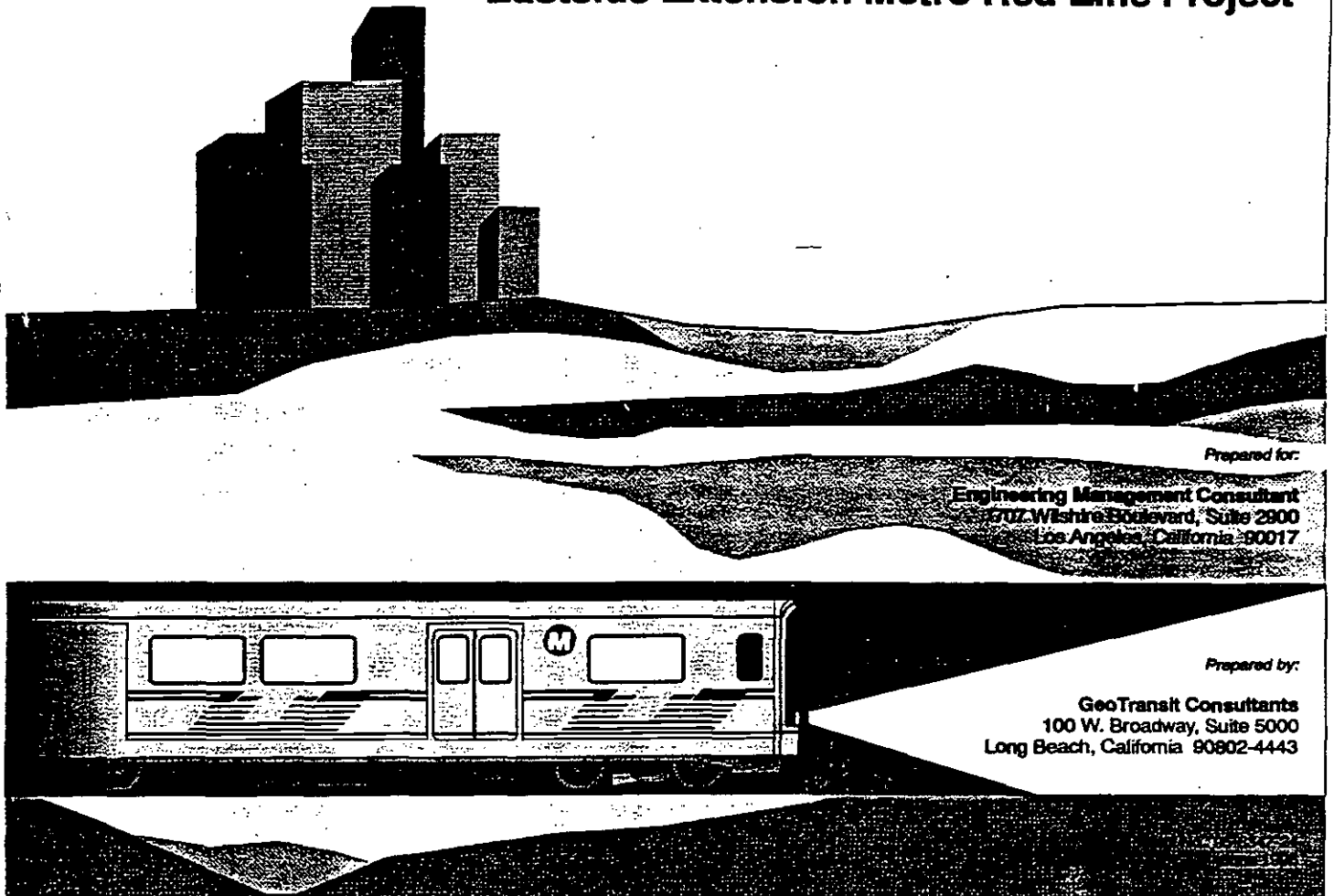


Final Geotechnical Investigation for:

**First/Boyle Station with Crossover
and Little Tokyo - First/Boyle Tunnels
Eastside Extension Metro Red Line Project**



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**GEOTECHNICAL INVESTIGATION
FOR THE FIRST/BOYLE STATION
WITH CROSSOVER AND
LITTLE TOKYO-FIRST/BOYLE TUNNELS
EASTSIDE EXTENSION
METRO RED LINE**

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1.0 EXECUTIVE SUMMARY

1.1 GENERAL

This report presents the results of a geotechnical investigation conducted by GeoTransit Consultants for the planned First/Boyle Station with crossover and the tunnels between the Little Tokyo/Arts District and First/Boyle Stations (referred to as the Little Tokyo-First/Boyle Tunnels). The tunnels and station are part of the proposed Eastside Extension of the Los Angeles Metro Red Line. The primary purposes of this investigation were to evaluate geologic and geotechnical conditions and to obtain geotechnical data for planning and design of the tunnels and station. The locations, dimensions, and configuration of the proposed station and tunnels in this report were based on available plans and profiles supplied by Engineering Management Consultant (EMC) at the time of this investigation.

1.2 PROJECT DESCRIPTION

The tunnels consist of two single track, 18-foot inside and 22-foot outside diameter openings in a double line configuration. Starting from the southern terminus of the Little Tokyo/Arts District Station (approximate Station CR 45+60), the tunnels proceed south then curve southeast and trend approximately east-west beneath the Los Angeles River (between approximate Stations CR 64+50 and CR 67+30) north of Fourth Street. After crossing beneath the Los Angeles River, the tunnels curve northeasterly and end at the western terminus of the First/Boyle Station (approximate Station CR 97+50).

The proposed First/Boyle Station with crossover consists of a cut-and-cover reinforced concrete structure approximately 60 feet in width. The station invert is about 65 to 80 feet below ground surface (BGS). The eastern terminus of the station is at approximate Station CR 106+00.

1.3 SCOPE

The scope of this investigation consisted of reviewing available literature; conducting a site reconnaissance and preparing a geologic map; performing field explorations including drilling 16 rotary-wash borings, one hollow-stem auger boring, and one 30-inch diameter bucket auger boring; installing nine monitoring wells;

monitoring groundwater levels; sampling groundwater; performing an aquifer pump test; conducting two downhole seismic velocity surveys; performing a geotechnical laboratory testing program on selected soil and bedrock samples, and a chemical testing program on groundwater samples; conducting an engineering evaluation; and preparing this report.

1.4 GEOLOGIC SETTING

The Eastside Extension alignment is located along the southern flank of the Repetto Hills area of the Los Angeles Basin. In the project area, the tunnels will be driven through alluvial deposits of Holocene and Pleistocene age, and Tertiary-aged bedrock units of the Fernando and Puente formations. Alluvium consists of mostly coarse granular deposits with local cobbles and boulders, interlayered with fine-grained deposits. Bedrock consists of siltstone and claystone with local hard to very hard, well-cemented calcareous interbeds and nodules.

The alignment is located in an area having a high seismic potential and has experienced ground shaking from a number of large earthquakes in historical time. The documented active faults closest to the alignment are the east-west trending Hollywood and Raymond faults about 6 ½ miles northwest and 5 miles northeast of the alignment, respectively. The area is underlain by the Elysian Park seismic zone, generally accepted as the source of the 1987 Whittier Narrows earthquake. This seismic zone is postulated to be a concealed, deep thrust fault that in part expresses itself at the surface as the Elysian Hills and Repetto Hills.

A linear topographic escarpment crosses the project area in the vicinity of the eastern terminus of the First/Boyle Station with crossover. The results and details of a project-specific-investigation performed to delineate and characterize the escarpment (Coyote Pass escarpment) and to assess its seismic capability are presented in a separate report (GeoTransit Consultants, 1996a). In essence, the results indicate that the Coyote Pass escarpment is an active structure consisting of folded alluvial deposits, and that its potential for movement should be considered in the design and construction of the project facilities at the projected escarpment crossings.

1.5 SUBSURFACE STRATIGRAPHY

The planned tunnel and station excavations will be within alluvium and the underlying bedrock units of the Fernando/Puente Formation. The alluvium is heterogeneous and consists of predominantly granular alluvium interbedded with fine-grained alluvium. In the portion of the project area west of Pecan Street, granular alluvium consists of predominantly coarse-grained materials ranging from sands to gravels with local zones of cobbles and boulders up to 4 feet in size. Dense to very dense silty sand, clayey sand and sand with varying amounts of silt and gravel, occasional gravel layers, and occasional cobbles and small boulders (up to 2 feet in size) are predominant in the remaining portion of the project area. The fine-grained soils in the project area consist predominantly of stiff to hard silt, lean clay, silty clay, and fat clay with varying amounts of sand and silt.

Bedrock units of the Fernando and Puente formations underlie the alluvium. Within the project area, the bedrock materials are only present in the eastern 1/5 of the station area. Where encountered, the bedrock consists predominantly of soft to very soft (as defined by the Engineering Geology Field Manual, U.S. Department of the Interior, Bureau of Reclamation and presented in Figure A-2 in Appendix A) siltstone and claystone, except for local zones of hard to very hard, well-cemented calcareous interbeds and nodules. Hard, well-cemented concretionary nodules of up to 2-1/2 inches in size were encountered in Borings SD-9 and SD-10 located in the eastern part of the First/Boyle station. However, available literature indicates that cemented interbeds up to 12 feet in thickness and nodules up to 20 inches in size are locally present in the general area.

1.6 GROUNDWATER LEVEL

The measured groundwater levels along the tunnel alignment are approximately 30 to 78 feet BGS. Assuming the groundwater levels during construction are the same as the most recently measured data, the portion of the tunnels approximately between stations CR 56+80 and CR 90+20 will be partly or entirely below the groundwater levels. In the station area, measured groundwater levels are about 55 to 60 feet BGS. The planned station invert will be about 3 to 22 feet below these groundwater levels.

Significant differences exist in groundwater level between the data recorded during this investigation and previous project-specific investigations (GeoTransit Consultants, 1994a and 1994b), and those recorded in

1983 by Converse and others (1984), in the portion of project area directly west of the Los Angeles River channel. The measured groundwater levels in 1983 were about 45 to 55 feet higher than those measured during both this investigation and previous project-specific investigations.

The project area is located in a region with known significant fluctuations in historic groundwater levels. Available groundwater-level data from a number of wells in the general region (maintained and recorded by the Los Angeles County Department of Public Works) indicates that groundwater levels in the general region can significantly fluctuate. At some of the well locations, the observed groundwater fluctuations were as much as 12 feet in one month, 69 feet in one year, and 183 feet in 10 years. Thus, significant fluctuations of groundwater levels should be anticipated during the life of the station and tunnel facilities. Such potential groundwater fluctuation should be considered in the construction and design. It is important that groundwater levels in the project area be continuously monitored prior to and during construction.

1.7 GROUNDWATER AND SOIL CONTAMINATION

Available chemical test data on soil samples from two previous environmental borings (GeoTransit Consultants, 1994b) and water quality samples from three monitoring wells in the project area indicate no contamination by hydrocarbons, hydrogen sulfide (H_2S), and a number of commonly encountered constituents. However, because of its proximity to the existing Union Station and Boyle Heights oil fields, there exists a potential for local soils and water inflows to be contaminated with oil field related contaminants (i.e., hydrocarbons, hydrogen sulfide, etc.) that, if encountered, will require treatment and disposal to approved facilities.

1.8 GASSY CONDITIONS

The proximity of the project area to the existing Union Station oil field suggests the likely presence of methane and other oil field related gases in the project area. Available field observations from this and other investigations in the project area, and measured methane concentrations (1.8 to 3.6% by volume or 34 to 68 percent of lower explosive limits [LEL]) from two sets of deep and shallow gas probes located in the project area (Engineering Science, Inc., 1994) indicate that methane and possibly H_2S are locally present in the tunnel zones and station area. Thus, there exists a potential for accumulation of toxic and explosive gases (especially H_2S and methane) in the project area.

The potentially gassy conditions in the tunnel area dictate the need for proper ventilation and monitoring of methane, H₂S and other toxic/explosive gases by the contractor during construction to provide a safe working environment in conformance with U.S. and California OSHA requirements.

1.9 TUNNELS

The tunnels will be in predominantly granular alluvium. Groundwater was encountered within the planned tunnel envelope over a major portion of the tunnels.

There are several conditions that may impact the tunnel excavation techniques, face stability, advance rates, and potential ground loss. These conditions should be taken into consideration in tunnel design and construction. These conditions include shallow groundwater conditions in alluvium within or above the tunnel envelope; raveling and running/flowing conditions in granular alluvium, local presence of gravels, cobbles and boulders; and shallow soil overburden above the tunnel crown in portions of the tunnel alignment. Based on available data, it is estimated that tunnel drilling will encounter very hard to extremely hard (as defined in Figure A-2, Appendix A) cobbles and boulders (up to 4 feet in size) up to 15 percent and 2 percent, respectively, by volume of excavated materials.

1.10 STATION

The station excavation will be primarily in heterogeneous alluvium and the Fernando/Puente Formation bedrock. Based on available information from the station borings, the alluvium above the station invert comprises roughly 2/3 granular and 1/3 fine-grained alluvial soils. It is anticipated that the cut-and-cover excavation can be achieved by conventional excavation methods. However, suitable excavation equipment must be considered to handle the local presence of gravelly and cobbly interbeds and boulders (up to 2 feet in size) in the alluvium, and hard to very hard, well-cemented calcareous interbeds and nodules in the bedrock. Most of the alluvium in the station area is expected to run or ravel readily. Thus, timely application of ground support is important.

Based on the results of this investigation, it is estimated that station excavation will encounter cobbles and boulders (up to 2 feet in size) up to 5 percent by volume of the excavated alluvium. Based on available subsurface data, it is also estimated that the excavated bedrock in the station area will include up to 5 percent

(by volume) of hard to very hard calcareous interbeds (up to 12 feet in thickness) and nodules (up to 20 inches in size).

If the groundwater levels during station construction are similar to the present groundwater levels, dewatering will be required to lower and maintain the groundwater level at least 5 feet below the station invert. Groundwater levels should be regularly monitored up to and through the construction period to verify this.

The planned station excavation will require vertical cuts and shoring due to proximity of the station to existing buildings and limited construction space within the public right-of-way. Based on local practice under similar subsurface conditions, soldier piles and lagging with internal bracing and/or tiebacks are the most likely shoring systems. The recommended lateral earth pressures for design as well as various other design and installation considerations are provided in this report.

Various geotechnical design parameters are provided in this report for station design. The planned station will be supported on bedrock approximately within the eastern 1/5 of the station area and on alluvium within the remaining station area. Upon unloading (station excavation) and loading (station construction), the underlying alluvium and bedrock will respond in terms of heave and settlement. The alluvium is predominantly granular in nature and will undergo little or no time-dependent, long-term consolidation responses; while the bedrock behaves similar to hard, fine-grained soil and will exhibit a certain amount of time dependent heave and consolidation response. For the mat foundation design and soil-structure interaction analysis, separate soil spring parameters for alluvium and bedrock are provided for two conditions, including the short term (elastic responses) and long-term (combined elastic and consolidation responses) conditions.

1.11 SEISMIC DESIGN CRITERIA

A seismic hazard study was not part of the scope of this investigation. For geotechnical analyses and design purposes, the results of a 1983 study titled "Seismological Investigation and Design Criteria" prepared by Converse Consultants and others for the Metro Rail Project were used. Geotechnical recommendations presented herein should be reviewed and revised as appropriate should seismic criteria be revised in the future.

1.12 LIQUEFACTION POTENTIAL

Liquefaction potential of subsurface soils in the tunnel segment and station area was evaluated. The results indicate that the potential for liquefaction of the soils in the project area under the maximum design earthquake (based on the 1983 "Seismological Investigation and Design Criteria" report by Converse and others for the Metro Rail Project) is very low and is not a consideration for design.

2.0 INTRODUCTION

2.1 GENERAL

This report presents the results of a geotechnical investigation for the First/Boyle Station and tunnels between the Little Tokyo/Arts District and the First/Boyle Stations (referred to as the Little Tokyo-First/Boyle Tunnels in this report). The station and tunnels are part of the proposed Eastside Extension of the Los Angeles Metro Red Line. This investigation was performed to support the engineering efforts being undertaken by Engineering Management Consultant (EMC) for the Los Angeles County Metropolitan Transit Authority (MTA).

This geotechnical investigation is part of an overall geotechnical investigation for the design of the first portion of the proposed Metro Red Line Eastside Extension which begins at the southeastern terminus of the Union Station in Los Angeles, and ends at the proposed First/Lorena Station and Tail Track Tunnels in East Los Angeles. This first portion of the Eastside Extension is approximately 3.7 miles in length and consists of twin tunnels and four cut-and-cover stations, including the tunnels and the Little Tokyo Station addressed in this report. Plate 1 presents the layout plan showing the locations of the station and adjacent tunnels with respect to the Eastside Extension alignment.

2.2 PROJECT DESCRIPTION

The locations, dimensions, and configuration of the proposed station and tunnels presented in this report were based on available plans supplied by EMC at the time of this investigation.

The plan and ground surface and tunnel/station profiles for the subject tunnel alignment are shown on Plate 2. The following section describes the dimensions and configurations of the tunnel alignment and station. All elevations used in this report are with respect to the City of Los Angeles datum.

2.2.1 Little Tokyo - First/Boyle Tunnels

The tunnels in this segment are approximately 5,100 feet in length and consist of two single track, 18-foot inside and 22-foot outside diameter openings in a double-line configuration. Starting from the southern terminus of the Little Tokyo/Arts District Station at approximate Station CR 46+60, the tunnel alignment proceeds south, then curves southeast underneath the existing MTA maintenance yard and trends approximately east-west under the Los Angeles River (between approximate stations CR 64+50 and CR 67+30) north of Fourth Street. After crossing beneath the Los Angeles River, the alignment curves in a northeasterly direction and terminates at the western terminus of the First Boyle Station at approximate Station CR 97+50.

Between the west end of the tunnel segment (approximate Station CR 46+60) and east curb of Pecan Street (approximate Station CR 94+40) the ground surface along the alignment is relatively flat and approximately ranges between Elevation 256 and 264 feet, except at the Los Angeles River crossing where the bottom of the concrete-lined river channel is at approximate Elevation 226 feet. Beyond Pecan Street, the ground surface rises abruptly from approximate Elevation 263 feet to about Elevation 308 feet at approximate Station CR 96+30 (east of U.S. 101 Freeway) and then drops down to approximate Elevation 294 feet near the eastern end of the tunnel segment (the western terminus of the First/Boyle Station). Plans indicate that the tunnel invert dips from the approximate Elevation 201.5 feet at the west end of the tunnel alignment at Station CR 46+60, to approximate Elevation 170 feet at approximate Station CR 62+00; then the tunnel inverts slopes upwards to approximate Elevation 235 feet at the east end of the tunnel segment. Along the tunnel alignment, the proposed tunnel inverts range from about 34 feet to 94 feet BGS. The tunnel portions approximately between Stations CR 65+00 and CR 67+00 (beneath the Los Angeles River) and approximately between Stations CR 81+00 and CR 97+30, have less than 40 feet (approximately 2 times the tunnel diameter) of soil overburden above the tunnel crown. The least soil overburden of about 13 feet above the tunnel crown occurs at approximate Station CR 94+30.

2.2.2 First/Boyle Station with Crossover

The proposed First/Boyle Station with crossover consists of a cut-and-cover reinforced-concrete station structure and auxiliary facilities. The station with crossover starts at approximate Station CR 97+50 (western

terminus) and ends at approximate Station CR 106+00 (eastern terminus). The station with crossover has an inside width of approximately 60 feet.

The ground surface at the station site varies from approximate Elevation 298 feet at the western terminus to approximate Elevation 218 feet at the eastern terminus. The planned station invert at the western terminus is at approximate elevation 232.5 feet and slopes up towards the east to approximate Elevation 237.5 feet at the eastern terminus of the station. Thus, the depth of the station excavation ranges approximately from 65 to 80 feet BGS.

2.3 OBJECTIVE AND SCOPE

The objective of the geotechnical investigation was to evaluate subsurface soil and groundwater conditions and to obtain geotechnical data for planning and design of the planned tunnels and station.

The scope of this investigation consisted of the following:

- Review of available literature and reports regarding the geologic, geotechnical, groundwater and seismic conditions in the project area.
- Planning and coordination of field work, including:
 - Development of field procedures and manuals
 - Planning of the field investigation program
 - Obtaining necessary permits and licenses
 - Coordination with government agencies and utility companies prior to, during, and after the field work
 - Development and implementation of a project-specific Health and Safety Plan
- Performance of a field exploration program, including:
 - Drilling and sampling 16 rotary wash test borings and one hollow-stem auger boring

- Drilling and sampling one 30-inch diameter bucket auger boring to evaluate size and distribution of coarse alluvium
 - Installing nine monitoring wells
 - Monitoring groundwater levels at all available monitoring well locations, including nine monitoring wells installed in this investigation and two monitoring wells installed in the preliminary geotechnical investigation program (GeoTransit, 1994a)
 - Obtaining groundwater samples from selected monitoring wells for chemical testing
 - Conducting two downhole seismic geophysical surveys to determine shear wave velocity and dynamic modulus characteristics of the subsurface materials
- Performance of a pump test to evaluate the hydraulic conductivity characteristics of coarse alluvium and to estimate water inflows and dewatering needs.
 - Performance of a laboratory testing program on selected representative soil and water samples to assess the index and engineering properties of subsurface materials, and to evaluate their chemical characteristics.
 - Preparation of this report documenting the results of the geotechnical investigation and providing recommendations for project design.

2.4 PREVIOUS INVESTIGATIONS AND AVAILABLE DATA

A number of project-specific and non project-specific geologic, geotechnical, and environmental investigations were previously performed in the project area. The results of these previous investigations conducted by GeoTransit Consultants and others were compiled and reviewed to help plan this investigation and to supplement the results of this investigation.

Existing non-project related geotechnical data consist primarily of the results of a 1983 geotechnical investigation performed by Converse and others (1984) for the MTA maintenance yard. Available subsurface information in the project area from the 1983 investigation by Converse and others is summarized in Table 2-1.

**TABLE 2-1. EXISTING SUBSURFACE INFORMATION IN THE PROJECT AREA BASED ON A
NON-PROJECT SPECIFIC INVESTIGATION BY CONVERSE AND OTHERS (1984)**

Boring/ Water Well	Approximate Station No. (Projected to Centerline of CR Track)	Ground Surface Elevation (feet above MSL)	Total Depth (feet)	Groundwater			Geologic Unit (depth in feet)			Comments
				Depth (feet)	Elevation (feet above or below MSL)	Date	Fill	Alluvium	Bedrock	
CC:3-15	46 + 15	264	30.5	23	+241	12-15-83	0-3	3-30.5+	-	Cobbles at 19'; piezometer installed
CC:3-19	54 + 65	261	29.5	-	-	-	0-2	2-29.5+	-	
CC:3-20	54 + 60	261	30	-	-	-	0-2	2-30+	-	
CC:3-22	57 + 15	260	30	-	-	-	0-3	3-30+	-	Caving at 12'
CC:3-23	58 + 00	260	31	-	-	-	0-3	3-31+	-	
CC:3-24	60 + 45	259	29.7	24	+235	12-15-83	0-9	9-29.7+	-	Cobbles throughout; piezometer installed
CC:3-27	62 + 40	259	10	-	-	-	0-2	2-10+	-	
CC:3-31	56 + 80	260.4	33	-	-	-	0-8	8-33+	-	Cobbles and boulders at 15', 18' and 26'
CC:3-32	50 + 10	261.5	20	-	-	-	0-0.7	0.7-20+	-	Caving from 7' to 8' and at 10.5', 13' and 16'; boulders (16") at 11' and 14' to 15'

Previous project-specific investigations for the Eastside Extension performed by GeoTransit Consultants include the following:

- Preliminary geotechnical investigation (GeoTransit Consultants, 1994a) which includes drilling and sampling of four geotechnical borings (PE-21, and PE-24 through PE-26) and installation of two monitoring wells at two of the boring locations (PE-21 and PE-25) in the project area.
- Stage II Environmental Site Assessment, Eastside Extension, Metro Red Line Project (GeoTransit Consultants, 1994b) with environmental sampling from two environmental borings (EB-15 and EB-16).

The locations, penetration depths and detailed geologic logs of the above geotechnical borings are included in Appendix A. The locations of these previous, project-specific geotechnical borings with respect to the station and tunnel alignment are presented in Section 3.0.

Engineering-Science, Inc. (ESI) conducted a subsurface gas investigation to support preliminary design of the Eastside Extension (Engineering-Science, Inc., 1994). This investigation included installation, monitoring, and gas sampling and testing of gas probes at two boring locations in the project area. This included one location (MW-3) in the MTA yard parking lot adjacent to Fourth Street/Santa Fe Avenue intersection in the vicinity of the tunnel alignment, and one location (MW-4) at Boyle Street/Pleasant Avenue intersection in the First/Boyle Station area.

3.0 FIELD EXPLORATION, FIELD TESTING AND LABORATORY TESTING

3.1 GENERAL

This section provides a description of the subsurface exploration, and field and laboratory testing performed for this project. The field exploration and field testing program are part of a larger overall geotechnical investigation program being performed for the entire Eastside Extension alignment. Applicable results from the overall geotechnical investigation program and previous investigations in the project area (Section 2.4) were also used in developing findings and conclusions presented in this report.

3.2 GEOTECHNICAL BORINGS

Sixteen rotary-wash borings, one hollow-stem auger boring and one bucket-auger boring were drilled in the project area. Thirteen of the borings (identified by the prefix DD-) were drilled along the tunnel segment. Five of the borings (identified by the prefix SD-) were drilled within the First/Boyle Station area. The locations and penetration depths of these borings are summarized in Table 3-1 and Plate 2. For completeness, geotechnical borings completed during our preliminary investigations in this area (GeoTransit Consultants, 1994a, 1994b) have also been included in Table 3-1.

The borings were logged in the field by a geologist or engineer under the direct supervision of a Registered Geotechnical Engineer (RGE) or a Certified Engineering Geologist (CEG). The materials were classified in general accordance with American Society of Testing and Materials (ASTM) Standards and the Unified Soil Classification System. The field logs were refined and reclassified, as appropriate, after further laboratory examination and testing of selected soil samples. The boring logs are presented in Appendix A.

