshall C. Payne

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA(ppm)
		12-inch CONCRETE.										
		SAND with Gravel. Base course material.		FILL								
5		CLAYEY SILT; Dark brown, moist, soft to medium stiff, medium plasticity fines,m micaceous, trace fine- to medium-grained sand.	ML	A2	1	S	2 3 4	6"/18"	5			5
10		SILTY SAND; Brown, moist, medium dense, low plasticity fines, fine- to coarse-grained sand, trace clay.	SM	A1	2	D	3 3	4"/12"	4	105	18	4
15		(Cuttings indicate more sand at 13 feet.) CLAYEY SAND; Brown, moist, medium dense, low plasticity fines, very fine- to fine-grained sand with some coarse-grained sand.	SC	A2	3	S	3 4 7	9"/18"	4			4
20		SANDY CLAY/CLAYEY SAND; Brown, moist, medium stiff, medium plasticity fines, very fine- to medium-grained sand, micaceous.	CL/SC	A2	4	D	4 5	9"/12"	5	106	20	4
25		SANDY CLAYEY SILT; Brown, moist, hard, low to medium plasticity fines, fine- to coarse-grained sand, micaceous, trace clay.	ML	A1	5	S	11 14 20	12"/18"	5			4
30												

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FIGURE A-6. LOG OF BORING PII-72

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-72 | Sheet 2 of 3

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		CLAYEY SAND; Dark brown, moist, dense to very dense, low to medium plasticity fines, fine- to coarse-grained sand, micaceous.	SC	A4	6	D	15 22	7"/12"	5	113	18	5
		Same as above. More sand, trace fine gravel.			7	D	17 25	7"/12"	5			5
35		CLAYEY SAND; Yellowish brown, moist, medium dense, low to medium plasticity fines, fine- to coarse-grained sand.	SC	A4	8	S	8 14 18	12"/18"	5			5
40		CLAYEY SAND; Dark yellowish brown, moist, dense, low to medium plasticity fines, very fine- to coarse-grained sand.	SC	A4	9	D	10 14	8"/12"	5			5
45		Same as above. Low plasticity fines, fine-grained sand.	SC	A4	10	S	10 14 16	14"/18"	5			5
50		SANDY CLAY; Dark yellowish brown, moist, hard, low to medium plasticity fines, very fine- to coarse-grained sand, micaceous.	CL	A4	11	D	17 28	6"/12"	5	109	20	5
55		SANDY CLAY; Dark yellowish brown, moist, hard, low to medium plasticity fines, fine- to medium-grained sand, micaceous.	CL	A4	12	S	14 17 23	16"/18"	5			5
		(Cuttings indicate some gravel between 58 and 58-1/2 feet.)										
60		CLAYEY SAND/SANDY CLAY; Brown, moist, hard, medium plasticity fines, very fine- to coarse-grained sand, micaceous.	SC/CL	A4	13	D	12 15	10"/12"	5	107	21	5
65		SANDY SILT/SANDY CLAY; Dark brown, moist, hard, medium plasticity fines, fine-grained sand, micaceous.	ML/CL	A4	14	S	17 27 37	18"/18"	5			5
70												

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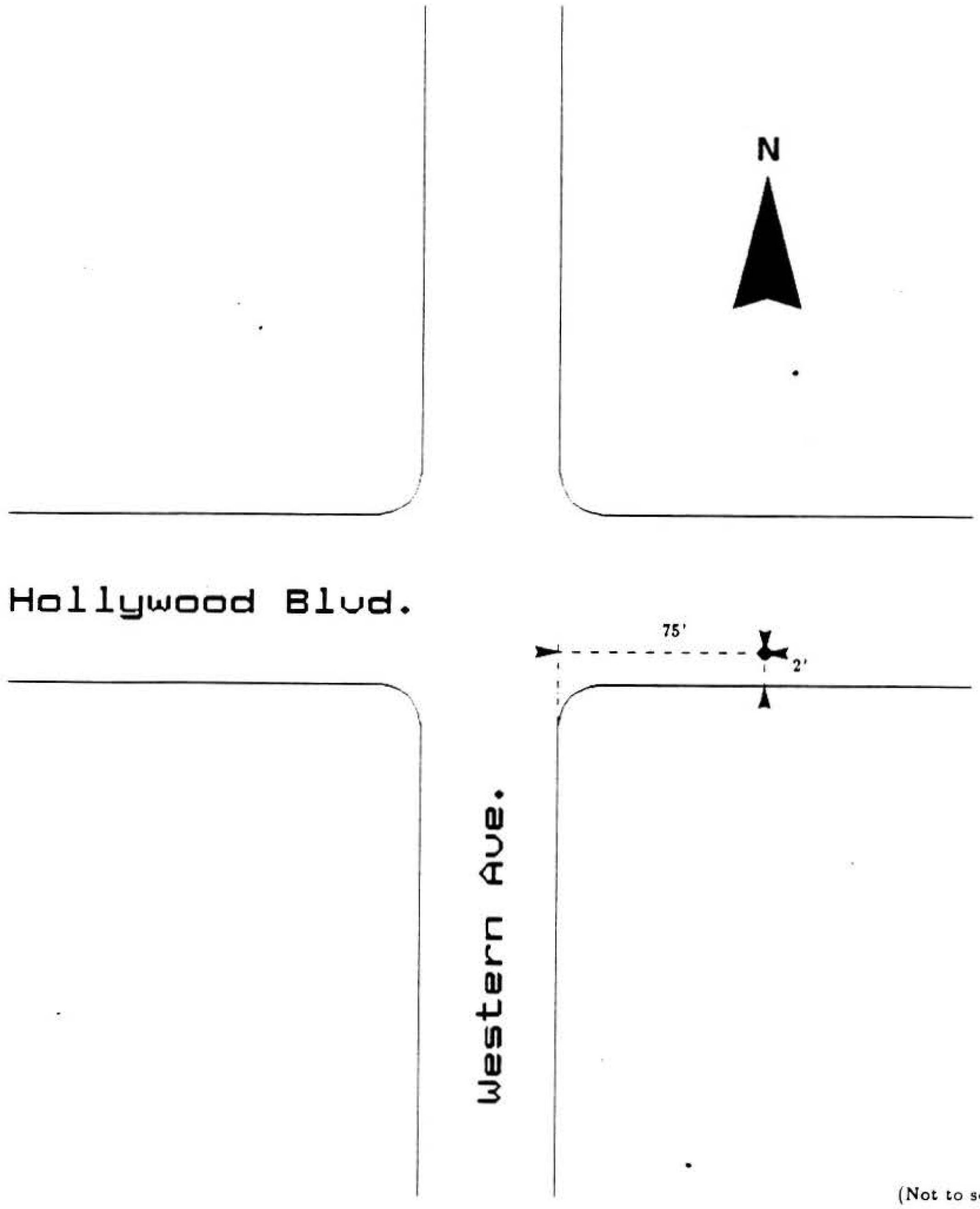
FIGURE A-6. LOG OF BORING PII-72

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-72 | Sheet 3 of 3

Depth (feet)	Description	USCS Classification	Geologic Unit	Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
	CLAYEY SAND/SANDY CLAY; Dark brown, moist, hard, fine- to medium-grained sand, medium plasticity fines, micaceous, trace coarse-grained sand and fine gravel.	SC/CL	A4	15	D	24 27	8"/12"	5	108	20	5
75	SANDY CLAY; Dark brown, moist, hard, medium plasticity fines, fine-grained sand, micaceous.	CL	A4	16	S	20 40 40/5"	17"/17"	5			5
80	SANDY CLAY; Brown, moist, hard, medium plasticity fines, fine-grained sand with occasional medium- to coarse-grained sand, micaceous.	CL	A4	17	D	39 50	8"/12"	5			5
85	SILTY SAND; Dark yellowish brown, wet, very dense, low plasticity fines, fine- to coarse-grained sand, micaceous, trace fine gravel up to 1/2-inch size.	SM	A3	18	S	18 32 50/5"	17"/17"	5			5
90	CLAYEY SAND; Dark brown, moist, very dense, low plasticity fines, fine- to coarse-grained sand.	SC	A3	19	D	20 26	3"/12"	6	108	21	5
95	Same as above.	SC	A3	20	S	16 24 36	18"/18"	6			5
100	CLAYEY SAND; Dark brown, moist, dense, low to medium plasticity fines, fine- to coarse-grained sand, micaceous, trace fine gravel.	SC	A3	21	D	15 ~~16~~	2"/12"	6	117	16	5
105	BORING TERMINATED AT 101 FEET.										
110											

NOTE: This borehole log is based on field classification and visual soil description, and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with passage of time. The data presented is simplification of actual conditions encountered. The stratification lines represent the approximate boundary between subsurface material types and the transition may be gradual.



The Earth Technology Corporation	PROJECT NO.: 89-409 Hollywood / Western Station

Location of Borehole PII-72

06-90

Figure 6A

FIGURE A-7. LOG OF BORING PII-73

Project Name: METRO RAIL - PHASE II - LOS ANGELES			
Project Number: 89-409	Borehole Number: PII-73		sheet 1 of 3
Borehole location: Hollywood Blvd., West of Western Ave.		Elevation and Datum(feet): 391	
Health and Safety: Upgraded Level D		Date Started: 5/5/89	Date Finished: 5/5/89
Drilling Equipment: Mayhew 1500		Total Depth(feet): 101.0	Depth to: Bedrock(feet): --
Drilling Method: Rotary Wash		Borehole Diameter: 5-inch	
Drilling Fluid: Bentonite Mud		Piezometer Installation: NO	Depth(feet): --
Hammer Information: SPT Hammer: 140-lb and 30-inch drop. DOWNHOLE Hammer: 265-lb and 18-inch drop.		Logged By: Curtis D. Cushman	Checked By: Marshall C. Payne

Depth (feet)	Description	USCS Classification	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
0	12-inch ASPHALT.										
	SANDY GRAVEL		FILL								
5	SAND with Gravel; Dark grayish brown. No recovery.	SP	A1	1	S	4 3 2	0"/12"	-0			4
10	CLAYEY SAND; Dark brown, moist, loose, medium plasticity fines, fine- to coarse-grained sand, micaceous, trace fine gravel.	SC	A1	2	D	3 3	5"/12"	5	109	18	4
15	CLAYEY SAND; Dark yellowish brown, moist, medium dense, low to medium plasticity fines, very fine- to coarse-grained sand, micaceous, moderately cemented.	SC	A1	3	S	4 7 8	9"/18"	11			8
20	SILTY SAND; Dark yellowish brown, moist, medium dense, low plasticity fines, very fine- to coarse-grained sand, micaceous, moderately cemented, trace gravel.	SM	A1	4	D	6 8	9"/12"	5	111	13	4
25	CLAYEY SAND; Dark yellowish brown, medium dense, low to medium plasticity fines, very fine- to medium-grained sand, micaceous, slightly cemented.	SC	A4	5	S	3 4 5	12"/18"	6			4
30											

FIGURE A-7. LOG OF BORING PII-73

The Earth Technology Corporation

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-73 | Sheet 2 of 3

Depth (feet)	Lith-ology	Description	USCS Classi-fication	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		CLAYEY SAND/SANDY CLAY; Reddish brown, moist, hard, medium plasticity fines, fine- to coarse-grained sand, no cementation. 1-inch size gravel in a ring.	SC	A4	6	D	12 12	8"/12"	5			4
					7	D	14 11	9"/12"	5			4
		CLAYEY SAND; Dark yellowish brown, moist, dense, low plasticity fines, very fine- to coarse-grained sand, micaceous.										
35		(Cuttings indicate gravel at 34 feet.) Same as above.	SC	A4	8	S	29 18 16	12"/18"	5			5
40		CLAYEY SAND; Dark yellowish brown, moist, medium dense, low plasticity fines, very fine- to coarse-grained sand, micaceous, trace fine gravel.	SC	A4	9	D	7 11	6"/12"	5	99	24	4
45		CLAYEY SAND; Dark yellowish brown, moist, medium dense, medium plasticity fines, fine- to medium-grained sand, micaceous.	SC	A4	10	S	8 11 15	14"/18"	5			5
50		SILTY SAND; Dark yellowish brown, moist, dense to very dense, low plasticity fines, fine- to medium-grained sand, micaceous, trace fine gravel. Silt content increases with depth.	SM	A3	11	D	20 20	6"/12"	5			4
55		CLAYEY SILT; Dark yellowish brown, moist, hard, medium plasticity fines, trace fine- to medium-grained sand.	ML	A4	12	S	14 21 33	14"/18"	5			5
60		CLAYEY SAND; Brown, moist, medium dense, low to medium plasticity fines, fine- to coarse-grained sand, micaceous.	SC	A4	13	D	12 16	8"/12"	5			5
65		CLAYEY SAND; Brown, wet, medium dense, low to medium plasticity fines, very fine- to coarse-grained sand, micaceous, trace fine gravel.	SC	A4	14	S	10 11 15	14"/18"	5			5
70												

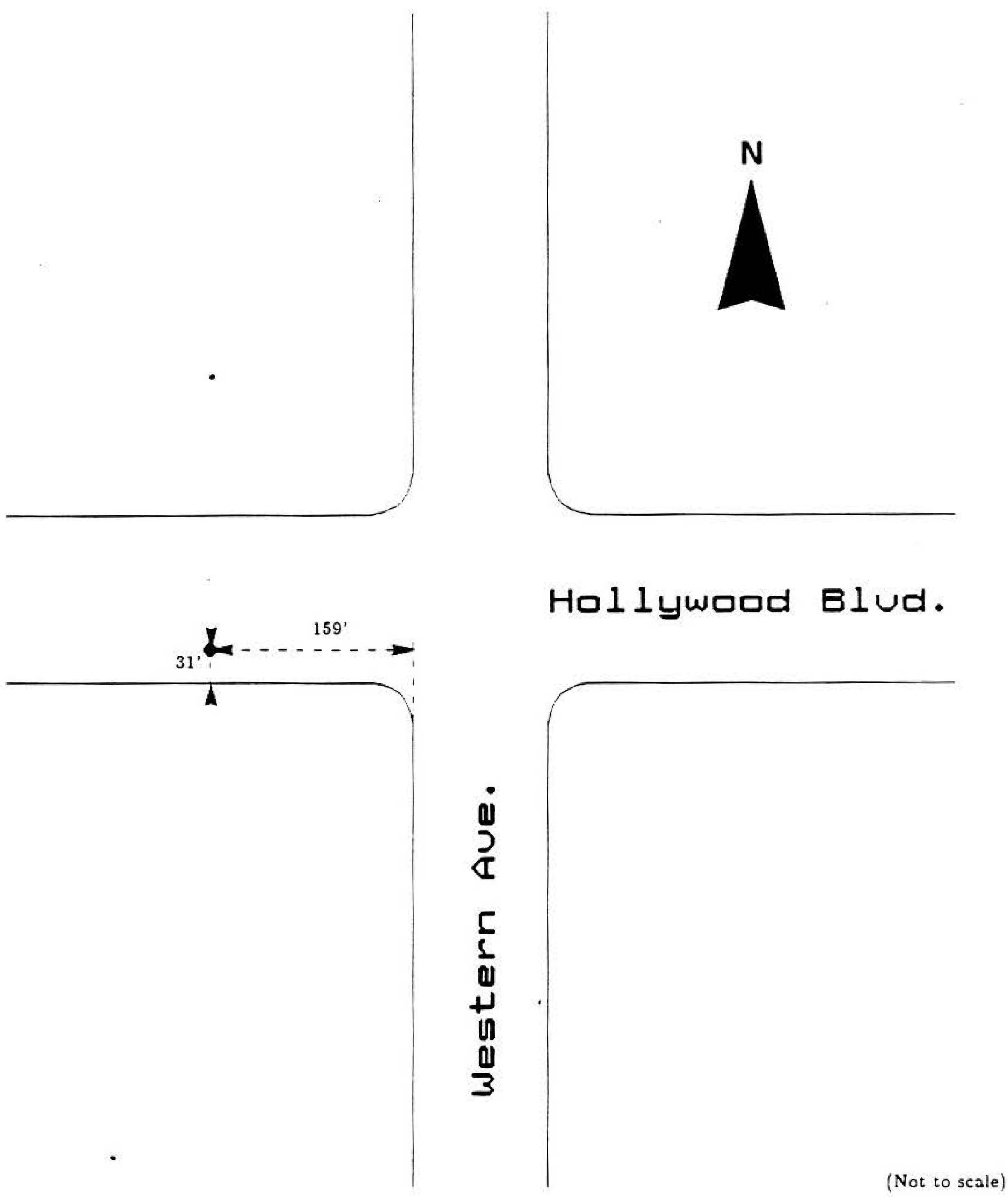
FIGURE A-7. LOG OF BORING PII-73

The Earth Technology Corporation

Project Name: METRO RAIL - PHASE II - LOS ANGELES

Project Number: 89-409 | Borehole Number: PII-73 | Sheet 3 of 3

Depth (feet)	Lith-ology	Description	USCS Classification	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		SILTY SAND; Brown, wet, dense, low plasticity fines, very fine- to coarse-grained sand, micaceous.	SM	A3	15	D	20 15	10"/12"	6			5
75		SILTY SAND/SANDY SILT; Brown, moist, very dense, medium plasticity fines, fine- to coarse-grained sand with occasional medium-grained sand, micaceous.	SM/ML	A3	16	S	20 38 42	16"/18"	6			5
80		CLAYEY SAND; Dark yellowish brown, moist, dense, low plasticity fines, very fine- to coarse-grained sand, micaceous.	SC	A4	17	D	23 30	8"/12"	6	102	20	5
85		CLAYEY SILT; Dark yellowish brown, moist, hard, low to medium plasticity fines, some fine- to medium-grained sand with occasional coarse-grained sand, micaceous.	ML	A4	18	S	12 17 26	18"/18"	6			6
90		SILTY SAND; Dark yellowish brown, moist, very dense, fine- to coarse-grained sand, trace gravel up to 1-inch size, micaceous. Nonplastic silt in the middle of the sample.	SM	A3	19	D	22 29	10"/12"	6	103	24	6
95		CLAYEY SAND; Dark yellowish brown, wet, medium dense, low plasticity fines, very fine- to coarse-grained sand, micaceous.	SC	A3	20	S	10 17 30	14"/18"	6			5
100		SILTY SAND; Dark yellowish brown, wet, very dense, fine- to coarse-grained sand, micaceous, trace fine gravel.	SM	A3	21	D	28 40	6"/12"	6	115	17	5
105 110		BORING TERMINATED AT 101 FEET. NOTE: This borehole log is based on field classification and visual soil description, and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with passage of time. The data presented is simplification of actual conditions encountered. The stratification lines represent the approximate boundary between subsurface material types and the transition may be gradual.										



The Earth Technology Corporation	PROJECT NO.: 89-409 Hollywood / Western Station

Location of Borehole PII-73

06-90

Figure 7A

BORINGS FROM EARTH TECHNOLOGY
1988 INVESTIGATION

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FIGURE A-8. LOG OF BORING LPE-11

Project Name: METRO RAIL MOS-2 ALIGNMENT - LOS ANGELES			
Project Number: 88-429	Borehole Number: LPE-11		Sheet 1 of 3
Borehole Location: Hollywood and Western.		Elevation and Datum(feet): 395.0	
Health and Safety: Level D		Date Started: 9/24/88	Date Finished: 9/25/88
Drilling Equipment: Failing 750		Total Depth (feet): 96.0	Depth to Bedrock(feet):
Drilling Method: Rotary Wash		Borehole Diameter: 5-inch	
Drilling Fluid:		Piezometer Installation: YES.	Depth(feet) 96.0
Hammer Information: SPT Hammer: 140-lb weight and 30-inch drop. DOWNHOLE Hammer: 365-lb weight and 18-inch drop.		Logged By: FJE	Checked By: C. M. Payne

Depth (feet)	Lith-ology	Description	USCS Classification	Geologic Unit	Samples Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		8-inch ASPHALT CONCRETE.										
		SANDY SILT; Brown, moist, stiff, some clay.	ML	A1								
5		SANDY CLAY; Brown, moist, stiff, slightly plastic fines, fine to coarse sand.	CL	A2	1	B						
10		SILTY SAND; Brown, moist, loose to medium dense, trace clay and gravel up to 1/4-inch size.	SM	A1	2	S	3 4 5	12"/18"	4.8			5.2
15		SILTY SAND; Brown, moist, medium dense, fine to coarse.	SM	A1	3	D	7 6 5	16"/18"	7.8	106	11.6	4.8
20		SANDY SILT; Dark yellowish brown, moist, medium dense, slightly plastic fines, fine sand with trace medium to coarse sand. (Becoming sandier.)	ML	A1	4	S	5 7 8	8.5"/18"	5.8			5.7
25		SILTY SAND; Brown, moist, medium dense to dense, medium to coarse, trace clay. (Harder drilling.)	SM	A1	5	D	8 12	12"/12"	5.9	115	17.3	5
30												

The Earth Technology Corporation

FIGURE A-8. LOG OF BORING LPE-11

Project Name: METRO RAIL MOS-2 ALIGNMENT - LOS ANGELES

Project Number: 88-429 | Borehole Number: LPE-11 | Sheet 2 of 3

Depth (feet)	Lith-ology	Description	USCS Classification	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		CLAYEY SAND; Dark yellowish brown, moist, very dense, fine to coarse, moderately plastic fines, trace gravel at top of the sample.	SC	A4	6	S	13 18 26	14"/18"	6.0			5.7
35		SILTY SAND; Brown, moist, medium dense to dense, fine to coarse, with some clay. More fines at tip.	SM	A3	7	D	8 12 •	12"/12"	6.7	112	14.5	6.2
40		SILTY SAND; Dark yellowish brown, moist, dense, fine to coarse, micaceous, slightly plastic fines.	SM	A3	8	S	13 15 19	14"/18"	6.9			6.8
45		CLAYEY SAND/SANDY CLAY; Brown, moist, very stiff, slightly plastic, fine to medium sand.	SC/CL	A4	9	D	11 14	12"/12"	6.5	112	14.8	6.8
50		CLAYEY SAND; Dark yellowish brown, moist, hard, micaceous, moderately plastic fines, fine to coarse sand, trace gravel up to 1/2-inch sise at top.	SC	A4	10	S	15 25 14	18"/18"	6.6			6.4
55		SILTY SAND; Brown, moist, medium dense to dense, some coarse sand and trace clay.	SM	A3	11	D	11 18	12"/12"	6.4	119	15.2	6.4
60		CLAYEY SAND; Reddish brown, moist, very stiff, fine to coarse, moderately plastic fines. More fines at tip. More fine at tip. (Easier drilling.)	SC	A4	12	S	8 16 12	18"/18"	7.5			7.5
65		SILTY SAND; Brown, moist, medium dense, medium to coarse at top and fine to medium at bottom of sample. (Drill chatter -- possibly encounters sand and gravel.)	SM	A3	13	D	13 14	12"/12"	8.3	112	17.0	8.0
70												

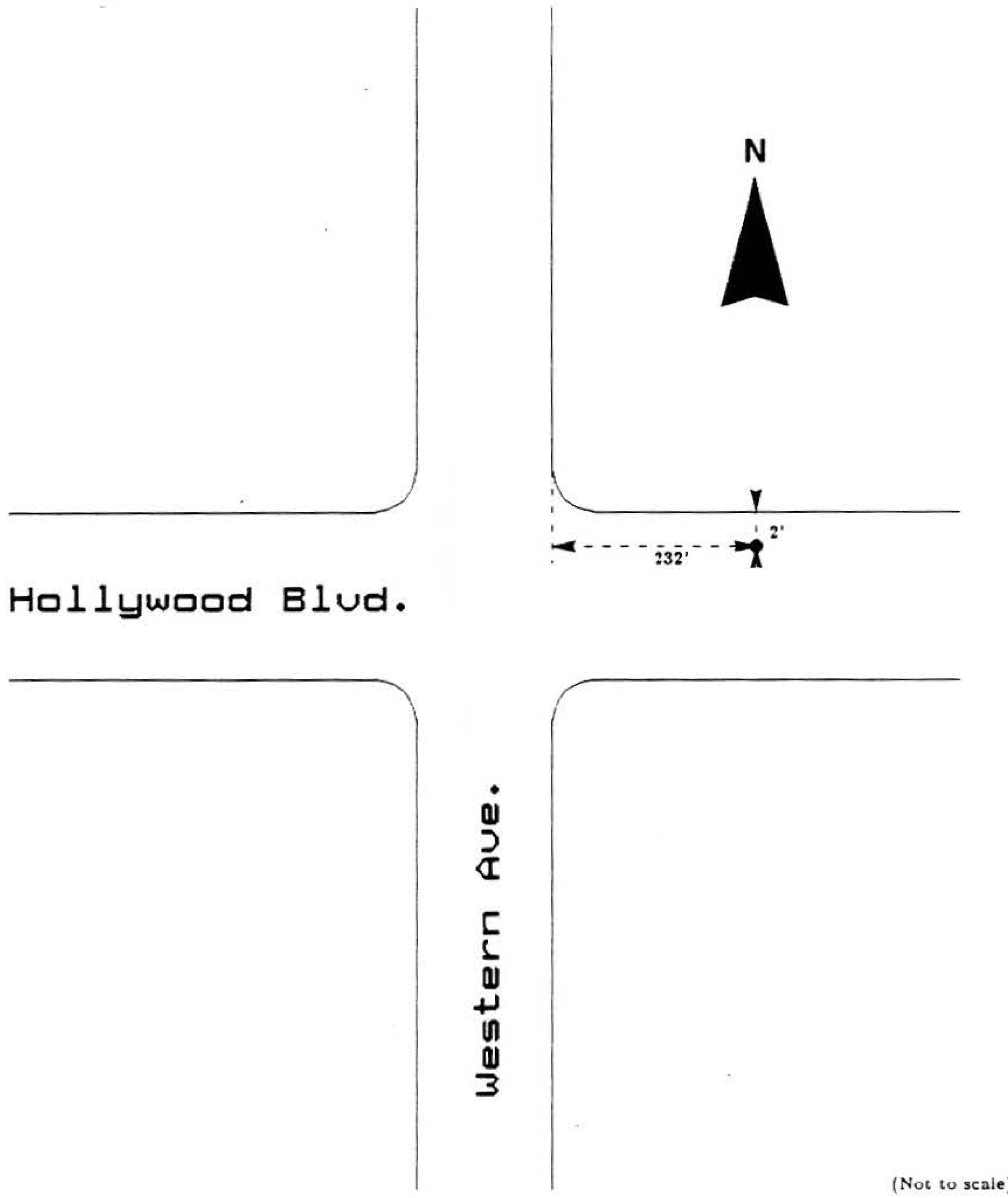
The Earth Technology Corporation

FIGURE A-8. LOG OF BORING LPE-11

Project Name: METRO RAIL MOS-2 ALIGNMENT - LOS ANGELES

Project Number: 88-429 | Borehole Number: **LPE-11** | Sheet 3 of 3

Depth (feet)	Lith-ology	Description	USCS Classification	Geologic Unit	Samples: Number	Type	Blow Count	Recovery	OVA (ppm)	Dry Density (pcf)	Moisture Content (%)	Background OVA (ppm)
		SAND-SILTY SAND WITH GRAVEL; Dark yellowish brown, moist to wet, dense, very fine to coarse, very micaceous, gravel up to 3/4-inch size. (Easier drilling.)	SP-SM	A3	14	S	25 30 40	18"/18"	7.3			8.0
75		SILTY SAND; Brown, moist, dense, fine to medium, trace coarse sand	SM	A3	15	D	15 23	12"/12"	7.2	114	16.4	7.0
80		SANDY CLAY; Reddish brown, moist, very stiff, slightly plastic fines, fine to medium sand.	CL	A4	16	S	13 16 26	18"/18"	5.8			5.8
85		SILTY SAND; Brown, moist, medium dense, medium to coarse on top and fine on bottom of sample, trace clay. (Thin 1-inch layer of silt at tip.)	SM	A3	17	D	9 20	12"/12"	6.0	112	16.6	
90		(No recovery.) (Drill chatter from 93 to 93-1/2 feet)			18	S	23 24 27	0"/18"				5.6
95		SAND-SILTY SAND; Brown, wet, dense, coarse to medium with some fine sand and silt and trace gravel up to 1/2-inch size.	SP-SM	A3	19	D	38 62	12"/12"	6.3			4.8
100 105 110		BORING TERMINATED AT 96 FEET. NOTE: This borehole log is based on field classification and visual soil description, and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. The subsurface conditions may differ at other locations and may change at this alocation with passage of time. The data presented is simplification of actual conditions encountered. The stratification lines represent the approximate boundary between subsurface material types and the transition may be gradual.										

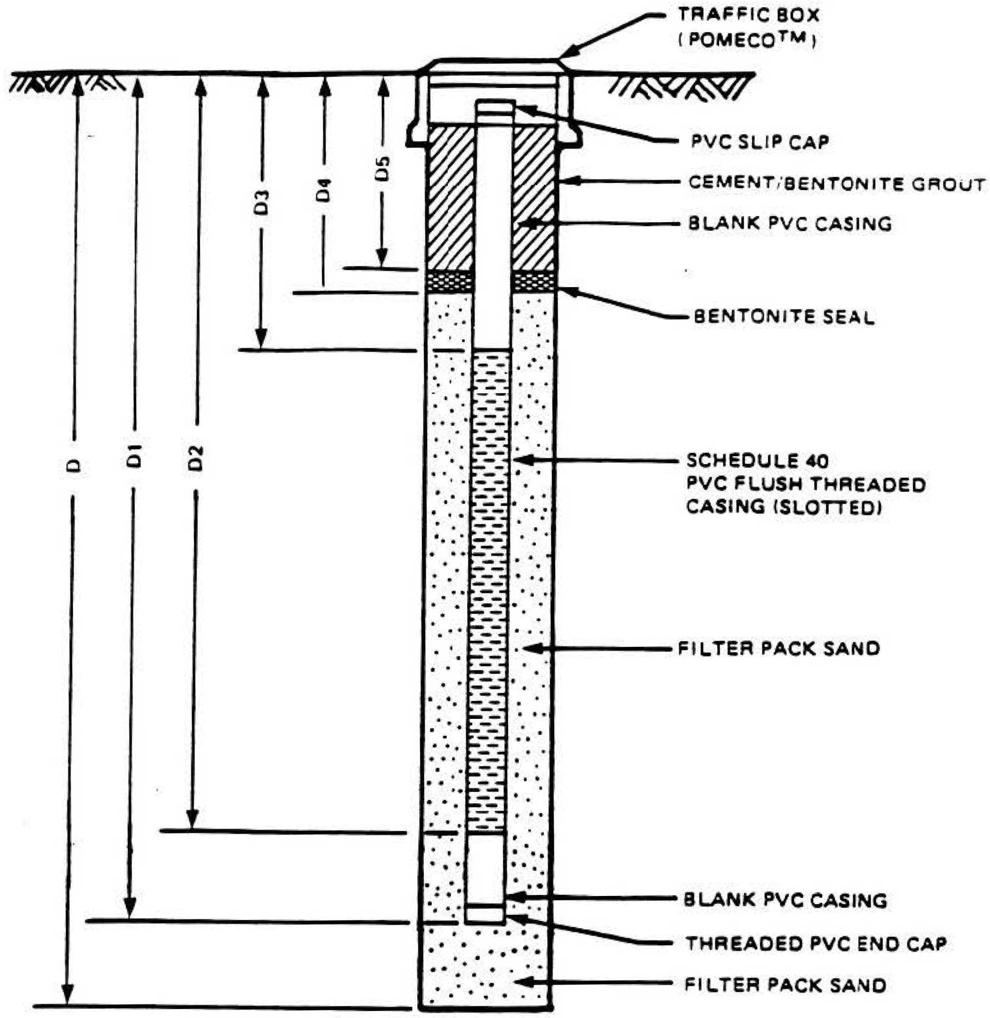


The Earth Technology Corporation	PROJECT NO.: 89-409 **Hollywood / Western Station**

Location of Borehole LPE-11

06-90

Figure 8A



TOTAL DEPTH (D)	=	96.0	FEET
TOTAL DEPTH OF CASING (D1)	=	95.0	FEET
DEPTH TO BOTTOM OF WELL SCREEN (D2)	=	95.0	FEET
DEPTH TO TOP OF WELL SCREEN (D3)	=	15.0	FEET
DEPTH TO BOTTOM OF TOP SEAL (D4)	=	13.0	FEET
DEPTH TO TOP OF TOP SEAL (D5)	=	11.0	FEET
WELL CASING DIAMETER	=	2	INCH
WELL SCREEN SLOT SIZE	=	0.02	INCH
FILTERPACK SAND TYPE	=	NO. 2	MONTEREY
BENTONITE SEAL TYPE	=		1/8" PELLETS

The Earth Technology Corporation

PROJECT NO.: 89-409
Hollywood / Western Station

Diagram of Piezometer LPE-11

06-90

Figure 8B

Appendix B

Results of Soil Mechanics Laboratory Test Program

APPENDIX B

RESULTS OF SOIL MECHANICS LABORATORY TEST PROGRAM

This appendix presents the results of soil mechanics laboratory tests performed on selected representative soil samples. A description of the soil mechanics laboratory test program and test procedures has been provided in Section 3.2. In this appendix, test results are presented in tables and figures as follows:

Table or Figure	Test Results
Table B-1	Dry Density, Moisture Content and Calculated Void Ratio
Table B-2	Grain Size Analysis
Table B-3	Atterberg Limits
Table B-4	Specific Gravity
Table B-5	Direct Shear Tests
Table B-6	Triaxial Tests
Table B-7	Permeability Determination
Table B-8	Engineering Properties of All Geologic Units - Summary of Laboratory Test Results
Table B-9	Engineering Properties of All Geologic Units - Summary of SPT Correlations
Figures B-1 through B-18	Grain Size Distribution Curves
Figures B-19 through B-24	Direct Shear Test Results
Figure B-25	Triaxial Test Results
Figures B-26 through B-28	Consolidation Test Results

TABLE B-1. SUMMARY OF DRY DENSITY, MOISTURE CONTENT, AND CALCULATED VOID RATIO

Boring No.	Sample[a] No.	Depth (Feet)	USCS Classification	General Soil Classification	Geologic Unit	Dry Density (PCF)	Moisture Content (%)	Calculated Void Ratio
PII-67	D-2	10-11	SM	Silty Sand	A1	100.8	21.0	0.67
PII-67	D-4	20-21	SM	Silty Sand	A1	111.6	11.0	0.51
PII-67	D-6	30-31	SC	Clayey Sand	A3	103.4	19.0	0.63
PII-67	D-11	50-51	CL/SC	Sandy Clay/Clayey Sand	A4	109.3	20.0	0.54
PII-67	D-13	60-61	SC	Clayey Sand	A3	108.8	21.0	0.55
PII-67	D-19	90-91	SM	Silty Sand	A3	112.7	19.0	0.50
PII-68	P-11	55-57.5	SM	Silty Sand	A3	109.4	16.0	0.54
PII-69	D-4	10-11	CL/SC	Sandy Clay/ Clayey Sand	A2	90.0	27.0	0.87
PII-69	D-6	20-21	SM	Silty Sand	A1	99.0	16.0	0.70
PII-69	D-8	30-31	SC/CL	Clayey Sand/ Sandy Clay	A4	102.9	24.0	0.64
PII-69	D-14	60-61	SM	Silty Sand	A3	108.8	17.0	0.55
PII-69	D-16	70-71	SC	Clayey Sand	A4	113.6	18.0	0.48
PII-69	D-20	90-91	SM	Silty Sand	A3	110.3	19.0	0.53
PII-70	D-6	20-21	SP-SM	Sand-Silty Sand	A1	92.8	21.0	0.82
PII-70	D-8	30-31	SC	Clayey Sand	A4	107.1	19.0	0.58
PII-70	D-10	40-41	CL/ML	Sandy Clay/ Sandy Silt	A4	98.2	27.0	0.72
PII-70	D-12	50-51	SM	Silty Sand	A3	111.1	17.0	0.52
PII-70	D-14	60-61	CH/SC	Sandy Clay/Clayey Sand	A4	110.8	17.0	0.52
PII-70	D-18	80-81	SC	Clayey Sand	A4	102.3	24.0	0.65
PII-70	D-20	90-91	SM	Silty Sand	A3	111.6	18.0	0.51
PII-72	D-2	10-11	SM	Silty Sand/Sandy Clay	A1	105.2	18.0	0.60
PII-72	D-4	20-21	CL/SC	Sandy Clay/Clayey Sand	A2	105.7	20.0	0.60
PII-72	D-6	30-31	SC	Clayey Sand	A3	112.6	18.0	0.50
PII-72	D-11	50-51	SC	Sandy Clay	A3	109.0	20.0	0.55
PII-72	D-13	60-61	SC/CL	Clayey Sand/ Sandy Clay	A4	106.9	21.0	0.58
PII-72	D-15	70-71	SC	Clayey Sand/Sandy Clay	A4	107.7	20.0	0.57
PII-72	D-19	90-91	SC	Clayey Sand	A3	108.3	21.0	0.56
PII-72	D-21	100-101	SC	Clayey Sand	A3	117.0	16.0	0.44
PII-73	D-2	10-11	SC	Clayey Sand	A1	109.2	18.0	0.54
PII-73	D-4	20-21	SM	Silty Sand	A1	110.6	13.0	0.52
PII-73	D-9	40-41	SC	Clayey Sand	A4	99.2	24.0	0.70
PII-73	D-17	80-81	SC	Clayey Sand	A4	101.7	20.0	0.66
PII-73	D-19	90-91	SM	Silty Sand	A3	103.3	24.0	0.63
PII-73	D-21	100-101	SM	Silty Sand	A3	114.9	17.0	0.47

Notes: (a) D = Drive Samples
P = Thin Wall Tube (Pitcher) Samples

TABLE B-2. SIEVE ANALYSIS RESULTS

Point Identif-ication	Sample[a] No.	Depth (Feet)	USCS Classification	General Soil Classification	Geologic Unit	Percent[b] GR	SA	Fines
PII-67	D-2	10-11	SC	Clayey Sand	A1	6	66	28
PII-67	D-15	70-71	SC	Clayey Sand	A3	2	57	41
PII-67	D-17	80-81	SM	Silty Sand	A3	3	62	35
PII-68	D-2	10-11	ML	Sandy Silt	A1	2	34	64
PII-68	S-9	45-46.5	SC	Clayey Sand	A4	2	55	44
PII-68	D-14	70-71	SC/CL	Clayey Sand/Sandy Clay	A4	0	50	50
PII-69	S-11	45-46.5	SC	Clayey Sand	A3	3	82	14
PII-69	D-20	90-91	SM	Silty Sand	A3	1	66	33
PII-70	D-4	10-11	CL	Sandy Clay	A2	0	48	52
PII-70	D-6	20-21	SP-SM	Sand-Silty Sand	A1	10	80	10
PII-70	D-8	30-31	SC	Clayey Sand	A4	0	60	40
PII-70	D-18	80-81	SC	Clayey Sand	A4	5	55	40
PII-70	D-20	90-91	SM	Silty Sand	A3	3	63	34
PII-71	S-8	35-36.5	SP-SM	Sand-Silty Sand	A3	12	76	12
PII-71	S-10	45-46.5	SC	Clayey Sand	A4	13	71	16
PII-71	S-14	65-66.5	SP-SM	Sand-Silty Sand	A3	16	73	11
PII-71	S-18	85-86.5	SC	Clayey Sand	A3	2	76	23
PII-72	D-11	50-51	CL	Sandy Clay	A4	0	46	54
PII-72	D-13	60-61	SC/CL	Clayey Sand/Sandy Clay	A4	0	52	48
PII-72	S-14	65-66.5	ML/CL	Sandy Silt/Sandy Clay	A4	1	43	56
PII-72	D-15	70-71	SC/CL	Clayey Sand/Sandy Clay	A4	0	49	51
PII-73	S-16	75-76.5	SM/ML	Silty Sand/Sandy Silt	A3	0	53	47
PII-73	D-19	90-91	SM	Silty Sand	A3	10	62	28
PII-73	D-21	100-101	SM	Silty Sand	A3	8	69	23

Notes: (a) D = Drive Samples
S = SPT Samples

(b) GR = Gravel
SA = Sand
FINES = Silt and Clay

TABLE B-3. ATTERBERG LIMIT TEST RESULTS

Point Identif-ication	Sample[a] No.	Depth (Feet)	USCS Class.	General Soil Classification	Geologic Unit	Liquid Limit	Plastic Limit	Plasticity Index
PII-67	D-2	10-11	SC	Clayey Sand	A1	33	18	15
PII-67	S-10	45-46.5	CH	Sandy Clay	A4	51	17	34
PII-67	S-14	65-66.5	SC	Clayey Sand	A3	35	19	16
PII-67	D-15	70-71	SC	Clayey Sand	A3	35	20	15
PII-68	D-10	50-51	SC	Clayey Sand	A3	33	18	15
PII-68	D-14	70-71	SC/CL	Clayey Sand/Sandy Clay	A4	45	18	27
PII-68	S-15	75-76.5	CL	Sandy Clay	A4	41	20	21
PII-69	S-9	35-36.5	SC	Clayey Sand	A4	30	17	13
PII-69	S-11	45-46.5	SC	Clayey Sand	A3	30	17	13
PII-70	D-4	10-11	CL	Sandy Clay	A2	35	19	16
PII-70	D-8	30-31	SC	Clayey Sand	A4	43	20	23
PII-70	D-8	31-32	SC	Clayey Sand	A4	35	20	15
PII-70	D-14	60-61	CH/SC	Sandy Clay/Clayey Sand	A4	52	19	33
PII-70	D-18	80-81	SC	Clayey Sand	A4	43	20	20
PII-72	D-7	31-32	SC	Clayey Sand	A3	35	20	15
PII-72	D-11	50-51	CL	Sandy Clay	A4	41	18	23
PII-72	D-13	60-61	SC/CL	Clayey Sand/Sandy Clay	A4	36	17	19
PII-72	D-15	70-71	SC/CL	Clayey Sand/Sandy Clay	A4	30	15	15
PII-73	D-6	30-31	SC	Clayey Sand	A4	40	18	22

Notes: (a) D = Drive Samples
S = SPT Samples

TABLE B-4. SPECIFIC GRAVITY TEST RESULTS

Boring No.	Sample No.[a]	Depth (Feet)	USCS Classification	General Soil Classification	Geologic Unit	Specific Gravity
PII-72	S-14	65-66.5	ML/CL	Sandy Silt/ Sandy Clay	A4	2.73

Notes: (a) S = SPT samples

TABLE B-5. RESULTS OF DIRECT SHEAR TESTS

Boring No.	Sample No.[a]	Depth (Feet)	USCS Class.	General Soil Classification	Geologic Unit	Applied Normal Stress (PSF)	Shear Stress (PSF) Peak	Shear Stress (PSF) Residual	Estimated Strength Parameters Cohesion (PSF)	Estimated Strength Parameters Friction Angle (Deg)
PII-67	D-11	50-51	CL/SC	Sandy Clay/ Clayey Sand	A4	3,000	3,929	3,413	3,030	17
						6,000	4,962	4,493		
						12,000	6,762	6,371		
PII-67	D-13	60-61	SC	Clayey Sand	A3	3,600	5,093	4,036	3,300	26
						7,200	6,770	6,200		
						14,400	8,819	7,180		
PII-69	D-14	60-61	SM	Silty Sand	A3	3,600	3,770	3,430	385	42
						7,200	6,750	6,140		
						14,400	13,520	12,320		
PII-69	D-16	70-71	SC	Clayey Sand	A4	4,000	4,750	3,590	2,355	30
						8,000	6,880	6,030		
						16,000	11,670	10,550		
PII-70	D-6	20-21	SP-SM	Sand-Silty Sand	A1	1,250	1,850	1,470	695	41
						2,500	2,790	2,460		
						5,000	5,100	5,100		
PII-70	D-12	50-51	SM	Silty Sand	A3	3,000	4,170	3,210	2,565	27
						6,000	5,490	4,720		
						12,000	8,700	8,700		
PII-72	D-11	50-51	SC	Sandy Clay	A4	3,000	4,160	3,150	2,855	30
						6,000	6,890	5,380		
						12,000	9,500	8,590		
PII-72	D-13	60-61	SC/CL	Clayey Sand/ Sandy Clay	A4	3,600	3,720	3,490	2,080	28
						7,200	6,440	5,980		
						14,400	9,720	9,690		
PII-73	D-9	40-41	SC	Clayey Sand	A4	2,500	3,290	2,630	1,940	28
						5,000	4,660	4,150		
						10,000	7,360	7,110		