3.2.1 Rotary-Wash Borings

Rotary wash borings for the geotechnical subsurface exploration program were drilled using Mayhew 1,000 and Midway 1300 mud-rotary drill rigs with 4-7/8-inch diameter tricone drill bits producing nominal 5- to 6-inch diameter boreholes. Boring DD-54C was drilled to a diameter of 10 inches to accommodate a 6-inch inside diameter well casing to be used for an aquifer pump test. The borings were generally drilled to depths

TABLE 3-1 SUMMARY OF FIELD EXPLORATION PROGRAM

(First/Boyle Station & Tunnels between Little Tokyo & First/Boyle Stations)

Boring #*	Type of Boring	Approximate Station along Center Line of CR track	Approximate Offset From Centerline of CR (ft)	Approximate Offset From Centerline of CL (ft)	Location	Approximate Ground Surface Elevation (ft)	Approximate Tunnel/Station Invert (Depth/ Elevation, ft)	Total Penetration Depth (ft)	Monitoring Well Installed
DD-13	Rotary Wash	56+80	-	0	MTA Yard	264	83/181	106	Yes
DD-13S	Rotary Wash	62+80	10 left	-	MTA Yard	262	92/170	115	No
DD-14	Rotary Wash	65+29	0	-	NW of Los Angeles River & 4th Bridge	227	54/173	80.5	Yes
DD-15	Rotary Wash	76+04	14 right	-	Artemus/Anderson	256	68/188	91	Yes
DD-16	Bucket Auger	85+65	60 left	-	Clarence/3rd Street	257	54/203	55	No
DD-17	Rotary Wash	90+66	4 left	-	North of 3rd on Gless	262	50/212	71.5	Yes
DD-51	Rotary Wash	49+95	-	10 right	MTA Yard	262	62/200	95.3	No
DD-52	Rotary Wash	66+75	-	0	NE of Los Angeles River & 4th St. Bridge	227	52/175	80.5	No
DD-54A	Rotary Wash	71+37	-	2 left	Mission/South of Artemus	256	74/182	101	Yes
DD-54B	Rotary Wash	71+05	5 left	-	Mission/South of Artemus	256	74/182	102	Yes
DD-54C	Rotary Wash	71+02	20 left	-	Mission/South of Artemus	256	74/182	104	Yes
DD-55	Rotary Wash	80+80	-	10 left	Boyd St. Nearest Cross St. Anderson	257	61/196	86	No
DD-56-1	Rotary Wash	85+50	0	-	3rd St. & Via Los Bamos	257	54/203	75.3	No
DD-57	Rotary Wash	94+60	0	-	Pecan near 1st Street	263	34/229	65	No
SD-6	Rotary Wash	97+14	-	0	Bodie & 1st Street	294	59/235	90.5	Yes
SD-7	Rotary Wash	100+30	55 right	-	Boyle/1st	311	69/242	109.7	No
SD-8	Rotary Wash	102+55	-	0	Boyle/1st at Pleasant	314	78/236	140.5	No
SD-9	Rotary Wash	104+44	-	3 left	Bailey/1st	312	75/237	112.5	Yes
SD-10	Hollow-stem Auger	106+30	2 right	-	Alley near E. 1st/Bailey	318	81/237	110	No
PE-21	Rotary Wash	101+40	0	-	1st/Boyle	313	78/235	110.4	Yes
PE-24	Rotary Wash	70+71	80 right	-	4th/Mission	257	76/181	85.3	No
PE-25	Rotary Wash	61+80	105 right	-	MTA Yard	262	92/170	86	Yes
PE-26	Rotary Wash	52+15	20 left	-	MTA Yard	262	66/196	85.4	No

Note:

- * Borings along tunnel alignment are identified by the prefix DD-; borings at station locations are identified by the prefix SD-;
- borings drilled during the preliminary investigation are identified by the prefix PE-.

of 20 feet or more below the tunnel invert, and 30 and 60 feet below the station invert as determined from the plan and profile drawings for the Eastside Extension alignment provided by EMC in October, 1995. Soil samples of the encountered alluvial soils were obtained at maximum 5-foot depth intervals or at changes in stratigraphy, whichever occurred first, by alternately using a split-spoon sampler (Standard Penetration Test Method) and a California drive sampler lined with 2.4-inch inside diameter by 1-inch-high brass rings.

Fernando/Puente Formation bedrock was encountered in Boring SD-9. Samples of the Fernando/Puente Formation in this boring were obtained by using Pitcher-barrel samplers and California drive samplers. The Split-spoon sampler was also occasionally used to assess the penetration resistance of the Fernando/Puente Formation bedrock.

3.2.2 Hollow-Stem Auger Boring

Because of low overhead high-voltage lines in the area, Boring SD-10 was drilled to the planned penetration depth of 100 feet BGS using a low-overhead CME 75 drill rig with an 8-inch diameter hollow-stem auger. In this boring soil and bedrock samples were also obtained at maximum 5-foot intervals by alternately using a split-spoon sampler and a California drive sampler.

3.2.3 Bucket-Augur Boring

A 30-inch diameter bucket-auger boring (DD-16) was drilled to estimate the extent and size distribution of cobbles and boulders in the project area. Bulk samples were obtained at approximately 5-foot depth intervals and at stratum changes. The boring was terminated at a depth of 55 feet, and backfilled due to encountering groundwater at a depth of 53.5 feet. Boulders up to 20 inches in size, and cobbles up to 12 inches in size were encountered within the penetration depth of the boring.

3.2.4 Monitoring Well Installation and Groundwater Level Monitoring

Nine monitoring wells were installed. Well installation diagrams are presented in Appendix A. Groundwater level measurements from these monitoring wells and from other existing monitoring wells (PE-21 and PE-25) installed during the preliminary engineering program (GeoTransit Consultants, 1994a) were recorded using an electronic water-level indicator. Table 3-2 presents a summary of these records.

TABLE 3-2 SUMMARY OF PROJECT-SPECIFIC GROUNDWATER LEVEL DATA

(First/Boyle Station & Tunnels between Little Tokyo & First/Boyle Stations)

BORING #	APPROXIMATE STATION ALONG CENTER LINE OF CR TRACK	APPROXIMATE GROUND SURFACE ELEVATION (ft)	APPROXIMATE DEPTH OF TUNNEL/ STATION INVERT (ft)	MEASURED GROUNDWATER LEVEL												DATE OF
				DATE	APPROXIMATE DEPTH (ft)	APPROXIMATE ELEVATION (ft)	DATE	APPROXIMATE DEPTH (ft)	APPROXIMATE ELEVATION (ft)	DATE	APPROXIMATE DEPTH (ft)	APPROXIMATE ELEVATION (ft)	DATE	APPROXIMATE DEPTH (ft)	APPROXIMATE ELEVATION (ft)	MONITORING WELL DEVELOPMENT
DD-13	56 + 80	264	83/181							11/21/95	76.2	187.8	10/31/95	76.3	187.7	11/30/95
DD-14	65 + 29	227	54/173				02/14/96	30.3	196.7	11/21/95	30.9	196.0	10/24/95	31.5	195.5	11/10/95
DD-15	76 + 04	256	68/188				02/14/96	51.4	204.6	11/21/95	52.4	203.6	11/1/95	52.6	203.4	11/14/95
DD-17	90 + 66	262	50/212				02/14/96	54.2	207.8	11/21/95	55.4	206.6				11/28/95
DD-54A	71 + 37	256	74/182							11/21/95	49.7	206.3				11/13/95
DD-54B	71 + 05	256	74/182	02/27/96	52	204	02/14/96	51.8	204.2							1/24/96
DD-54C	71 + 02	256	74/182	02/27/96	51.3	204.7	02/14/96	52.2	203.8							1/25/96
SD-6	97 + 14	294	59/235				02/14/96	57.9	236.1	11/21/95	57.8	232.6				11/14/95
SD-9	104 + 44	312	75/237				02/14/96	55.9	256.1	11/21/95	56.2	255.8				11/21/95
PE-21	101 + 40	313	78/235				02/14/96	58.1	254.9	11/21/95	59.0	254.0	1/11/94	58.4	254.6	12/93
PE-25	61 + 80	262	66/196										1/11/94	72.3	189.7	12/93

3.3 FIELD TESTS

3.3.1 Aquifer Pump Testing

An aquifer pump test was performed at Boring/Pump Well DD-54C. Water levels were monitored at two nearby observation wells (DD-54A and DD-54B) located 56.5 and 16.5 feet, respectively, from DD-54C. The pump test was conducted on South Mission Road south of Artemus Street. The aquifer pump test was performed to evaluate the hydraulic characteristics of the coarse alluvium. The aquifer pump test included a step drawdown test at pumping rates of 15, 30, 50, 80 and 105 gallons per minute (gpm), a constant discharge rate test at a pumping rate of 147 gpm for a duration of about 24 hours, and water-level recovery test for a period of about 19 hours.

At the pump well location the depth to static groundwater is about 52 feet BGS. The total depth of the pump well is 95 feet. Thus, the test zone at the pump well location is about 43 feet thick. The depth to the Fernando/Puente Formation bedrock is estimated to be about 175 feet based on the logs of older water production wells in the area (California Department of Water Resources [CDWR], 1961). The aquifer at the test location is therefore estimated to be about 123 feet thick, and consists predominantly of sands, gravels, and silts to the top of bedrock.

Details and results of the aquifer pump testing are presented in a separate report entitled "Results of Aquifer Pump Testing at Mission Road and E. Fourth Street, Eastside Extension, Metro Rail Red Line, Los Angeles, California," by GeoTransit Consultants (1996b). In summary, the results of the aquifer pump testing indicate the following:

1. The aquifer is unconfined with an estimated transmissivity of about 20,000 to 70,000 gallons per day per foot (gpd/ft) and a storage coefficient of about 0.005 to 0.01.
2. Over the test zone (i.e., upper 43 feet of the aquifer), the aquifer has an average hydraulic conductivity (coefficient of permeability) of about 2×10^{-2} cm/sec.

3.3.2 Downhole Seismic Velocity Survey

Downhole seismic velocity surveys were performed within Boring DD-15 (located on the tunnel alignment) and Boring SD-6 (located near the western terminus of the First/Boyle Station). Procedures used for seismic velocity measurements were in general accordance with those described by the U.S. Army Corps of Engineers (1979) and Mooney (1984). In general, downhole compressional (P) and shear (S) wave velocities were measured at approximately 5-foot intervals, using three-mutually perpendicular geophones (one vertical and two horizontal) mounted in a 1.75-inch diameter steel cylinder in the borehole. P and S wave sources were generated by hitting a vertical hammer against a metal plate and a horizontal hammer on a wooden beam, respectively. Both the metal plate and wooden beam were located on the ground surface about 10 to 12 feet away from the boring. The results of the seismic velocity surveys are summarized in Table 3-3.

3.4 LABORATORY TESTING PROGRAM

3.4.1 Geotechnical Laboratory Testing

All drive, split-spoon, Pitcher-barrel, and bulk samples obtained during the subsurface exploration were brought to EARTH TECH's soil mechanics laboratory where they were visually examined. Samples of the various material types encountered were selected for laboratory testing. The laboratory test program was designed to classify the predominant soil types encountered in the borings and to evaluate the in situ moisture and density, gradation, shear strength, uniaxial compressive strength, permeability and consolidation characteristics, slake durability, and corrosion potential. The tests were performed in accordance with applicable standard test methods specified by the American Society for Testing and Materials (ASTM), the Environmental Protection Agency (EPA), and the California Department of Transportation (Caltrans).

The test program and applicable test standards are summarized in Table 3-4. Laboratory test results are summarized in Table 3-5 and included in Appendix B. In situ density and moisture content are also shown on the boring logs included in Appendix A. A discussion of the engineering properties of subsurface materials is presented in Section 4.4.

**TABLE 3-3 RESULTS OF DOWNHOLE SEISMIC VELOCITY SURVEYS
(First/Boyle Station & Tunnels between Little Tokyo & First/Boyle Stations)**

Boring No.	Depth Range (ft)	Geological Stratigraphy*	Measured Compressional Wave Velocity (ft/sec)	Measured Shear Wave Velocity (ft/sec)	Calculated Dynamic Modulus and Poisson's Ratio			
					Shear Modulus 10'ksf	Young's Modulus 10'ksf	Bulk Modulus 10'ksf	Poisson's Ratio
DD-15	0-33	Sand with Gravel	1340	760	2.3	5.9	4.1	0.26
	33-55	Sand and Gravel	1800	940	3.6	9.4	8.3	0.31
	55-88	Saturated Sand/ silty Sand	4450	1420	8.2	23.5	69.2	0.44
SD-6	0-40	Silty Sand/ Clay/Silt	1770	1120	5.1	11.8	5.9	0.17
	40-58	Clay/ Silt and Sand	3000	1460	8.6	23.2	24.9	0.35
	58-89	Clayey Sand/ Clay	5200	1460	8.6	25.1	97.8	0.46

Note: * Geological stratigraphy description is defined in Appendix A, Figure A-1.

TABLE 3-4 GEOTECHNICAL LABORATORY TEST PROGRAM
(First/Boyle Station and Tunnels between Little Tokyo & First/Boyle Stations)

TEST TYPE	NUMBER OF TESTS	TEST PROCEDURE
Visual Soil Classification	Every Sample	ASTM D2487 / D2488
Moisture Content	186	ASTM D 2216
Dry Density	176	ASTM D 2937
Grain Size Distribution	121	ASTM D 422
Percent Passing #200 Sieve	44	ASTM D 1140
Atterberg Limits	24	ASTM D 4318
Specific Gravity	4	ASTM D 854
Direct Shear (3 Points)	10	ASTM D 3080
Unconfined Compression	3	ASTM D 2166
Triaxial Compression	1	ASTM D 4767
One Dimensional Consolidation/ and Collapse Potential	7	ASTM D 2435 / and ASTM D 5333
Triaxial Permeability	4	ASTM D 5084
Slake Durability Test	-	ASTM D 4464
pH	14	EPA Method 9045
Chloride Content	14	CALTRANS Test 422
Sulphate Content	14	CALTRANS Test 417-B
Electrical Resistivity	14	CALTRANS Test 532

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST /BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equipment SPT Value	Moisture Content ASTM D2216 (%)	Dry Density ASTM D2937 (pcf)	Grain-Size Distribution ASTM D422 GR 5A FI (%)	AASHTO Limits ASTM D4318 LL PL PI	Percent Passing #200 Sieve ASTM D1140 (%)	Specific Gravity ASTM D 854	Unconfined Compressive Strength ASTM D2166 (ksf)	Direct Shear ASTM D3080 (Peak Strength) Effective Cohesion (psf) Effective Friction Angle (degrees)	Triaxial Compression ASTM D4767 (Peak Strength) Effective Cohesion (psf) Effective Friction Angle (degrees)	Consolidation Characteristics ASTM L 2435 & Collapse Potential ASTM D5333 Cc Cs Cγ Vertical Stress (ksf) Swell (+) Collapse (-) (%)					Initial Permeability ASTM D5084 Permeability (cm/sec)	Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 417-B (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity DOT CA Test 532 @ Insulr (Saturated) Moisture Content (unh/cm)		
(A) This Investigation																										
DD-13	D-1	5	SM	Qa	(22)	12.3	114.3																			
	S-2	10	SM		21																					
	D-3	15	(SM)		(29)	10.2	126.1																			
	S-4	20	SP		32																					
	D-5	25	SP		(31)	7.3	132.6																			
	S-6	30	SP		67																					
	D-7	35	(SM)		(>100)	20.5	116.3																			
	S-8	40	(SW-SM)		99			34:57.9																		
	D-9	45	GP/SP		(>100)	13.7	127.1																			
	S-10	49	SP		>100																					
	D-11	53	SP		(59)	12.2	117.6																			
	S-12	55	GP		>100																					
	D-13A	58	ML		(28)	22.5	101.8																			
	S-14	61	ML		31			37:27:10	84																	
	D-15B	64	SM		(36)	23.1	101.2																			
	S-16	67	SM		40																					
	D-17B	70	SM		(30)	16.9	112.7							400	38											
	S-18	73	SM		93			1:56:43													8.20	152	110			(1389)
	D-19	76	SP		(78)	16.1	108.5																			
	S-20	79	ML		60			0:19:81																		
	D-21B	82	SM		(26)	23.2	103.7																			
	S-22	85	SM		95			0:78:22																		
	D-23	88	(GM)		(>100)			52:35:13																		
	S-24	91	GP		>100																					
	D-25	94	SM		(78)	20.6	107.6																			
	S-26	97	(SM)		>100			18:67:15																		
	D-27	100	GP/SP		(>100)																					
	S-28	105	(SM)		>100			34:52:14																		
DD-13S	D-1	5	SP-SM	Qa	(13)	12.2	101.8																			
	S-2	10	SP-SM		26																					
	D-3	15	SP-SM		(30)	14.0	102.6																			
	S-4	20	SP-SM		45																					
	D-5	25	(SM)		(52)	9.1	117.2																			
	S-6	30	SP-SM		68																					
	D-7	35	SP-SM		(40)	12.9	108.5																			
	S-8	40	(SP-SM)		>100			40:54:6																		
	D-9	45	GP		(>100)																					
	D-10B	48	(SM)		(>100)	13.2	118.5																			
	S-11	50	(SP-SM)		>100			36:59:5																		
	D-12B	55	SP		(46)	18.1	109.2																			
	S-13	57.5	ML		34																					
	D-14	61	ML		(25)	23.4	100.6		30:25:5																	
	S-15	64	SM		67					51																
	D-16	67	SM		(34)	16.7	106.5																			
	S-17	70	SM		>100			4:83:13													9.20	137	640			(1839)
	D-18	73	SP-SM		(40)	20.3	105.0																			
	S-19	76	ML		48																					
	D-20B	80	(ML)		(25)	28.1	98.4																			
	S-21	83	ML		85			0:48:51																		

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST /BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equivalent SPT Value	Moisture Content ASTM D2216 (%)	Dry Density ASTM D2937 (pcf)	Grain Size Distribution ASTM D422 GR SA PI (%)	Atterberg Limits ASTM D4318 LL PL PI	Percent Passing #200 Sieve ASTM D1140 (%)	Specific Gravity ASTM D 854	Unconfined Compressive Strength ASTM D2166 (ksf)	Direct Shear ASTM D3080		Triaxial Compression ASTM D4767		Consolidation Characteristics ASTM C 435 & Collapse Potential ASTM D5333						Triaxial Permeability ASTM D5084		Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 411-B (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity DOT CA Test 532 @ Initial (Saturated) Moisture Content (ohm-cm)
													(Peak Strength)	(Peak Strength)	Cc	Cs	Cr	Vertical Stress (ksf)	Swelling Collapse (%)	Effective Confining Stress (psf)	Permeability (cm/sec)							
																						Effective Cohesion (psf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)				
DD-15	S-18	65	(SW-SM)	Qa	>100			3.85:12															7.52	161	212	(2778)		
	D-19	68	SP		(46)	18.7	112.0																					
	S-20	71	CH/MH		73			50.28:22	63																			
	D-21	75	SM		(34)	18.9	109.2																					
	S-22	77	SM		>100			0.83:17																				
	D-23	81	SM		(58)	13.5	118.4																					
	S-24	85	(SW-SM)		>100			34.57:9																				
D-25	90	(SP-SM)	(95)	14.5	119.3																							
DD-16	B-3	10	(SP)	Qa	-			32.65:3																				
	B-4	15	(GP)					58.38:4																				
	B-5	20	(GP)					50.46:4																				
	B-7	25	(SP-SM)		-			41.51:8																				
	B-9	35	(GP-GM)		-			49.46:5																				
	B-10	39	(SP)		-			48.48:4																				
	B-11	41.5	CL		-				34.19:15	70																		
	B-13	47	CL		-			0.36:64																				
	B-14	49	SP-SM		-			2.90:8																				
B-15	53.5	SP-SM	-			4.90:6																						
DD-17	D-2	10	SW-SM	Qa	(9)	11.5	106.4																					
	S-3	15	SW-SM		42			12.78:10																				
	D-4	18	SW-SM		(15)	15.6	113.7																					
	S-5	21	SW-SM		68			13.75:12																				
	D-6	24	GW		(10)	4.7																						
	S-7	27	(SW-SM)		57			17.74:9																				
	D-8	30	SM		(21)	17.7	106.8																					
	S-9	33	(SW-SM)		99	9.4		35.55:10															9.03	73	88	20833		
	D-10	36	SP-SM		(66)	15.6	110.1																					
	S-11	39	GM/SM		80																							
	D-12	42	GM/SM		(>100)	2.6	110.0																					
	S-13	45	ML		54																							
	D-14	48	ML		(18)	22.1	106.3			59																		
	S-15	51	SP-SM		>100																							
	D-16	54	SP-SM		(46)	19.6	100.6			5																		
	S-17	57	(SM)		87			0.86:14																				
	D-18	60	SP-SM		(52)	16.4	109.8																					
	S-19	63	(SW-SM)		87			2.90:8																				
	D-20	66	SP-SM		(58)	20.9	106.9																					
	S-21	70	SW-SM		>100			0.88:12																				
DD-51	D-1	5	SP	Qa	(5)	16.8	100.8																					
	S-2	10	SP		45																							
	D-3	15	GP		(10)	11.9																						
	S-4	20	SP/GP		43																							
	D-5	25	GP		(31)	10.2	121.8																					
	S-6	30	(SW-SM)		>100			30.62:8																				
	D-7	35	SP/GP		(82)	14.9	112.0																					
	S-8	38	(GP-GM)		>100			65.29:6																				
	D-9	41	(GP-GM)		(>100)																							
	S-10	44	(GW-GM)		>100			48.47:5																				
	D-11	47	(GW-GM)		(92)																							

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST/BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equipment SPT Value	Moisture Content ASTM D2216 (%)	Dry Density ASTM D2937 (pcf)	Grain-Size Distribution ASTM D422 GR SA FI (%)	Atterberg Limits ASTM D4318 LL PL PI	Percent Passing #200 Sieve ASTM D1143 (%)	Specific Gravity ASTM D 854	Unconfined Compressive Strength ASTM D2166 (ksf)	Direct Shear ASTM D3080		Triaxial Compression ASTM D4767		Consolidation Characteristics ASTM D2435 & Collapse Potential, ASTM D5333					In-situ Permeability ASTM D5084		Soil pH USEPA Method 9045	Sulfate Content DOT CA Test #17-B (ppm)	Chloride Content DOT CA Test #22 (ppm)	Electrical Resistivity DOT CA Test 532 @ 100kV (Saturated) Moisture Content (ohm-cm)
													(Peak Strength)		(Peak Strength)		Cc	Cs	Cr	Vertical Stress (ksf)	Swelling Collapse (%)	Effective Confining Stress (psi)	Permeability (cm/sec)				
													Effective Cohesion (psf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)	Effective Friction Angle (degrees)											
DD-13S	D-22B	86	CL	Qa	(22)	25.0	100.2		38.17.21																		
	S-23	89	SM		>100			0.52.48																			
	D-24	92	ML		(16)	23.2	102.9																				
	S-25	95	SM		>100			2.51.47																			
	D-26	98	(SP)		(>100)	10.3																					
	S-27	101	SP-SM		>100					11																	
	D-28	104	SM		(>100)	23.2	106.6			13																	
	S-29	107	SM		>100																						
	D-30	110	SM		(>100)	11.7	123.8																				
S-31	115	GP	>100																								
DD-14	D-1	5	GP	Qa	(40)	7.3	132.0																				
	S-2	10	SP		63						2.67																
	D-3	15	SP		(92)	10.7	126.4				9																
	S-4	20	(SP-SM)		97																						
	D-5	23	SP		(88)	11.8	111.6													20	7.0E-04						
	S-6	26	ML		27			0.36.64																			
	D-7A	29	SM		(24)	18.2	110.4																				
	S-8	32	ML		85			0.19.81																			
	D-9	35	SP-SM		(40)	22.5	98.1																				
	S-10	38	(SW-SM)		85	17.7		13.77.10														9.17	205	85	3125		
	D-11	41	SP-SM		(35)	19.2	112.5																				
	S-12	44	(ML)		36			0.30.70																			
	D-13B	47	SM		(28)	25.6	102.6			45																	
	S-14	50	SM		55			0.71.29																			
	D-15A	53	ML		(43)	27.8	98.8																				
	S-16	56	(SW-SM)		>100			40.51.9																			
	D-17	59	SP/GP		(85)	8.8	134.5																				
	S-18	62	(GW-GM)		>100			56.36.8																			
	D-19	65	ML		(40)	21.2	106.2																				
	S-20	68	ML		55					65																	
	D-21	71	ML		(43)	25.6	101.7																				
	S-22	75	SP		>100																						
	D-23	79	(SP)		(98)	13.2	123.2																				
	DD-15	D-1	5		SP	Qa	(8)																				
S-2		14	SP	14																							
D-3		15	SP	(29)	10.2		115.3																				
S-4		20	SP	41																							
D-5		25	SP	(34)	9.5		108.3																				
S-6		30	SP	53																							
D-7		33	SP	(48)	10.1		122.2																				
S-8		36	(SP-SM)	>100				38.54.8																			
D-9		39	SP/GP	(40)	17.3		102.8																				
S-10		42	(SP-SM)	>100				40.53.7																			
D-11		45	SP/GP	(37)	16.2		113.7																				
S-12		47	SM	>100				2.79.19																			
D-13		51	(SP-SM)	(28)	18.4		106.1																				
S-14		54	(SM)	>100				0.87.13																			
D-15B		57	SP	(24)	11.4		114.3																				
S-16		59	SM	88				0.79.21																			
D-17		62	(SP-SM)	(41)	20.7		103.3				9	2.64		600	38												

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST/BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equivalent SPT Value	Moisture Content ASTM D2216 (%)	Dry Density ASTM D2937 (pcf)	Grain-Size Distribution ASTM D422 GR SA FI (%)	AASHTO Limits ASTM D4318 LL PL PI	Percent Passing #200 Sieve ASTM D1140 (%)	Specific Gravity ASTM D 854	Unconfined Compressive Strength ASTM D2166 (ksf)	Direct Shear ASTM D3080		Triaxial Compression ASTM D4767		Consolidation Characteristics ASTM D2435 & Collapse Potential ASTM D5333						Triaxial Permeability ASTM D5084		Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 417-B (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity DOT CA Test 532 @ Insitu (Saturated) Moisture Content (ohm-cm)
													Effective Cohesion (psf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)	Effective Friction Angle (degrees)	Cc	Cs	Cr	Vertical Stress (ksf)	Swelling Collapse (%)	Effective Confining Stress (psi)	Permeability (cm/sec)					
DD-51	S-12	50	(GW-GM)	Qa	>100			49.45.6																				
	D-13	53	SP/GP		(74)	16.2																	9.4	139	91	4762		
	S-14	56	GP		>100			59.37.4																				
	D-15	59	ML		(24)	23.0	101.5			70																		
	S-16	62	ML		82			7.41.52																				
	D-17	65	ML		(55)	20.2	101.3		31.27.4																			
	S-18	68	SM		>100			5.75.20																				
	D-19	71	ML		(34)	21.7	106.6			55																		
	S-20	74	ML		80																							
	D-21	77	SP		(61)																							
	S-22	80	SP		>100																							
	D-23	83	GP/SP		(79)	12.7	121.5																					
	S-24	86	ML		>100																							
	D-25	89	SM		(81)	23.5	104.6																					
	S-26	95	SP		>100																							
DD-52	D-18	5	(SP)	Qa	(53)	4.2	123.8																					
	S-2	10	SP		75																							
	D-3	15	GP		(64)																							
	D-4	16	(SP)		(34)	10.9	125.8																					
	S-5	20	SP-SM		44			39.46.15																				
	D-6	23	SP-SM		(24)	6.3	109.8																					
	S-7	26	ML		29			0.43.57																				
	D-8	29	SM		(52)	19.3	104.5																					
	S-9	32	ML		61			0.14.86																				
	D-10	35	SP-SM		(67)	13.2	119.3			6																		
	S-11	38	SW-SM		>100			11.80.9																				
	D-12A	41	SM		(29)	23.9	100.5															35	1.9E-07					
	S-13	44	ML		45	24.9		0.33.67															8.81	132	53	2011		
	D-14	47	SM		(25)	22.1	78.8																					
	S-15	50	SM		78					31																		
	D-16B	53	(SP-SM)		(64)	14.1	120.2			6			0	49														
	S-17	56	SP-SM		83			0.92.8																				
	D-18	59	GP		(>100)																							
	D-19B	62	(SM)		(27)	24.0	102.5																					
	S-20	63	(ML)		49			0.28.72																				
	D-21B	66	SM		(37)	27.4	99.0																					
	S-22	69	SM		98																							
	D-23	74	SP		(>100)	15.6	112.2																					
	S-24	79	SP		83																							
DD-54A	D-1	10	SP/SW	Qa	(20)																							
	S-2	14	SP		35																							
	D-3	20	SP		(7)																							
	D-4	25	SP		50																							
	D-x	30	SP		(73)																							
	S-5	35	SP		>100																							
	D-x	40	SP		(>100)																							
	S-6	43	SP		>100																							
	D-7	46	SP		(21)	8.8	114.0																					
S-8	49	SM	75			4.83.13																						
D-9	52	SP-SM	(74)	18.8	103.8																							