Notes: (a) D = Drive Samples

TABLE B-6. SUMMARY OF TRIAXIAL COMPRESSION TEST RESULTS

Boring Number	Sample Number[a]	Depth (feet)	General Soil Classification	Geologic Unit	Effective Confining Pressure (ksf)	Back Pressure (ksf)	Peak Strength (ksf)	Pore Pressure at Peak Shear(ksf)	Residual Shear (ksf)	Pore Pressure at Residual Shear(ksf)
PII-68	P-11	55-57.5	Silty Sand	A3	2.8	8.8	10.8	-1.00	10.8	-1.00
					5.6	8.8	9.5	1.85	9.5	1.85

Notes: (a) P = Pitcher Tube Samples

TABLE B-7. RESULTS OF LABORATORY PERMEABILITY TESTS

Boring No.	Sample No.[(a)]	Depth (feet)	USCS Classification	General Soil Classification	Geologic Unit	Permeability (cm/sec)
PII-69	D-20	90-91	SM	Silty Sand	A3	3.72×10^{-7}
PII-70	D-20	90-91	SM	Silty Sand	A3	1.75×10^{-6}
PII-72	D-15	70-71	SC	Clayey Sand/ Sandy Clay	A4	1.13×10^{-7}

Notes: (a) D = Drive Samples

TABLE B-8. ENGINEERING PROPERTIES OF ALL GEOLOGIC UNITS - SUMMARY OF LABORATORY TEST RESULTS

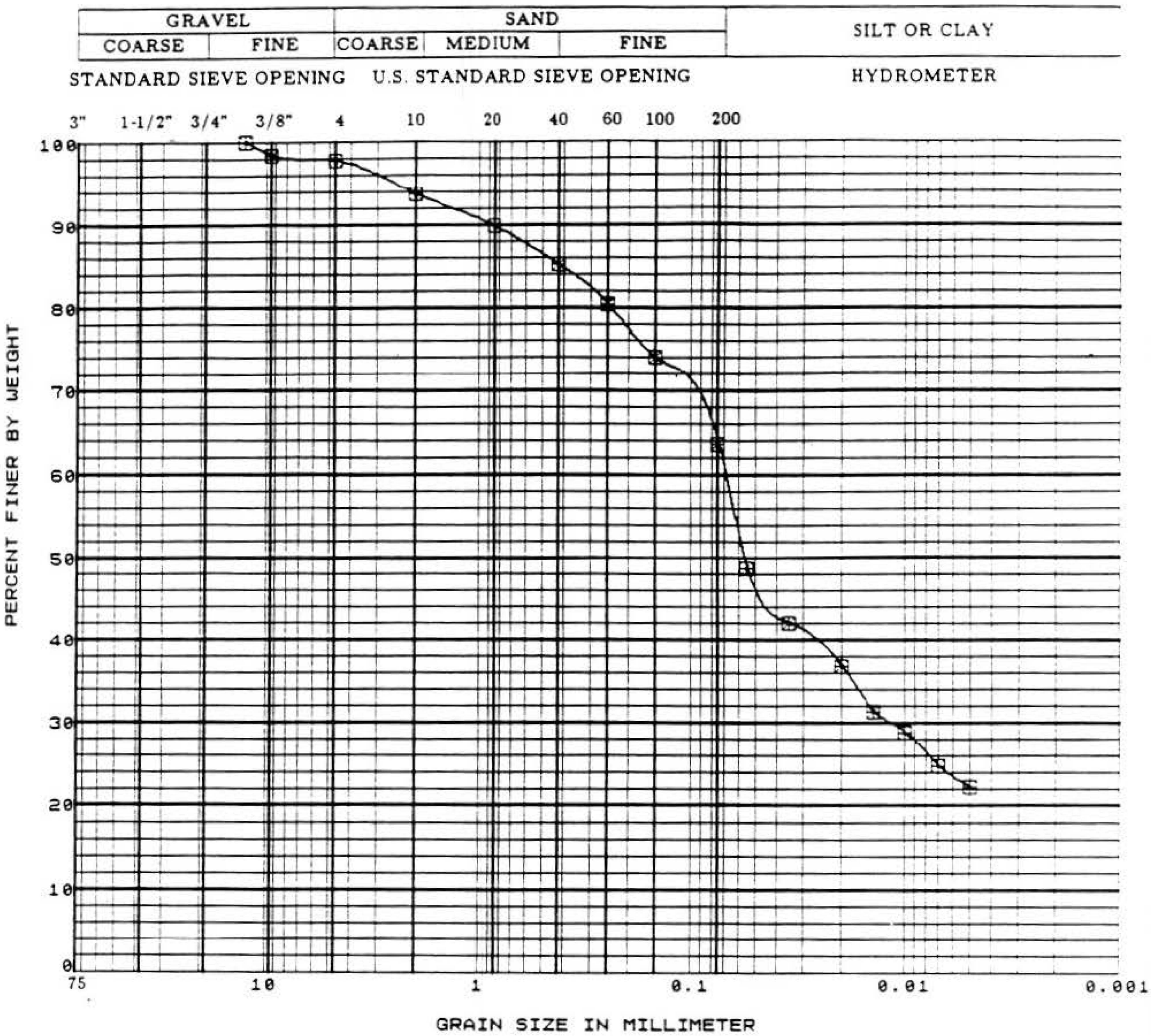
	GEOLOGIC UNIT											
	GRANULAR YOUNG ALLUVIUM (A1)			FINE-GRAINED YOUNG ALLUVIUM (A2)			GRANULAR OLD ALLUVIUM (A3)			FINE-GRAINED OLD ALLUVIUM (A4)		
USCS SOIL CLASSIFICATION	SM, SP, SP-SM, GM, SM/ML			CL, SC/CL, ML, SC, CH, OL, ML-CL, ML			SM, SP, SP-SM, GM, SM/ML			CL, SC/CL, ML, SC, CH, OL, ML-CL, ML		
	Range	Mean	S.D.[a]	Range	Mean	S.D.[a]	Range	Mean	S.D.[a]	Range	Mean	S.D.[a]
Friction Angle (degrees)	-	41	-	-	-	-	26-42	33	7.9	17-30	29	-
Cohesion (psf)	-	700	-	-	-	-	400-2,900	1,900	1,400	2,000-3,300	2,200	-
Dry Density (pcf)	92.8-105.2	99.0	6.2	90.0-105.7	97.9	-	108.3-117.0	111.1	2.8	98.2-113.6	107.3	4.0
Moisture Content (%)	16.0-21.0	18.3	2.5	20.0-27.0	23.5	-	16.0-21.0	18.1	1.7	17.0-27.0	21.6	3.6
Permeability	-	-	-	-	-	-	1.75×10^{-6}-3.72×10^{-7}	1.06×10^{-6}	-	-	1.13×10^{-7}	-
Calculated Void Ratio	0.60-0.82	0.71	0.11	0.60-0.80	0.74	-	0.44-0.56	0.52	0.04	0.48-0.72	0.59	0.08
Young's Modulus[b] (ksf)	-	-	-	-	-	-	750-1,500	1,125	-	-	-	-

Notes: (a) S.D. = Standard Deviation
(b) Young's Modulus Obtained From Triaxial Test Results

TABLE B-9. OTHER ENGINEERING PARAMETERS OF ALL GEOLOGIC UNITS ESTIMATED USING SPT DATA AND AVAILABLE CORRELATIONS

GEOLOGIC MATERIAL	GEOLOGIC UNIT	USCS SOIL CLASSIFICATION	STANDARD PENETRATION RESISTANCE			SHEAR WAVE VELOCIY (ft/s)			DYNAMIC SHEAR MODULUS[a] (10^5 x psf)			STATIC SHEAR MODULUS[b] (10^5 x psf)			SUBGRADE MODULUS[c] (10^3 x lb/ft^3)		
			RANGE	MEAN	S.D[d]	RANGE	MEAN	S.D[d]	RANGE	MEAN	S.D[d]	RANGE	MEAN	S.D[d]	RANGE	MEAN	S.D[d]
YOUNG ALLUVIUM (Granular)	A1	SM,SP SP-SM GM,SC SM/ML	6- 47	17	11	375- 857	580	148	5- 27	13	7	0.36- 2.82	1.04	0.68	80- 1000	300	219
YOUNG ALLUVIUM (Fine-Grained)	A2	CL,SC/CL ML,SC CH,OL, ML-CL,ML	5- 11	8	2	350- 540	440	69	5- 11	7	2	0.30- 0.66	0.47	0.14	--	150	--
OLD ALLUVIUM (Granular)	A3	SM,SP, SP-SM, GM,SC SM/ML	12- 120	45	20	630- 1,437	1,000	163	15- 77	38	12	0.72 7.20	2.69	1.21	80- 1,000	352	288
OLD ALLUVIUM (Fine-Grained)	A4	CL,SC/CL, ML,SC, CH,OL, ML-CL,ML	16 107	46	22	640 1,324	975	172	15- 65	37	13	0.96 6.42	2.78	1.33	300- 600	513	136

Notes: (a) Based on correlations recommended by Ohta and Goto (1978).
(b) Based on correlations recommended by Schmertmann (1970).
(c) Based on correlations recommended by Terzaghi (1955).
(d) S.D. = Standard Deviation.



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-68	D - 2	10.0	DRIVE	SANDY SILT		

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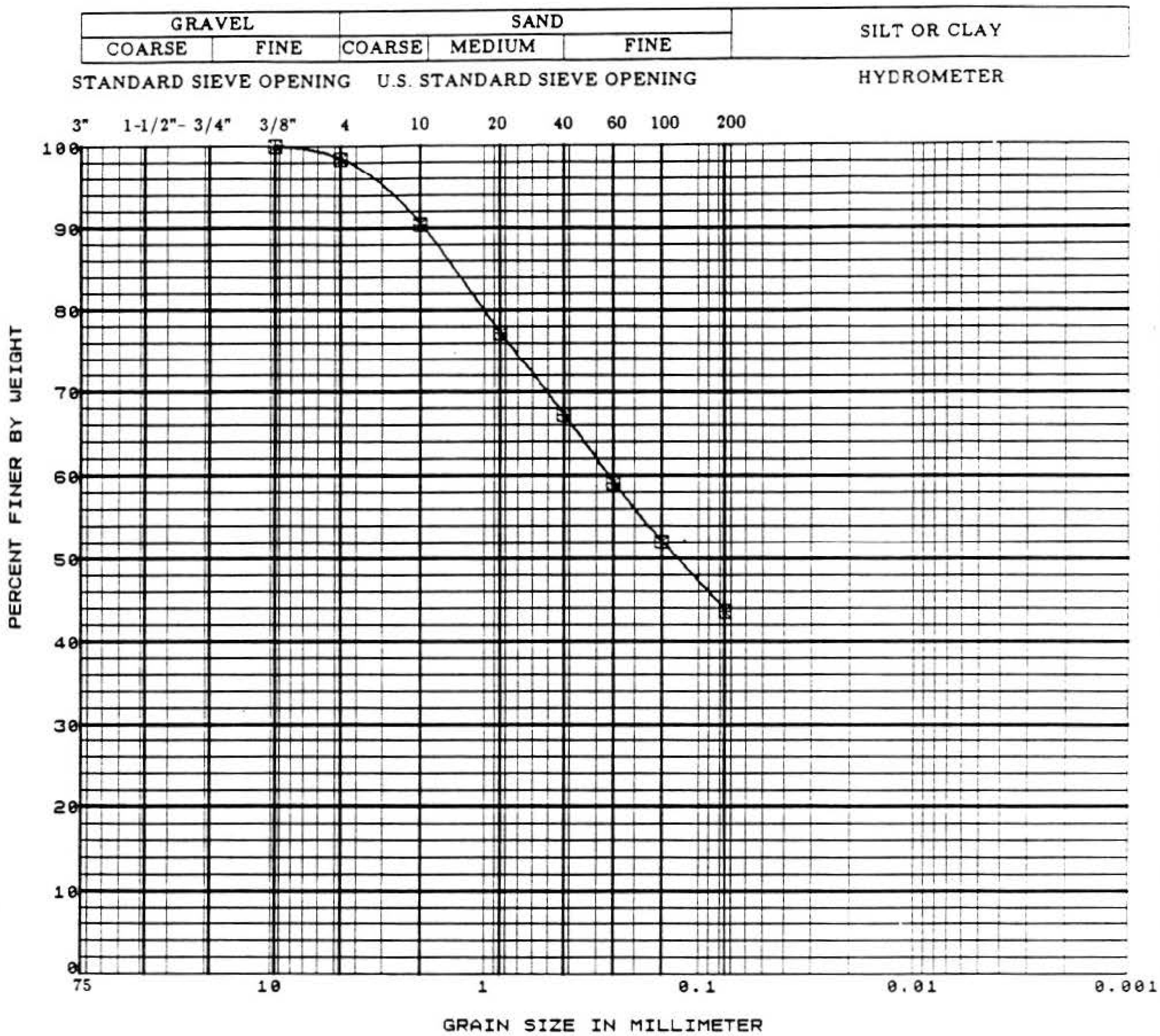
Figure B-1



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
⊠	PII-68	S - 9	45.0	SPT	CLAYEY SAND		

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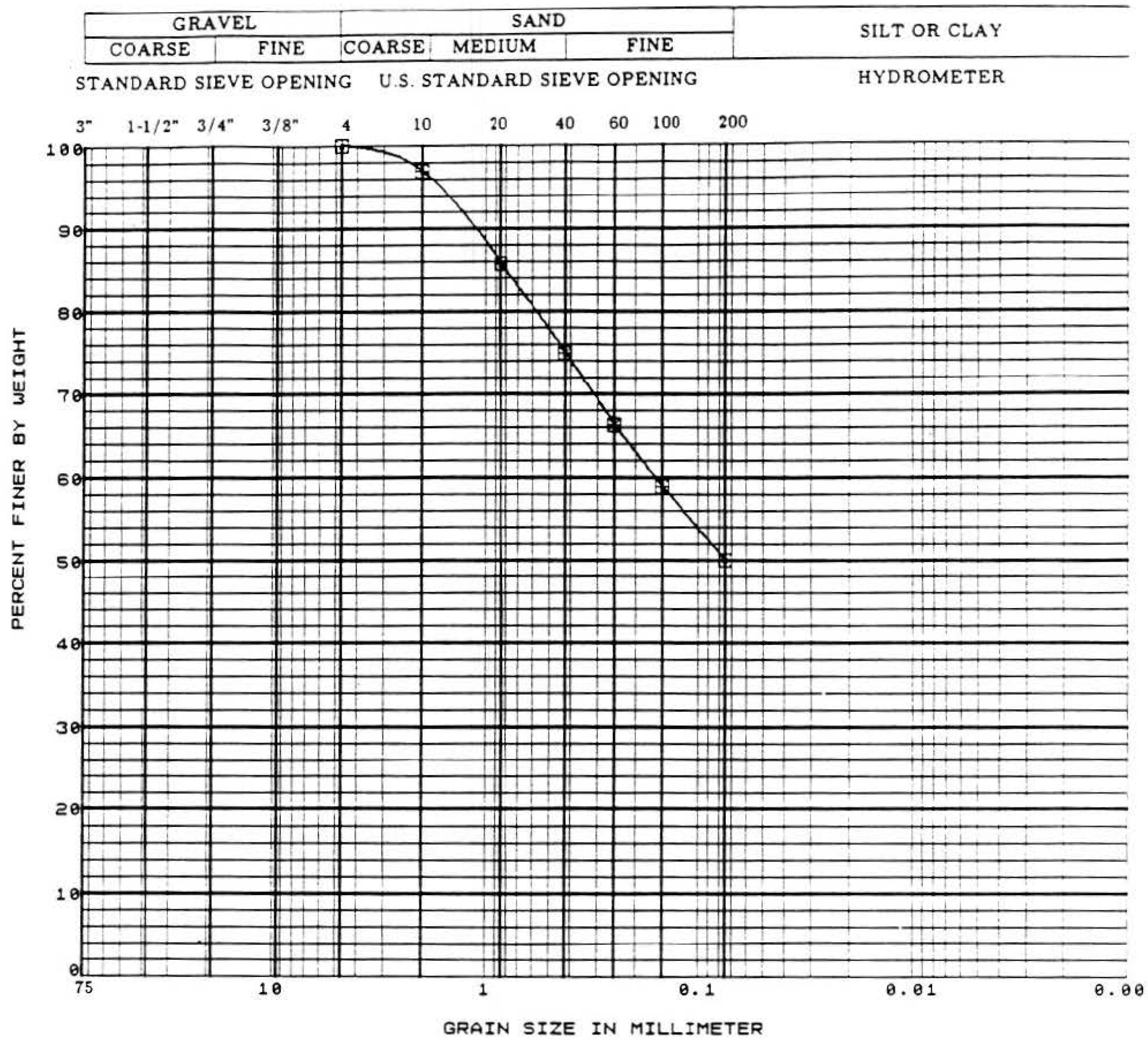
Figure B-2



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-68	D-14	70.0	DRIVE	Clayey Sand/Sandy Clay	45	27

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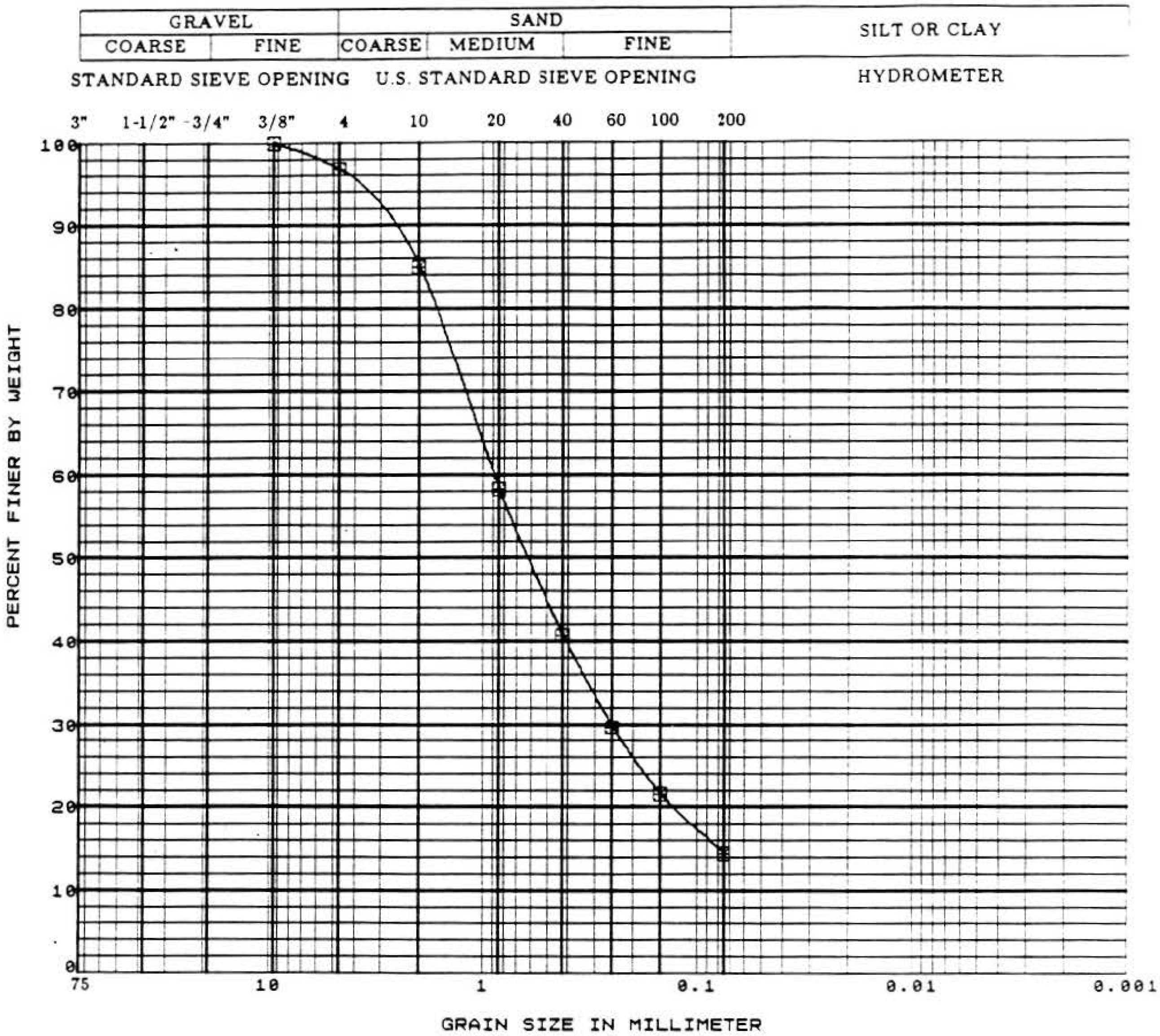
Figure B-3



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-69	S - 11	45.0	SPT	CLAYEY SAND	30	13

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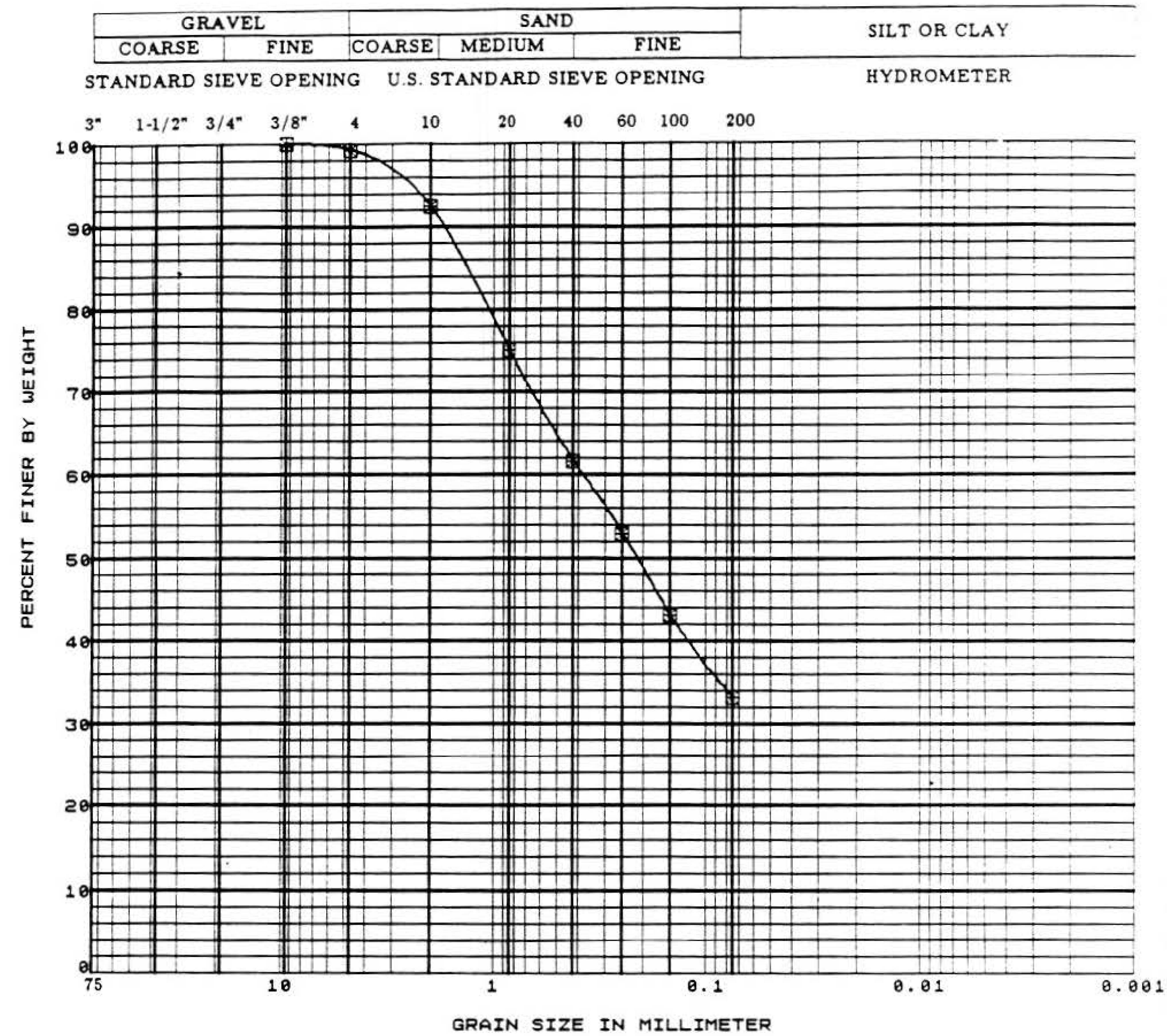
Figure B-4



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-69	D - 20	90.0	DRIVE	SILTY SAND		

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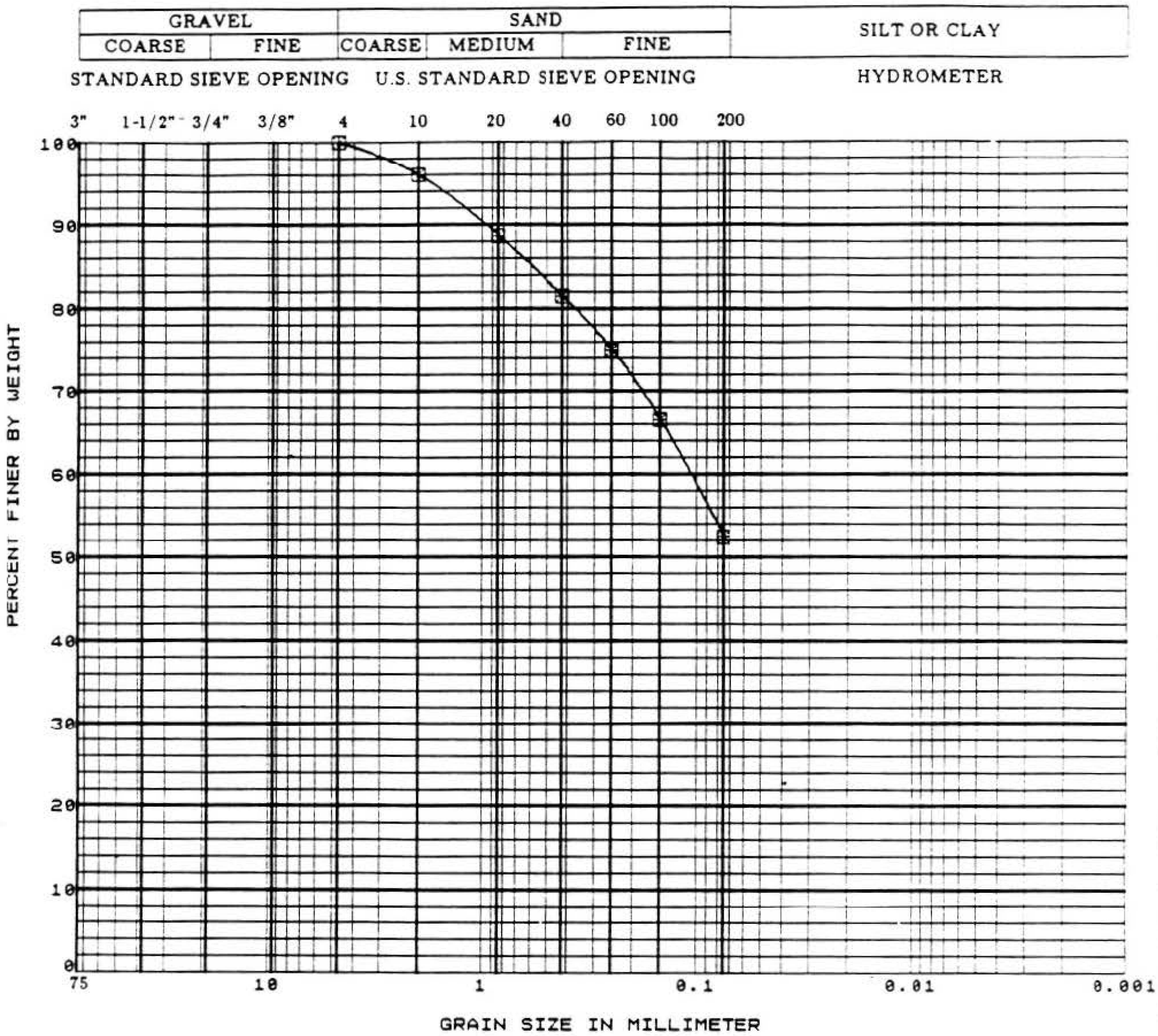
Figure B-5



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-70	D-4	10.0	DRIVE	SANDY CLAY	35	16

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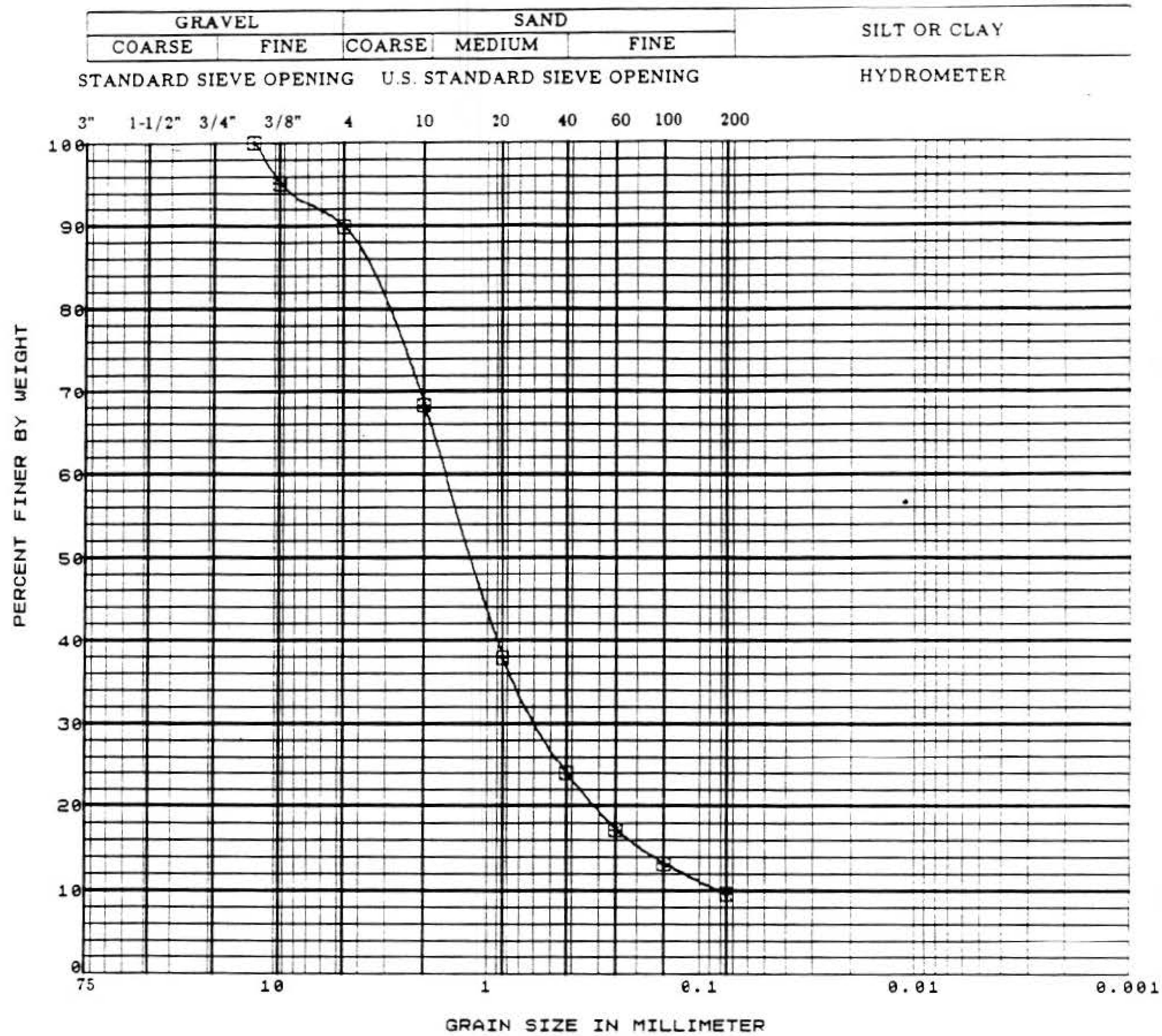
Figure B-6



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-70	D-6	20.0	DRIVE	SAND-SILTY SAND		

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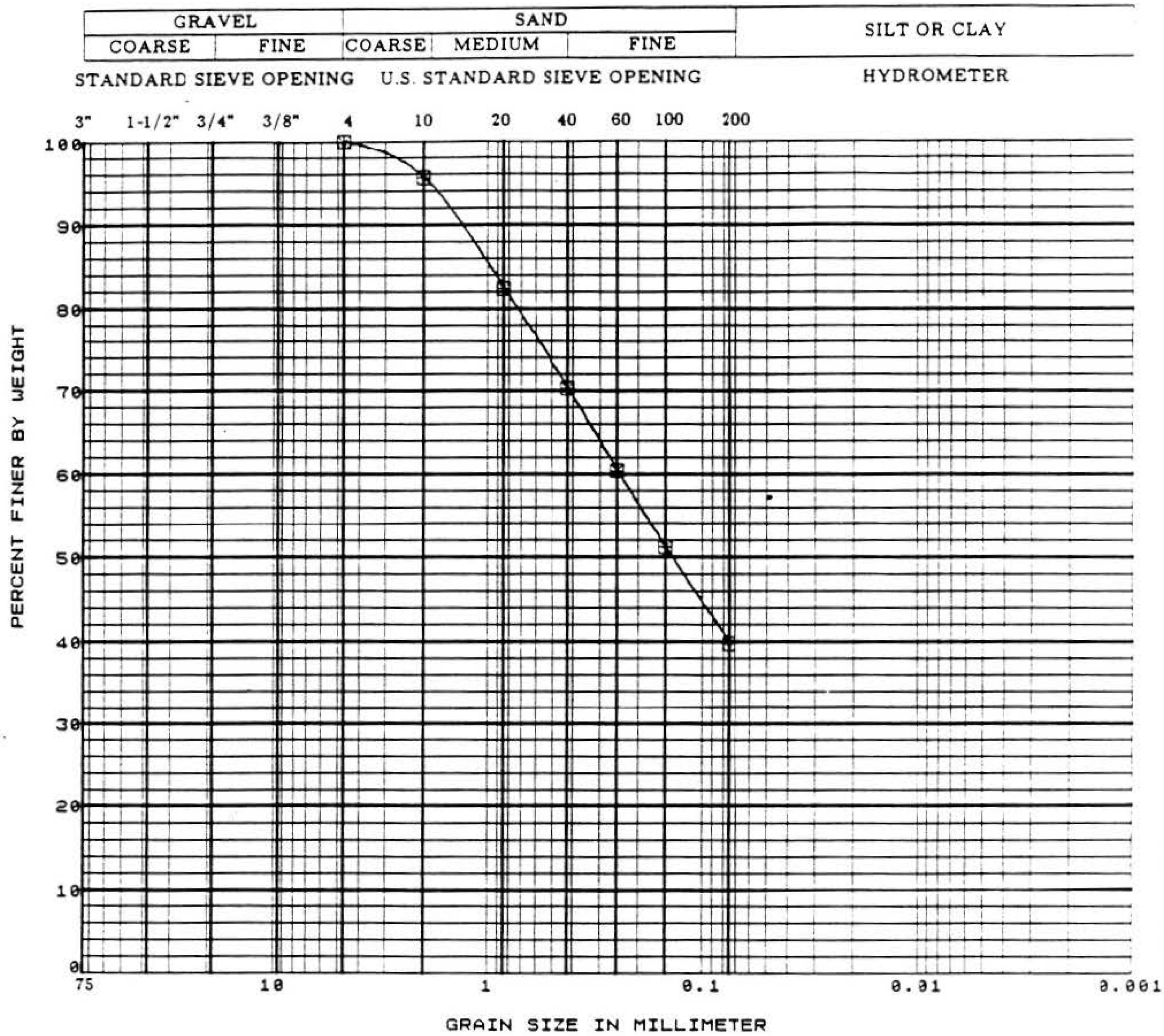
Figure B-7



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
⊠	PII-70	D-8	30.0	DRIVE	CLAYEY SAND	33	15

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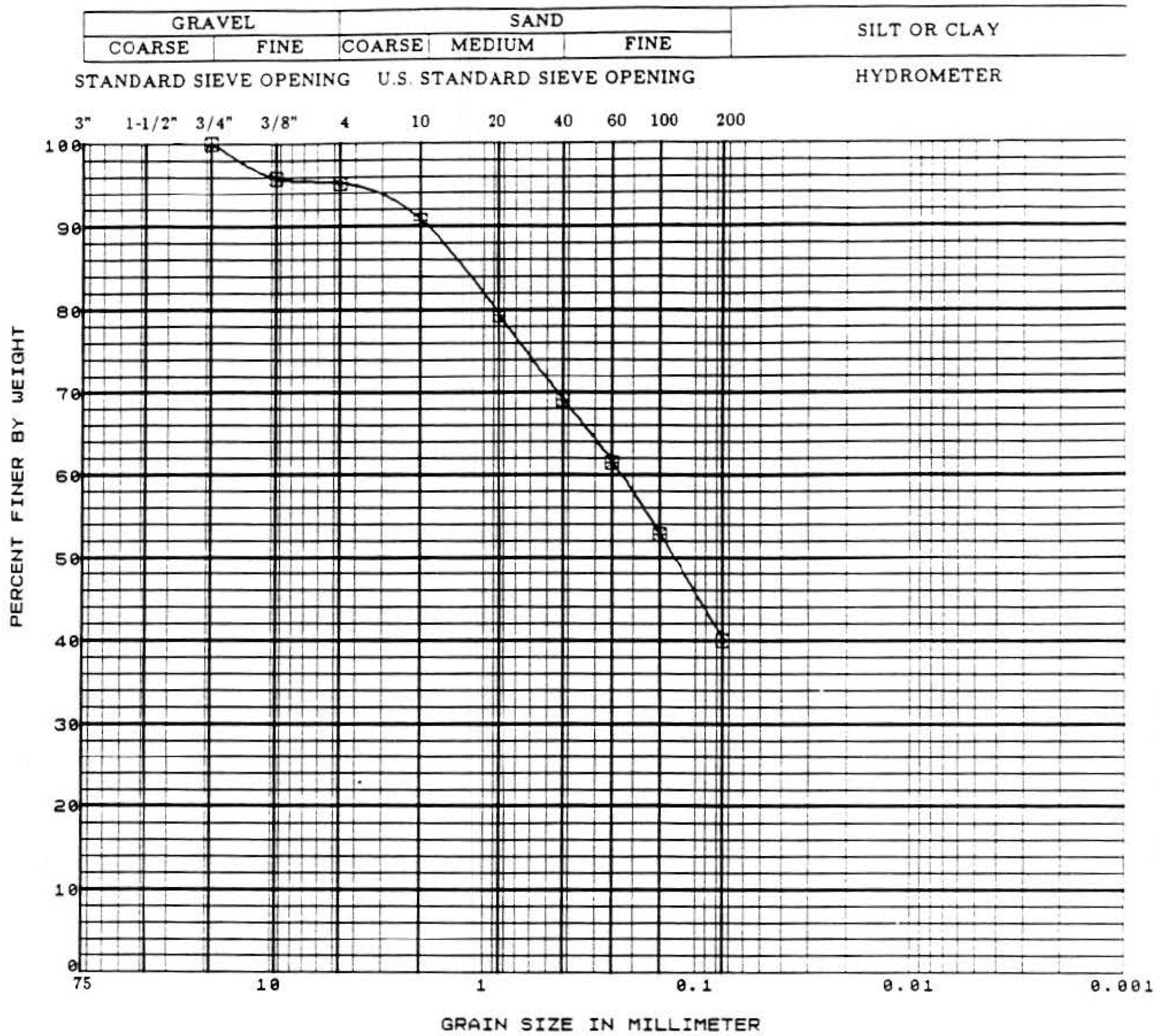
Figure B-8



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-70	D-18	80.0	DRIVE	CLAYEY SAND	43	23

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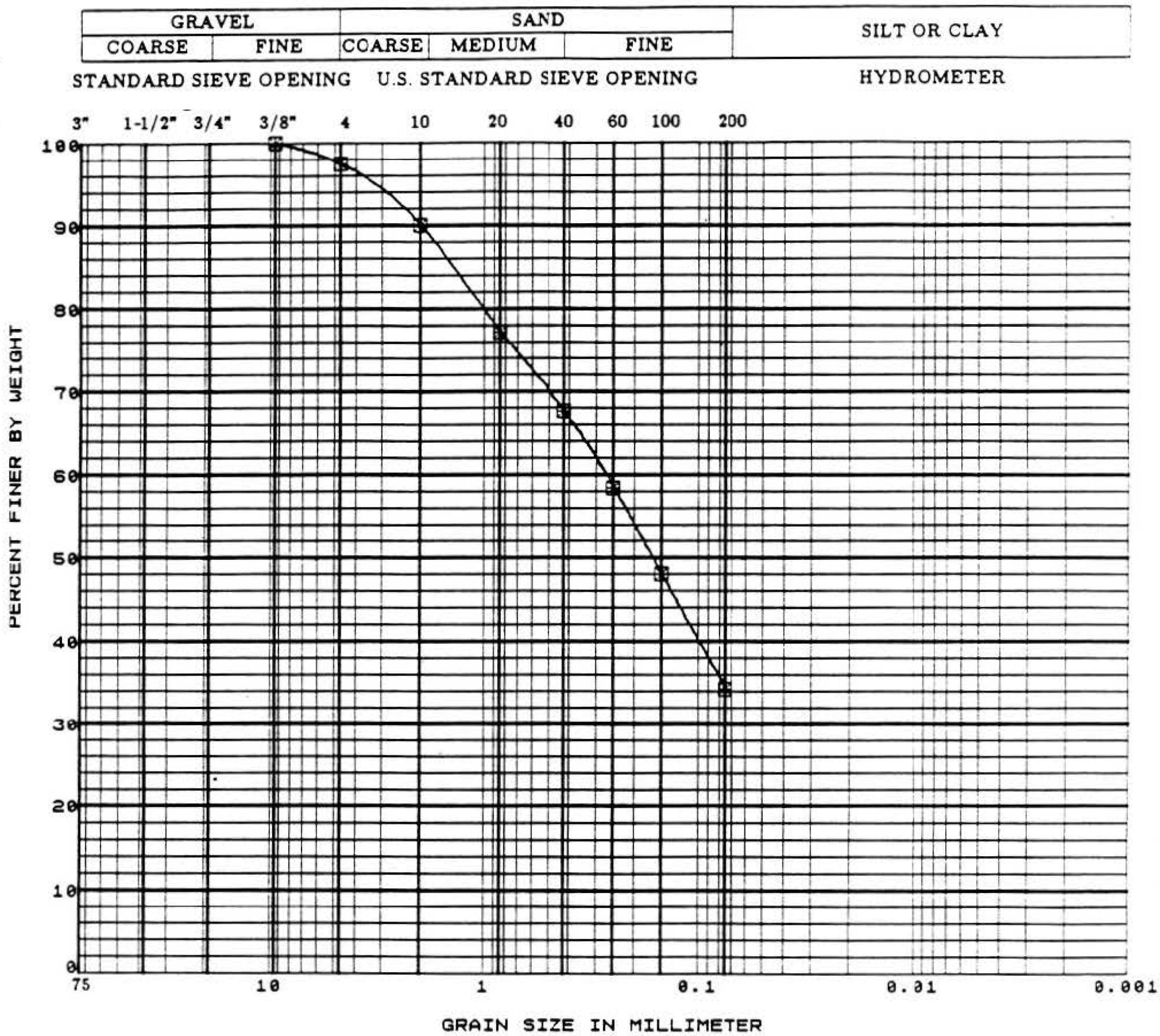
Figure B-9