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST/BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equivalent SPT Value	Moisture Content ASTM D2218 (%)	Dry Density ASTM D2937 (pcf)	Grain-Size Distribution ASTM D422 GR 5A FI (%)	Atterberg Limits ASTM D4318 LL PL PI	Percent Passing #200 Sieve ASTM D1140 (%)	Specific Gravity ASTM D 854	Unconfined Compressive Strength ASTM D2166 (ksf)	Direct Shear ASTM D3080 (Peak Strength) Effective Cohesion (psf) Effective Friction Angle (degrees)	Triaxial Compression ASTM D4767 (Peak Strength) Effective Cohesion (psf) Effective Friction Angle (degrees)	Consolidation Characteristics ASTM D2135 & Collapse Potential ASTM D5333 Cc Cs Cr Vertical Stress (ksf) Swell (+) Collapse (-) (%)					Triaxial Permeability ASTM D5084 Effective Confining Stress (psf) Permeability (cm/sec)	Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 417.B (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity DOT CA Test 532 @ Insitu (Saturated) Moisture Content (ohm-cm)
DD-54A	S-10	55	SM	Qa	99			0.86:14																
	D-11	58	SP-SM		(67)																			
	S-12	61	(ML)		>100			1.45:54		44														
	D-13	64	SM		(43)	19.0	116.8																	
	S-14	67	SM		100			0.83:17																
	D-15	70	SM		(83)	24.8	101.5																	
	S-16	73	ML		75			0.34:66																
	D-17	76	SM		(37)	18.8	108.1																	
	S-18	79	ML		90			4.41:55																
	D-19	82	SP		(73)																			
	S-20	85	SP		>100																			
	D-21	90	SP/GP		(>100)																			
	S-21	95	ML/CL		80																			
DD-54B	S-22	100	SP		90																			
	S-1	50	SW	Qa	55																			
	S-2	55	(SM)		33			9.75:16																
	S-3	60	SW		75																			
	S-4	65	(SM)		55			4.83:13																
	S-5	70	ML		28			0.19:81																
	S-6	75	SP-SM		32																			
	S-7	80	SW-SM		75			7.82:11																
	S-8	85	SW-SM		95			33:56:11																
	S-9	90	ML		29			0.18:82																
	S-10	95	(SM)		60			0.28:18																
DD-54C	S-11	100	SW		>100																			
	S-1	50	SW	Qa	70																			
	S-4	55	SW-SM		52			16.72:12																
	S-8	60	SW-SM		18																			
	S-10	63.5	SM		20			6.63:31																
	S-13	68	(SM)		60			35.52:13																
	S-18	75.5	ML		20			0.29:71																
	S-21	80	SW		60																			
	S-25	87	(SM)		90			33:52:15																
DD-55	S-29	93	ML	Qa	29			1:16:83																
	S-32	97.5	ML		70																			
	D-2	10	SP-SM		(18)																			
	S-3	15	(SW-SM)		61																			
	D-4	20	GP		(13)																			
	S-5	25	GP		53																			
	D-6	28	GP		(18)			68:30:2																
	S-7	31	GP		91																			
	D-8	34	SP		(>100)	13.0	118.2																	
	S-9	37	(GW-GM)		>100			59:35:6																
	D-10	40	SP		(92)	11.6	124.4																	
	S-11	43	ML		30			6:33:61																
	D-12	48	SP-SM		(58)	15.3	121.0																	
	S-13	49	SP-SM		50	28.2		4:87:9													6.40	280	924	3226
	D-14	52	(SM)		(48)	24.3	99.9																	
	D-15	55	ML		(24)	23.5	100.5																	
	S-16	56	(ML)		97			1:47:52																

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equivalent SPT Value	Moisture Content ASTM D2216 (%)	Dry Density ASTM D2937 (pcf)	Grain Size Distribution ASTM D422 GR 5A FI (%)	Asterberg Limits ASTM D4318 LL PL PI	Percent Passing #200 Sieve ASTM D1140 (%)	Specific Gravity ASTM D 854	Unconfined Compressive Strength ASTM D2166 (ksf)	Direct Shear ASTM D3080		Triaxial Compression ASTM D4767		Consolidation Characteristics ASTM D2435 & Collapse Potential ASTM D5333					Triaxial Permeability ASTM D5084		Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 417-B (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity DOT CA Test 532 @ Initial (Saturated) Moisture Content (ohm-cm)
													Effective Cohesion (psf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)	Effective Friction Angle (degrees)	Cc	Cs	Cr	Vertical Stress (ksf)	Swelling Collapse (%)	Effective Confining Stress (psi)	Permeability (cm/sec)				
DD-55	D-17	58	(SM)	Qa	(62)	25.1	103.3																				
	S-18	61	(SM)		>100			0.85:15																			
	D-19	64	SP-SM		(52)	17.5	109.5																				
	S-20	67	(SM)		>100					13																	
	D-21	70	SP-SM		(82)	19.2	107.6																				
	S-22	73	SP-SM		>100					10																	
	D-23	76	SM		(36)	25.7	99.8																				
	S-24	79	ML		>100					52																	
D-25	85	SP	>100	17.7	111.5																						
DD-56-1	S-1	5	SP	Qa	23																						
	D-2	10	SP/GW		(24)	9.3	118.1																				
	S-3	15	SP		58																						
	D-4	19	SP/GW		(25)	5.2	124.3																				
	S-5	22	SW		65																						
	D-6	25	SW		(20)																						
	S-7	28	SP		50																						
	D-8	31	SP		(12)																						
	D-8	32	SP		(18)																						
	S-9	35	(SW-SM)		>100			30.63:7																			
	D-10	38	SP		(12)																						
	S-11	41	SP		100																						
	D-12	44	SM		(35)	20.8	100.7																				
	S-13	47	SM		>100			0.74:26																			
	D-14	50	SP-SM		(58)	17.5	104.7					200	41									40.0	3.4E-05				
	S-15	53	SP-SM		80			3.85:12															9.34	277	237	(2632)	
	D-16	56	CL		(32)	27.2	100.6		38.23:15	94																	
	S-17	59	SM		>100			0.85:15																			
	D-18	62	SM		(67)	20.9	103.1																				
	S-19	65	SM		>100																						
	D-20	68	SM		(18)																						
D-20	69	SM	(73)																								
S-21	75	SP/GP	>100																								
DD-57	D-2	9	SM	Qa	(9)	12.0	91.4																				
	S-3	12	SM		31			1:57:42																			
	D-4	15	SM		(19)	11.6	105.1																				
	S-5	18	ML		34			3:35:62																			
	D-6	21	SM		(18)	15.4	99.2																				
	S-7	24	ML		38			5:41:54																			
	D-8	27	SP-SM		(38)	8.1	101.9			7																	
	S-9	30	(SW-SM)		51			4:66:10															8.13	258	135	5882	
	D-10	33	(SM)		>100	18.8	111.3																				
	S-11	36	(SM)		>100			2:84:14																			
	D-12	39	SP-SM		(57)	13.7	117.6																				
	S-13	42	(SW-SM)		>100																						
	D-14	45	SW-SM		(82)	13.8	120.6	9.80:11																			
	S-15	48	MH		67																						
	D-16	51	MH		(42)	27.1	95.8																				
	S-17	54	MH		40																						
	P-18	55.5	MH		-				57.31:26			8.583															
	D-19	58.5	MH		(17)	31.6	89.5																				

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST/BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equivalent SPT Value	Moisture Content ASTM D2216 (%)	Dry Density ASTM D2937 (pcf)	Grain Size Distribution ASTM D422 GR SA FI (%)	Atterberg Limits ASTM D4318 LL PL PI	Percent Passing #200 Sieve ASTM D1140 (%)	Specific Gravity ASTM D 854	Unconfined Compressive Strength ASTM D2166 (ksf)	Direct Shear ASTM D3080		Triaxial Compression ASTM D4767		Consolidation Characteristics ASTM D2435 & Collapse Potential ASTM D5333					In-situ Permeability ASTM D5084		Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 417.8 (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity DOT CA Test 532 @ 100% (Saturated) Moisture Content (ohm-cm)
													Effective Cohesion (psf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)	Effective Friction Angle (degrees)	Cc'	Cs'	Cx'	Vertical Stress (ksf)	Swelling Collapse (%)	Effective Confining Stress (psi)	Permeability (cm/sec)				
DD-57	S-20	59.5	SM	Qa	85					46																	
	D-21	64	SM		(53)	23.0	102.7			19																	
SD-6	S-1	5	SP	Qa	95																						
	D-2	10	(SM)		(18)	17.8	111.5																				
	S-3	15.0	SM		57			0.76:24																			
	D-4	20	(ML)		(27)	27.3	94.1		30.25.5																		
	S-5	25.0	CL		42			0.33:67																			
	D-6	30	(SC)		(21)	15.6	118.1			36																	
	S-7	35	(SC-SM)		70			0.61:39																			
	D-8	40	SP-SM		(50)	12.6	106.0			11																	
	S-9	45	CL		95				30.21.9	75																	
	D-10	50	CL		(27)	17.7	110.2																				
	S-11	53	CL		45			0.33:67																			
	D-12	58	CL		(26)	15.4	118.8			58																	
	S-13	59	CL		46																						
	D-14	62	CL		(25)	25.4	100.2		32.19.13			900	28			0.117	0.017	0.0007	8	0.07							
	S-15	65	CL		80	14.7		0.46:54															7.91	97	70	1680	
	D-16	68	SM		(46)	19.8	112.7			38																	
	S-17	71	CL		88			0.46:54																			
	D-18	74	ML/CL		(33)	18.9	112.4																				
	S-19	77	SC		>100			0.59:41																			
	D-20	80	SC		(76)	15.8	118.8																				
	S-21	85	SC		>100					20																	
	D-22	90	SP		(37)	18.9	112.6																				
SD-7	D-1	10	CL	Qa	(27)	17.4	111.3																				
	S-2	15	CL		41			0.40:60																			
	D-3	20	SM		(17)	13.5	109.4																				
	S-3	25	SM		41																						
	D-4	30	SM		(30)	11.2	109.2																				
	S-6	31	SM		79	12.7				34													7.84	353	618	7892	
	S-7	35	ML		48			0.10:90																			
	D-8	40	CL		(12)	23.2	100.9		45.20.25	85																	
	S-9	45	SW-SM		83			3.89:8																			
	D-10	50	SC		(17)	17.0	113.0																				
	S-11	55	(CL)		43			2.47:51	28.16.12																		
	D-12	60	SC		(17)	18.2	112.7		27.16.11	40			0	38													
	S-13	65	SC		100																						
	D-14	69	(SM)		(26)	28.3	96.5																				
	S-15	74	(SM)*		>100			13.73:14																			
	D-16	79	(SP)		(41)	14.2	118.9																				
	S-17	84	SM		>100			4.70:26																			
	D-18	89	SM		(>100)	24.1	105.8			25-35						0.05	0.005	0.0004	8	-0.02							
	S-19	94	SM		>100			0.68:32																			
	D-20	99	SP-SM		(79)	20.2	106.2																				
	S-21	104	SP-SM		>100																						
	D-22	109	SP-SM		(>100)	15.9	111.7																				
SD-8	D-2	10	CL	Qa	(48)	18.4	109.6																				
	S-3	15	CL		55					58																	
	D-4	20	CL		(43)	15.0	117.4		34.16.18		2.72																
	S-5	25	CL		72			0.12:88																			

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equivalent SPT Value	Moisture Content	Dry Density	Grain-Size Distribution	Azimuthal Limit	Percent Passing #200 Sieve	Specific Gravity	Unconfined Compressive Strength	Direct Shear	Triaxial Compression	Consolidation Characteristics ASTM D2435 & Collapse Potential ASTM D5333					Triaxial Permeability ASTM D5084		Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 417-B (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity DOT CA Test 532 @ Moisture Content (Saturated Moisture Content (mm-cm))		
						ASTM D2216 (%)	ASTM D2937 (pcf)	ASTM D422 GR SAI (%)	ASTM D4318 LL PL P _h	ASTM D1140 (%)	ASTM D854	ASTM D2166 (ksi)	(Peak Strength)		(Peak Strength)		Cc	Cs	Cu	Vertical Stress (ksi)	Swelling Collapse (%)					Effective Confining Stress (psi)	Permeability (cm/sec)
SD-8	D-6	30	SC	Qa	(30)	14.4	115.4						500	35													
	S-7	34	SC		33			0.51.49																			
	D-8	40	SC		(90)	9.0	128.7																				
	S-9	45	SC		108			10.88.22																			
	D-10	50	SC		(73)	8.9	113.5																				
	S-11	53	(SM)		111			2.83.35																			
	D-12	55.0	SP-SM		(73)	15.7	98.8																				
	S-13	60	SM		>100			2.82.16																			
	D-14	65	SM		(49)	18.7	108.0																				
	S-15	69	ML/CL		81			1.28.73																			
	D-16	75	(SP-SM)		(97)	12.2	109.5			12										65	1.7E-04						
	S-17	80	CH		76			59.24.35																			
	D-18	84	CL/ML		(48)	34.7	88.3																				
	S-19	87	(SM)		>100			0.72.28																			
	D-20	90	SP-SM		(82)	14.6	97.1																				
	S-21	93	(SM)		>100			8.80.14																			
	D-22	96	SP		(>100)	15.8	102.5																				
	S-23	100	(SM)		>100					18																	
	D-24	105	SP		(>100)	10.3	110.8																				
	S-25	110	CL		>100																						
	D-26	115	(CL)		(74)	41.0	81.0																				
	S-27	120	CL		70																						
	D-28	123	ML		(35)	28.3	98.3																				
	D-30	128	GM/SM		>100																						
	D-31	130	SP-SM		(>100)	25.3	98.3																				
	S-32	135	SP-SM		>100																						
	D-33	140	(SC)		(>100)	13.0	118.5																				
	SD-9	D-2	10		CL	Qa	(12)	12.8	120.0																		
		S-3	14		CL		20																				
		D-4	18		SP-SM		(21)	17.2	109.7			7															
		S-5	24		CL		33																				
		D-6	28		CL		(14)	14.6	113.6																		
		S-7	33		SC		35			5.48.47																	
D-8		38	SP	(43)	12.0		118.8																				
S-9		42	SM	81				2.80.18																			
D-10		47	SP-SM	(37)	11.9		113.4																				
S-11		50	SM	>100				0.73.27																			
D-12		54	CL/ML	TVTp	(26)	27.9	95.8																				
S-13		59	CL/ML		33																						
P-14		81	CL/ML		-	27.2	98.8		47.28.21	95	2.78	11.101	1200	31								8.15	79	854	2885		
D-15		83.5	CL/ML		(25)	28.1	98.8																				
D-17		87	CL/ML		(28)																						
D-18		70.5	CL/ML		(21)	25.5	98.9																				
D-21		75	CL/ML		(25)	28.5	98.8																				
D-23		81	CL/ML		(27)	25.3	98.9																				
P-24		84	CL		-	24.4	101.1		48.25.23	98					0	35	0.057	0.018	0.0006	10	0.15						
S-25		87	CL/ML		51																						
P-28		88.5	CL/ML		-	28.2	98.3					18.404															
D-27		95	CL		(36)	28.4	97.3		47.27.20									0.073	0.013	0.0004	2	0.36					
D-29		105	CL/ML		(30)	24.9	99.4																				

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST /BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equivalent SPT Value	Moisture Content ASTM D2216 (%)	Dry Density ASTM D2937 (pcf)	Grain Size Distribution ASTM D422 GR SA FI (%)	Atterberg Limits ASTM D4318 LL PL PI	Percent Passing #200 Sieve ASTM D1140 (%)	Specific Gravity ASTM D 854	Unconfined Compressive Strength ASTM D2166 (ksf)	Direct Shear ASTM D3080		Triaxial Compression ASTM D4767		Consolidation Characteristics ASTM D2435 & Collapse Potential ASTM D5333					Triaxial Permeability ASTM D5084		Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 417 B (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity DOT CA Test 532 @ Insitu (Saturated) Moisture Content (ohm-cm)
													Effective Cohesion (psf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)	Effective Friction Angle (degrees)	Cc	Cs	Cv	Vertical Stress (ksf)	Swelling Collapse (%)	Effective Confining Stress (psi)	Permeability (cm/sec)				
SD-10	D-2	10	SM	Qa	(17)	8.8	113.3			22																	
	S-3	15	CL		26																						
	D-4	20	CL		(11)	19.3	105.5																				
	S-5	25	CL		22																						
	D-6	30	CL		(8)	16.5	111.1		31,13,18	66		400	30														
	S-7	35	CL		19																						
	D-8	40	CL		(10)	11.3	113.2																				
	S-9	45	SC		29			2:59:39																			
	D-10	48	SC		(32)	8.0	105.4																				
	S-11	51	CL		19																						
	D-12	54	SC		(9)	14.6	114.9																				
	S-13	57	SM		29			4:53:33																			
	D-14	60	SM		(20)	15.3	119.2		24,15,9	35																	
	S-15	63	SM		56			11:71:18																			
	D-16	66	CL/ML		Tt/Tp	(26)	27.6	95.7																			
	S-17	69	CL/ML	31																							
	D-18	72	CL/ML	(35)		27.0	96.7																				
	S-19	75	CL/ML	27																							
	D-20	78	CL/ML	(9)		27.4	98.3																				
	S-21	81	CL/ML	34																							
	D-22	84	CL	(14)		24.5	100.5		42,21,21			2200	25														
	S-23	87	CL/ML	31																							
	D-24	90	CL	(25)		24.2	100.6		47,24,23								0.09	0.01	0.0003	2	0.37						
	S-25	93	CL/ML	39																							
	D-26	96	CL/ML	(83)		24.3	99.2																				
	S-27	100	ML	42																							
	D-28	105	CH	(9)		26.2	98.2		50,24,26								0.113	0.017	0.0004	2	0.51						
	S-29	109	ML	>100																							
	(B) Previous Preliminary Investigation																										
PE-21	D-1	5	CL	Qa	(27)	14.8	117.7																7.60	45	36	2083	
	S-2	10	CL		35																						
	D-3	15	CL		(19)	14.9	114.9																				
	S-4	20	SC		>100																						
	D-5	25	SM		(29)	18.4	107.8																				
	S-6	30	SM		83			0:73:27																			
	D-7	35	CL		(26)	18.6	114.0	0:26:74	24,15,8		2.71	450	34				0.09	0.01	0.0026	4	-0.02						
	S-8	40	CL		44				33,15,18	57													8.44	210	158	12987	
	D-9	45	SW/GW		(>100)	9.0	130.2																				
	S-10	50	CL		100				38,23,15	53																	
	D-11	55	SW		(>100)	12.1	108.6																				
	S-12	60	SW-SM		>100					12																	
	D-13	65	SW-SM		(>100)	11.1																					
	S-14	70	SW-SM		98			4:85:11																			
	D-15	75	SW-SM		(>100)	18.5																					
	S-16	80	GW/SW		>100																						
	D-17	85.5	SP-SM		(>100)	20.9																					
	S-18	90	CH		100				55,24,31																		
	D-19	95	CH		(50)	34.2	88.6		61,24,37	99	2.72						0.16	0.04	0.0021	8	+0.53						
	S-20	100	SW/ML		>100																						
	D-21	105	SW/ML		(87)	17.0	104.9																				

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST/BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Equivalent SPT Value	Moisture Content ASTM D2216 (%)	Dry Density ASTM D2937 (pcf)	Grain-Size Distribution ASTM D422 GR SA F (%)	Atterberg Limits ASTM D4318 LL PL PI	Percent Passing #200 Sieve ASTM D1140 (%)	Specific Gravity ASTM D 854	Unconfined Compressive Strength ASTM D2166 (ksf)	Direct Shear ASTM D3080		Triaxial Compression ASTM D4767		Consolidation Characteristics ASTM D2431 & Collapse Potential ASTM D5333					Triaxial Permeability ASTM D5084		Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 417.8 (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity DOT CA Test 532 Moisture Content (ohm-cm)
													Effective Cohesion (psf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)	Effective Friction Angle (degrees)	Cc	Cs	Cr	Vertical Stress (ksf)	Swelling Collapse (%)	Effective Confining Stress (psf)	Permeability (cm/sec)				
PE-21	D-22	110	SW/ML	Qa	(>100)	18.4																					
PE-24	D-1	5	SP-SM	Qa	(4)	19.9	90.7			7																	
	S-2	10	SP		20																						
	D-3	15	SP		(23)	10.7	118.6																				
	S-4	20	SP-SM		68			8.83.9																			
	D-5	25	SM		(32)	18.2	112.0																				
	S-6	30	(SP-SM)		100			20.72.8																			
	D-7	35	GW		(68)	11.3	117.9																				
	S-8	40	(SP-SM)		>100			35.60.5																			
	D-9	45	GW		(78)	7.7																					
	S-10	50	SP-SM		>100			6.81:11																			
	D-11	55	SP-SM		(98)	20.9	108.7																				
	S-12	60	SM		100			0.84:16															8.17	76	98	4000	
	D-13	65	SM		(78)	19.1	109.1																				
	S-14	69	ML/SM		68			26.23.3	50																		
	D-15	75	ML		(46)	25.2	100.6	0.43:57				1250	33														
	S-16	80	SM		>100			19.64:17																			
	D-17	85	GP		(>100)	5.0																					
PE-25	D-1	5	SM	Qa	(10)	18.4	95.6																				
	S-2	10	ML		4																						
	D-3	15	SW		(14)	12.8	118.5																				
	S-4	20	(SP-SM)		31			7.84.9																			
	D-5	25	GP-GM/SP-SM		(24)	9.8																					
	S-6	30	(SP-SM)		63			20.70:10																			
	D-7	35	GP-GM		(68)	10.9	124.7																				
	S-8	41	(SP-SM)		>100			37.56:7																			
	D-9	45	GP		(>100)	8.8																					
	S-10	50	GP		>100			52.43:5																			
	D-11	58	GP		(61)	8.6	130.5																				
	S-12	59	CL		34			43.23.20															8.59	289	112	3333	
	D-13	65	SM/ML		(23)	16.8	115.3	0.51:49				1600	27														
	S-14	70	SP-SM		>100			0.90:10																			
	D-15	75	SP		(73)	18.3	111.0																				
	S-16	80	ML		72			0.25:75																			
	D-17	85	ML		(59)	21.3	104.7																				
PE-26	D-2	10	ML	Qa	(26)	13.6																					
	S-3	15	SP-SM		9																						
	D-4	20	SP-SM		(46)	18.0		14.81:5																			
	S-5	25	GP-GM		>100			55.37:8																			
	D-6	30	SM		(60)	12.1	115.0																				
	D-9	57	CL		(58)	23.2	102.1	0.24:76	34.21.13			900	30									7.89	87	172	1887		
	S-10	64	CL		>100				28.20.8	72																	
	D-11	70	CL		(48)	26.7	99.6																				
	D-12	80	SM		(>100)	18.8	104.5	0.85:15																			
	D-13	85	CL		Ti/Tp	(>100)	21.7	106.2		36.24.12	84																

- NOTES:
- USCS Classifications are based on the visual-manual procedure (ASTM 2488) and laboratory test results (ASTM D2487).
 - Some of the material classifications (identified in parentheses) shown in column 4 of this table are not consistent with the general classification of that interval in the boring logs. This generally occurs in gravelly and cobbly layers where due to presence of gravels and cobbles larger than sampler size (2.4-inch inner diameter), laboratory gradations and classifications only reflect the finer matrix materials in alluvium.

TABLE 3-5 SUMMARY OF LABORATORY TEST RESULTS
(FIRST/BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

NOTES (Continue):

3. For the same reasons presented above, results of gradation, fines content, in situ moisture content and in situ dry density tests in layers identified as gravels, silty/clayey gravel, gravel with sand and sand with gravel, are only representative of the finer matrix materials in the alluvium.
4. Geologic units Af, Qa and Tt/Tp denote artificial fill, alluvium and the Fernando/Puente Formation, respectively.
5. For California Drive Samples, Equivalent SPT values were obtained by applying the appropriate corrections for different hammer weights, hammer drop and sampler dimensions (see Appendix A, Figure A-2). Equivalent SPT values corrected from drive sampler blowcounts are shown in parentheses.
6. Compression Index (Cc') and Swelling Index (Cs') are based on vertical strain-log stress plots. Rate of Secondary Compression (Cx') is based on vertical strain-log time plot.
7. Swell/collapse indicates measured strains in sample when saturated from in situ moisture conditions at approximately the in situ overburden pressure.
8. Explanation of symbols:
 - GR:SA:FI = Gravel: Sand : Fines (percent passing #200 sieve)
 - LL,PL,PI = Liquid Limit, Plastic Limit, Plasticity Index

3.4.2 Analytical (Chemical) Testing

Analytical (chemical) testing was performed on the following samples of groundwater:

- Groundwater samples from Pump Well DD-54C, including one obtained at about the mid-point of the step-drawdown test and one after completion of the aquifer pump testing.
- One groundwater sample each from Monitoring Wells PE-21 and DD-15.

The test program, relevant test standards and the results of the analytical testing of groundwater are summarized in Tables 3-6a and 3-6b are presented in Appendix C.

3.5 FIELD OBSERVATIONS

Table 3-7 summarizes various field observations noted during drilling, sampling, and development of monitoring wells. These observations include the following:

- Locations and approximate sizes of cobbles and boulders
- Occurrence of caving and/or loss of drilling mud circulation
- Depth intervals of potential hydrocarbon contamination
- Depth intervals of sulfurous and/or hydrocarbon odor
- Hydrogen sulfide measurements made during well development and groundwater quality sampling
- Locations and concentrations of volatile organic vapor from soil samples having organic vapor analyzer (OVA) measurements at least 10 ppm higher than the corresponding background readings.

It is noted that the locations and sizes of boulders and cobbles encountered in the field investigation, as summarized in Table 3-7 and described in the boring logs (Appendix A), were based on observations and estimates made during drilling, rate of drilling advance, and the occurrence of drill rig chatter. Taking into account the size and type of drill bit employed on this project (4 7/8-inch, tricone bit which is capable of drilling through cobbles and boulders), and based on drilling experience with the particular drill rigs and drill bits used in this investigation, the occurrence of drill rig chatter is considered to be indicative of the presence of dense cobbly soils with clast sizes on the order of 3 inches or more.