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-70	D-20	90.0	DRIVE	SILTY SAND		

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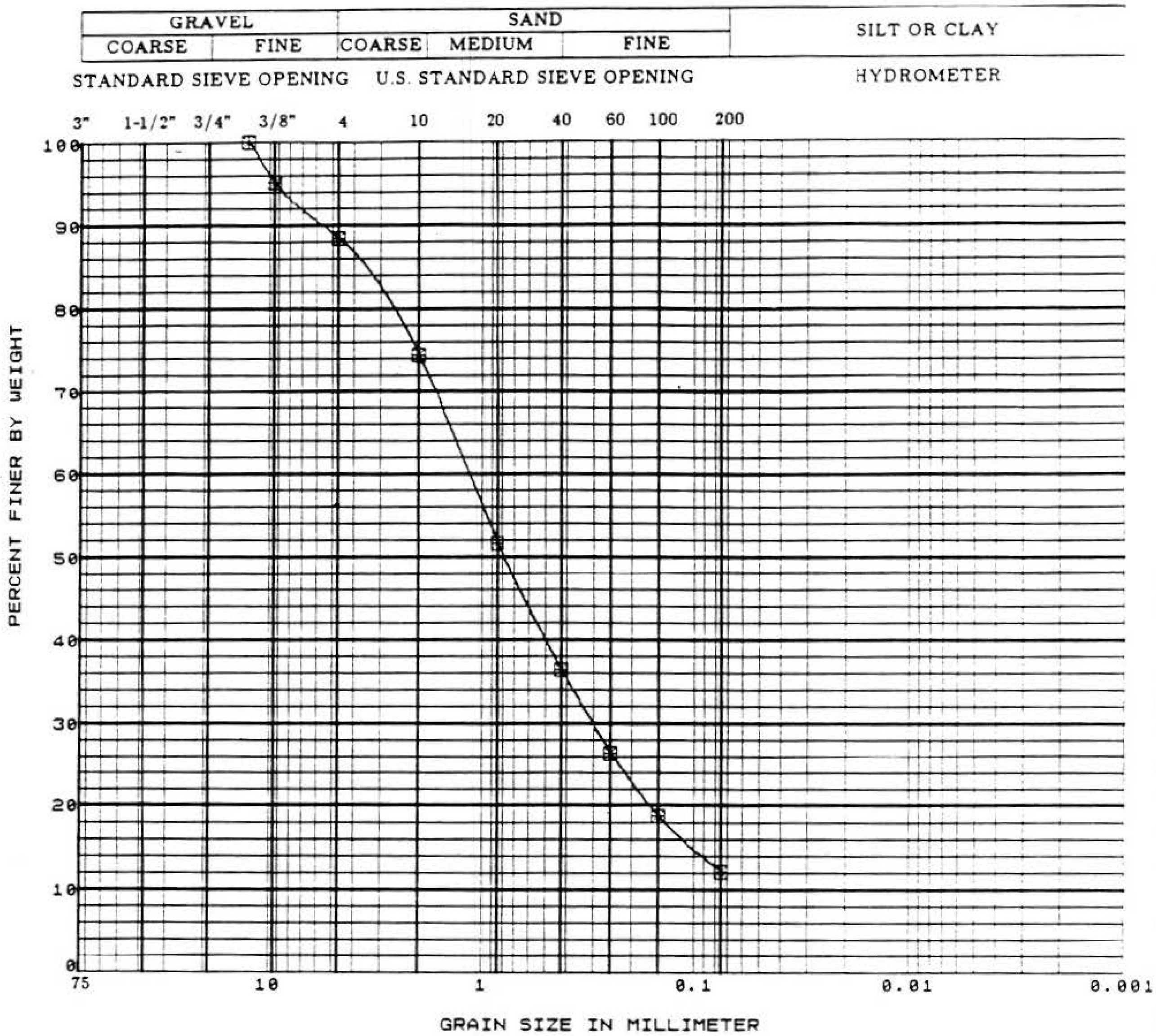
Figure B-10



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
⊠	PII-71	S - 8	35.0	SPT	SAND-SILTY SAND		

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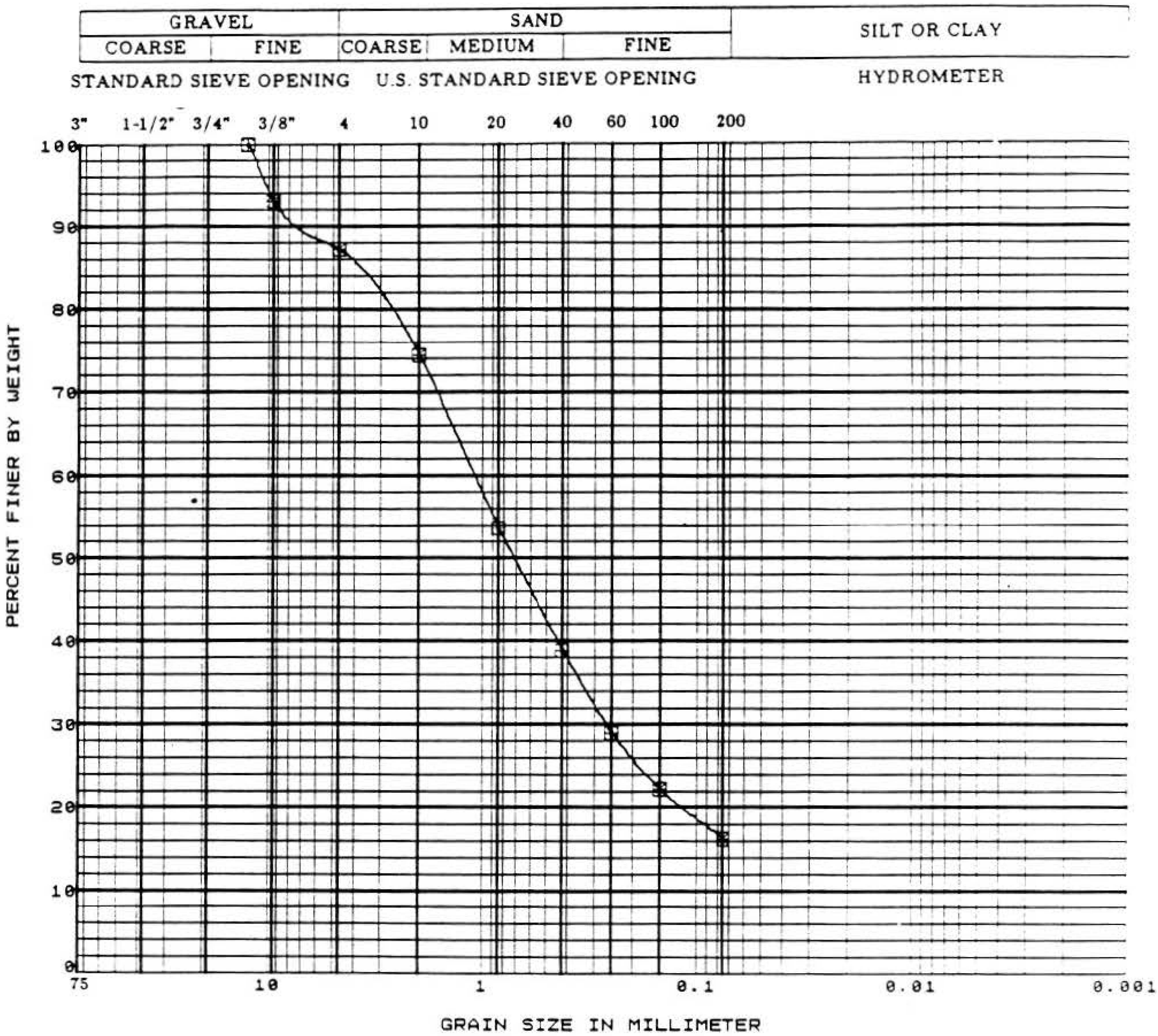
Figure B-11



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
⊠	PII-71	S - 10	45.0	SPT	CLAYEY SAND		

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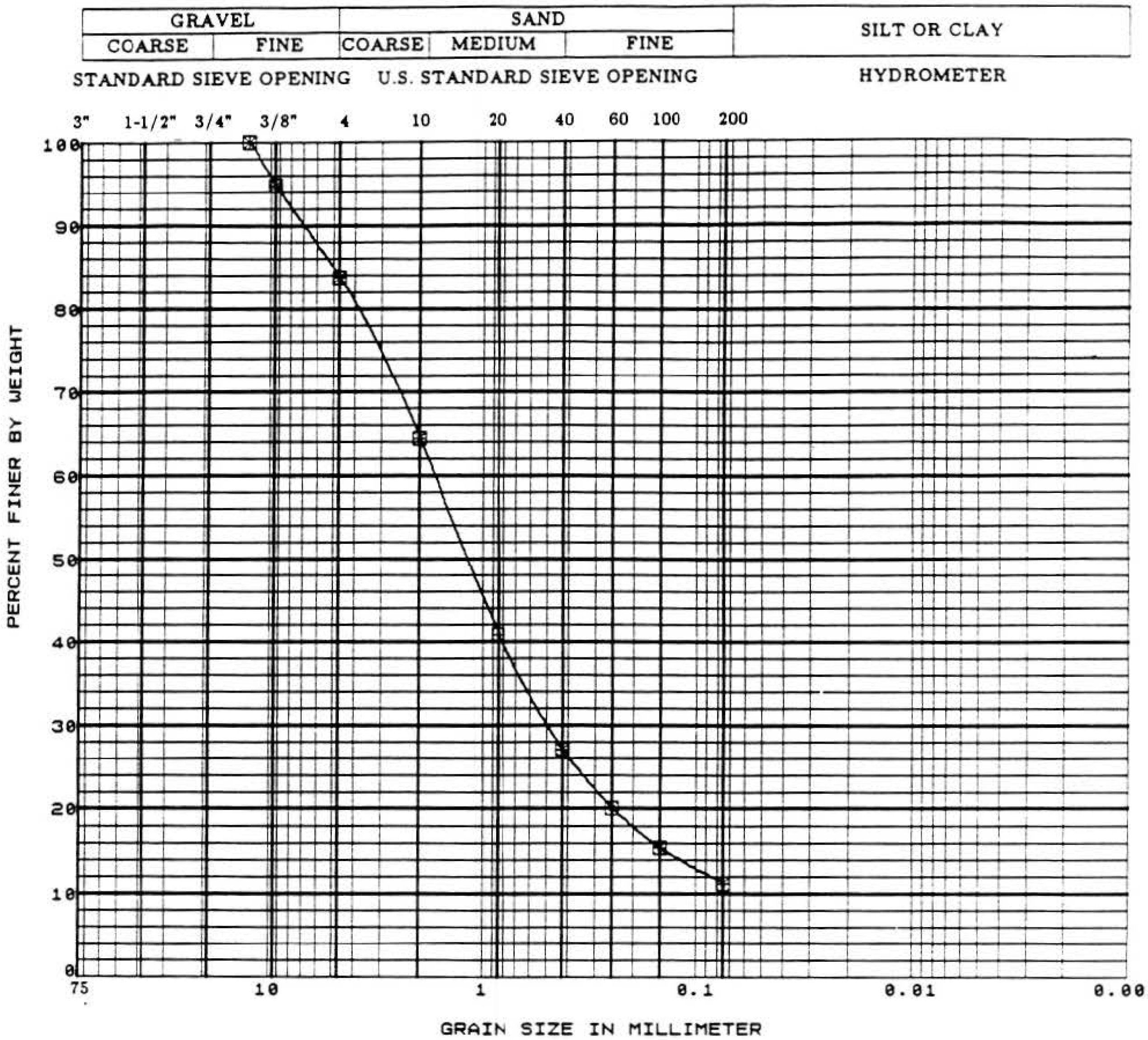
Figure B-12



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-71	S - 14	65.0	SPT	SAND-SILTY SAND		

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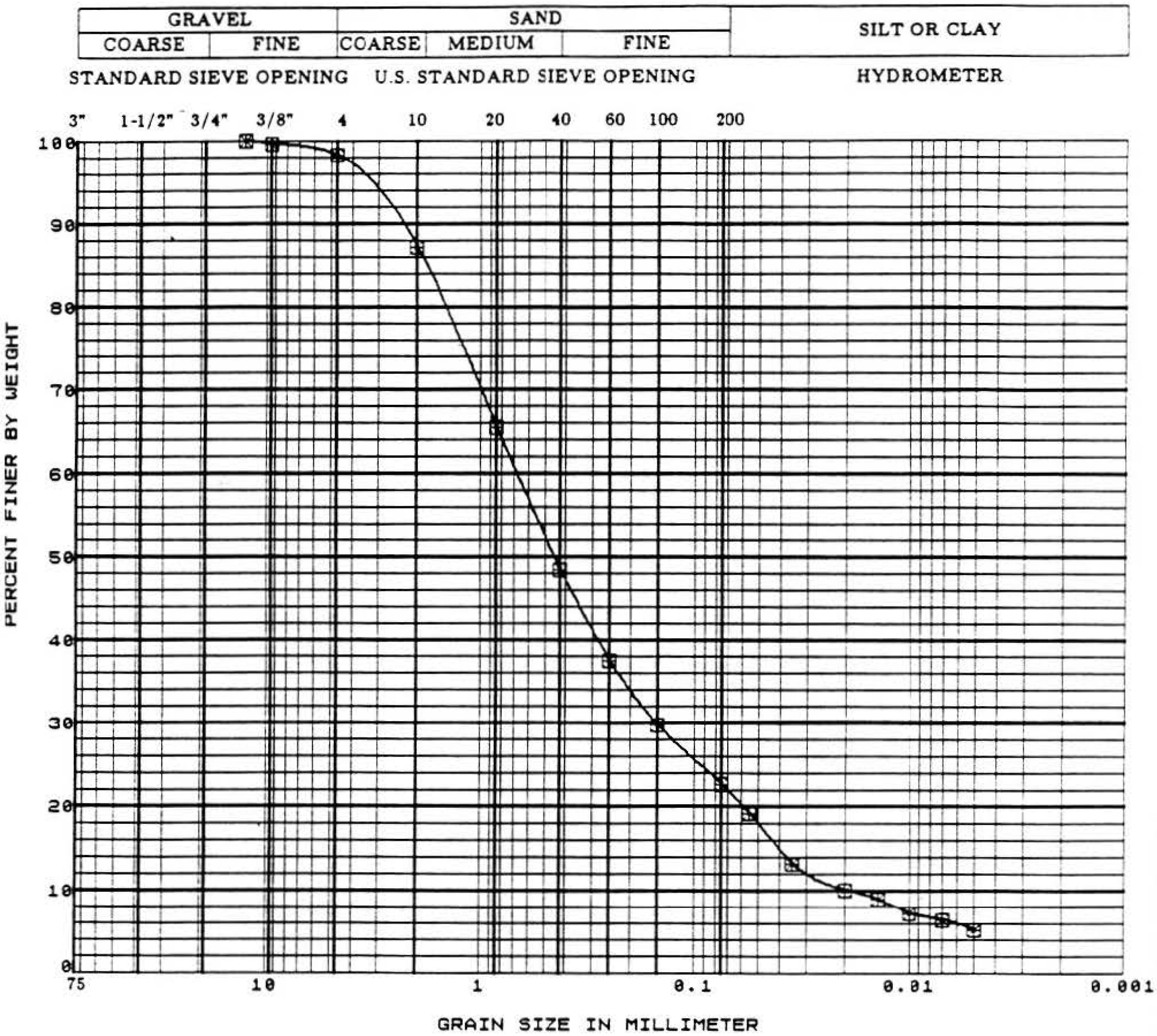
FIGURE B-13



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-71	S - 18	85.0	SPT	CLAYEY SAND		

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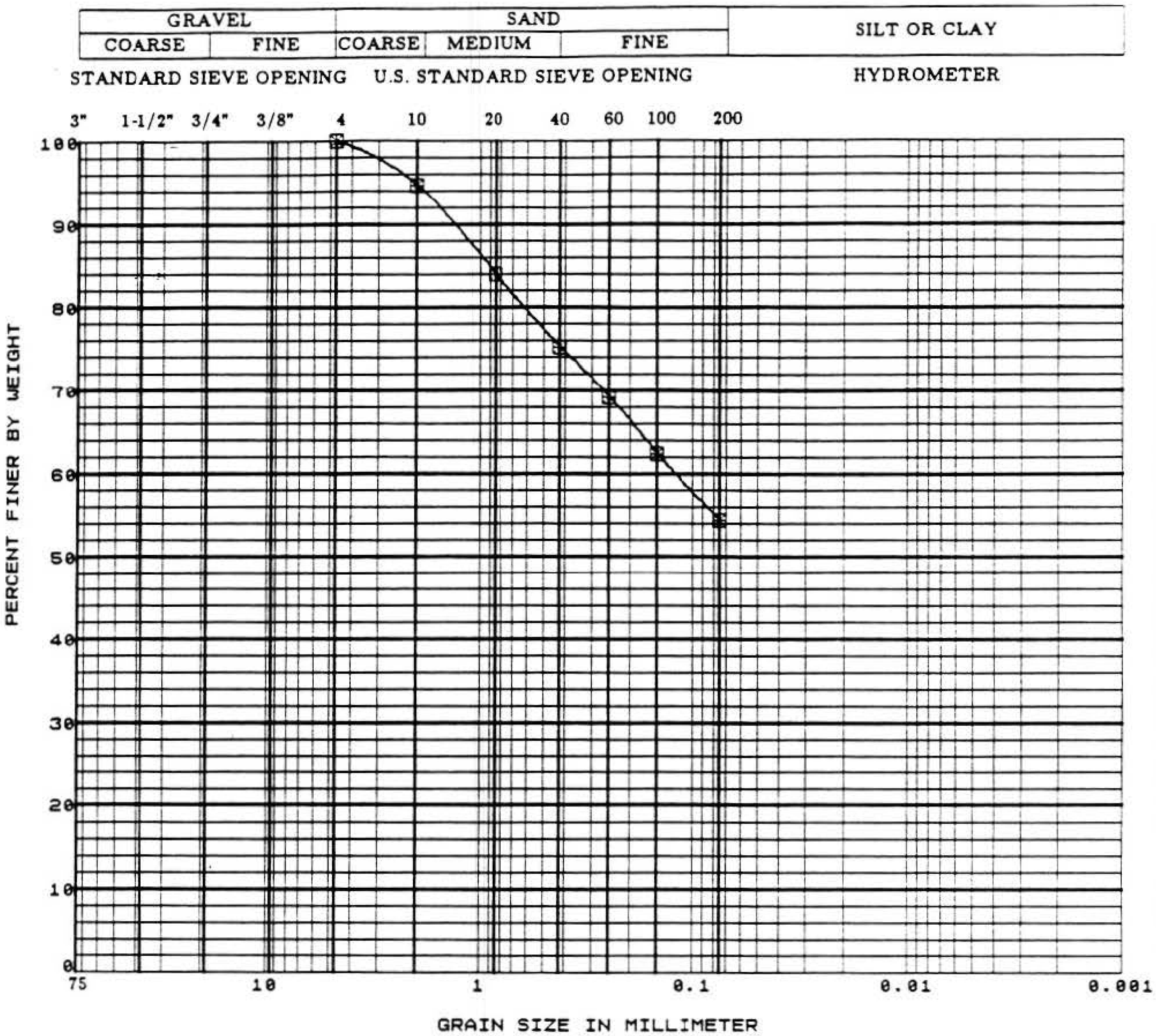
Grain Size Distribution Curve