TABLE 3-6a SUMMARY OF LABORATORY TESTS RESULTS ON GROUNDWATER SAMPLES
- MONITORING WELLS PE-21 AND DD-15

Constituents	EPA Test Method	Units	Well PE-21 Results	Well DD-15 Results	DL	Max. Discharge Limits
<u>Conventional</u>						
pH	150.1	pH	6.9	7.5	0.1	6 to 9
Suspended Solids	160.2	mg/L	628	653	10	75
BOD, 20°	405.1	mg/L	20	ND	20	30
Oil and grease	413.2	mg/L	1.2	ND	1	15
Settleable solids	160.5	mg/L	1.5	2	0.5	2
Turbidity	180.1	NTU	270	151	1	75
Total dissolved solids	160.1	mg/L	1640	710	10	1,500
Chlorides	300	mg/L	203	47	10	150
Sulfates	300	mg/L	511	120	50	350
Nitrites + Nitrates	300	mg/L	8.99	4.7	0.5	8
Sulfides	376.1	mg/L	ND	ND	0.6	1
<u>Metals</u>						
Arsenic	3005/6010	ug/L	ND	ND	50	50
Chromium	3005/6010	ug/L	ND	ND	10	50
Silver	3005/6010	ug/L	ND	ND	10	50
Cadmium	3005/6010	ug/L	ND	ND	5	10
Selenium	3005/6010	ug/L	ND	ND	10	10
Lead	3005/6010	ug/L	ND	ND	50	50
Mercury	7470	ug/L	ND	ND	0.2	2
Copper	3005/6010	ug/L	ND	ND	10	1000
Zinc	3005/6010	ug/L	25.1	16.7	10	5000
<u>Base, Neutral, & Acid Extractables</u>						
1,4-dichlorobenzene	625	ug/L	ND	ND	10	5
Phenols	625	ug/L	ND	ND	10	1000
<u>Volatile Organic Chemicals</u>						
Benzene	602	ug/L	ND	ND	1	1
Toluene	602	ug/L	ND	ND	1	10
Xylene	602	ug/L	ND	ND	3	10
Ethylbenzene	602	ug/L	ND	ND	1	10
Carbon tetrachloride	601	ug/L	ND	ND	1	0.5
Tetrachloroethylene	601	ug/L	ND	ND	1	5
Trichloroethylene	601	ug/L	ND	ND	1	5
1,1-dichloroethane	601	ug/L	ND	ND	1	5
1,2-dichloroethane	601	ug/L	ND	ND	1	0.5
1,1-dichloroethylene	601	ug/L	ND	ND	1	6
Vinyl chloride	601	ug/L	ND	ND	5	0.5
TPH	M8015	mg/L	ND	ND	0.05	
TRPH	418.1	mg/L	1.4	ND	1	

Notes:

mg/L - milligrams per liter

ug/L - micrograms per liter

EPA - Environmental Protection Agency

ND - not detected above the laboratory method detection limit

DL - Detection Limit

TPH - Total petroleum hydrocarbons

TRPH - Total recoverable petroleum hydrocarbons

**TABLE 3-6b SUMMARY OF LABORATORY TESTS RESULTS ON GROUNDWATER SAMPLES
- PUMP WELL DD-54C**

Constituents	Method of Analyses	Units	Sample Identification and Collection Date		NPDES MDL Maximum Discharge Limit	MCL Maximum Contaminant Level
			2/9/96	2/18/96		
			DD-54C Test Dewatering Well			
			Sample: At the End of Well Development. Total 6,000 gallons removed.	Sample: After Pumping Well for 1400 Minutes at 147 gpm. Total 235,000 gallons removed.		
Conventional						
pH	150.1	pH	7.5	7.2	6 to 9	6.5 to 8.5 (secondary)
Suspended Solids	160.2	mg/L	<10	<10	75	NA
BOD, 20'	405.1	mg/L	<1	<1	30	NA
Oil and Grease	413.2	mg/L	<1	<1	15	NA
TPH	M8015	mg/L	<0.05	<0.05	NA	NA
TRPH	418.1	mg/L	<1	<1	NA	NA
Settleable Solids	160.5	mg/L	<0.5	<0.5	2	NA
Turbidity	180.1	NTU	4.5	2.02	75	5 (secondary)
Total Dissolved Solids	160.1	mg/L	440	1010	1,500	500 (secondary)
Alkalinity	310.1	mg/L	NA	302	NA	NA
Calcium	3005/6010	mg/L	71.7	171	NA	NA
Chlorides	300	mg/L	43.2	275	150	250 (secondary)
Magnesium	3005/6010	mg/L	20.3	47.8	NA	NA
Nitrites + Nitrates (as N)	300	mg/L	2.97	0.42	8	10
Sodium	3005/6010	mg/L	55	117	NA	NA
Sulfates	300	mg/L	102	221	350	250 (secondary)
Sulfides	376.1	mg/L	<0.2	<0.2	1	NA
Title 22 Metals						
Arsenic	3005/6010	ug/L	<50	<50	50	50
Cadmium	3005/6010	ug/L	<5	<5	10	10
Chromium	3005/6010	ug/L	<10	<10	50	50
Copper	3005/6010	ug/L	54.3	<10	1,000	1,000 (secondary)
Lead	3005/6010	ug/L	<50	<50	50	50 (CA) 15 (EPA)
Mercury	7470	ug/L	<0.2	<0.2	2	2
Selenium	3005/6010	ug/L	<10	<10	10	10
Silver	3005/6010	ug/L	<10	<10	50	50
Zinc	3005/6010	ug/L	149	95.7	5,000	5,000 (secondary)
Organic Compounds						
Semi-Volatile - Base, Neutral & Acid Extractables						
1,4-Dichlorobenzene	3550/625	ug/L	<5	<5	5	5
Phenols	3550/625	ug/L	<10	<10	1,000	NA
Volatile						
Benzene	602	ug/L	<1	<1	1	1
Toluene	602	ug/L	1.2	1	10	1,000
Xylene	602	ug/L	<3	<3	10	1,750
Ethylbenzene	602	ug/L	<1	<1	10	680
Bromodichloromethane	601	ug/L	4.3	<1	NA	100
Carbon Tetrachloride	601	ug/L	<0.6	<0.6	0.5	0.5
Chloroform	601	ug/L	8	1	NA	100
Tetrachloroethylene	601	ug/L	1.5	<1	5	5
Trichloroethylene	601	ug/L	<1	<1	5	5
1,1-Dichloroethane	601	ug/L	<1	<1	5	5
1,2-Dichloroethane	601	ug/L	<0.3	<0.3	0.5	0.5
1,1-Dichloroethene	601	ug/L	<1	<1	6	6
Vinyl chloride	601	ug/L	<0.5	<0.5	0.5	0.5

Notes:

mg/L - milligrams per liter

ug/L - micrograms per liter

EPA - Environmental Protection Agency

NPDES - National Pollutant Discharge Elimination System

NA - Not Analyzed or Not Applicable

MCL - California or US EPA drinking water standard maximum contaminant level.

TPH - Total petroleum hydrocarbons

TRPH - Total recoverable petroleum hydrocarbons

**TABLE 3-7 SUMMARY OF VARIOUS FIELD OBSERVATIONS DURING DRILLING SAMPLING
AND DEVELOPMENT OF MONITORING WELLS
(First/Boyle Station and Tunnels between Little Tokyo and First/Boyle Stations)**

Boring/ Well No.	Approximate Station Along CR Track	Approximate Depth to Tunnel Invert/Station Bottom (ft)	Groundwater Depth measured (date) (ft)	Boulder Size/Depth	Cobbles Size/Depth (inch/ft)	Depth of Caving or Loss of Circulation	Depth of Detected Sulfur Odor (ft)	Depth of Detected Hydrocarbon Odor (ft)	OVA Reading Depth/OVA(1) (ft/ppm)	REMARKS
(A) This Investigation										
DD-13	58+80	83/181	76.2 (11/21/95)		'13'-30' '32'-45' '45'-55' '55'-57.5'					Monitoring well installed.
DD-13S	82+80	92/170			'1'-56' '99.5' '103'-115'					
DD-14	65+29	54/173	30.3 (2/14/96)		'1' '8'-20' '22' '54.5'-65' '72'-80'					Monitoring well installed.
DD-15	78+04	68/188	51.4 (2/14/96)		(')/1'-15' '15'-20' (*)/20'-32.5' '32.5'-45.0' (*)/51'-53' (*)/65'-68' '80'-90.5'					Monitoring well installed.
DD-16	85+65	54/203		20"/40'	3.5"-7"/7' 8"/18" 7.5"/23'					
DD-16	85+65	54/203			6"/35' 10"/40' 6"/53.5'					
DD-17	90+68	50/212	54.2 (2/14/96)		'5.2'-44.5' 6"-8"/37' 8"/38'					Monitoring well installed.

**TABLE 3-7 SUMMARY OF VARIOUS FIELD OBSERVATIONS DURING DRILLING SAMPLING
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Boring/ Well No.	Approximate Station Along CR Track	Approximate Depth to Tunnel Invert/Station Bottom (ft)	Groundwater Depth measured (date) (ft)	Boulder Size/Depth	Cobbles Size/Depth (inch/ft)	Depth of Caving or Loss of Circulation	Depth of Detected Sulfur Odor (ft)	Depth of Detected Hydrocarbon Odor (ft)	OVA Reading Depth/OVA(1) (ft/ppm)	REMARKS
DD-51	49+95	62/200			(*)/12' **/20' 6"/38' */38'-48' 8"/41' **/48' **/50' */82'-86.5' */93.5'					
DD-52	66+75	52.3/175			*/1.3'-23' */59.5'-61.5' */72' */75'-79'					
DD-54A	71+37	74/182	49.7 (11/21/95)		*/29' */37' * and 8"/41' */45' */83.5' */88' **/89'					Monitoring well installed.
DD-54B	71+05	74/182								Monitoring well installed.
DD-54C	71+02	74+182			**/81.5' **/86.5'					Pump well installed.
DD-55	60+80	61/196			3"/38.5' 3.5"/47.5'					
DD-56-1	65+50	54/203			*/9' */24' */27' */33'					

**TABLE 3-7 SUMMARY OF VARIOUS FIELD OBSERVATIONS DURING DRILLING SAMPLING
AND DEVELOPMENT OF MONITORING WELLS
(First/Boyle Station and Tunnels between Little Tokyo and First/Boyle Stations)**

Boring/ Well No.	Approximate Station Along CR Track	Approximate Depth to Tunnel Invert/Station Bottom (ft)	Groundwater Depth measured (date) (ft)	Boulder Size/Depth	Cobbles Size/Depth (inch/ft)	Depth of Caving or Loss of Circulation	Depth of Detected Sulfur Odor (ft)	Depth of Detected Hydrocarbon Odor (ft)	OVA Reading Depth/OVA(1) (ft/ppm)	REMARKS
DD-56-1	85+50	54/203			*137' *142' *170'-75.4'					
DD-57	94+60	34/229			-					
SD-6	97+14	59/235	57.9 (2/14/96)		6"/2.5' *180' *187'-88'					Monitoring well installed.
SD-7	100+30	69/242			*182'	Loss of circulation (43'-45')				
SD-8	102+55	78/236			*149' *153' *169' *175' *125.5' *133' *138'			45/140		
SD-9	104+44	75/237	55.9 (2/14/96)		*139' *142'		63.5 65			Monitoring well installed.
SD-10	106+30	81/237			-					
(B) Previous Preliminary Investigation										
PE-21	101+40	78/235	58.1 (2/14/96)	about 12"/78' about 12"/80'	*143' *198'					Monitoring well installed.
PE-24	70+71	76/181			*17'-12' *132' *139' 8"/147' *182'					
PE-25	61+80	92/170	72.3 (1/11/94)	about 12"/49'	*118' 4"/144'					Monitoring well installed.
PE-26	52+15	66/196			**12'					

**TABLE 3-7 SUMMARY OF VARIOUS FIELD OBSERVATIONS DURING DRILLING SAMPLING
AND DEVELOPMENT OF MONITORING WELLS
(First/Boyle Station and Tunnels between Little Tokyo and First/Boyle Stations)**

Boring/ Well No.	Approximate Station Along CR Track	Approximate Depth to Tunnel Invert/Station Bottom (ft)	Groundwater Depth measured (date) (ft)	Boulder Size/Depth	Cobbles Size/Depth (inch/ft)	Depth of Caving or Loss of Circulation	Depth of Detected Sulfur Odor (ft)	Depth of Detected Hydrocarbon Odor (ft)	OVA Reading Depth/OVA(1) (ft/ppm)	REMARKS
PE-26	52+15	66/195			*5'-9'					
					**/10'					
					*/27'					
					*/34'					
					*/36'					
					**/37'					
					**/50'					
					*/67'					
					*/75'					

NOTES:

(1) Organic Vapor Analyzer (OVA) Concentration ≥ 10 ppm than the corresponding OVA background readings.

- Taking into account the size and type of drill bit (4-7/8 - inch tricone bit) used in the geotechnical investigations, chatter of rotary wash rigs is considered to be indicative of the presence of dense cobbly zones with clast sizes on the order of 3 inches or larger.

** Encountered cobbles of unspecified size.

(*) Occasional encountered cobbles of unspecified size.

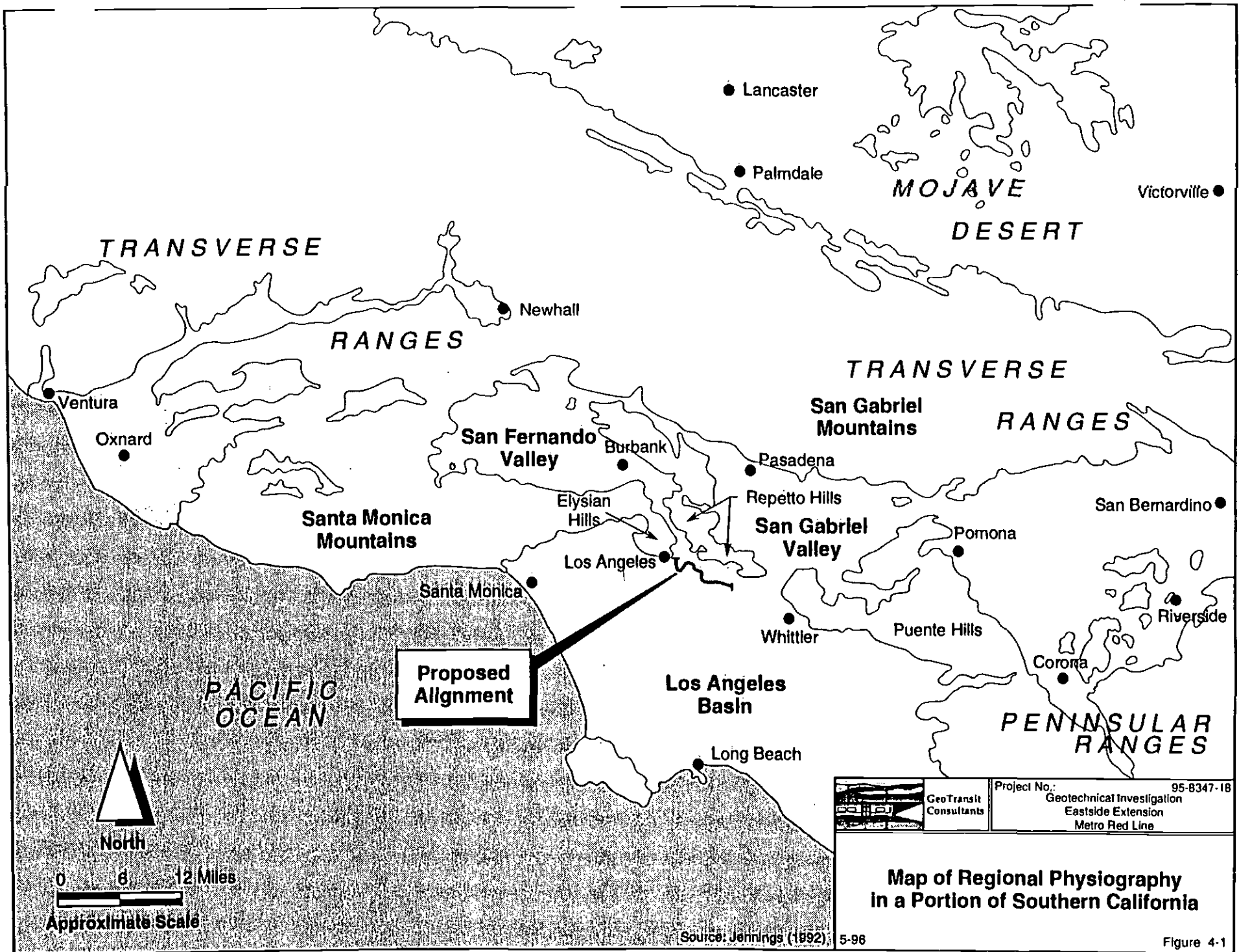
4.0 GEOLOGIC AND GROUNDWATER CONDITIONS

4.1 REGIONAL SETTING

4.1.1 Regional Geology

The proposed Metro Rail Eastside Extension alignment is on the northern edge of the Los Angeles coastal plain and the underlying structural basin, at the junction between the Transverse Ranges and Peninsular Ranges geomorphic provinces in Southern California (Figure 4-1). The Elysian Park and Repetto Hills in central and eastern Los Angeles are a northwest extension of the Peninsular Ranges trending northwest from Baja, California. The east-west oriented San Gabriel, Verdugo, and Santa Monica Mountains to the north of the hills are in the western part of the Transverse Ranges, which extend across Southern California from the Colorado Desert to Point Arguello. The Peninsular Ranges are largely defined by right-lateral strike-slip faulting and associated folding parallel to their trend. The western Transverse Ranges are uplifted by northward-dipping thrust faults along their southern margin. The hilly terrain of the Eastside Extension area appears to result from folding and faulting in a zone of convergence between these major sets of structures.

Bedrock units of the mountainous areas on the margins of the basin consist of a wide variety of Precambrian to Mesozoic igneous and metamorphic basement rocks, and a partial cover of Mesozoic to early Tertiary sedimentary and volcanic strata. Tertiary marine sediments and lesser volcanic rocks that were deposited in the developing Los Angeles basin during Miocene and Pliocene time compose much of the folded and faulted, northwest-trending hills of the present coastal plain. The oldest strata exposed in the southern and western Repetto Hills near the proposed alignment are those of the Puente Formation, which consist primarily of siltstone, claystone, and sandstone. Puente Formation strata are conformably overlain by deposits of the Pliocene-age Fernando Formation, which generally grade upward from siltstone near the base to conglomerate near the top. This unit apparently records the final episode of marine deposition in the Los Angeles Basin, before the coastal plain was elevated above sea level.



Deformation of Miocene and Pliocene marine deposits in the Repetto Hills has been accompanied during Pleistocene time by deposition of alluvium from the Transverse Ranges to the north. Cycles of alluvial deposition, continued deformation, and partial erosion have left a fringe of uplifted and dissected alluvial fans and terraces on the flanks of the hills.

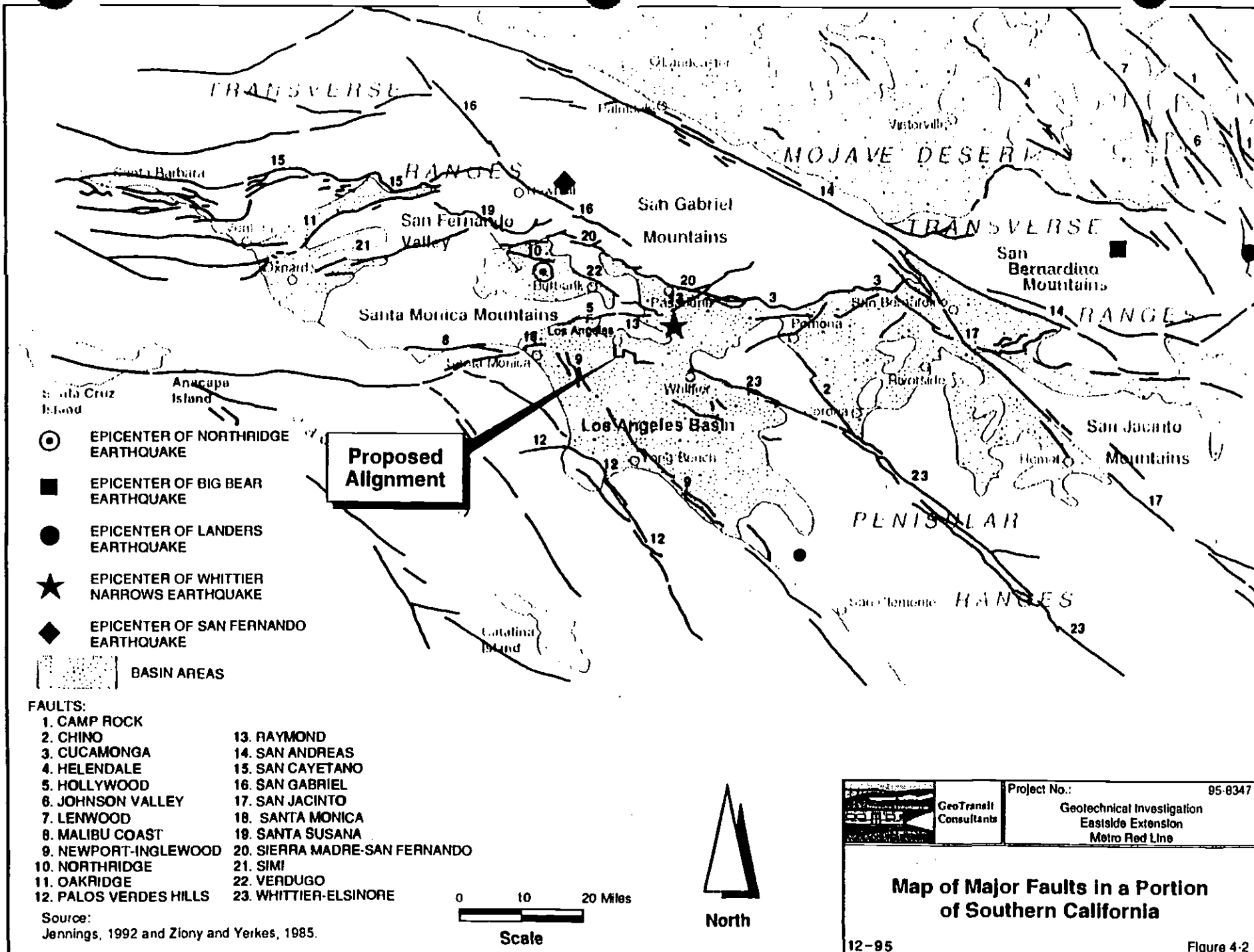
There is current debate among geologists about the geologic structure and ongoing tectonic activity in the Repetto and Elysian Park hills. Speculation in the wake of the 1987 Whittier Narrows earthquake suggests that a northeast- to north-dipping extension of faulting beneath the northwest trend of the Whittier fault has produced thrust-fault offsets of well-consolidated bedrock at depth that are expressed in the weaker near-surface materials by folding, faulting, or a combination of the two comprising the Repetto and Elysian Park hills.

4.1.2 Regional Faulting and Seismicity

4.1.2.1 Regional Faulting

The proposed alignment is located in an area of high seismic-potential that has experienced ground shaking from a number of earthquakes in historical time. The earthquakes are being generated by periodic slip across the northwesterly-trending strike-slip San Andreas and Peninsular Ranges fault systems, and on the generally east-west trending thrust faults of the Transverse Ranges.

Figure 4-2 shows the known major active and potentially active faults in the greater Los Angeles area. According to the California Division of Mines and Geology (CDMG), the term "active" applies to any fault that has moved within Holocene time (i.e., the past 11,000 years). Such activity is recognized by displacement of Holocene-age sediments or by direct association with seismic activity. The term "potentially active" applies to a fault that has been active during Pleistocene time (i.e., 2 to 3 million years preceding the Holocene). Such faults may have remained active during Holocene time, but direct geologic evidence for continued activity is not available. The CDMG does not specifically define an inactive fault, although they do indicate that a fault may be presumed to be inactive based on "direct geologic evidence" of inactivity during the past 11,000 years or longer (Hart, 1994).



The documented active faults closest to the alignment are the east-west trending Hollywood, Santa Monica, and Raymond faults. The Hollywood and Santa Monica faults are located at the southern base of the Santa Monica Mountains about 6½ miles northwest of the alignment. The Raymond fault passes through the northern part of the Repetto Hills into the south Pasadena-San Marino area to the east, and is about 5 miles north of the alignment at its closest point. A fault that is postulated to be the extension of the Whittier fault to the northeast of the Montebello and Monterey Park Hills area is located approximately 6 miles northeast of the alignment (Treiman, 1991; Bullard and Lettis, 1993). Other active and potentially active faults that are within 30 miles of the alignment are listed in Table 4-1 together with the San Andreas fault, which has been included in the table for comparative purposes.

In addition to the fault traces that are shown in Figure 4-2, topographic features having tectonic origins have been identified in the vicinity of the alignment (Plate 1). An east-west-trending linear escarpment in alluvium that crosses the Eastside Extension alignment at three locations (approximate Stations CR 35+50, CR 109+00 and CR 155+00) coincides with the "Coyote Pass fault" as mapped by the California Department of Water Resources (1961). Several investigators have interpreted the escarpment to be a tectonic feature related to a postulated buried thrust fault system within this part of the Los Angeles basin (Bullard and Lettis, 1993; Dolan and Sieh, 1992a and 1992b; Davis and others, 1989). Our subsurface evaluation of the escarpment and its geologic significance for the project alignment are discussed in a separate report (GeoTransit Consultants, 1996a).

4.1.2.2 Regional Seismicity

Moderate to large earthquakes can be expected to occur in the site region during the life of the project. In the event that a nearby fault were to slip and produce a major earthquake, strong ground motions would affect the alignment.