6/90

FIGURE B-14



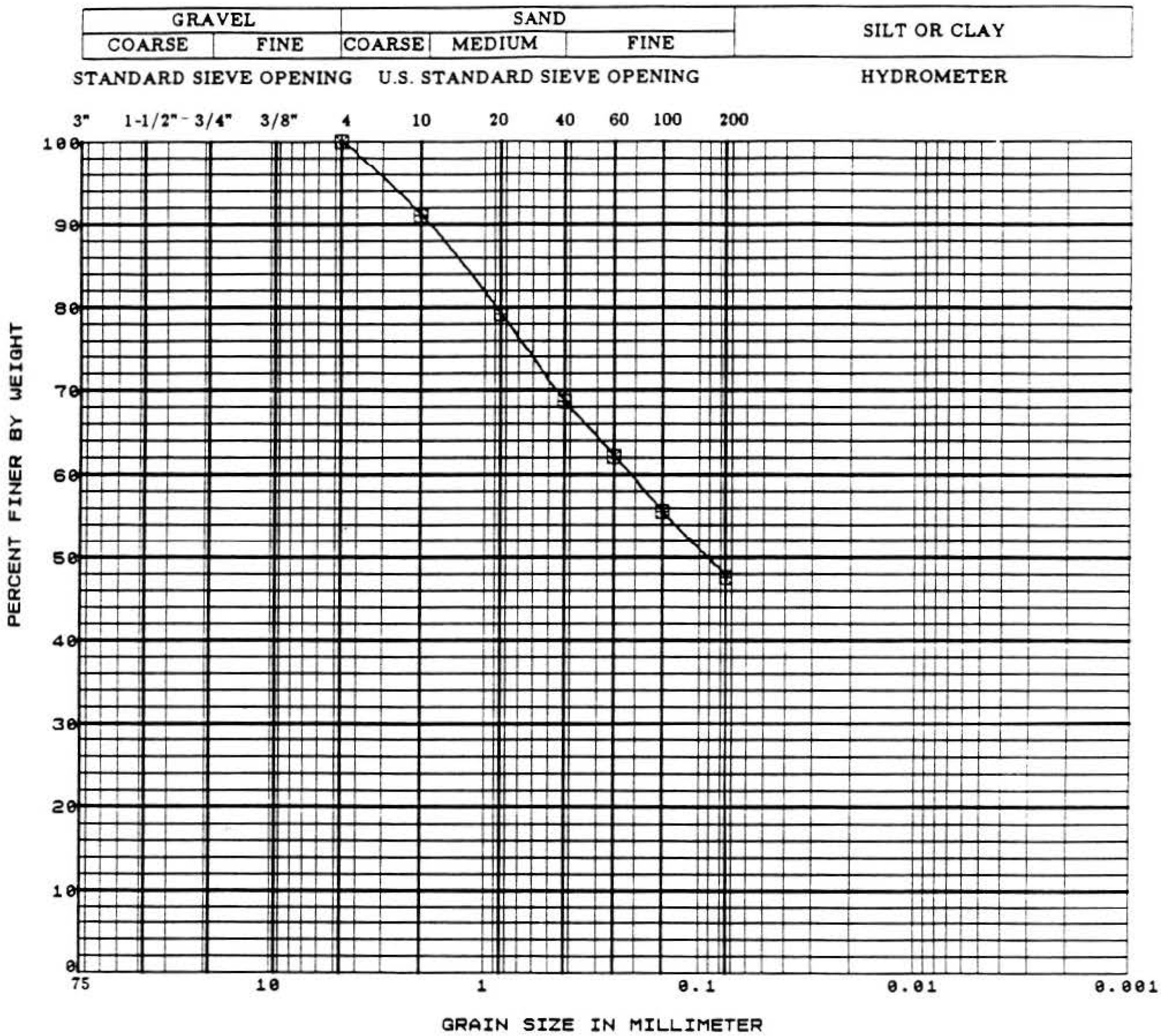
SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-72	D-11	50.0	DRIVE	SANDY CLAY		

The Earth Technology Corporation	PROJECT NO.: 89-409 Hollywood/Western Station

Grain Size Distribution Curve

6/90

FIGURE B-15



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-72	D-13	60.0	DRIVE	Clayey Sand/Sandy Clay		

The Earth Technology Corporation

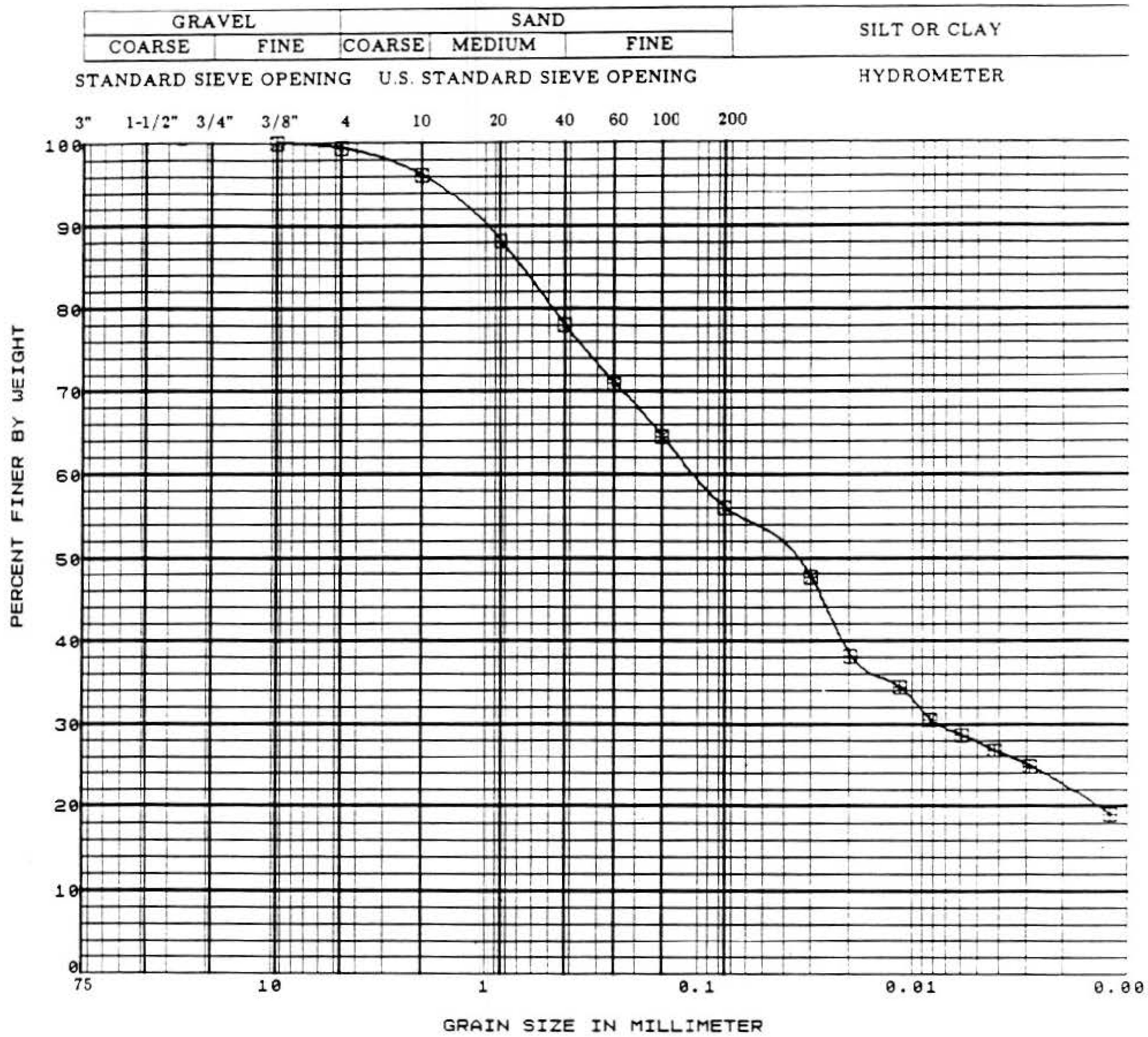
PROJECT NO.: 89-409

Hollywood/Western Station

Grain Size Distribution Curve

6/90

FIGURE B-16



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
⊠	PII-72	S - 14	65.0	SPT	Sandy Silt/Sandy Clay		

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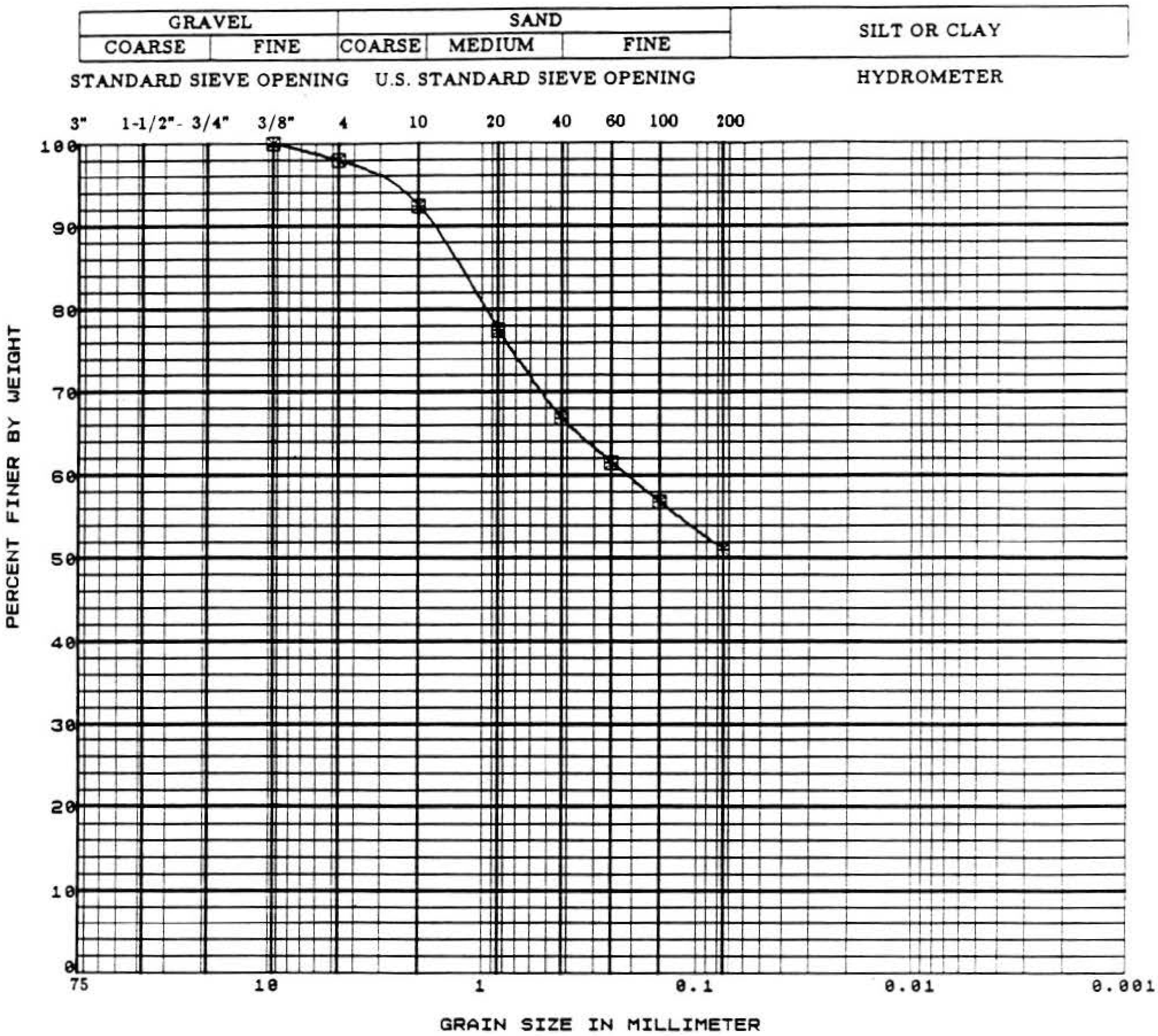
Hollywood / Western Station

Grain Size Distribution Curve

06-90

Figure B-17



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTICITY INDEX
⊠	PII-72	D-15	70.0	DRIVE	Clayey Sand/Sandy Clay		

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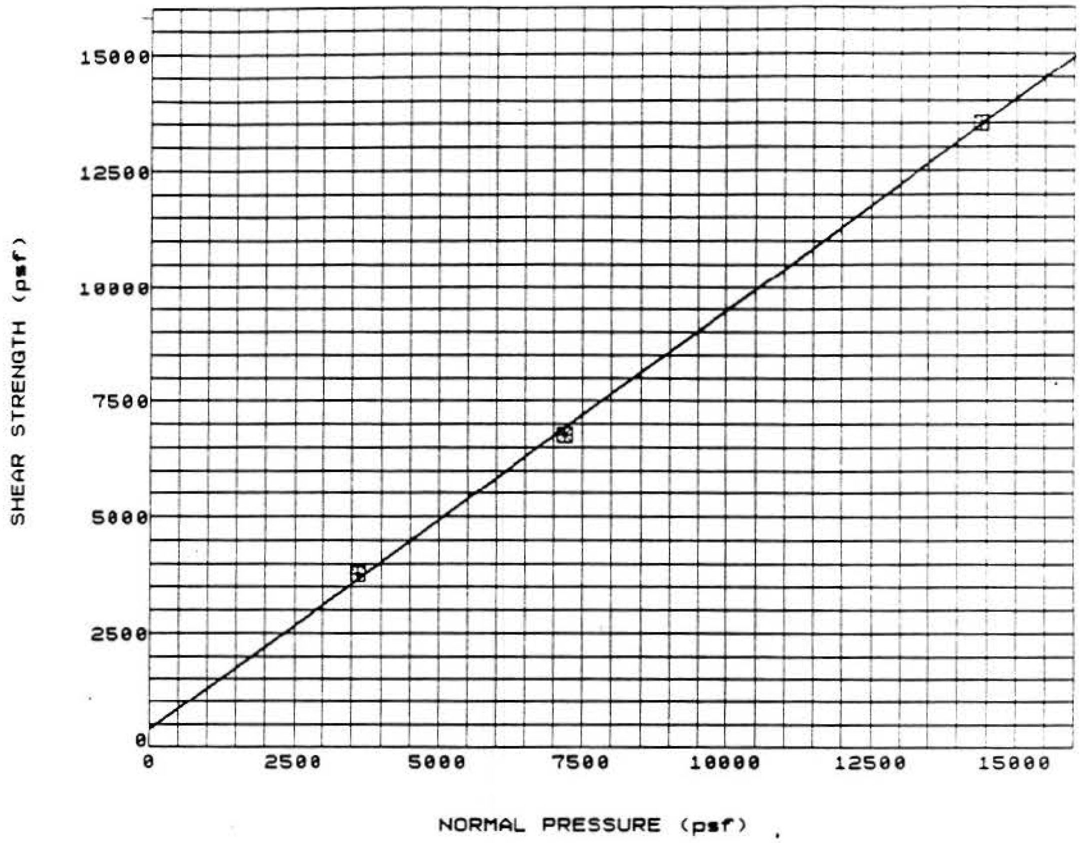
Hollywood / Western Station

Grain Size Distribution Curve

06-90

Figure B-18



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	COHESION C (psf)	FRICTION ANGLE (degree)
⊠	PII-69	D-14	60.0	DRIVE	SILTY SAND	385	42

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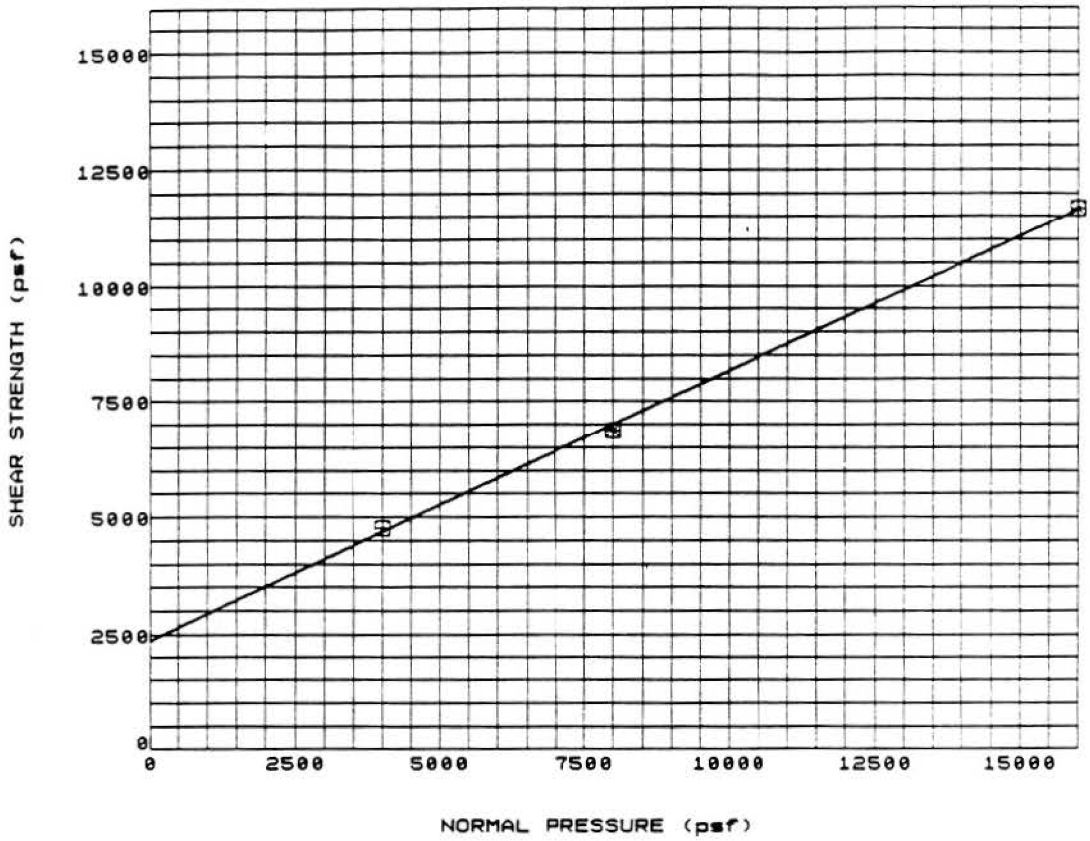
Hollywood / Western Station

Direct Shear Test Results

06-90

Figure B-19



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	COHESION C (psf)	FRICTION ANGLE (degree)
⊠	PII-69	D-16	70.0	DRIVE	CLAYEY SAND	2355	30

The Earth Technology Corporation

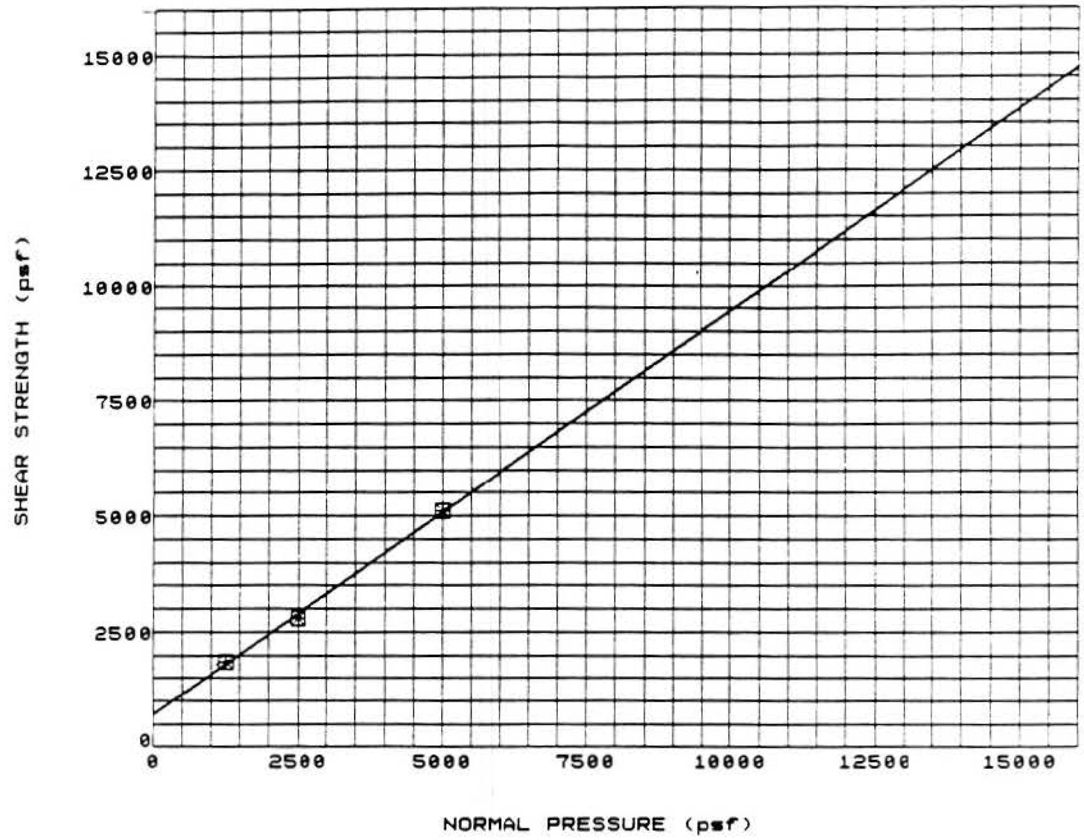
PROJECT NO.: 89-409

Hollywood / Western Station

Direct Shear Test Results

06-90

Figure B-20



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	COHESION C (psf)	FRICTION ANGLE (degree)
⊠	PII-70	D-6	20.0	DRIVE	SAND-SILTY SAND	695	41

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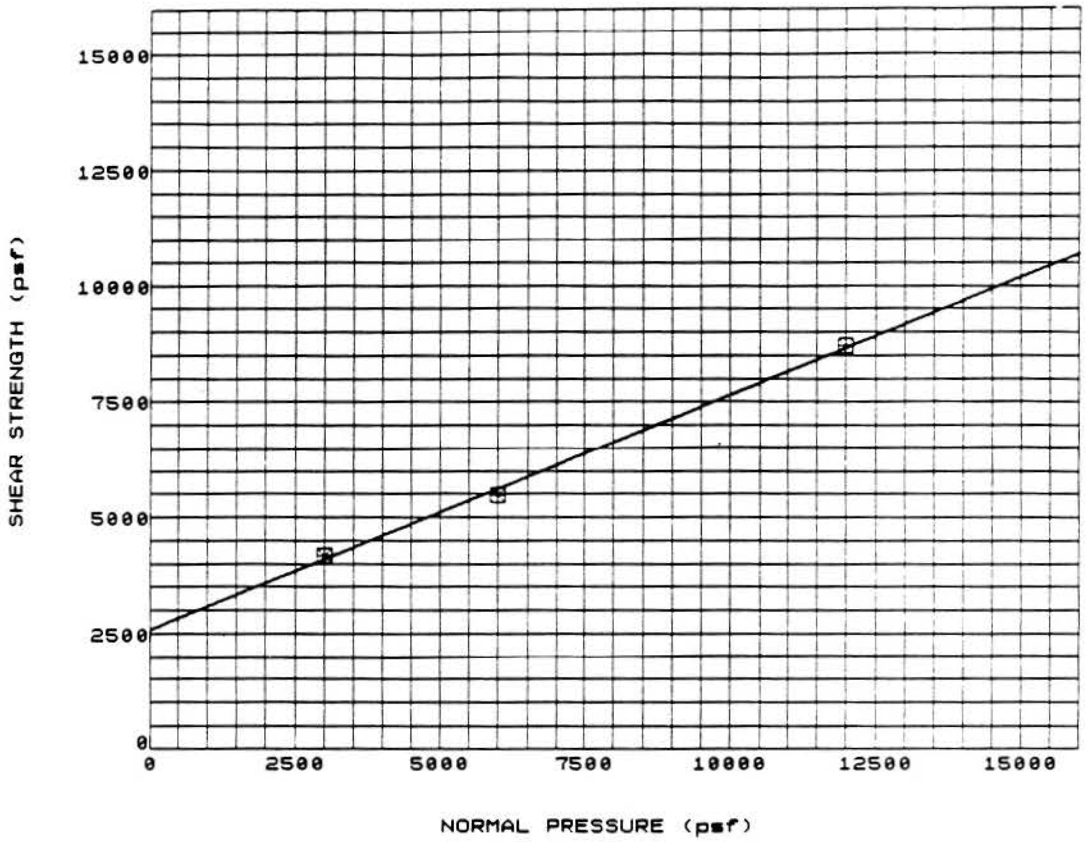
PROJECT NO.: 89-409