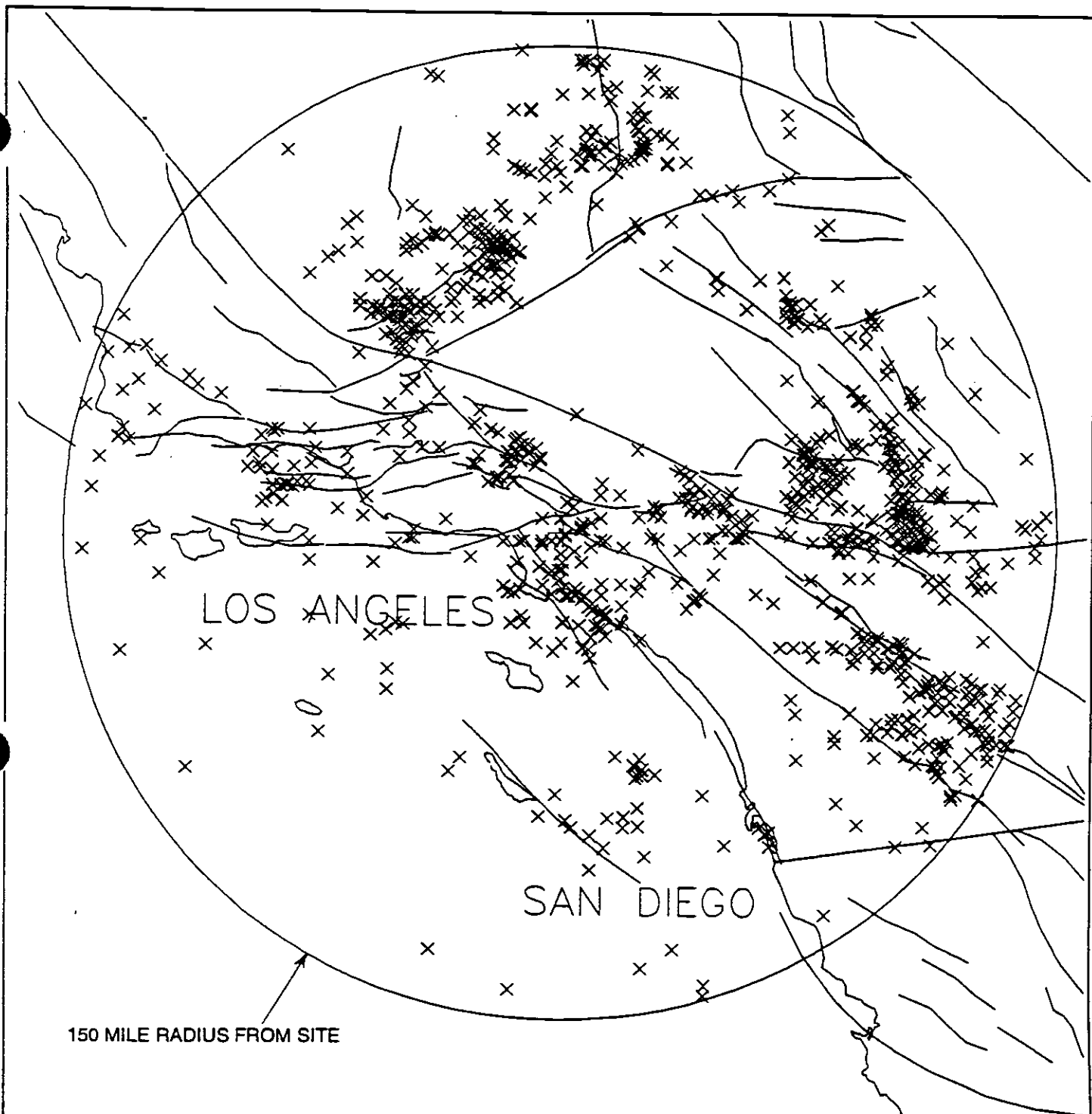
An earthquake computer search (Blake, 1992) was performed to locate historical earthquake epicenters with respect to the entire alignment of the Eastside Extension. A search radius of 150 miles from the approximate mid-point of the alignment was selected in order to include the larger magnitude earthquakes that have occurred in Southern California. Catalogued earthquakes since the year 1800 with magnitudes ranging from 4 to 7.9 are shown in Figures 4-3 and 4-4. The largest historical event was the 1857 Fort Tejon earthquake (estimated M 7.9) on the San Andreas fault, about 125 miles northwest of the proposed alignment. The

TABLE 4-1. ESTIMATED SEISMIC CHARACTERISTICS OF PRINCIPAL FAULTS

Fault	Approximate Distance from Station⁽¹⁾ (miles)	Magnitude of Maximum Credible Earthquake⁽²⁾	Age of Most Recent Displacement⁽³⁾
Chino	27	7 1/2	Late Quaternary
Cucamonga	29	7	Holocene
Hollywood	7	7 1/2	Holocene
Malibu Coast	24	7 1/2	Holocene
Newport-Inglewood	9	7	Historic (1933)
Northridge	23	7 1/2	Historic (1994)
Palos Verdes Hills	18	7	Late Quaternary, Holocene
Raymond	5	7 1/2	Holocene
San Andreas	33	8	Historic (1857)
San Gabriel	16	7 1/2	Late Quaternary, Holocene
Santa Monica	12	7 1/2	Late Quaternary, Holocene ⁽⁴⁾
San Fernando	18	7 1/2	Historic (1971)
Sierra Madre	12	7 1/2	Late Quaternary, Holocene
Verdugo	10	6 3/4	Late Quaternary, Holocene
Whittier	5	7 1/2	Late Quaternary, Holocene

Notes:

- (1) Distance measurements are based on fault traces shown in Jennings (1992) and Treiman (1991).
- (2) Maximum Credible Earthquake Magnitudes from Mualchin and Jones (1992).
- (3) Age of Most Recent Displacement from Jennings (1992) except where noted; multiple ages apply to separate fault segments; "Late Quaternary" is the past 700,000 years; Holocene is the past 11,000 years.
- (4) Dolan and Sieh (1992a).



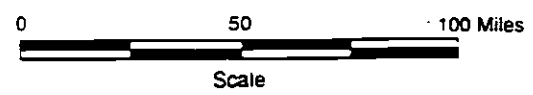
150 MILE RADIUS FROM SITE

Explanation:

x M = 4.0-4.9

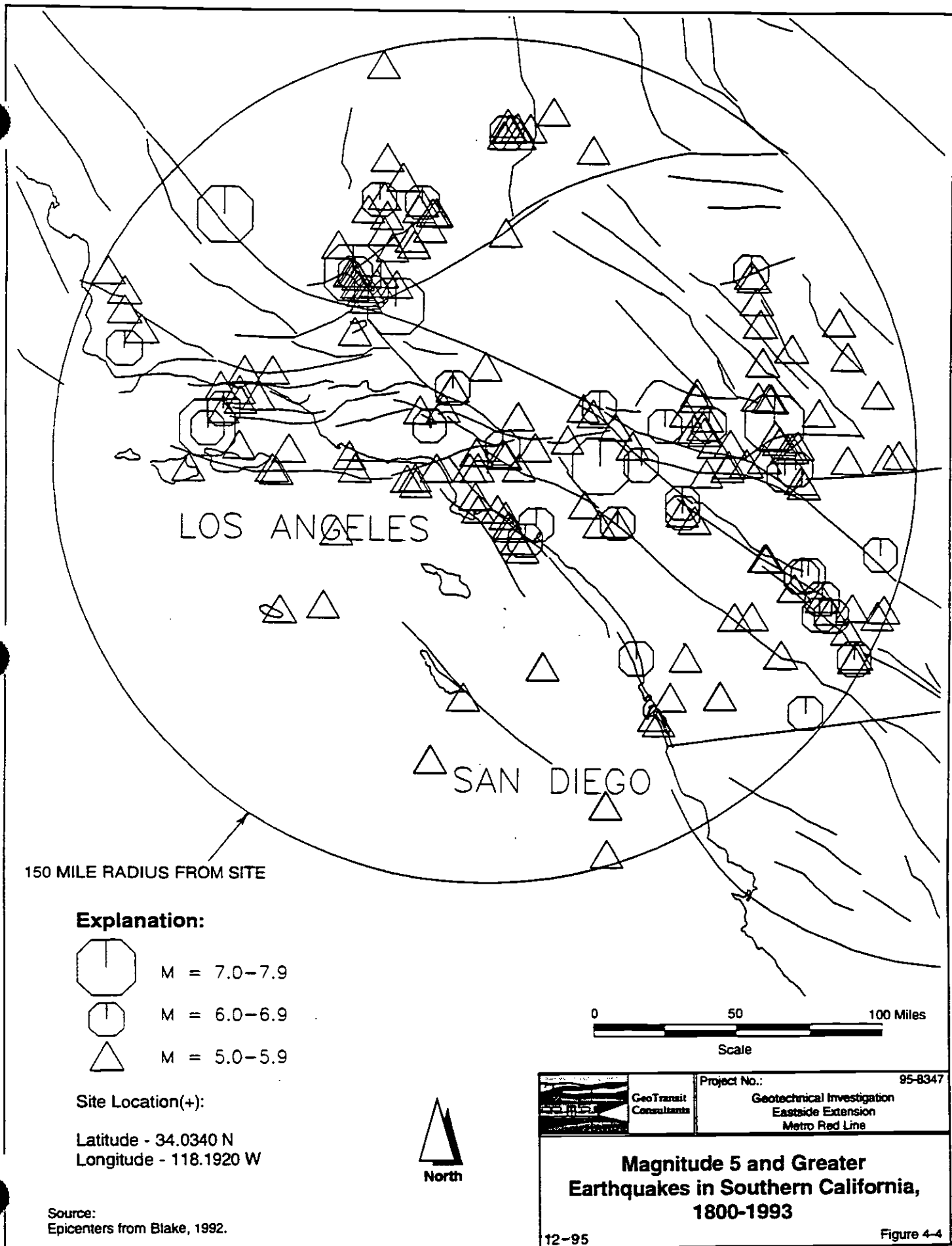
Site Location(+):

Latitude • 34.0340 N
Longitude • 118.1920 W



Source:
Epicenters from Blake, 1992.

	Project No.: 95-8347
	Geotechnical Investigation Eastside Extension Metro Red Line
Magnitude 4.0 - 4.9 Earthquakes in Southern California, 1800-1993	
12-95	Figure 4-3



epicenter of the closest moderate-sized historical earthquake was that of the 1987 Whittier Narrows earthquake (M 5.9), with an epicenter about 10.5 miles east-northeast of the alignment. The Whittier earthquake occurred on a previously unknown northeast-dipping buried thrust fault that has since been named the Elysian Park seismic zone (Mualchin and Jones, 1992).

More recently, the M 6.6 Northridge earthquake occurred on January 17, 1994 on a previously unknown buried thrust fault dipping south beneath the alluvium of the San Fernando Valley. The epicenter of that earthquake was about 24 miles northwest of the alignment. Records of ground accelerations released by the California Division of Mines and Geology for a strong ground motion instrument located in the vicinity of City Terrace (approximately 3 miles northeast of the project area) indicates maximum free field accelerations of 0.32g horizontal and 0.13g vertical for the January 17, 1994 earthquake.

4.1.3 Regional Hydrogeology

The hydrogeology of the greater Los Angeles area includes two general types of groundwater regimes: bedrock uplands and alluvial lowland basins. The bedrock uplands surrounding most of the basins are generally considered to be non-water bearing, while adjacent alluvial basins have supplied groundwater that has been extensively used for domestic, commercial, and agricultural purposes.

The California Department of Water Resources (CDWR, 1961) divides the Los Angeles coastal plain into the Santa Monica, Hollywood, Central, and West Coast groundwater basins. The Central Basin of the coastal plain is further subdivided into the Los Angeles Forebay, Montebello Forebay, Whittier, and Central Basin Pressure Areas. The subject segment of the Eastside Extension alignment lies entirely within the Los Angeles Forebay Area.

The Los Angeles Forebay Area extends southward from the narrows of the Los Angeles River and has been characterized by the CDWR (1961) as an area of unrestricted infiltration of surface water. Because of the presence of low permeability sediments in the shallow bedrock of the Repetto and Elysian Park Hills, however, the actual area of effective surface water infiltration to underlying aquifers is largely restricted to the younger and older alluvial deposits in the vicinity of the narrows.

Groundwater in the Los Angeles Forebay Area occurs in young alluvium and in older permeable Pleistocene sediments. Some limited groundwater also may be present in Pliocene and Miocene bedrock underlying these deposits. According to the CDWR (1961), the water-bearing sediments extend to depths on the order of 1,600 feet below the ground surface, particularly in the southern portions of the Forebay Area.

Aquifers underlying the Forebay Area in the vicinity of the subject segment of the alignment include the Semiperched, Gaspar, Exposition, Gage, and Gardena aquifers at increasing depths in the Holocene and Pleistocene sediments (CDWR, 1961). Because bedrock occurs at relatively shallow depths along the subject segment, only the upper Semiperched and Gaspar aquifers appear to be present (CDWR, 1961). The Semiperched aquifer consists of the older Pleistocene deposits overlying bedrock near the Repetto and Elysian Park Hills; the Gaspar aquifer largely comprises of the coarse-grained Holocene deposits overlying bedrock in the Los Angeles River Narrows.

4.2 LOCAL SETTING

4.2.1 Local Geologic Conditions

Unconsolidated to weakly consolidated Holocene and Pleistocene alluvial sediments, and consolidated bedrock of the Miocene and Pliocene age Puente and Fernando Formations will be encountered during construction of the subject tunnels and station. All borings in the project area, except Borings SD-9 and SD-10 located in the eastern portion of the First/Boyle Station, were entirely in alluvium. Borings SD-9 and SD-10 penetrated through the alluvium and into the underlying Fernando/Puente Formation bedrock. Plate 2 illustrates the subsurface conditions along the alignment based on the results of subsurface exploration.

4.2.1.1 Surficial Deposits

The tunnels and station will be mostly in alluvium. Both granular and fine-grained intervals occur in the alluvial units. The alluvial deposits can be differentiated into two units: Older Alluvium (Qoa) of Pleistocene age and Young Alluvium (Qya) of Holocene age. The portion of tunnels between the Little Tokyo/Arts District Station and approximate Station CR 94 + 70 is within the Los Angeles River floodplain, where young granular alluvial deposits are most common. The sediments there consist largely of sand and gravel with interbedded lenses of gravel, cobbles and boulders. The largest observed clasts range up to 4 feet in

size (Converse and others, 1981) with intervals of coarse gravel to large cobbles frequently present. The clasts are primarily composed of granitic and metamorphic rock types and are unweathered and durable. Locally, the alluvium in the floodplain is characterized by intervals of boulders and cobbles (Converse and others). Frequent cobble zones as indicated by frequent rig chatter (Table 3-7) were found in the project area in all borings, west of Boring DD-57 (approximate Station CR 94 + 65). The Young Alluvium in the floodplain appears to transition into older alluvial deposits below a depth ranging from approximately 40 to 60 feet BGS. The transition is generally characterized by the presence of a higher percentage of fine-grained material that is interbedded or mixed with granular sediments.

The remaining tunnel alignment (i.e., tunnels east of approximate Station CR 94 + 65) and the First/Boyle station will be in older alluvial deposits which underlies the elevated erosional surface east of the Los Angeles River floodplain. The Older Alluvial deposits primarily consist of granular sediments interbedded with fine-grained materials. Compared with granular Young Alluvium, the granular deposits in the Older Alluvium generally appear to be finer grained, contain less gravel, cobbles and boulders, and are more frequently interspersed with and contain more fine-grained materials. Older Alluvium primarily consists of sands and gravels with varying amounts of silt and/or clay. Occasional cobbly zones and small boulders (larger than 1 foot and less than 2 feet in size) were locally encountered in Borings SD-6 through SD-9 and PE-21, all of which are located in or within 50 feet of the station area.

4.2.1.2 Bedrock

Bedrock strata of the Pliocene Fernando Formation crop out northwest of the Los Angeles River Narrows along the south base of the Elysian Hills. The Fernando Formation typically consists of massive to indistinctly bedded siltstone or mudstone and well bedded sandstone (Lamar, 1970). The older Miocene Puente Formation is exposed to the north of the Fernando Formation exposures and underlies much of the Elysian and Repetto Hills. The Puente Formation consists of well-bedded siltstone, claystone and very fine sandstone (Lamar, 1970). In the area shown in Plate 1, the contact between these formations is covered by alluvium over most of its length. Where exposed, the contact is often difficult to locate accurately because the lithologic change between the formations can be gradational (Lamar, 1970). Also, engineering properties of both formations are considered similar. Therefore, we have not attempted to differentiate the Fernando Formation from the Puente Formation during subsurface investigations. When referring to bedrock

information obtained from borings, bedrock is designated the Fernando/Puente Formation in the text, and on the boring logs by a dual symbol, Tf/Tp.

Bedrock was encountered in two borings (SD-9 and SD-10) in the eastern portion of the First/Boyle Station. Within the borings, the bedrock material consists of poorly bedded to massive siltstone and claystone with hard to very hard, well-cemented interbeds and nodules locally present. The top portion of the bedrock (about 10 and 20 feet in Boring SD-10 and SD-9, respectively) is variably weathered. Fresh bedrock is typically dark olive or greenish gray while weathered bedrock is typically light olive gray or brown.

Overall, the bedrock materials range from very soft to soft according to criteria provided by the Bureau of Reclamation in their "Engineering Geology Field Manual" (Figure A-2, Appendix A). A very hard, well-cemented nodule about 2-½ inches in size was encountered in Boring SD-10. Available literature indicates that nodules up to 20 inches in size and cemented beds and lenses, locally up to 12-feet thick, are present (Lamar, 1970; Converse, Davis and Associates, 1975; LeRoy Crandall and Associates, 1979; Converse and others, 1981 and 1984) in the general area.

An abrupt transition in the bedrock surface occurs between Borings SD-8 and SD-9. At Boring SD-9, the bedrock surface was encountered at an elevation of approximately 259 feet. Bedrock was not encountered in Boring SD-8 or in any of the other borings located to the west within the project area. Review of topographic maps indicate that this transition could represent a buried river channel that was eroded into the bedrock. The resulting, steeply-sloping bedrock bluff has since been buttressed and buried by deposition of alluvial sediments against it.

4.2.2 Local Faulting and Folding

An east-west trending topographic escarpment (the Coyote Pass escarpment) forms the southern margin of the City Terrace area in the Repetto Hills and is as much as 80 feet high. It can be traced as an intermittent feature from near the channel of the Los Angeles River in the west to the southern base of the Monterey Park Hills near Atlantic Boulevard in the east (Plate 1). The escarpment is highest along the southern edge of the heights of City Terrace in East Los Angeles and diminishes to an indistinct feature that is less than 20 feet high near its intersection with the alignment, possibly encompassing the eastern portion of the proposed First/Boyle Station and the immediately adjacent tunnels. A second topographic escarpment occurs

approximately one mile south of the Coyote Pass escarpment. The southerly escarpment has an east-northeast to northeast trend, and its surface expression is relatively subdued when compared to the Coyote Pass escarpment.

Geologic studies following the 1987 Whittier Narrows earthquake (M 5.9) attribute these and similar escarpments in the Elysian Park and Repetto hills to ongoing folding and faulting. Seismologic, geodetic, and geomorphic analyses indicate that the escarpments could result from either surface faulting or near-surface folding of weakly consolidated materials that overlie movements on deeply buried (or "blind") thrust faults (Davis and others, 1989). Project-specific investigations carried out by GeoTransit Consultants (1996a) to evaluate the Coyote Pass escarpment have concluded that the escarpment as well as the southerly escarpment are primarily the result of monoclinal-fold deformation associated with faulting at some unknown depth.

The Coyote Pass escarpment in the area of the First/Boyle Station is not as well defined topographically as at locations along its trace to the east. A series of closely-spaced, continuously-sampled borings were completed on State Street to evaluate the subsurface configuration of the escarpment close to its intersection with the alignment. Our interpretation of the boring data indicated a sequence of older alluvial sediments that were deposited on an eroded bedrock surface, all of which have been tilted as much as 14 degrees in a southerly direction. Projecting this configuration from State Street to the project alignment indicates that the Coyote Pass escarpment intersects the alignment approximately in the vicinity of Station CR 109+00. The pronounced monoclinal folding associated with the escarpment to the east is subdued at State Street and the locations of the fold's axial surfaces are not well defined. The station structure, however, appears to be located on the southern part of the fold and could be subject to deformation, most likely in the form of tilting, during an earthquake on the blind thrust fault that underlies the area. A more detailed description of the Coyote Pass escarpment in the project area is presented in a separate report (GeoTransit Consultants, 1996a).

No published active faults trend toward or cross the project site and there are no Alquist-Priolo earthquake fault zones identified by the State in the area.

4.3 SUBSURFACE STRATIGRAPHY AND GROUNDWATER CONDITIONS

4.3.1 Subsurface Stratigraphy

Plate 2 presents the plans and generalized subsurface cross-sectional profiles of the tunnels and station illustrating the subsurface stratigraphy. Plate 2 is based on the subsurface information obtained during this investigation and previous investigations in the project area.

The subsurface stratigraphy along the subject tunnel alignment and in the vicinity of the station consists of shallow surficial fills (for pavement and structure subgrade) overlying Young and Older Alluvium along the tunnel alignment. Bedrock was encountered underlying old alluvium in Borings SD-9 and SD-10 in the eastern portion of the First/Boyle Station. Bedrock was not encountered in other borings in the project area.

At the boring locations, the fill ranges from 0 to up to about 10 feet in thickness and consists predominantly of base course, subbase and other miscellaneous fill materials (sand and silty sand with varying amounts of silt and gravel). Locally thicker layers of fill should be expected, especially in the vicinity of underground utilities.

4.3.1.1 Alluvium in the Los Angeles River Floodplain

The alluvium underlying surficial fill in the floodplain area consists of Young Alluvium overlying Older Alluvium. The Young Alluvium and Older Alluvium are heterogeneous and non-uniform, and their differentiation is difficult. In general, the transition is characterized by an increase in fine-grained sediments, with the transition occurring in the floodplain area at depths ranging from approximately 40 to 60 feet BGS. For this investigation no differentiation of the young and older alluvial units was made. For those borings located in the floodplain, Young Alluvium and Older Alluvium are collectively named "Alluvium" (Qa) on the boring logs.

Within the depths of exploration, the alluvium is predominantly granular and consists of loose to very dense gravel (with varying amounts of sand and/or silt), sands (with varying amounts of gravel and/or silt) and silty sands (with varying amounts of gravel), with cobbles and boulders. Unified Soil Classification System (USCS) classifications of granular alluvium encountered along this portion of the alignment include GP,

GW, GW-GM, GP-GM, GM, SW, SP, SW-SM, SP-SM, SC-SM, SM and SC. The predominantly coarse grained alluvium is locally interlayered with fine-grained alluvium consisting of silt, lean clay and sandy clay ranging from about ½ foot to 20 feet thick. The equivalent standard penetration test (SPT) blowcounts in the alluvium range from 4 per foot to values in excess of 100 per foot. Loose (SPT blowcounts of less than 10 per foot) and medium dense (SPT blowcounts between 10 and 30) granular alluvium are generally located at depths of less than 10 to 20 feet BGS. The SPT blowcounts for gravel and sand/silt with gravel are generally high (in excess of 100). These high SPT blowcounts are indicative of the presence of gravel and/or cobbles and may not reflect the density of these soils. Based on the results of Becker Hammer blowcounts performed elsewhere along the alignment, the density of the gravelly and cobbly alluvial intervals in the project area is estimated to range from dense to very dense (GeoTransit Consultant, 1996c).

As summarized in Table 3-7, cobbles from 3 to 12 inches were encountered in all borings drilled in the tunnel alignment west of Pecan Street during the current investigation. Cobbles of similar sizes were also encountered during the preliminary investigation program (Borings PE-24 through PE-26, GeoTransit Consultants, 1994a). In the Los Angeles River flood plain area, boulders ranging in size from about 12 inches up to about 20 inches, were encountered in Boring DD-16 and Boring PE-25. The cobbles and boulders are primarily composed of very hard to extremely hard granitic and metamorphic rock types that are mostly unweathered and durable. The possibility of encountering larger boulders up to 4 feet or more exists (Converse and others, 1981). Four-foot diameter boulders were observed at the surface prior to lining the Los Angeles River at the Macy Street (Cesar Chavez Avenue) crossing.

Based on the available data described in the boring logs (Appendix A), it is estimated that tunnel excavation between the Little Tokyo and the First/Boyle Station will encounter cobbles and boulders (up to 4 feet in size) up to 15 percent and 2 percent, respectively, by volume of the excavated alluvium.

A significant portion of the granular alluvium within the tunnel zone in the Los Angeles River Floodplain area will be susceptible to raveling and running/flowing conditions during tunneling excavation. Incidents of caving and loss of circulation were observed in a number of borings drilled for previous, non-project specific investigations. These incidents are summarized in Table 2-1.

4.3.1.2 Older Alluvium - East of Pecan Street

Subsurface soils underlying surficial fill in the portion of project area east of Pecan Street (Boring DD-59) consists of Older Alluvium. Older Alluvium is also heterogeneous and primarily consists of granular alluvium interspersed with layers of fine grained alluvium. In this portion of the project area, the granular alluvium consists predominantly of medium dense to very dense silty sand, clayey sand and sand with varying amount of gravel and silts and occasional gravel and cobble layers. Scattered zones of small boulders of about 12-inches to 15 inches in size were encountered in Boring PE-21. USCS classifications of the encountered old granular alluvium in this portion of the project area are predominately SP, SM, SC, SW, SW-SM, SP-SM, GP and GW.

Based on available data, it is estimated that tunnel and station excavation will encounter cobbles (3 to 12 inches) and small boulders (less than 2 feet in size) up to 5 percent of excavated alluvium by volume.

In this portion of the project area, fine-grained alluvium consists predominantly of stiff to hard silt, sandy silt, sandy clay, lean clay, silty clay and clay with various amounts of sand and silt. USCS classification of the encountered fine-grained alluvium include ML, CL and CH.

4.3.1.3 Bedrock

The bedrock of the Puente/Fernando Formation underlying the old alluvium was encountered in Borings SD-9 and SD-10 in the eastern part of the First/Boyle Station. The encountered bedrock consists predominantly of soft to very soft (Figure A-2, Appendix A), weathered to fresh, vaguely laminated to massive siltstone and claystone interbedded with occasional hard to very hard (Figure A-2, Appendix A), well-cemented calcareous nodules and beds. As described in Section 4.2.1.2, hard, cemented nodules about 2½ inches in size were encountered in Boring SD-10. Based on available as-built geologic logging for the nearby City Terrace trunk sewer tunnel in the Puente/Fernando Formation, these occasional well-cemented zones ranged in size from up to 20-inch nodules to lenses and beds up to 12 feet thick. The cemented materials accounted for less than two percent of the strata that were tunneled.

Except for the local presence of well cemented materials, the Puente/Fernando Formation bedrock is expected to behave in a manner similar to that of hard and dense soil. The unconfined compressive strengths

of this bedrock obtained from laboratory tests on Pitcher-barrel samples (Table 3-5) range from about 11,100 psf (75 psi) to about 18,400 psf (130 psi). Due to material variability and potential sample disturbance, the actual in situ maximum strength of the Puente/Fernando Formation bedrock is anticipated to be higher.

For the Metro Red Line, Segment 2 construction, a maximum unconfined compressive strength of about 600 psi was obtained from testing of a number of bedrock samples of the Puente Formation which is considered to be similar to the Fernando/Puente Formation in the project area. Thus, similar in situ maximum strength must be anticipated in the Fernando/Puente Formation (excluding the hard to very hard, well cemented layers and nodules) in the project area.

4.3.2 Groundwater Levels

Groundwater levels in the project area were monitored in 11 monitoring wells, including nine installed during this investigation and two (PE-21 and PE-25) installed during the preliminary investigation (GeoTransit Consultants, 1994a). The measured groundwater levels are summarized in Table 3-2. The most recent groundwater level readings are also shown in Plate 2.