Hollywood / Western Station

Direct Shear Test Results

06-90

Figure B-21



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	COHESION C (psf)	FRICTION ANGLE (degree)
⊠	PII-70	D-12	50.0	DRIVE	SILTY SAND	2565	27

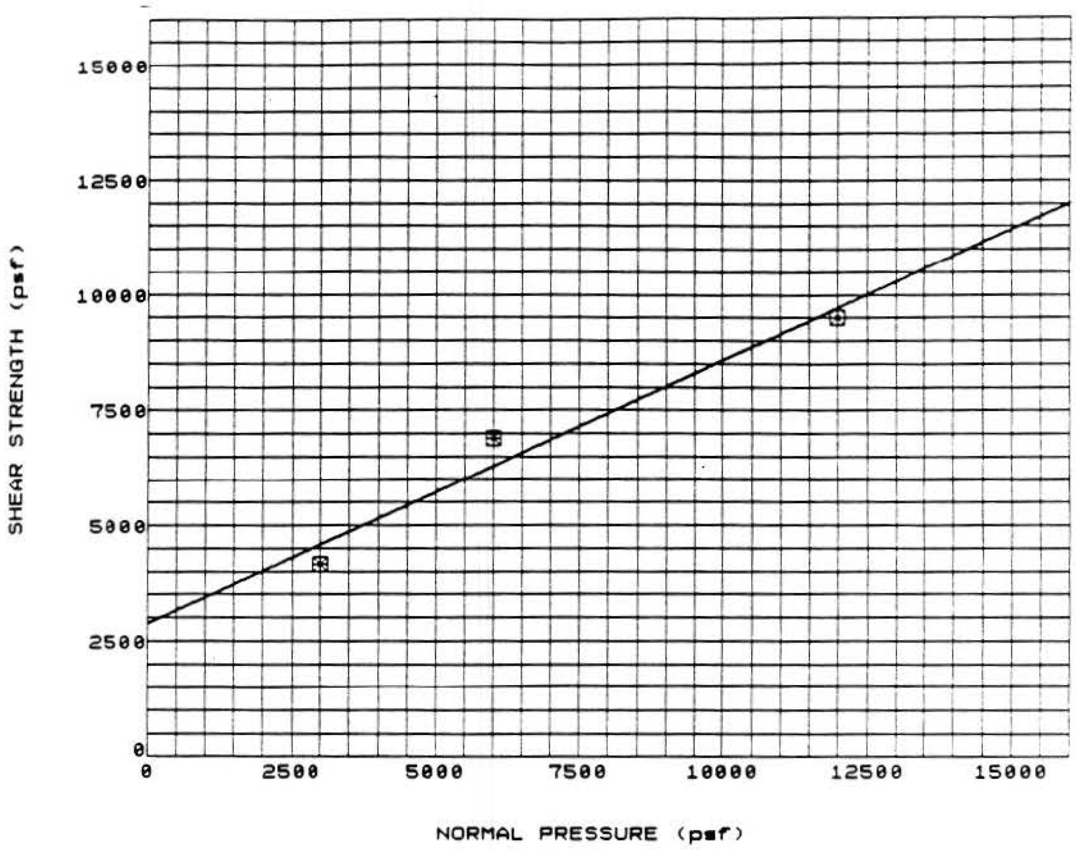
The Earth Technology Corporation

PROJECT NO.: 89-409
Hollywood / Western Station

Direct Shear Test Results

06-90

Figure B-22



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	COHESION C (psf)	FRICTION ANGLE (degree)
⊠	PII-72	D-11	50.0	DRIVE	SANDY CLAY	2855	30

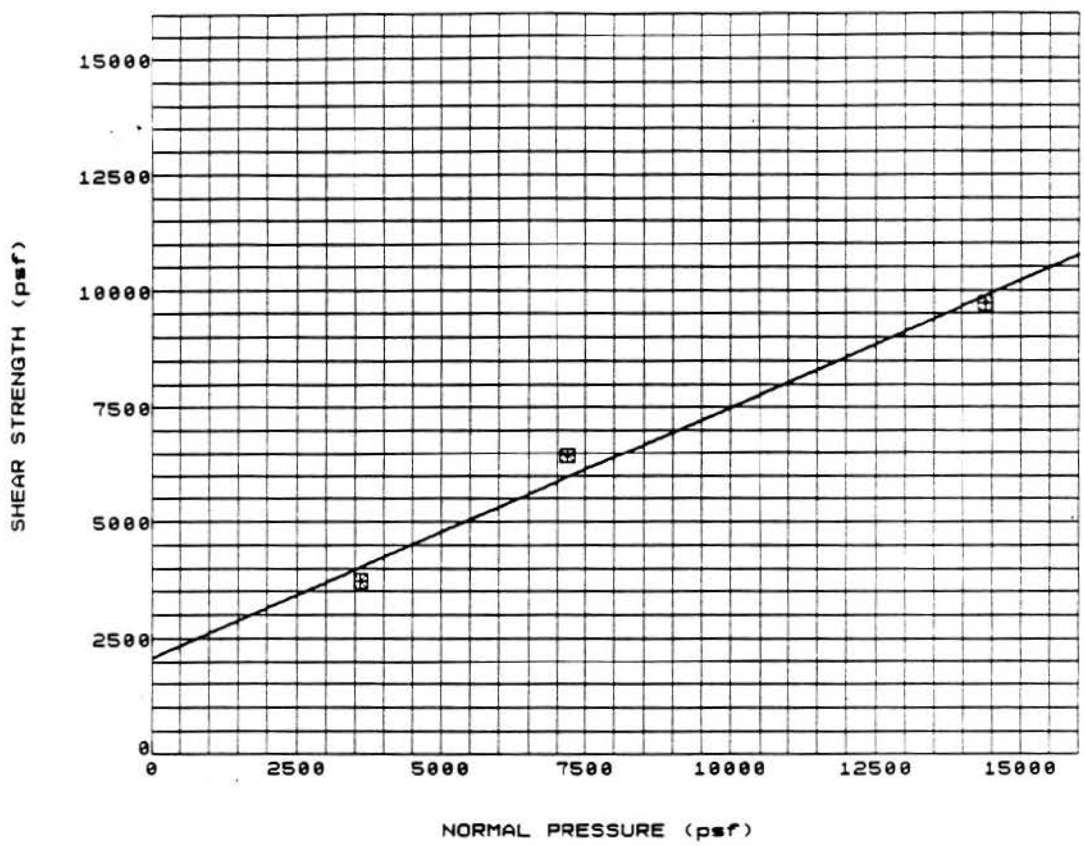
The Earth Technology Corporation

PROJECT NO.: 89-409
Hollywood / Western Station

Direct Shear Test Results

06-90

Figure B-23



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	COHESION C (psf)	FRICTION ANGLE (degree)
⊠	PII-72	D-13	60.0	DRIVE	Clayey Sand/Sandy Clay	2080	28

The Earth Technology Corporation

PROJECT NO.: 89-409
Hollywood / Western Station

Direct Shear Test Results

06-90

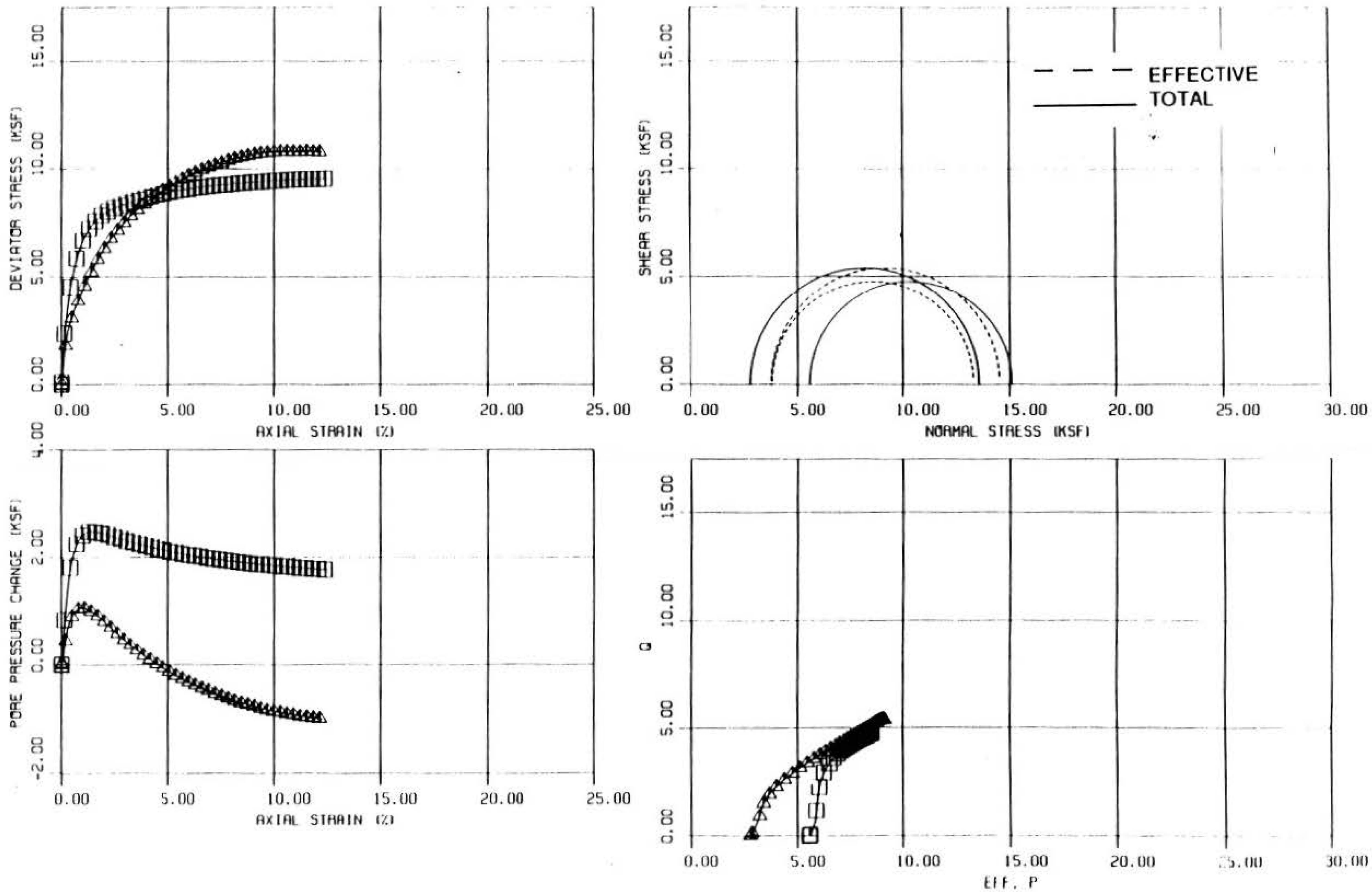
Figure B-24

PROJECT: Hollywood / Western Station
PROJECT NO.: 89-409
DATE: 06-90

The Earth Technology Corporation

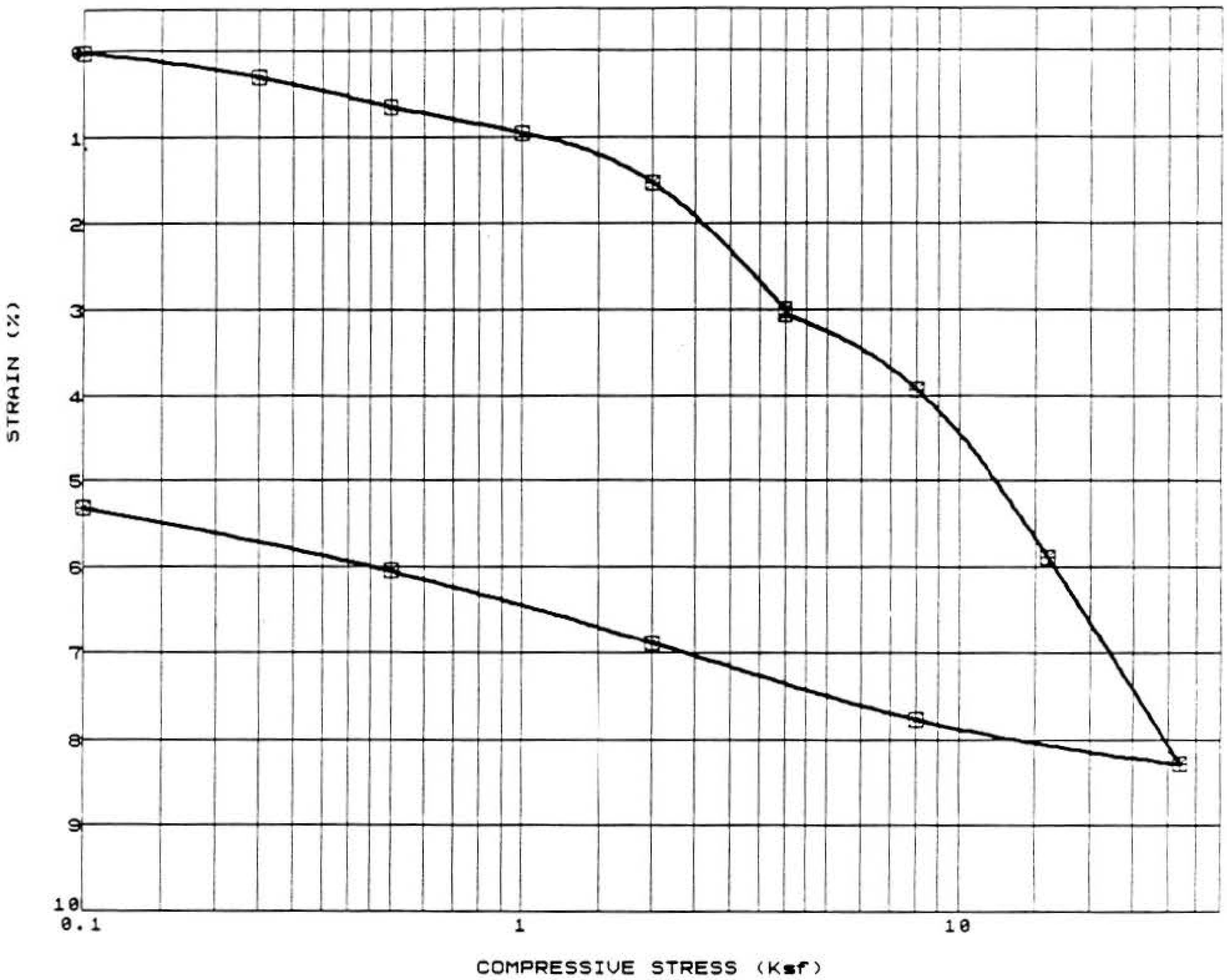
TRIAXIAL TEST RESULTS

TEST TYPE: CIU



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	EFF. CONF. PRESSURE (KSF)	MAX DEV. STRESS (KSF)	STRAIN RATE (%/HR)	BACK PRESSURE (KSF)
□	PII-68	P-11	55-57.5	Pitcher	Silty Sand	109.3	15.6	5.8	9.5	10.000	8.8
▲	PII-68	P-11	55-57.5	Pitcher	Silty Sand	109.5	15.6	2.8	10.8	10.000	8.8

Figure B-25



SYMBOL	BORING NO.	SAMPLE NO	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	Cc	Cr	REMARKS
⊠	PII-69	D- 16	70.00	DRIVE	Clayey Sand	7.9	0.8	Coefficients Strain Related

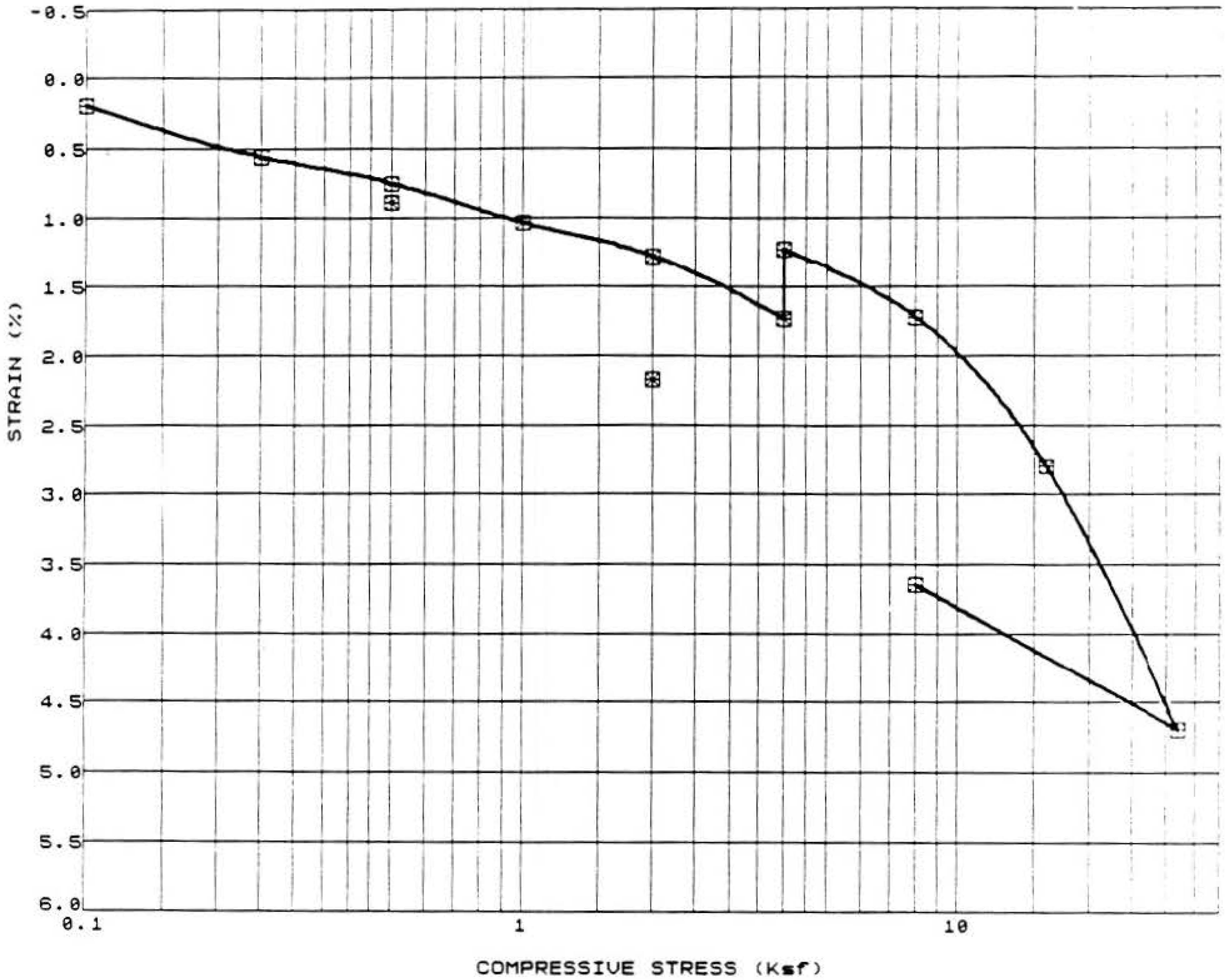
The Earth Technology Corporation

PROJECT NO.: 89-409
Hollywood / Western Station

Consolidation Test Results

06-90

Figure B-26



SYMBOL	BORING NO.	SAMPLE NO	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	Cc	Cr	REMARKS
⊠	PII-70	D-14	60.00	DRIVE	Sandy Clay/ Clayey Sand	6.5	1.7	Coefficients Strain Related

The Earth Technology Corporation

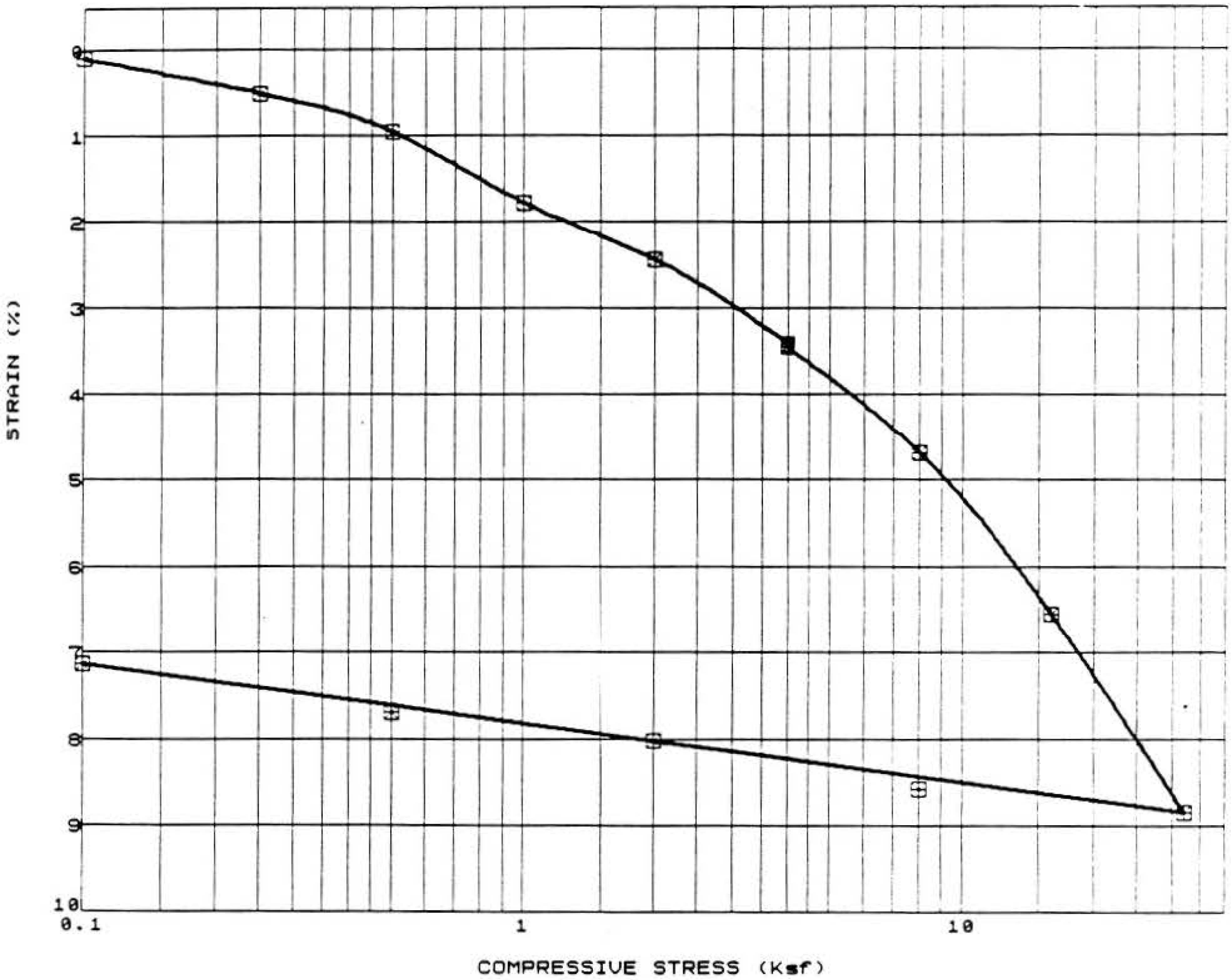
PROJECT NO. 89-409

Hollywood / Western Station

Consolidation Test Results

06-90

Figure B-27



SYMBOL	BORING NO.	SAMPLE NO	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	Cc	Cr	REMARKS
⊠	PII-72	D-13	60.00	DRIVE	Clayey Sand/ Sandy Clay	8.0	0.7	Coefficients Strain Related

The Earth Technology Corporation

PROJECT NO.: 89-409
Metro Rail
Phase II

Consolidation Test Results

06-90

Figure B-28

Appendix C

Chemical Laboratory Test Results

APPENDIX C

CHEMICAL LABORATORY TEST RESULTS

A total of five soil samples were selected and transported to CKY Environmental Services, Inc. of Torrance, California, for a limited characterization of potential chemical contamination. The results presented in their reports are included in this Appendix.