The current groundwater levels along the tunnel segment range from approximately 30 to 78 feet BGS. Based on the current groundwater levels, and plans and profiles, the section of tunnels between the vicinity of Boring DD-13 (approximate Station CR 56+80) and Boring DD-17 (approximate Station CR 90+66) will be partly or entirely below groundwater levels. In the station area, the current groundwater levels range from approximately 55 to 60 feet BGS. Based on current plans and profiles, the planned invert of the First/Boyle Station ranges from about 3 to 22 feet below the current groundwater levels.

Significant differences exist in groundwater levels between the data recorded during this and previous project-specific investigations (GeoTransit Consultant, 1994a and 1994b), and those recorded in 1983 by Converse Consultants and others (1984) in the portion of project area west of the Los Angeles River. In this area the measured groundwater levels in 1983 were about 45 to 55 feet higher than those measured in the current investigation and the 1994 preliminary investigation (GeoTransit Consultants, 1994a).

The project area is located in a region with known significant fluctuations in historic groundwater levels. Table 4-2 summarizes available groundwater level data from a number of wells in the general area that are

**TABLE 4-2. GROUNDWATER LEVEL RECORDS FROM EXISTING WELLS
MAINTAINED BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS**

Page 1 of 4

Water Well*	Ground Surface Elevation (feet above MSL)	Total Depth (feet)	Groundwater ⁽¹⁾			Geologic Unit (depth in feet)			Comments
			Depth (feet)	Elevation (feet above or below MSL)	Date	Fill	Alluvium	Bedrock	
2765	259.0	-	109.1 90.0 113.6	+149.9 +169.0 +145.4	3-79 10-38 4-72	-	-	-	Water well
2775	268.0	100	52.6 40.2 70.8	+215.4 +227.8 +197.8	10-75 11-34 6-40	-	0-76	76-100+	Water well
2807	200.0	556	156.2 126.6 286.2	+43.8 +73.4 -86.2	11-90 3-35 4-60	-	0-556+	-	Water well
2808A	185.0	744	196.2 192.8 220.7	-1.2 -8.5 -77.8	11-77 4-71 12-72	-	0-744+	-	
2808C	197.9	-	241.7 239.8 284.0	-43.8 -41.9 -86.1	4-78 4-70 10-60	-	-	-	Water well
2818B	188.6	-	162.0 131.5 388.0	+26.6 +57.1 -199.4	4-92 2-43 5-59	-	-	-	Water well
2818C	187.2	-	191.0 155.0 338.0	-3.8 +32.2 -150.8	10-88 1-47 7-57	-	-	-	Water well

**TABLE 4-2. GROUNDWATER LEVEL RECORDS FROM EXISTING WELLS
MAINTAINED BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS**

Page 2 of 4

Water Well*	Ground Surface Elevation (feet above MSL)	Total Depth (feet)	Groundwater ⁽¹⁾			Geologic Unit (depth in feet)			Comments
			Depth (feet)	Elevation (feet above or below MSL)	Date	Fill	Alluvium	Bedrock	
2818D	184.5	-	351.0 146.0 363.0	-166.5 +38.5 -178.5	7-78 7-44 6-78	-	-	-	Water well
2827A	227.0	680	196.2 192.8 220.9	+30.8 +34.2 +6.3	11-60 4-59 5-51	-	0-680	680+	Destroyed in 1961
2827F	211.1	-	186.8 185.8 352.0	+24.3 +25.3 -140.9	5-83 11-82 4-66	-	-	-	Water well
2827G	200.4	-	184.0 209.0 348.0	+16.4 -8.6 -147.6	4-92 2-51 9-60	-	-	-	Water well
2827J	210.5	-	201.3 133.2 262.8	+9.2 +77.3 -52.3	11-79 11-74 1-62	-	-	-	Water well
2828	192.9	306	182 119.9 228.0	+10.9 +73.4 -35.1	9-51 3-35 3-50	-	0-306+	-	Destroyed in 1957
2828A	193.0	-	189.9 120.0 206.9	+3.1 +7.3 -13.9	9-51 1-35 7-49	-	-	-	

**TABLE 4-2. GROUNDWATER LEVEL RECORDS FROM EXISTING WELLS
MAINTAINED BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS**

Page 3 of 4

Water Well*	Ground Surface Elevation (feet above MSL)	Total Depth (feet)	Groundwater ⁽¹⁾			Geologic Unit (depth in feet)			Comments
			Depth (feet)	Elevation (feet above or below MSL)	Date	Fill	Alluvium	Bedrock	
2828D	196.0	-	244.0 202.0 378.0	-48.0 -6.0 -182	2-77 2-51 9-60	-	-	-	Water well
2828E	195.0	-	236.5 210.5 346.5	-41.5 -15.5 -151.5	11-80 4-51 5-61	-	-	-	Water well
2828F	185.8	-	175.0 170.0 323.0	+10.8 +15.8 -137.2	4-92 4-85 9-57	-	-	-	Water well
2828G	193.1	-	170.0 194.0 342.0	+23.1 -0.9 -148.9	4-92 4-77 9-60	-	-	-	Water well
2837A	196.0	407	203.0 107.0 352.5	-7 +89 -156.5	1-68 1-46 9-60	-	0-407 +	-	
2837B	196.5	-	158.0 123.2 368.0	+38.5 +73.3 -171.5	4-92 1-35 7-74	-	-	-	Water well
2838A	174.2	500	131.0 131.0 277.0	+43.2 +43.2 -129.8	4-92 4-92 7-78	-	0-500 +	-	Water well

**TABLE 4-2. GROUNDWATER LEVEL RECORDS FROM EXISTING WELLS
MAINTAINED BY LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS**

Page 4 of 4

Water Well*	Ground Surface Elevation (feet above MSL)	Total Depth (feet)	Groundwater ⁽¹⁾			Geologic Unit (depth in feet)			Comments
			Depth (feet)	Elevation (feet above or below MSL)	Date	Fill	Alluvium	Bedrock	
2838B	161.6	-	142.0	+19.6	4-92	-	-	-	Water well
			138.4	+23.2	1-50				
			263.4	-101.8	9-57				
2847	190.0	534	201.5	-11.5	11-80	-	0-534 +	-	Water well
			116.0	+74.0	2-42				
			360.5	-170.5	5-61				
2847B	203.7	470	145.0	+58.7	4-92	-	0-470 +	-	Water well
			145.0	+58.7	4-92				
			323.0	-119.3	7-57				
2847C	228.3	-	200.0	+28.3	4-92	-	-	-	Water well
			150.8	+77.5	4-35				
			322.0	-93.7	9-60				
2857C	228.0	-	212.0	+16.0	11-80	-	-	-	Water well
			212.0	+16.0	2-70				
			336.0	-108.0	8-60				

Note: * Refer to Plate 1 for well locations with respect to the project area.

maintained by the Los Angeles Department of Public Works (LADPW). Locations of these wells with respect to the project area are shown in Plate 1. These records show that the groundwater in the general region can significantly fluctuate. As shown in this table, the observed groundwater levels at some of the well locations fluctuate as much as 12 feet in one month (Well No. 2818D), 69 feet in one year (Well No. 2808A), and 183 feet in 10 years (Well No. 2818C). Potential fluctuation in groundwater levels must be considered in the design and construction of the tunnel and station facilities in the project area.

The presence of occasional, less permeable fine-grained alluvium interbedded within the granular alluvium indicate the possibility of local perched groundwater zones within the station excavation depths and tunnel zone.

4.3.3 Soil and Groundwater Contamination

An assessment of the soil and groundwater contamination for the project area has been presented in the Stage II Environmental Site Assessment report for the Eastside Extension prepared by GeoTransit Consultants (1994b). The results of the Stage II Environmental Site Assessment together with the data obtained from the current investigation and available data from other previous investigations were used in evaluating the potential for soil and groundwater contamination.

The scope of environmental monitoring in this investigation was limited to field observations of sulfurous and/or hydrocarbon odors, screening soil samples with an OVA for the potential presence of volatile organic compounds (VOCs), and chemical testing of groundwater samples from monitoring wells PE-21, DD-15, and DD-54C. The results of hydrogen sulfide/hydrocarbon OVA monitoring are summarized in Table 3-7. Excepting Borings SD-8 and SD-9, no significant OVA readings (exceeding 10 ppm above background levels), or noticeable hydrogen sulfide (H_2S), and/or hydrocarbon odors were measured in the borings drilled for either this investigation or the preliminary engineering program (GeoTransit Consultants, 1994a). An OVA reading of 140 ppm above the background level was measured in one sample from Boring SD-8 at a depth of 45 feet BGS and sulfur odors were noted from two bedrock samples obtained from Boring SD-9 at depths about 63.5 to 65 feet BGS.

4.3.3.1 Groundwater Contamination

No evidence of floating hydrocarbon product was detected during development and groundwater level monitoring of the monitoring wells installed during these investigations and in the preliminary engineering program. Chemical tests (Tables 3-6a and 3-6b) on groundwater samples from Monitoring Wells DD-15, DD-54C, and PE-21 did not detect hydrocarbons, hydrogen sulfide, organic components, and the California Title 22 metals. As shown in Tables 3-6a and b, the constituents of concern from the groundwater quality data are suspended solids, turbidity and some components of total dissolved solids (such as chlorides, sulfates, nitrates and nitrites, etc.) with concentrations exceeding the National Pollutant Discharge Elimination System (NPDES) maximum discharge limit (MDL). Thus, groundwater from the area will require treatment for these constituents before disposal to the storm drain, unless a waiver is granted by the California Regional Water Quality Control Board (RWQCB).

As described previously, the currently observed groundwater levels are at or above the station and portions of the tunnel inverts. Thus, construction dewatering is anticipated. In addition, the potential for localized perched groundwater inflows into the excavation exists even with dewatering provisions. Judging from available observations and groundwater quality data, most of the groundwater in the area is likely to have a low potential for contamination except for the above-mentioned components of suspended solids, turbidity and dissolved solids. However, the potential for local hydrocarbon contamination of discharged groundwater and perched groundwater inflows cannot be completely precluded due to the proximity of the project area to the existing Boyle Heights and Union Station oil fields (a number of known oil and gas wells are located in the vicinity of project area). Such contaminated groundwater and inflows, if encountered, should be tested and properly disposed to meet applicable provisions for disposal, including all applicable standards, conditions, and requirements imposed by the City of Los Angeles Sanitation District, and RWQCB.

4.3.3.2 Soil Contamination

Results of chemical tests on soil samples from two borings (EB-15 and EB-16) performed during the Stage II Environmental Site Assessment investigation are presented in our previous report (GeoTransit Consultants, 1994b). These data together with available field observation data from this investigation indicate that the soils within the station and tunnel zones are generally "clean"; i.e. hydrocarbon, sulfide, and organic and inorganic constituent concentration levels are less than the generally accepted action levels published by the

California Department of Health Services and RWQCB. Thus, no special disposal requirements are anticipated. However, the localized significant OVA readings detected from one soil sample above the station invert (Section 4.3.3) and the proximity of the project area to the existing Boyle Heights and Union Station oil fields indicate that there is a possibility that some excavated materials will be locally contaminated with hydrocarbons and, if encountered, will require treatment or disposal at a facility approved for disposal of contaminated waste.

4.3.3.3 Gassy Conditions

The potential accumulation of methane and other gases within oil fields in the Los Angeles Basin is well known. The project area is adjacent to or traversed by the known boundaries of the Boyle Heights and Union Station oil fields. Oil fields are known sources of methane and other oil field gases such as hydrogen sulfide. In addition to the oil field, the following evidence indicates the possibility of encountering gassy conditions in the project area:

1. A high OVA reading (140 ppm above background) was noted for one sample in Boring SD-8 at a depth of 45 feet BGS (about 33 feet above station invert).
2. Sulfur odors were noted in two samples (at approximate depths of 63.5 and 65 feet BGS, or about 12 and 10 feet above station invert) in Boring SD-9.
3. Engineering Science, Inc. (1994) measured methane concentrations of 3.6 and 1.8 percent by volume or 68 percent and 34 percent of lower explosive limit (LEL) in gas samples from Boring MW-3 located adjacent to the tunnel alignment and Boring MW-4 located in the station area, respectively.

4.4 ENGINEERING PROPERTIES OF SUBSURFACE MATERIALS

The engineering properties of subsurface materials, as obtained from results of field and laboratory tests, are summarized in Table 3-5. Blowcount data from drive sampling and standard penetration tests (SPT N-values) are shown in the borehole logs and presented in Table 3-5.

Table 4-3 presents a summary of the measured/interpreted ranges of relevant geotechnical parameters for the various material types encountered within the project area. Although generally containing less gravels and more fine-grained soils, old alluvium is expected to be similar to young alluvium in terms of stiffness and strength characteristics. For purposes of presentation, the young and old alluvium are collectively referred to as alluvium which has been broadly categorized into fine-grained and coarse-grained alluvium. Some of the high blowcounts recorded within the coarse grained alluvium are partly due to the presence of gravels and cobbles within the alluvium and partly due to the dense to very dense nature of the coarse grained alluvium. Also, due to the presence of gravels and cobbles larger than the sampler size (except at Boring DD-16, where bulk samples were obtained from 30-inch diameter bucket auger), the results of gradation tests only reflect the gradations of the matrix materials and are therefore finer than the actual gradations in some of the gravelly and cobbly alluvium.

No engineering properties are presented for the locally present surficial fill which is considered to have little or no effect on the station and tunnel design. Based on available geotechnical data and engineering evaluations, the static and dynamic engineering properties for the alluvium and Fernando/Puente Formation bedrock are summarized in Tables 4-3 and 4-4. The engineering properties are presented and used in the engineering analysis presented in Section 5.0.

The following section provides a description of relevant engineering properties of the subsurface materials in the project area.

4.4.1 Alluvium

4.4.1.1 Grain Size Distribution

The alluvium in the tunnel envelope and station excavation area is heterogeneous and is predominantly coarse-grained. Results of grain-size distribution and fines content (percentage passing #200 sieve) tests are summarized in Table 3-5. The bulk of the gradation and fines content tests were performed on selected samples of granular alluvium within and immediately surrounding the tunnel envelopes in tunnel borings, and above the station invert in station borings. This was done primarily to evaluate areas of cohesionless sands and gravels which may be susceptible to raveling/running/flowing conditions. The results of gradation

TABLE 4-3 SUMMARY OF ESTIMATED ENGINEERING PROPERTIES
(FIRST/BOYLE STATION AND TUNNELS BETWEEN LITTLE TOKYO AND FIRST/BOYLE STATIONS)

ENGINEERING CHARACTERISTICS USCS Classification	FINE-GRAINED ALLUVIUM CL,CH,ML,MH CL-ML		COARSE-GRAINED ALLUVIUM SP,SW,GP,GW,SM,SC GP-GM,GW-GP SP-SM,SW-SM,SC-SM		Fernando/Puente Formation ML,MH,CL,CH	
	Range	Best Estimate	Range	Best Estimate	Range	Best Estimate
Equivalent SPT Blow Counts	4->100	-	4->100	-	9->100	-
Insitu Moisture Content (%)	11.3-41	22	2.6-28.3	15	21.7-27.9	25
Insitu Dry Density (pcf)	81.0-120.0	104	78.8-134.5	112	95.8-106.2	100
Void Ratio	0.41-1.09	0.63	0.22-1.09	0.48	0.62-0.8	0.72
Fines Content(% passing #200 Sieve) (%)	51-94	-	5-49	-	84-98	-
Specific Gravity	2.71	2.71	2.64-2.67	2.65	2.76	2.76
Liquid Limit (%)	28-59	34	0-27	-	36-50	45
Plasticity Index (%)	5-35	15	0-11	-	12-26	19
Peak Shear Strength: Cohesion (psf)	400-1600	400	0-600	0	0-2200	1400
Friction Angle, (degrees)	28-34	28	35-49	35	25-35	28
Uniaxial Compressive Strength (psf)	-	-	-	-	11100-18400	14000
Poisson's Ratio	0.3-0.45	0.4	0.2-0.4	0.35	0.4-0.48	0.4
Static Young's Modulus (10 ³ psf)						
0-40'	-	-	500-1700	1000	-	-
40'-60'	-	-	1300-2400	1550	-	-
Below 60'	-	-	1500-3750	2150	1500-3550	2200
pH	7.6-8.8	-	6.4-9.3	-	8.2	-
Chloride Content (ppm)	36-158	-	85-924	-	654	-
Sulphate Content (ppm)	45-289	-	73-353	-	79	-
Electrical Resistivity (ohms-cm)	1660-12987	-	(1389)-20833	-	2665	-
Compression Index- Cc'	0.09-0.117	0.09	0.05	0.05	0.057-0.113	0.07
Swelling Index-Cs'	0.01-0.018	0.01	0.005	0.005	0.01-0.018	0.01
Rate of Secondary Compression-Cx'	0.0007-0.0028	0.001	0.0004	0.0004	0.0003-0.0017	0.001
Swelling (+)/Collapse (-), %	-0.02-(+0.07)	-	-0.02	-	0.15-(+0.51)	-

NOTES:

1. Results of gradation, insitu moisture content and insitu dry density tests on gravelly, cobbly and bouldery alluvium are only representative of the finer matrix materials in the alluvium.
2. Shear strength parameters (cohesion and friction angle) were obtained by direct shear tests and triaxial tests.
3. Electrical resistivity tests, in general were conducted at in situ moisture content. The value of () parenthesis corresponds to saturated condition of the samples.
4. Compression Index (Cc') and Swelling Index (Cs') are based on vertical strain-log stress plots. Rate of Secondary Compression (Cx') is based on vertical strain-log time plot.

TABLE 4-4 ENGINEERING PROPERTIES FOR DYNAMIC ANALYSIS
(FIRST/BOYLE STATION)

MATERIAL PROPERTY	ALLUVIUM						Fernando/Puente Formation Bedrock	
	0 to 40 feet		40 to 60 feet		Below 60 Feet		Range	Best Estimate
	Range	Best Estimate	Range	Best Estimate	Range	Best Estimate		
Shear Wave Velocity (ft/sec)	700-1300	1000	1100-1500	1200	1100-1950	1400	1100-1700	1250
Poissons Ratio	-	0.25	-	0.35	-	0.35	-	0.48
Shear Modulus * (10 ³ ksf)	2.0-6.8	4.0	4.9-9.0	5.8	5-12	8.0	5.0-12.0	8.0
Youngs Modulus * (10 ³ ksf)	5.0-17.0	10.0	13.0-24.0	15.5	13.5 - 37.5	21.5	15.0 - 35.5	22.0
Damping	See Note (2)							

Notes:

* Values correspond to small strains (shear strain $\leq 0.001\%$).

Apply the reduction factor for other strain values:

Shear Strain (%)	Reduction Factor
1.0E-02	0.65
1.0E-01	0.2
1.0E+00	0.05

* Recommended damping value is strain-dependent as follows:

Shear Strain (%)	Damping (%)
2.0E-03	5
1.0E-02	10
5.0E-02	15
2.0E-02	20

tests show the presence of significant zones of granular alluvium with low fines content (poorly to well graded sands and gravels) within tunnel and station excavations.

As summarized in Table 3-7 and shown in the boring logs (Appendix A), frequent zones of cobbles and boulders were also encountered in the geotechnical borings. In selecting tunneling machines and/or station excavation equipment, the gradations of materials to be excavated must include boulders (up to 2 and 4 feet in size in station and tunnel excavations, respectively) and various sizes and distributions of cobbles (3 to 12 inches in size), and gravels (#4 sieve size to 3 inches).

4.4.1.2 In Situ Conditions and Index Properties

Laboratory test data indicate that the dry densities of the alluvium range from 78 to 134.5 pcf and the in situ moisture content ranges from 2 to 41 percent. The relatively wide ranges of density and moisture content values and the large number of soil types encountered in the alluvium are indicative of the nonuniform and heterogeneous nature of the alluvium in the project area.

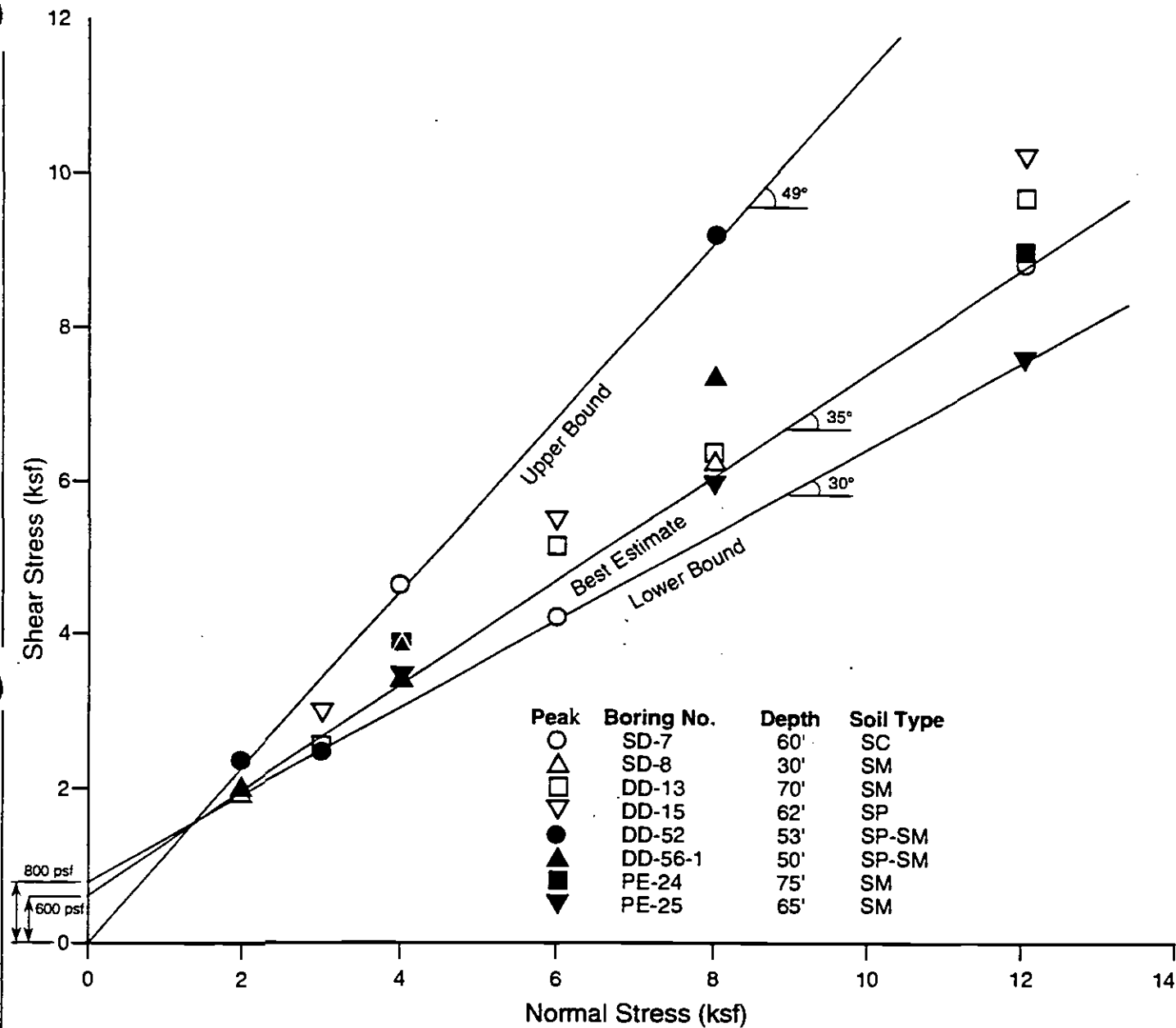
Atterberg limit tests on the fine-grained alluvium encountered indicate that these materials are predominantly silts, lean clay, and fat clay, with liquid limits ranging from 28 to 59 and plasticity indices ranging from 5 to 35.

4.4.1.3 Shear Strengths

Shear strength parameters for the alluvium were derived based on the results of direct shear tests on samples from the current and preliminary investigations (GeoTransit Consultants, 1994a). Results of these direct shear tests are graphically presented in Figures 4-5 and 4-6.

4.4.1.4 Static and Dynamic Modulus

The dynamic modulus and Poisson's ratio for the alluvium were estimated based on results of the three downhole geophysical surveys, the results of a previous pressuremeter tests conducted in similar alluvial materials in the proposed tail tracks tunnel area east of the First/Lorena Station (GeoTransit Consultants, 1996d), available literature on similar materials, available correlations with SPT data, and engineering



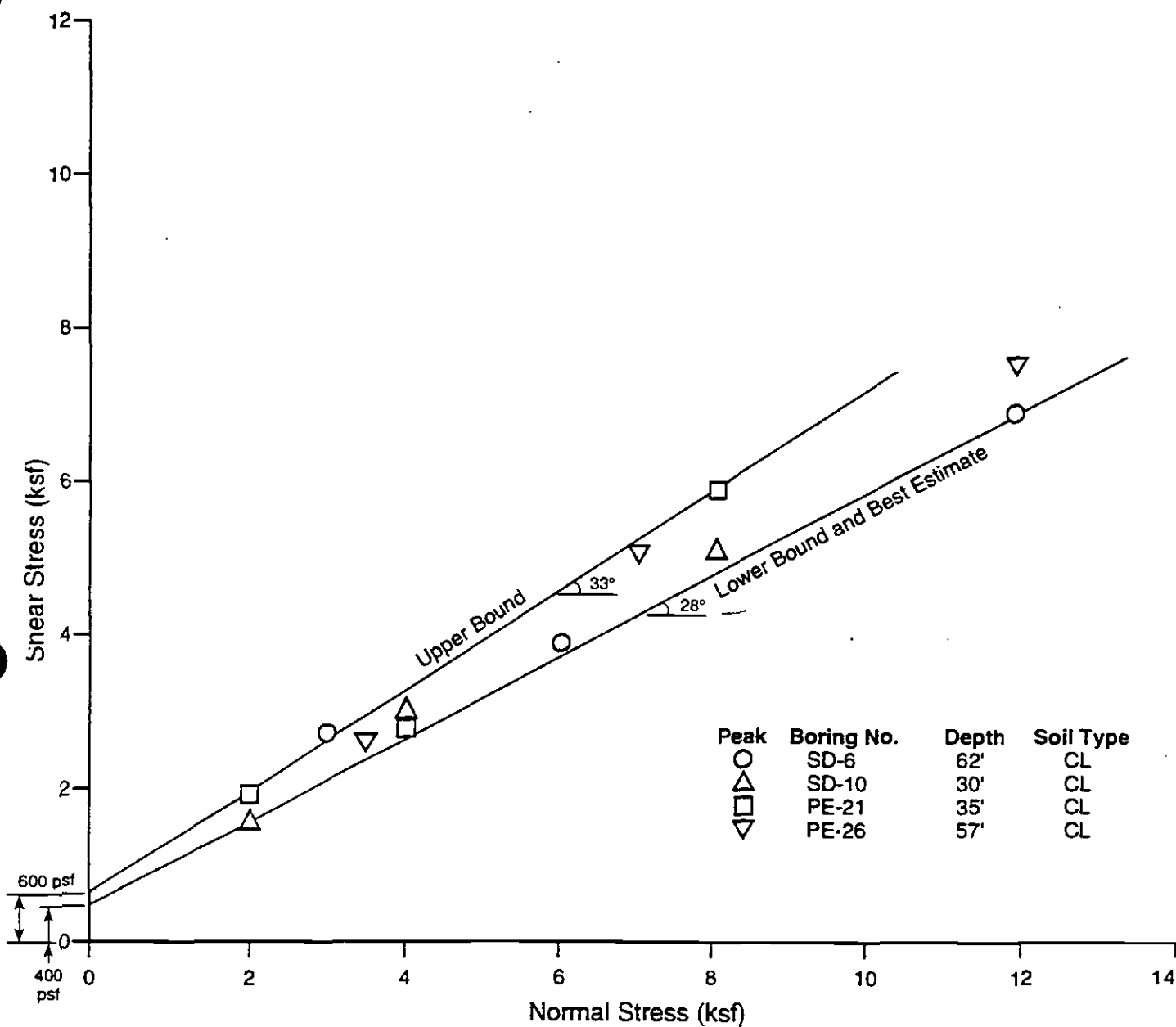
Note:
Direct shear tests were conducted on samples taken from First/Boyle station
and tunnel borings between Little Tokyo and First/Boyle stations.



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Geotechnical Investigation
Eastside Extension
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Direct Shear Test Results on Coarse-Grained Alluvium



Note:
Direct shear tests were conducted on samples taken from First/Boyle station and tunnel borings between Little Tokyo and First/Boyle stations.



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Direct Shear Test Results on Fine-Grained Alluvium

judgement. Modulus of soil is strain-dependent. The modulus values determined from seismic velocity surveys correspond to small strain ranges appropriate for dynamic loading situations (shear strain about 10^{-3} percent or less). Under static loading, shear strains are expected to be considerably larger and the corresponding Moduli should be reduced in accordance with the recommended reduction factors given in Table 4-4.

4.4.1.5 Consolidation and Collapse Potential

Results of three consolidation tests on fine-grained alluvium and two collapse potential and consolidation tests on finer coarse-grained alluvium (i.e. SM, SP) are summarized and presented in Table 3-5. The measured collapse potential of the finer coarse grained alluvium when saturated at in situ overburden pressures ranges from 0.02 percent to 0.28 percent with an average value of about 0.15 percent. Thus, the collapse potential of the finer coarse grained alluvium in the event of saturation is considered small.

4.4.1.6 Corrosion Potential

Results of soluble sulfate content tests (45 to 353 ppm) summarized in Table 4-3 indicate that alluvial materials are mildly corrosive to concrete. Results of electrical resistivity tests (1,389 to 12,987 ohm-cm) indicate that these materials are corrosive to very corrosive to metals.

4.4.2 Fernando/Puente Formation Bedrock

The Fernando/Puente Formation bedrock was encountered in two borings (SD-9 and SD-10) in the eastern 1/5 portion of the First/Boyle station. The most important parameters of the bedrock materials with respect to tunnel and station design are its strength, stiffness, and consolidation characteristics. Thus, emphasis of laboratory testing on bedrock samples was placed on evaluating these characteristics. Available engineering data on similar bedrock materials obtained from other portions of the Eastside Extension (GeoTransit Consultants, 1996c and 1996d and 1996e) were also utilized in developing the engineering properties of the Fernando/Puente Formation bedrock shown in Tables 4-3 and 4-4.

4.4.2.1 In Situ Conditions and Index Properties

The Fernando/Puente Formation bedrock in the project area consists predominantly of very soft to soft (based on Bureau of Reclamation, Engineering Geology Manual Classification) claystone, clayey siltstone and siltstone.

In situ dry density of the bedrock ranges from 95 to 106 pcf, and in situ moisture content ranges from 22 to 28 percent. The fine-grained soils derived from the bedrock are predominantly silts, and lean and silty clays with liquid limits ranging from 36 to 50, and plasticity indices ranging from 12 to 26.

4.4.2.2 Shear Strength Characteristics

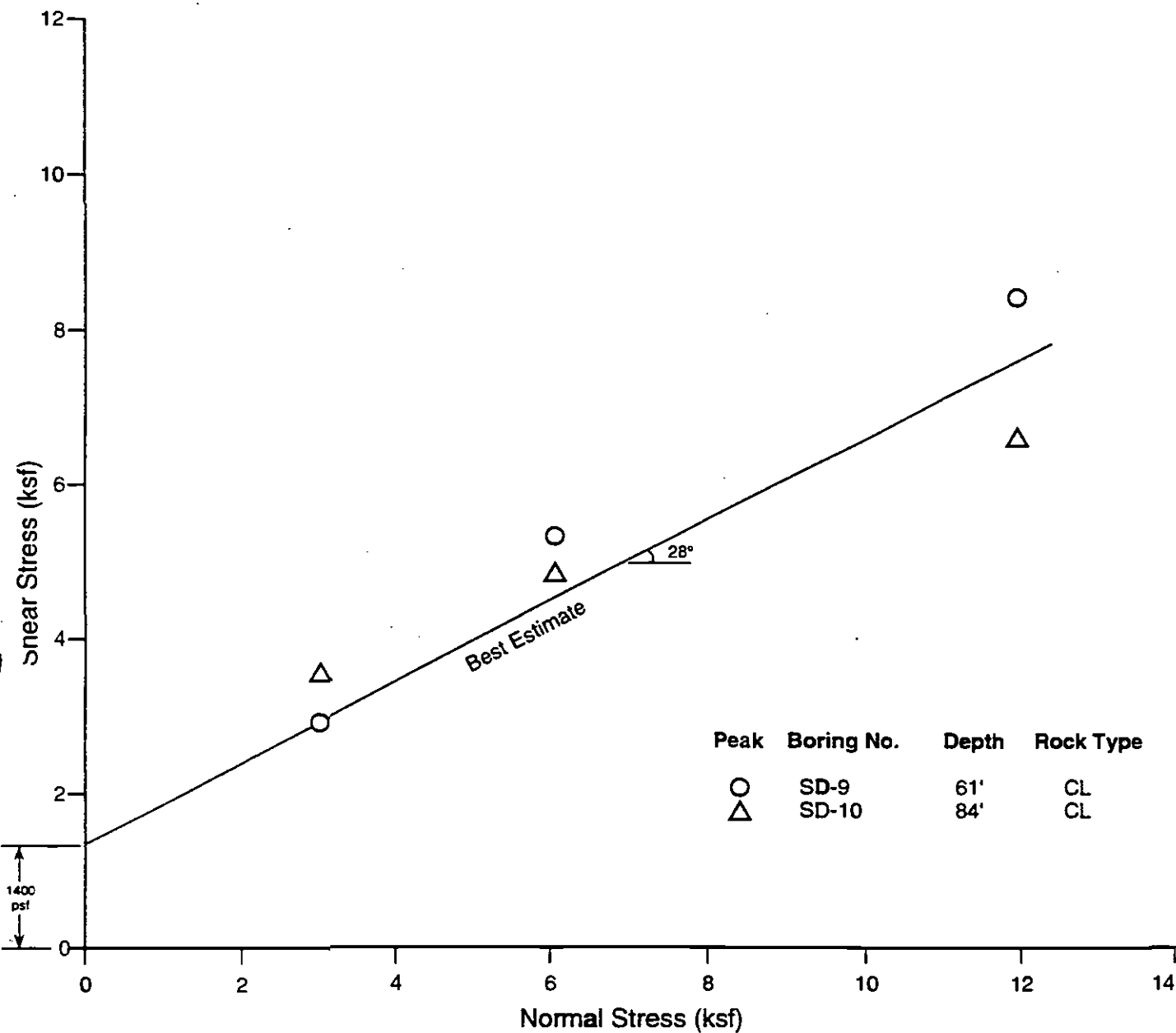
Shear strength characteristics of bedrock materials are based on the results of uniaxial compression tests, direct shear tests, and consolidated undrained triaxial compression tests with pore pressure measurements on selected bedrock samples (Tables 3-5 and 4-3). The range of uniaxial compressive strength of the bedrock is provided in Table 4-3. Results of direct shear tests and triaxial compression tests are presented in Figures 4-7 and 4-8, respectively.

4.4.2.3 Static and Dynamic Modulus Characteristics

Dynamic modulus characteristics of the Fernando/Puente Formation bedrock were estimated based on data from similar bedrock materials in other portions of the Eastside Extension (GeoTransit Consultants, 1996c, 1996d, and 1996e). Results are presented in Tables 4-3 and 4-4. Static modulus characteristics of the Fernando/Puente Formation bedrock may be obtained by applying a reduction factor to the dynamic modulus as indicated in Table 4-4.

4.4.2.4 Compressibility

Results of four consolidation tests on Fernando/Puente Formation bedrock samples are presented in Table 3-5. Compressibility parameters presented in Table 4-3 are based on these tests and other tests on similar bedrock materials from other portions of the Eastside Extension (GeoTransit Consultants, 1996c, 1996d and 1996e).



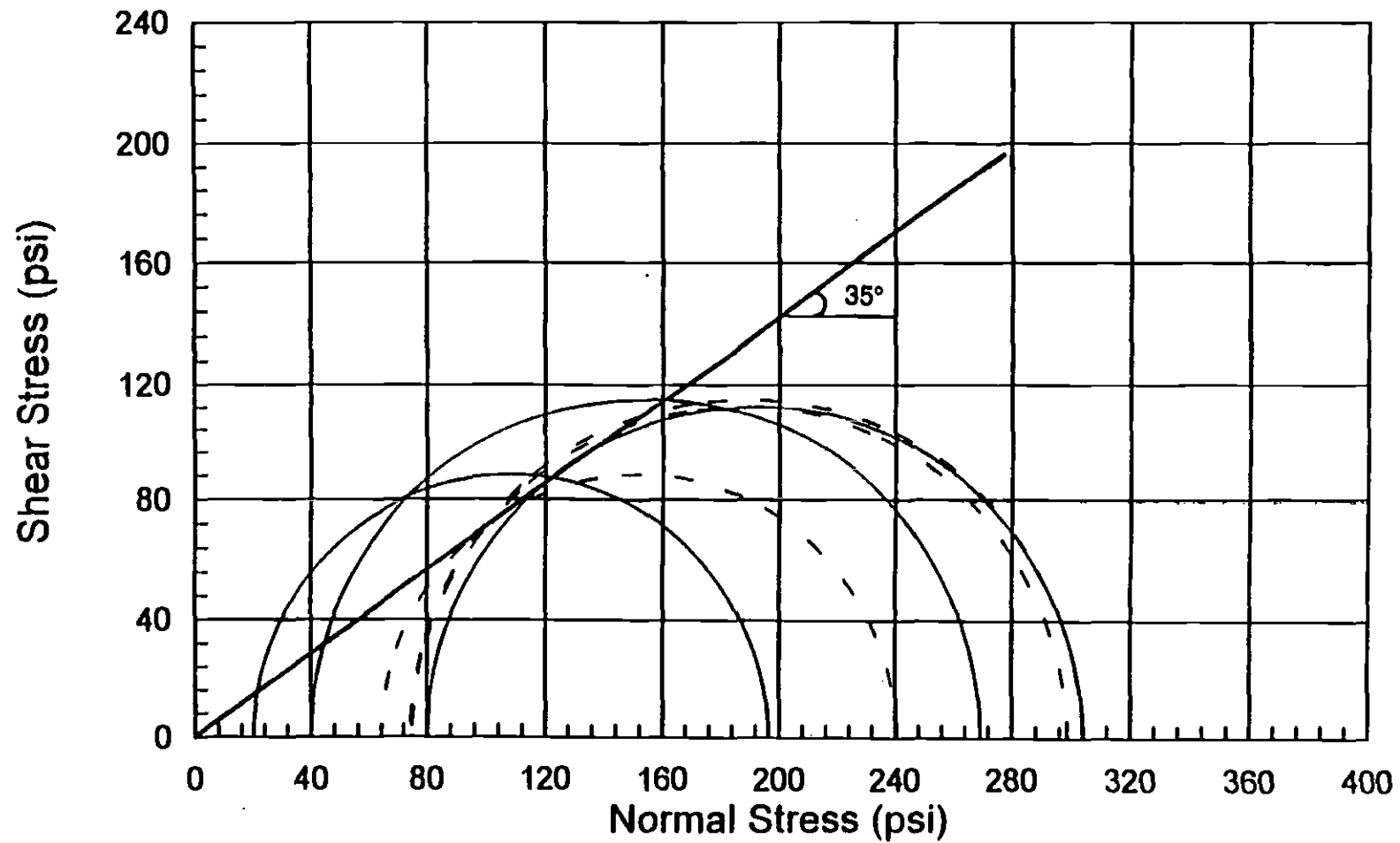
Note:
Direct shear tests were conducted on samples taken from First/Boyle station and tunnel borings between Little Tokyo and First/Boyle stations.



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Direct Shear Test Results on Fernando/Puente Formation Bedrock



	<u>Boring No.</u>	<u>Depth</u>	<u>Eff. Conf. Pressure (psi)</u>
—————	SD-9	85.0	20, 40, 80
- - - - -	SD-9	85.0	20, 40, 80

Total Stress
Effective Stress



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**Triaxial Compression Test Results on
Fernando/Puente Formation Bedrock**

4.4.2.5 Slake Durability

Previously, two slake durability tests were performed on selected Fernando/Puente Formation bedrock samples from other portions of the Eastside Extension (GeoTransit Consultants, 1995c). The results showed slake durability indices (second cycles) of 1.1 and 17.5 percent, indicating high susceptibility to slaking. Thus, the Fernando/Puente Formation bedrock has a high potential to slake and ravel if subject to moisture changes due to prolonged exposure.

5.0 DESIGN AND CONSTRUCTION

5.1 GENERAL

This section provides a description of geotechnical evaluations and recommendations, and key geotechnical issues for the design and construction of the Little Tokyo-First/Boyle Tunnels and the First/Boyle Station with crossover.

5.2 SUMMARY OF SUBSURFACE STRATIGRAPHY

Based on current plans and profiles, the Little Tokyo-First/Boyle Tunnels will be within Young and Older Alluvium. The First/Boyle Station will be partly within the Older Alluvium and partly within Fernando/Puente Formation bedrock. The alluvium along the tunnel alignment is heterogeneous and non-uniform and consists predominantly of gravels, gravelly sands, sands, and silts with local cobbles and boulders and occasional localized layers of clayey sand, lean clay and clayey silt. Local cobbles very hard to extremely hard (Figure A-2, Appendix A.) Boulders up to 4 feet in size can be anticipated within the tunnel envelopes. The alluvium in the station area is also heterogeneous and non-uniform and consists predominantly of granular alluvium interspersed with layers of fine-grained alluvium. Granular alluvium in the station area consists predominantly of medium dense to very dense silty sand, clayey sand, and sands with varying amounts of silt and gravel and occasional gravel layers and scattered cobbly zones and small boulders (up to 2 feet in size). The granular alluvium over a large portion of the project area consists of sands and gravels with low fines content. The boulders and cobbles encountered are typically very hard to extremely hard (as defined in Figure A-2, Appendix A), unweathered granitic and metamorphic rock types.

Within the limits of the Los Angeles River Floodplain (west of Pecan Street) cobbles and boulders within the tunnel excavation are estimated to comprise up to 15 percent and 2 percent, respectively, of the alluvium by volume. As within the Older Alluvium east of Pecan Street, cobbles and boulders are estimated to comprise up to 5 percent of the alluvium by volume. Within the station excavation, the bedrock materials are expected approximately in the eastern 1/5 of the station area and consist predominantly of soft to very soft siltstone and claystone except for local zones of hard to very hard, well-cemented calcareous interbeds and nodules. Based on available information, well-cemented interbeds up to 12 feet in thickness and nodules

up to 20 inches in size are possible. Except for locally hard to very hard, well-cemented interbeds and nodules, the Fernando/Puente Formation bedrock is expected to behave similar to hard and dense soils.

5.3 GROUNDWATER LEVEL FLUCTUATIONS

Groundwater levels are an important input for assessing dewatering needs during construction, and to determine appropriate hydrostatic pressures for the design of tunnels and station structures. As described in Section 4.3.2, the groundwater levels in the project area appear to fluctuate significantly as evidenced by the most recent measured groundwater levels in the portion of the project area west of the Los Angeles River being 45 to 55 feet lower than those measured in a 1983 investigation by Converse and others (1984). As summarized in Table 4-2, available well records in the general area also show significant fluctuations of groundwater levels in the project area. This significant groundwater fluctuation indicates that it is difficult to exactly predict the groundwater levels during construction or the maximum groundwater levels that the station structures and tunnel may experience during their design life. For design and construction purposes, the following groundwater levels were assumed:

- Groundwater levels in the project area before and during tunnel and station construction will be the same as the most recent measured groundwater levels obtained from this investigation.
- The design groundwater level corresponding to the maximum sustained groundwater level over the design life of the station structure can be represented by a groundwater level near the top of station box (about 50 feet above the station invert).
- The design groundwater level for the tunnels corresponds to the groundwater level at the ground surface or 50 feet above the current level, whichever is less.

It is recommended that groundwater levels be monitored prior to and during the construction. The geotechnical evaluation and recommendations, especially those related to groundwater dewatering, should be examined and, if needed, modified to reflect the measured groundwater levels at that time.

We understand that EMC applies a load factor of 1.7 on groundwater pressures in tunnel and station design in accordance with the current ACI code requirements, to account for potential future groundwater fluctuations. The maximum design groundwater level recommended above is based on actual groundwater levels measured in 1983, and represents a reasonable estimate. The potential exists for groundwater levels to periodically rise higher than the recommended design value. To account for this possibility and at the same time avoid over conservatism in design, the following are recommended:

1. Use the design groundwater level recommended above in conjunction with the current ACI code requirements (i.e. apply a load factor of 1.7).
2. Check the design by using a load factor of one and assuming groundwater levels to be at the ground surface.

5.4 SEISMIC DESIGN CONSIDERATIONS

A project-specific seismic hazard analysis to determine project-specific design earthquake accelerations for the Eastside Extension was not part of the scope for this investigation. The seismic criteria established in a 1983 report titled "Seismological Investigation & Design Criteria" prepared by Converse and others (1983) for the Metro Rail Project, was adopted in our analyses. For geotechnical analyses and design purposes, the maximum design earthquake (MDE) with a maximum horizontal ground acceleration of 0.60g as recommended in the above report, was used. An earthquake corresponding to the Operating Design Earthquake (ODE) specified in the 1983 report by Converse and others with a ground acceleration of 0.3g was assumed for estimating the earthquake loading imposed on shored excavations during construction.

There have been significant changes in our understanding of the seismicity of the area, the state of the art in seismic hazard analyses, and local code requirements since 1983. If the seismic design criteria are revised in the light of these changes, the seismic related parameters and recommendations presented in this report should be reviewed and modified as appropriate.

5.5 TUNNEL

5.5.1 Excavation Considerations

Based on current plans and profiles, the Little Tokyo-First/Boyle Tunnels will be in alluvium.

Tunnel excavation considerations that would impact tunnel design and construction, tunnel face stability, tunnel excavation techniques, advance rates, and the potential for ground loss include the following:

- Cobbles (3 to 12 inches in size) and boulders up to 4 feet in size will be present in alluvium along the tunnel alignment. During tunnel driving cobbles and boulders are estimated to comprise up to 15 percent and 2 percent, respectively of the excavated alluvium by volume. The encountered cobbles and boulders are expected to be very hard to extremely hard.
- Tunneling in alluvium along the alignment will encounter raveling and running conditions because of the predominantly granular nature of the alluvium. Slow raveling conditions can be anticipated under dewatered conditions or above groundwater in silty sand and clayey sand. Fast raveling conditions and running/flowing conditions can be anticipated in cobbles, gravels, gravelly sand, and poorly graded sands above or below groundwater, or well-graded sand below groundwater. Fast raveling and running/flowing conditions are anticipated along the entire the tunnel alignment.
- Shallow soil overburden exists in the portions of tunnels beneath the Los Angeles River and approximately between Boyd Street (approximate Station CR 81+60) and the vicinity of U.S. 101 Freeway (approximate Station CR 95+70), where the thickness of the overburden above the tunnel crown is 40 feet or less (i.e., approximately 2 times the tunnel diameter or less).

5.5.2 Groundwater Control

Assuming groundwater levels during construction are the same as the most recent measured groundwater levels from this investigation, the portion of the tunnels between approximate Stations CR 54+00 and CR 97+00 will likely be fully or partially below groundwater.

If an open face shield is used to drive the tunnel, dewatering will be necessary to enhance stability and reduce the potential for ground settlement and inflows of water during tunnel excavation. It is anticipated that the groundwater level in the above portions of the tunnel segment will be reduced and maintained at least 5 feet below the planned tunnel invert. The Contractor will be responsible for designing, installing and operating a construction dewatering system subject to review and acceptance by the owner. Based on local practice, a possible dewatering system may consist of a series of deep wells placed along the affected tunnel segments.

It should be noted that the aquifer pump test summarized in Section 3.3.1 with details presented in a separate report (GeoTransit Consultants, 1996b) is applicable only for the subsurface conditions at the test site and the pump test results do not necessarily represent the aquifer and hydrological characteristics of the entire tunnel segment. If dewatering is required, potential variability in aquifer and hydrological characteristics along the affected tunnel segment should be considered in designing, installing and operating an appropriate dewatering system.

The potential for significant fluctuation of the groundwater levels in the area indicates the need for continuing groundwater level monitoring before and during tunnel construction to verify groundwater levels and to re-evaluate dewatering needs, as appropriate.

5.5.3 Liquefaction Potential

Most of the alluvium along the tunnel alignment is granular in nature and contains variable amounts of gravel and cobbles. Based on similarity of soil origin and composition and the results of Becker Hammer borings performed at three locations in the station and tunnel area immediately north of the Little Tokyo - First/Boyle Tunnels (GeoTransit Consultants, 1996c), it is expected that the granular alluvium encompassing the tunnels are generally dense to very dense with very low liquefaction potential. The tunnel alignment is not expected to experience earthquake-induced liquefaction of the surrounding subsurface materials.

5.6 FIRST/BOYLE STATION WITH CROSSOVER

5.6.1 General

The planned cut-and-cover construction of the First/Boyle Station with crossover will involve about 65 to 80 feet of excavation from the ground surface to the planned station invert. The excavation will be primarily in the alluvium and Fernando/Puente Formation bedrock. The station structure will essentially be a water-tight, rigid reinforced concrete box structure bearing partly in alluvium and partly in bedrock.

The primary considerations that require geotechnical engineering evaluation for design and construction of the planned station facilities include the following:

- Excavation methods
- Construction dewatering and related issues
- Excavation-related temporary shoring systems
- Foundation design and recommendations for soil, water, and earthquake loading on the permanent station structures
- Evaluation of potential for earthquake-induced liquefaction and its effects on the station structure.

5.6.2 Excavation Methods

Station excavation will be primarily in alluvium and bedrock. Based on the results of this investigation and design and construction experience under similar subsurface conditions, it is anticipated that the cut-and-cover excavation can be achieved using conventional excavations methods. However, suitable heavy excavation equipment to handle the very dense gravelly and cobbly alluvium with scattered boulders (up to 2 feet in size), as well as hard, well-cemented calcareous interbeds and nodules in the bedrock would be required. Most of the granular alluvium in the station area will run and ravel readily. The Fernando/Puente Formation bedrock has a high potential to slake and ravel if subject to moisture changes due to prolonged exposure. Thus, timely application of ground support is important to prevent ground loss.

5.6.3 Dewatering and Groundwater Control

The most recent observed groundwater level data indicate that the groundwater table in the station area is about 3 to 22 feet above the planned bottom of station excavation. Preconstruction or construction dewatering should be anticipated to reduce and maintain the groundwater levels at least 5 feet below the bottom of excavation during station construction. It is the Contractor's responsibility to design, install and operate an adequate dewatering system subject to review and acceptance by the owner.

Even with dewatering provisions, localized groundwater inflows can be anticipated due to the potential local presence of perched groundwater conditions. If these inflows are large enough, the accumulated inflow will need to be collected and pumped out of the excavation using ditches and sumps.

The potential for significant fluctuation of the groundwater levels in the area dictates the need for continuing groundwater level monitoring before and during station construction to verify groundwater levels and to re-evaluate the dewatering needs, as appropriate.

5.6.4 Sloped Excavation

Compared to shored excavations, sloped excavations will require more construction space and 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.

Temporary slopes in alluvium and bedrock should be no steeper than 1½H:1V (1½ horizontal to 1 vertical) and 1H:1V, respectively. 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. The design, construction, and proper maintenance of safe, stable slopes are the responsibility of the Contractor and the above slopes are for reference only. Such safe, stable slopes must be based on actual construction conditions and subsurface conditions encountered during excavation.

5.6.5 Shored Excavation and Shoring Support

The planned station excavation will require shoring due to the proximity of the station to existing buildings and roads, and limited construction space along the alignment. Various shoring systems may be appropriate. These include various temporary walls such as sheet pile, soldier pile and lagging, precast, and slurry walls supported by tiebacks, anchors and/or internal bracing struts. The most appropriate shoring system must consider subsurface conditions, excavation geometry, the dewatering scheme (if applicable), construction procedures, characteristics of nearby buildings, and local experience. Based on local practice in the Los Angeles area in subsurface geotechnical conditions similar to those encountered at the Eastside Extension, soldier piles and lagging walls with tiebacks and/or internal bracing (struts and wales) are the most likely shoring systems. The use of slurry wall construction for support of excavations in lieu of soldier piles and lagging would be relatively expensive and is not likely practical. Driving of sheet piles may not be feasible due to the presence of gravel, cobbles and boulders.

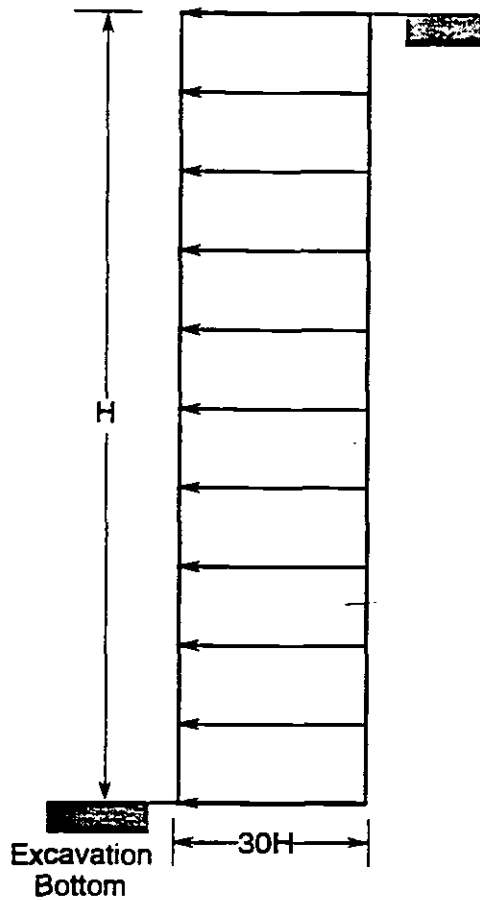
5.6.5.1 Lateral Pressure

Lateral earth pressure on the shoring system depends on the type of shoring system, construction procedures, and subsurface and groundwater conditions. Based on the available laboratory test results, anticipated shoring system, and construction procedures, as well as previously stated engineering assumptions, lateral earth pressures on the temporary shoring walls for the following cases are shown in Figures 5-1 through 5-3:

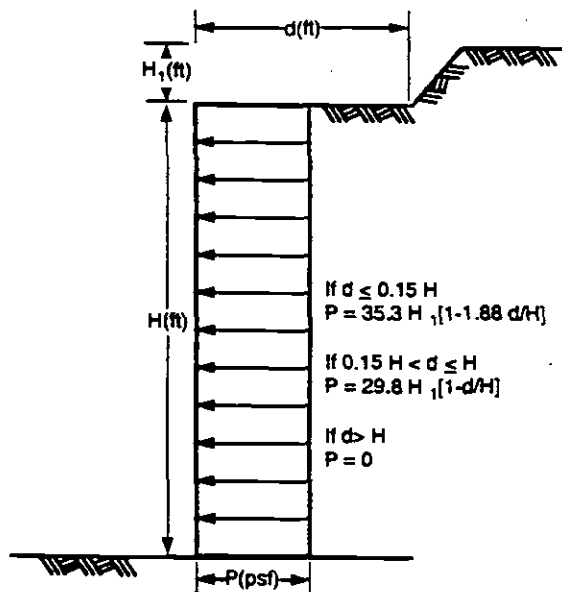
- Braced sheeting above the excavation
- Cantilevered sheeting above and below the excavation
- Surcharges from a sloped excavation, existing buildings, construction loads, and earthquake-induced loads
- Active and passive earth pressures on soldier piles below the excavation.