C K Y incorporated
Environmental Services

Date: 07/21/89
890705

Earth Technology Corporation
3777 Long Beach Blvd.
Long Beach, CA 90807-3309

Attn: Mr. Mahi Galagoda

Subject: Laboratory Report
Project: Metro Rail/89-409-0009

Enclosed is the laboratory report for samples received on 07/07/89. The samples were received in coolers with ice and intact; the chain-of-custody forms were properly filled out. The data reported includes:

Method	No. of Analysis
EPA 418.1 (TRPH)	10 Soils
EPA 8020 (BTEX)	10 Soils
EPA 9038 (Sulfate)	10 Soils
EPA 9030 (Sulfide)	10 Soils
EPA 8240	1 Soil
EPA 8270	1 Soil
CAM Metals	1 Soil

The results are summarized on eleven pages.

Please feel free to call if you have any questions concerning these results.

Sincerely,

Dr. Kam Pang
Laboratory Director

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

CLIENT:	Earth Technology	**DATE REC'D:**	07/07/89
PROJECT:	Metro Rail	**DATE EXTRACTED:**	07/07/89
CONTROL NO:	890705	**DATE ANALYZED:**	07/10/89
MATRIX TYPE:	Soil		

SAMPLE ID:	CONTROL NO:	RESULTS (mg/kg)	DETECTION LIMIT (mg/kg)
PII-69 D-6	890705-1	ND	5
PII-69 D-14	890705-2	ND	5
PII-70 D-16A	890705-3	ND	5
PII-72 D7A	890705-4	ND	5
PII-72B D-13	890705-5	ND	5
PII-86 D-14	890705-6	ND	5
PII-86 D-6	890705-7	ND	5
PII-88 D-6	890705-8	ND	5
PII-105 D-15	890705-9	ND	5
PII-105A D-7	890705-10	ND	5

EPA METHOD - 8020
BTEX

CLIENT:	Earth Technology	**DATE REC'D:**	07/07/89
PROJECT:	Metro Rail	**DATE EXTRACTED:**	07/13/89
CONTROL NO:	890705	**DATE ANALYZED:**	07/13/89
MATRIX TYPE:	Soil		

		RESULTS (ug/kg)			
SAMPLE ID:	CONTROL NO:	Benz	Toluene	Et Benz	Xyls
PII-69 D-6	890705-1	ND	ND	ND	ND
PII-69 D-14	890705-2	ND	ND	ND	ND
PII-70 D-16A	890705-3	ND	ND	ND	ND
PII-72 D7A	890705-4	ND	ND	ND	ND
PII-72B D-13	890705-5	ND	ND	ND	ND
PII-86 D-14	890705-6	ND	ND	ND	ND
PII-86 D-6	890705-7	ND	14	ND	12
PII-88 D-6	890705-8	ND	6.4	ND	6.4
PII-105 D-15	890705-9	ND	ND	ND	ND
PII-105A D-7	890705-10	ND	ND	ND	ND
DETECTION LIMIT		5	5	5	5

EPA METHOD 9038
SULFATE

CLIENT:	Earth Technology	**DATE REC'D:**	07/07/89
PROJECT:	Metro Rail	**DATE EXTRACTED:**	07/19/89
CONTROL NO:	890705	**DATE ANALYZED:**	07/21/89
MATRIX TYPE:	Soil		

SAMPLE ID:	CONTROL NO:	RESULTS (mg/Kg)	DETECTION LIMIT (mg/Kg)
PII-69 D-6	890705-1	70	10
PII-69 D-14	890705-2	60	10
PII-70 D-16A	890705-3	70	10
PII-72 D7A	890705-4	30	10
PII-72B D-13	890705-5	50	10
PII-86 D-14	890705-6	60	10
PII-86 D-6	890705-7	50	10
PII-88 D-6	890705-8	30	10
PII-105 D-15	890705-9	20	10
PII-105A D-7	890705-10	60	10

EPA METHOD 9030
SULFIDE

CLIENT:	Earth Technology	**DATE REC'D:**	07/07/89
PROJECT:	Metro Rail	**DATE EXTRACTED:**	07/14/89
CONTROL NO:	890705	**DATE ANALYZED:**	07/14/89
MATRIX TYPE:	Soil		

SAMPLE ID:	CONTROL NO:	RESULTS (mg/Kg)	DETECTION LIMIT (mg/Kg)
PII-69 D-6	890705-1	2.0	1
PII-69 D-14	890705-2	ND	1
PII-70 D-16A	890705-3	1.0	1
PII-72 D7A	890705-4	1.0	1
PII-72B D-13	890705-5	ND	1
PII-86 D-14	890705-6	ND	1
PII-86 D-6	890705-7	1.0	1
PII-88 D-6	890705-8	ND	1
PII-105 D-15	890705-9	ND	1
PII-105A D-7	890705-10	ND	1

EPA METHOD - 8240
VOLATILE ORGANICS BY GC/MS

CLIENT:	Earth Technology Corp.	**DATE REC'D:**	07/07/89
PROJECT:	Metro Rail/89-409-0009	**DATE EXTRACTED:**	07/18/89
SAMPLE ID:	PII-70 D-16A	**DATE ANALYZED:**	07/18/89
CONTROL NO:	890705-3	**MATRIX TYPE:**	Soil

PARAMETERS (8240)	**RESULTS (ug/kg)**	**DETECTION LIMIT (ug/kg)**
Acetone	ND	200
Benzene	ND	10
Bromodichloromethane	ND	10
Bromoform	ND	10
Bromomethane	ND	50
2-Butanone (MEK)	ND	100
Carbon Disulfide	ND	10
Carbon Tetrachloride	ND	10
Chlorobenzene	ND	10
Chlorodibromomethane	ND	10
Chloroethane	ND	50
2-Chloroethyl vinyl ether	ND	10
Chloroform	ND	10
Chloromethane	ND	50
1,1-Dichloroethane	ND	10
1,2-Dichloroethane	ND	10
1,1-Dichloroethene	ND	10
1,2-Dichloroethene (total)	ND	10
1,2-Dichloropropane	ND	10
cis-1,3-Dichloropropene	ND	10
trans-1,3-Dichloropropene	ND	10
Ethylbenzene	ND	10
2-Hexanone	ND	100
Methylene chloride	ND	200
4-Methyl-2-pentanone (MIBK)	ND	50
Styrene	ND	10
1,1,2,2-Tetrachloroethane	ND	10
Tetrachloroethene	ND	10
Toluene	ND	10
1,1,1-Trichloroethane	ND	10
1,1,2-Trichloroethane	ND	10
Trichloroethene	ND	10
Trichlorofluoromethane	ND	50
Vinyl Acetate	ND	100
Vinyl Chloride	ND	50
Xylene (total)	ND	10

ND = Not Detected

% Surrogate Recovery:

1,2 Dichloroethane-d_4	100
Toluene-d_8	98
Bromofluorobenzene	94

EPA METHOD - 8270
SEMIVOLATILE ORGANICS BY GC/MS

CLIENT:	Earth Technology Corp.	**DATE REC'D:**	07/07/89
PROJECT:	Metro Rail/89-409-0009	**DATE EXTRACTED:**	07/08/89
SAMPLE ID:	PII-70 D-16A	**DATE ANALYZED:**	07/19/89
CONTROL NO:	890705-3	**MATRIX TYPE:**	Soil

PARAMETER	RESULTS (mg/kg)	PARAMETER	RESULTS (mg/kg)
Phenol	ND (0.1)	Acenaphthene	ND (0.1)
bis(2-chloroethyl)ether	ND (0.1)	2,4-Dinitrophenol	ND (0.5)
2-Chlorophenol	ND (0.1)	4-Nitrophenol	ND (0.5)
1,3-Dichlorobenzene	ND (0.1)	Dibenzofuran	ND (0.1)
1,4-Dichlorobenzene	ND (0.1)	2,4-Dinitrotoluene	ND (0.1)
Benzyl Alcohol	ND (0.2)	2,6-Dinitrotoluene	ND (0.1)
1,2-Dichlorobenzene	ND (0.1)	Diethylphthalate	ND (0.1)
2-Methylphenol	ND (0.1)	4-Chlorophenyl-phenylether	ND (0.1)
bis(2-chloroisopropyl)ether	ND (0.1)	Fluorene	ND (0.1)
4-Methylphenol	ND (0.1)	4-Nitroaniline	ND (0.5)
N-Nitroso-Di-n-Propylamine	ND (0.1)	4,6-Dinitro-2-Methylphenol	ND (0.5)
Hexachloroethane	ND (0.1)	N-Nitrosodiphenylamine	ND (0.1)
Nitrobenzene	ND (0.1)	4-Bromophenyl-phenylether	ND (0.1)
Isophorone	ND (0.1)	Hexachlorobenzene	ND (0.1)
2-Nitrophenol	ND (0.1)	Pentachlorophenol	ND (0.5)
2,4-Dimethylphenol	ND (0.1)	Phenanthrene	ND (0.1)
Benzoic Acid	ND (0.5)	Anthracene	ND (0.1)
bis-(2-Chloroethoxy)methane	ND (0.1)	Di-n-Butylphthalate	ND (0.1)
2,4-Dichlorophenol	ND (0.1)	Fluoranthene	ND (0.1)
1,2,4-Trichlorobenzene	ND (0.1)	Pyrene	ND (0.1)
Naphthalene	ND (0.1)	Butylbenzylphthalate	ND (0.1)
4-Chloroanline	ND (0.2)	3,3'-Dichlorobenzidine	ND (0.2)
Hexachlorobutadiene	ND (0.1)	Benzo(a)Anthracene	ND (0.1)
4-Chloro-3-Methylphenol	ND (0.2)	bis(2-Ethylhexyl)Phthalate	ND (0.1)
2-Methylnaphthalene	ND (0.1)	Chrysene	ND (0.1)
Hexachlorocyclopentadiene	ND (0.1)	Di-n-Octyl Phthalate	ND (0.1)
2,4,6-Trichlorophenol	ND (0.1)	Benzo(b)Fluoranthene	ND (0.1)
2,4,5-Trichlorophenol	ND (0.1)	Benzo(k)Fluoranthene	ND (0.1)
2-Chloronaphthalene	ND (0.1)	Benzo(a)Pyrene	ND (0.1)
2-Nitroaniline	ND (0.5)	Indeno(1,2,3-cd)Pyrene	ND (0.1)
Dimethyl Phthalate	ND (0.1)	Dibenz(a,h)Anthracene	ND (0.1)
Acenaphthylene	ND (0.1)	Benzo(g,h,i)Perylene	ND (0.1)
3-Nitroaniline	ND (0.5)		

ND = Not Detected
( ) = Detection Limit (mg/kg

% Surrogate Recovery	
2-Fluorophenol	59
Phenol-d_5	52
Nitrobenzene-d_5	60
2-Fluorobiphenyl	66
Terphenyl-d_{14}	115

CAM METALS

CLIENT:	Earth Technology Corp.	**DATE REC'D:**	07/07/89
PROJECT:	Metro Rail/89-409-0009	**DATE EXTRACTED:**	07/19/89
SAMPLE ID:	PII-70 D16A	**DATE ANALYZED:**	07/19/89
CONTROL NO:	890705-03	**MATRIX TYPE:**	Soil

PARAMETERS	RESULTS (mg/kg)	DETECTION LIMIT (mg/kg)
Antimony	6.0	5.0
Arsenic	12	1.0
Barium	69	5.0
Beryllium	ND	1.0
Cadmium	4.5	1.0
Chromium - Total	39	1.0
Cobalt	16	1.0
Copper	25	1.0
Lead	20	1.0
Mercury	ND	0.05
Molybdenum	ND	1.0
Nickel	37	1.0
Selenium	ND	1.0
Silver	ND	1.0
Thallium	6.1	1.0
Vanadium	3.8	5.0
Zinc	70	1.0

QUALITY CONTROL DATA

CLIENT: Earth Technology Corporation
PROJECT: Metro Rail
CKY I.D.: 890705

==

METHOD 418.1
MATRIX: Soil

SAMPLE ID: Blank Spike II

COMPOUND	SAMPLE RESULTS (ppm)	AMOUNT SPIKED (ppm)	% REC.	DUP. % REC.	RPD
IR Ref Oil	ND	134	82	82	0

METHOD 418.1
MATRIX: Soil

SAMPLE ID: 890705-03

COMPOUND	SAMPLE RESULTS (ppm)	AMOUNT SPIKED (ppm)	% REC.	DUP. % REC.	RPD
IR Ref Oil	ND	134	80	78	2

METHOD 9030
MATRIX: Soil

SAMPLE ID: Blank Spike

COMPOUND	SAMPLE RESULTS (ppm)	AMOUNT SPIKED (ppm)	% REC.	DUP. % REC.	RPD
Sulfide	Blank	800	99	99	0

QUALITY CONTROL DATA

CLIENT: Earth Technology Corporation
PROJECT: Metro Rail/89-409-0009
CKY I.D.: 890705

==

METHOD 8020
MATRIX: Soil

SAMPLE ID: 890705-1

COMPOUND	SAMPLE RESULTS (ppb)	AMOUNT SPIKED (ppb)	% REC.	DUP. % REC.	RPD
Benzene	ND	20	90	80	12
Toluene	ND	20	105	100	5
Et. Benzene	ND	20	80	75	6
Xylenes	ND	40	110	100	10

METHOD 9038
MATRIX: Soil

SAMPLE ID: 890554-6

COMPOUND	SAMPLE RESULTS (mg/kg)	AMOUNT SPIKED (mg/kg)	% REC.	DUP. % REC.	RPD
Sulfate	68	500	87	93	6

QUALITY CONTROL DATA

CLIENT: Earth Technology Corporation
PROJECT: Metro Rail/89-409-0009
CKY I.D.: 890705

==

METHOD 8240
MATRIX: Soil

SAMPLE ID: 890630-6

COMPOUND	SAMPLE RESULTS (ug/kg)	AMOUNT SPIKED (ug/kg)	% REC.	DUP. % REC.	RPD
1,1, DCE	ND	50	80	75	11
Benzene	ND	50	88	92	4
TCE	ND	50	89	91	2
Toluene	ND	50	85	86	1
Chlorobenzene	ND	50	96	96	0

METHOD 8270
MATRIX: Soil

SAMPLE ID: 890657-12

COMPOUND	SAMPLE RESULTS (mg/kg)	AMOUNT SPIKED (mg/kg)	% REC.	DUP. % REC.	RPD
Phenol	ND	40	63	55	14
2-Chlorophenol	ND	40	100	98	2
1,4-Dichlorobenzene	ND	20	98	88	10
1,2,4 Trichloro- benzene	ND	20	105	98	7
4-Chloro-3-methyl phenol	ND	40	100	100	0
Acenaphthathens	ND	20	100	98	2
2,4-Dinitrotoluene	ND	20	74	75	1
Di-n-butylphthalate	ND	20	90	90	0
Pyrene	ND	20	130	110	17

Appendix D
Earth Work Recommendations

APPENDIX D
EARTHWORK RECOMMENDATIONS

Earthwork and site preparation activities will encompass clearing and grubbing, subgrade preparation for pavements and structural support, excavation for foundation and utility line relocations and fill placement. The following guidelines are recommended for earthwork associated with the Hollywood/Western Station.

Clearing and Grubbing

Fill material, trash and any vegetation should be removed from the site area to be graded. Existing asphalt pavement may be crushed (if economically justified) for reuse in fills. Subsurface conditions at the site may differ from those observed in the borings and, therefore, a geotechnical engineer should observe and approve the prepared graded area prior to the placement of fill.

Excavations

Minor excavations at the site will include those for utility lines and near-surface foundations. Major excavations will be for the main station housing the rail facilities. Recommendations for major temporary excavations are presented in Section 5.2 of this report. Temporary shallow excavations to a depth of 5 feet can be expected to remain stable with near vertical slopes for short periods. Temporary excavations deeper than 5 feet should be shored or sloped back. Sloped excavations should not be steeper than 1:1 (horizontal to vertical) in fine-grained alluvium, and 1½:1 (horizontal to vertical) in granular alluvium.

Fill Materials and Placements

Fill materials may consist of excavated onsite granular soils or approved clean granular soils free from expansive materials, debris, organic contaminants or rock fragments larger than 6 inches. The existing asphalt pavement may be crushed and blended with granular soils for reuse in fills.

The following specifications are recommended for fill placments.

- o All areas that are to receive compacted fill shall be observed by a geotechnical engineer

- o Exposed soil surface shall be scarified to a minimum of 6 inches, moisture conditioned as necessary and compacted to a minimum dry density of 90 percent of the maximum dry density as determined by procedure ASTM D1557

- o All fill materials shall be placed in layers, compatible with the type of compaction equipment used, but not exceeding 8 inches in loose thickness. Each layer shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM procedure D1557. Granular fill material shall be moisture conditioned to within plus or minus 2 percent of the optimum moisture content, either by drying or wetting, prior to compaction

- o A geotechnical engineer or an experienced soils technician shall observe fill placement and compaction and conduct inplace field density tests on the compacted fill to check the adequacy of compaction. If the dry density of the compacted layer is less than 90 percent of the maximum dry density, soils shall be moisture conditioned as necessary and recompacted until 90 percent of the maximum dry density is attained.

In deep fill areas or fill areas for support of sensitive structures, the compaction requirement should be increased from the normal 90 percent to 95 percent or 100 percent of the maximum dry density, as directed by a geotechnical engineer.

Subgrade Preparation

If existing fill soils are encountered at near surface subgrade, they should be removed completely to at least 5 feet from the foundation area and replaced with properly compacted fill. In fine-grained alluvium, exposed subgrade should be excavated at least 2 feet below the design grade and replaced with properly compacted fill. In granular alluvium, exposed subgrade should be observed by a geotechnical engineer, and, if disturbed, should be scarified to a minimum of 6 inches and recompacted. All fill placements and compactions should be performed as recommended in "Fill Materials and Placements."

QUALITY CONTROL DATA

CLIENT: Earth Technology Corporation
PROJECT: Metro Rail/89-409-0009
CKY I.D.: 890705

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METHOD 6010
MATRIX: Soil

SAMPLE ID: 890705-3

COMPOUND	SAMPLE RESULTS (mg/kg)	AMOUNT SPIKED (mg/kg)	% REC.	DUP. % REC.	RPD
Beryllium	ND	10	110	100	10
Copper	25	50	86	94	6
Thallium	6.1	50	74	78	4
Silver	ND	10	88	89	1
Vanadium	38	100	87	88	1

METHOD 7470
MATRIX: Soil

SAMPLE ID: 881118-30

COMPOUND	SAMPLE RESULTS (mg/kg)	AMOUNT SPIKED (mg/kg)	% REC.	DUP. % REC.	RPD
Mercury	ND	2.5	132	92	36

Site Drainage

Adequate positive drainage should be provided away from the surface structures to prevent water from ponding and to reduce water percolation into subsoils. If there is any granular backfill directly underneath the area of surface drainage, the backfill should be covered or capped with at least 18 inches of relatively impervious clayey soils.