The lateral loading diagrams presented in Figures 5-1 through 5-3 are for use in the design of soldier pile details, tiebacks, or an internal bracing system.

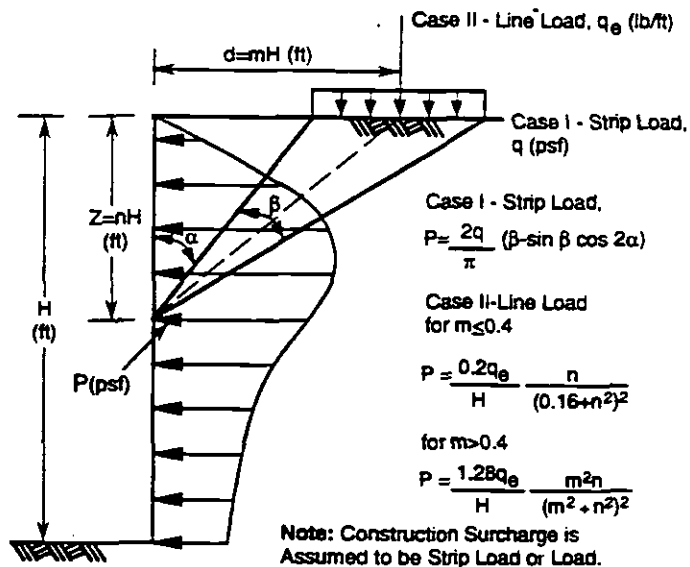
Lateral earth pressures on lagging depend on a number of factors, including subsurface conditions and engineering properties, spacing between soldier piles, and dimensions and configuration of the excavation.



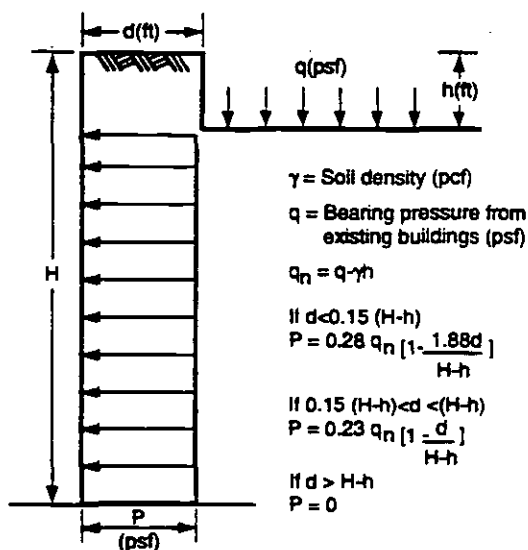
**Lateral Earth Pressure
On Braced Sheetting**



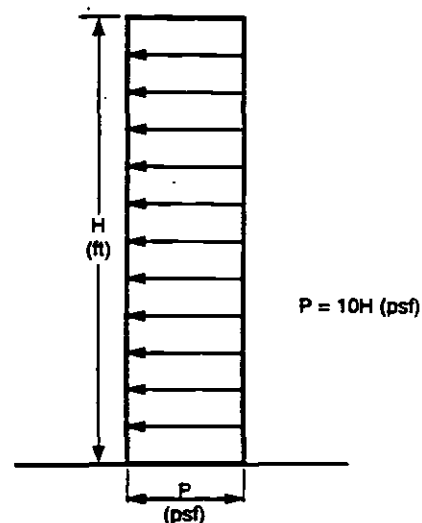
(a) Sloped Excavation Surcharge



(b) Construction Surcharge



(c) Building Surcharge



(d) Earthquake Surcharge



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**Additional Lateral Earth Pressure
on Braced or Cantilevered Sheet Piling
(First/Boyle Station)**

For sizing purposes, the lateral earth pressure on lagging can be taken as 50 percent of that recommended for the temporary shoring walls (Figures 5-1 through 5-3), to account for soil arching effects. However, soldier piles must be designed to carry the full lateral loading.

It is understood that design and construction of an appropriate shoring system to minimize ground loss and disturbance of the site and adjacent buildings and to provide a safe worksite is the sole responsibility of the Contractor. Various design considerations are described in the following sections for use as general guidelines.

5.6.5.2 Soldier Piles and Lagging

The soldier piles and lagging walls should be designed to adequately 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, including pile sizing, embedment depth, spacing, installation, and lagging provisions, should be in compliance with appropriate building codes and city requirements.

Pile sizing includes proper determinations of pile diameter, cross section, length, and 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 soldier piles should be sufficiently embedded below the excavation depth to safely resist anticipated lateral and vertical loads. The passive resistance should exceed the imposed lateral loads (active resistance minus the resistance from tiebacks or internal bracing) with a reasonable safety factor. The effective excavation width that each pile can support should be taken as 1-1/2 times the soldier pile diameter or half of the pile spacing, whichever is less. It should be noted that piles may undergo some movement before mobilizing the anticipated capacities. It is recommended that pile load tests be performed to verify estimated capacities and that movement under design load will be acceptable.

Optimal pile spacing depends on a number of factors, including subsurface conditions and engineering properties of subsurface materials, pile sizing, construction procedures and cost. Considering the need for lagging to alleviate soil raveling and reduce ground loss, a pile spacing of 8 feet or less would be reasonable.

Local noise abatement requirements, and the local presence of cobbles and boulders in alluvium generally preclude the use of conventional impact driving to install soldier piles. Thus, the soldier piles, if used, would likely be installed in predrilled holes. Rock coring of boulders may be required. Slurry and/or casing will be required to handle potential caving conditions within the granular alluvium.

Lagging between soldier piles will be required. Timber, shotcrete, or pre-cast reinforced concrete members can be used as lagging between soldier piles. The Contractor will be responsible for designing, installing and maintaining a suitable lagging system subject to review and acceptance by the owner or his representative. The Contractor must control the temporary height of exposed soil prior to lagging placement to eliminate raveling and ground loss problems. If shotcrete lagging is used, the Contractor must have effective drainage provisions in the lagging design to prevent accumulation of groundwater at the shotcrete-soil interface.

5.6.5.3 Tieback Anchors

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 of adjacent buildings. Many types of tieback anchors exist, including shaft anchors, belled anchors, anchor blocks, and high-pressure grout anchors. In general, the allowable capacity of the tieback anchor should be determined in the field based on load tests. The following recommendations should be considered in the design and installation of tieback anchors.

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 5-4. The anchors may be installed at inclinations between 20 degrees and 50 degrees below the horizontal. Potential caving conditions in the granular alluvium are possible, so the Contractor should use appropriate measures to prevent caving and 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, November 1984) or local site-specific experience of the Contractor. The load in the tiebacks should be locked off at 100 percent of the design load and monitored periodically.

5.6.5.4 Internal Bracing

If braced shoring systems are employed, the strut loads should be determined using the full load diagrams shown in Figures 5-1 through 5-3. The vertical spacing between struts should be appropriately designed to reduce ground movements. All struts must be preloaded to eliminate slack and reduce ground movement. A preload of 25 percent of the design load is recommended. However, it must be noted that a preload of 25 percent of the design load may induce undue loading on basements, if any, of adjacent buildings. This possibility must be analyzed on a case-by-case basis.

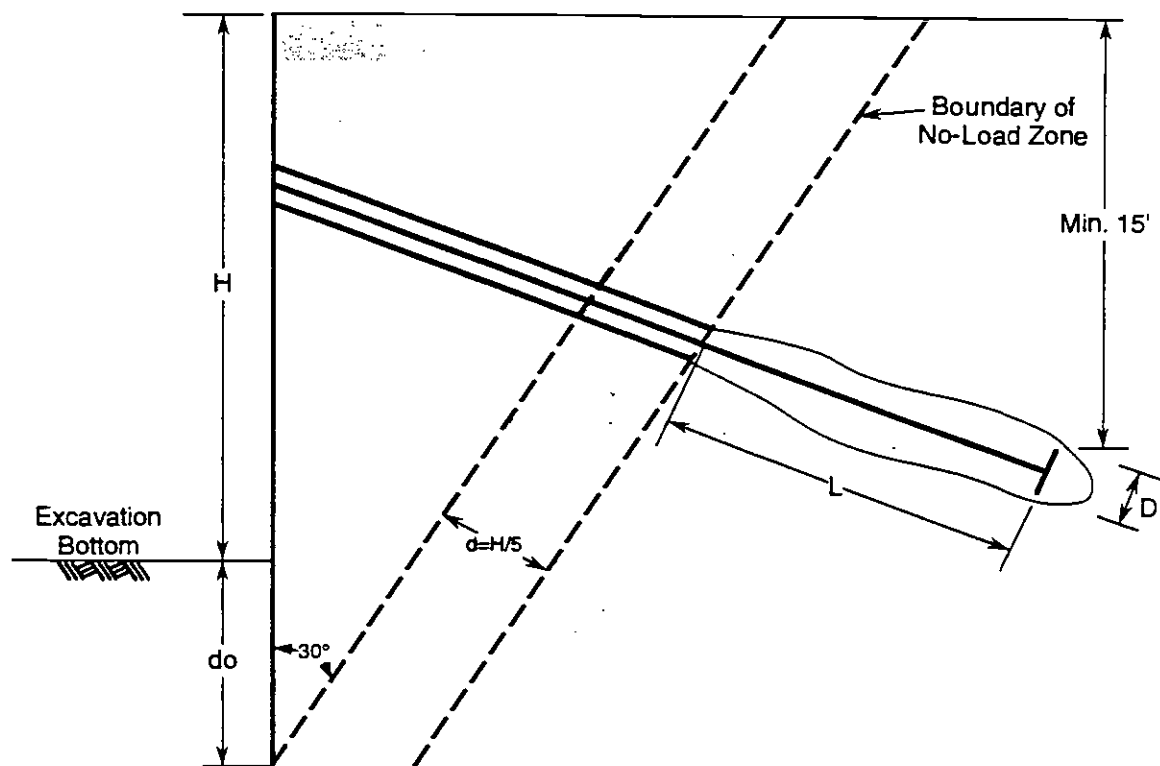
Procedures to compensate for the effects of temperature changes on the strut loads should be developed and implemented so that proper strut load levels can be monitored and maintained during construction.

5.6.5.5 Combined Shoring System

If a shoring system which combines external tiebacks and internal bracing or struts and wales is selected for support of excavations, the support design by the contractor must account for the variation in relative stiffness and deflection characteristics of the support elements which may induce substantially different load distributions.

5.6.5.6 Wall Movement

Station excavations will experience 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 schedule, specifications, and subsurface conditions. In general, for a well-designed and constructed shoring system, the maximum horizontal wall deflection may be about 0.1 percent to 0.2 percent of the excavation depth. For the First/Boyle Station the corresponding maximum horizontal wall movement for a well designed and constructed shoring system is estimated to be about 1 inch to 2 inches. For a shoring system with tiebacks, this maximum horizontal deflection will likely occur near the surface, and will decrease with depth. For a well-designed and constructed internally braced system with struts and wales, the maximum horizontal deflection will probably occur near the bottom of the excavation and decrease to about 0.2 inch to 0.5 inch near the surface. It is estimated that, for a well-designed and constructed shoring system, a maximum vertical settlement of about 0.5 inch to 1 inch will probably occur



L = Bond length of anchor beyond no-load zone.
 d_o = Depth of penetration required for stability.
 d_o , d , D , H , and L are in feet.



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Anchor Locations for Tieback Walls

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.

5.6.6 Protection of Adjacent Buildings/Structures and Underpinning

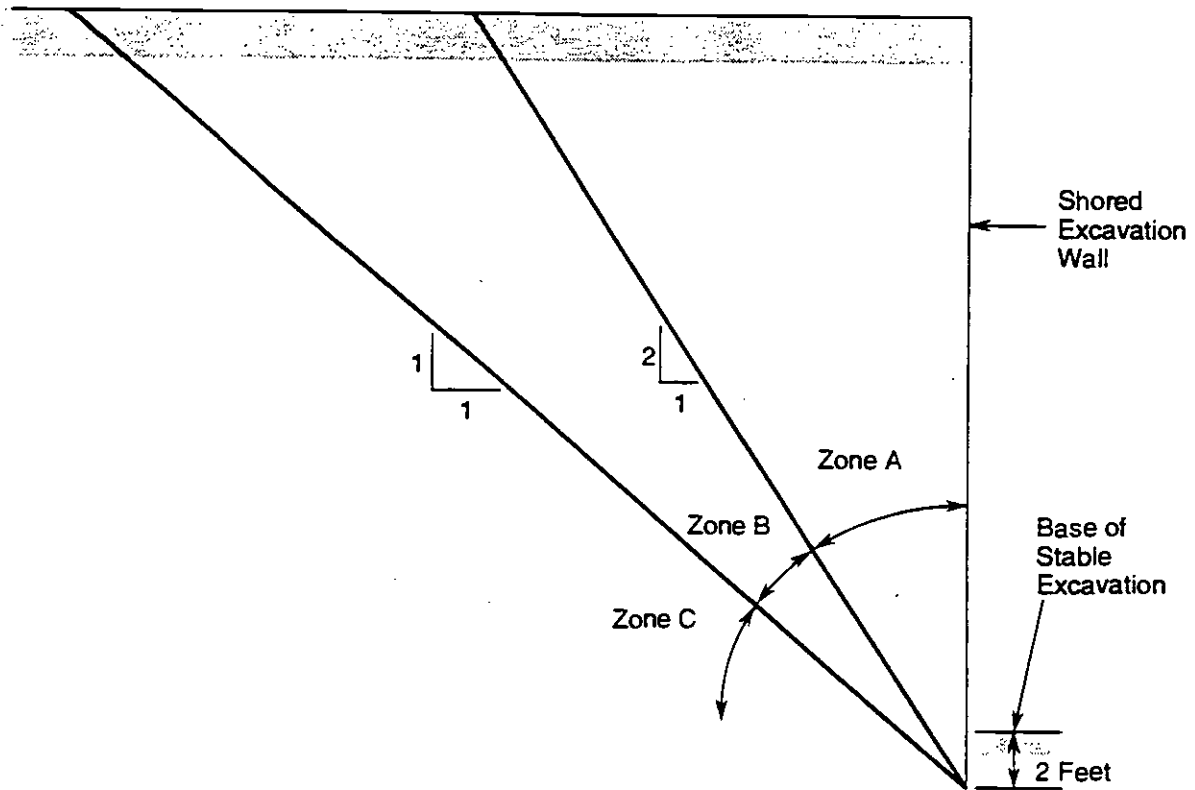
The proposed station is located within an existing residential and commercial area with 1 and 2-story buildings/structures. It is our understanding that the buildings/structures located directly above the station structures will be demolished. There would however be several 1 and 2-story buildings/structures within the zone of influence of the station excavation.

Station excavation and construction may cause some ground settlement or angular distortion. The Contractor is responsible for carrying out the excavation with timely placement of an adequate support system to mitigate potential disturbance to the adjacent buildings. The need for underpinning these adjacent buildings will depend on whether their foundations are adequate and whether the buildings can satisfactorily resist anticipated settlement due to excavation-related deformation. Figure 5-5 presents rough guidelines to estimate whether adjacent buildings require underpinning. The final need for underpinning must be evaluated by the owner's structural engineer on a case-by-case basis. These adjacent buildings, whether underpinned or not, should be monitored for settlement and lateral movement on a regular basis during station construction. If the monitored settlements indicate the potential for excessive settlements beyond the maximum allowable limits, excavation work should be suspended temporarily and immediate remedial measures taken.

5.6.7 Main Station Structure

5.6.7.1 General

In this investigation, bedrock was encountered within the station excavation depths in two borings (SD-9 and SD-10) located in the eastern one-fifth of the station area. Subsurface information from the available borings in the station area and available topographic data in the general vicinity indicate that the configuration of the bedrock surface in the station area is bluff-like, as a result of past erosion. This bedrock bluff has been subsequently buried by alluvial deposits. Thus, at the planned station invert, the station excavation will expose bedrock approximately in the eastern one-fifth of the station area and alluvium in the remaining area.



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

Zone A: Foundations within this zone generally require underpinning

Zone B: Sensitive structure foundations within this zone generally require underpinning

Zone C: Underpinning may not be required



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General Guidelines for Underpinning

The compressibility/stiffness characteristics of the eastern 1/5 of the station subgrade will be therefore different from that of the rest. Also, the transition from the bedrock to alluvium will be abrupt.

5.6.7.2 Excavation Heave

The excavation depth of the First/Boyle Station is approximately 65 to 80 feet. This would mean a stress relief of about 8,500 to 10,400 psf at the bottom of station excavation. It is estimated that the excavation heave due to elastic rebound in alluvium (in approximately four-fifths of the station area) will be about 1 to 2 inches and the heave due to elastic rebound in the bedrock area (eastern one-fifth of station area) will be about 1 to 1½ inches. Elastic rebounds will take place instantaneously during excavation. The consolidation rebounds are estimated to be about ½ to 1½ inches in the alluvium and 1 to 2 inches in the bedrock area. Bulk of the consolidation rebound is anticipated to take place within 3 to 6 months following the excavation. Rupture of the excavation bottom due to excessive heave is not likely.

5.6.7.3 Foundation Support and Settlement

The overall station will be designed and constructed as a relatively rigid box, and the main station housing and the rail facilities will be supported on wide, thick slabs that will function as relatively rigid mat foundations. The design of mat foundations are generally governed by settlement considerations rather than by bearing capacity. Available information indicates that the average bearing pressure on the mat foundations from the station and backfill would be on the order of 5,000 psf, which is less than the overburden removed by the excavation. Therefore, this anticipated station load can be adequately supported on the alluvium underlying the station mat foundation. An allowable bearing capacity of 5,000 psf may be used for design of mat foundations provided the settlements estimated below are considered in the design. Due to non uniformity of mat foundation subgrade properties, some uneven settlements (tilt) and uneven stress distributions within the foundation mat should be anticipated. Soil stiffness/modulus parameters to be used in station design are provided in Section 5.6.9.2.

Assuming a uniform bearing pressure distribution of 5,000 psf over the entire foundation mat footprint, our estimates of vertical movement (elastic and consolidation) within the alluvium and bedrock portions of the subgrade were made, and are provided below. These estimates can be refined, if required, by carrying out

a soil-structure interaction analysis considering the relative stiffnesses of the bedrock, alluvium and foundation mat.

Assuming a uniform pressure distribution of 5,000 psf below the foundation mat, it is estimated that the elastic settlements of the foundation on the alluvium portion and the bedrock portion will be about $\frac{3}{4}$ to $1\frac{1}{2}$ inches and $\frac{1}{2}$ to 1 inch, respectively. Long term consolidation settlements of the foundation on the alluvium portion and bedrock portion are estimated to be about $\frac{1}{4}$ to $\frac{1}{2}$ inch and $\frac{1}{4}$ to $1\frac{1}{2}$ inches, respectively. The long-term consolidation settlement is expected to continue after completion of construction. Some long-term differential settlement of the structure should be expected. It is estimated that the differential settlement over the width of the station will be about 1 inch or less.

If the groundwater levels in the station area rise from current levels to the assumed design levels (i.e., about 50 feet above the station invert), the station mat foundation will experience a vertical stress relief of about 3,100 psf, resulting in heave due to elastic and consolidation rebounds. It is estimated that the corresponding elastic rebound of the portions of the foundation mat on alluvium and bedrock will be on the order of about $\frac{1}{2}$ to $\frac{3}{4}$ inch and about $\frac{1}{2}$ inch, respectively. The estimated consolidation rebound of the foundation mat is estimated to be about $\frac{1}{4}$ to $\frac{1}{2}$ inch, and $\frac{1}{2}$ to $\frac{3}{4}$ inches, on alluvium and bedrock, respectively.

5.6.8 Surface and Near Surface Structures

Near surface structures can be supported on conventional spread footings founded on properly compacted fill. All spread footings should be a minimum of 2 feet wide and at least 2 feet below the lowest adjacent grade. Subgrade for shallow footings should be overexcavated to a depth equal to the footing width and replaced with properly compacted fill. Overexcavation must extend a minimum distance equal to half the width or 2 feet, whichever is larger, beyond the perimeter of the footing. Fill must be compacted to at least 95 percent of the maximum dry density as determined by ASTM Procedure D-1557. Allowable bearing capacities and estimated total settlement in terms of footing width and bearing pressures for shallow spread footings are graphically presented in Figure 5-6. Some differential settlement between adjacent footings should be anticipated. This differential settlement between adjacent footings is estimated to be one-half of the average total settlements or the differences in total settlement, whichever is larger.

In the absence of specific information on loads, dimensions and locations of surface and near surface structures, Figure 5-6 is provided as a general guideline for foundation support needs. Structure-specific foundation evaluation and recommendations can be provided when such information becomes available.

Figure 5-6 can be used for vertical, concentric loading. Bearing capacity will be reduced due to eccentric and/or inclined (combined vertical and horizontal loads) loading conditions. A site-specific and loading specific study can be performed for such cases once design loading conditions are known.

Lateral resistance of the footing can be assumed to be provided by passive earth pressure on the side of the footing and friction resistance between the footing and soil. An allowable passive pressure of 250 psf per foot, and an allowable frictional coefficient of 0.4 are appropriate for lateral resistance considerations.

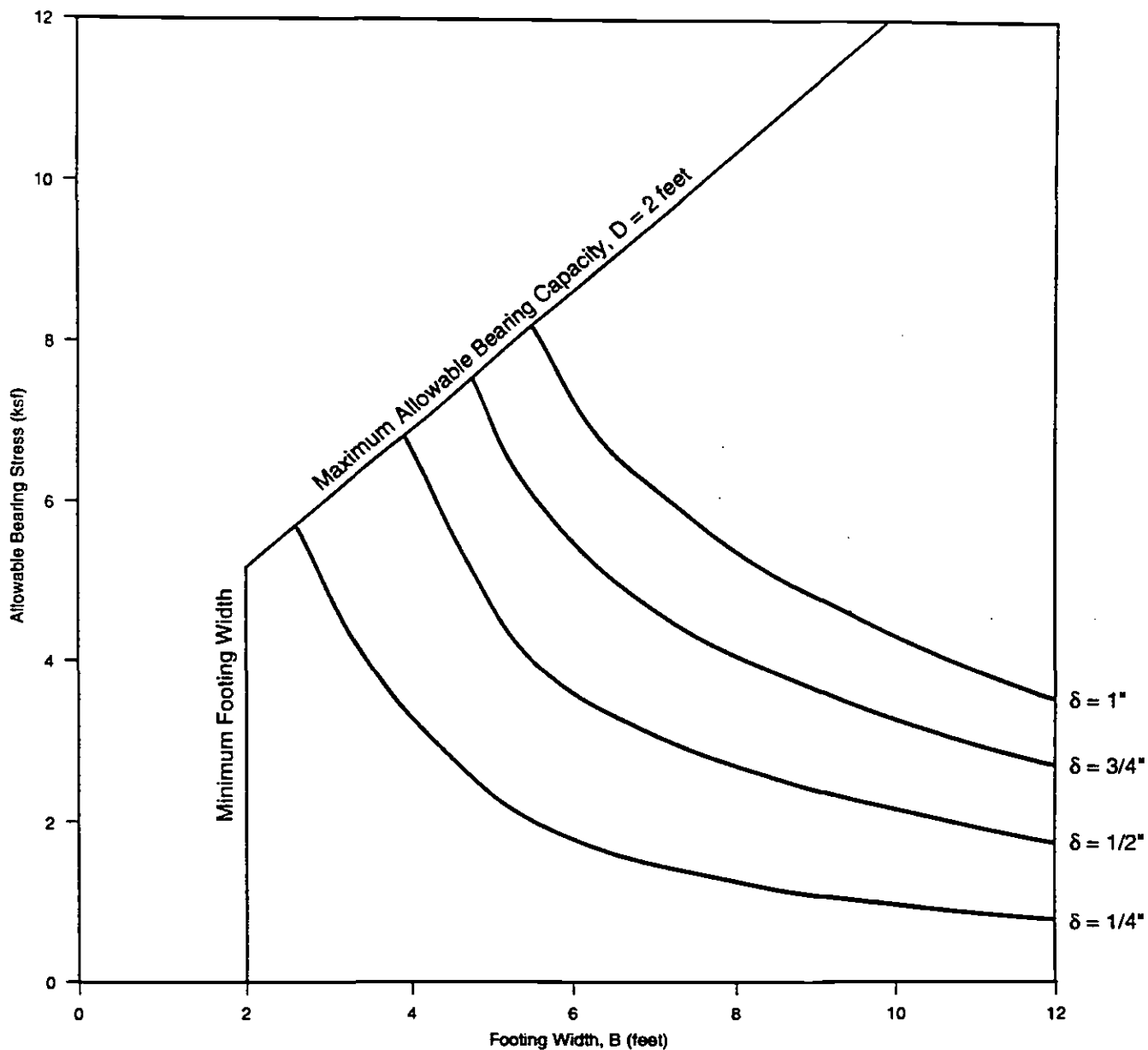
5.6.9 Geotechnical Input for Station Design

5.6.9.1 Geotechnical Parameters

Table 5-1 summarizes recommended geotechnical design parameters for station design based on available data. These design parameters include lateral earth pressure coefficients, unit weight of soil, shear strength, long term maximum groundwater level, modulus of subgrade reaction for shallow foundations, and seismic coefficients.

5.6.9.2 Soil Spring Constants for Main Station Structures

Estimated ranges and best estimates of static and dynamic soil spring constants for design of the main station structure are presented in Figure 5-7. It is recommended that the full estimated ranges of stiffness be considered in the structural design to account for the potential variability of the subsurface materials in the station area. An upper bound/lower bound approach is recommended for the structural response analysis of the station box structure. The lower bound values of soil spring constants should be used for evaluation of settlements and differential settlements, while the upper bound values should be used for evaluation of stresses in the structures.



Explanation:

δ = Immediate Settlement for a Square Footing

D = Footing Embedment Below Adjacent Grade

Note: Factor of safety of 3 is included.



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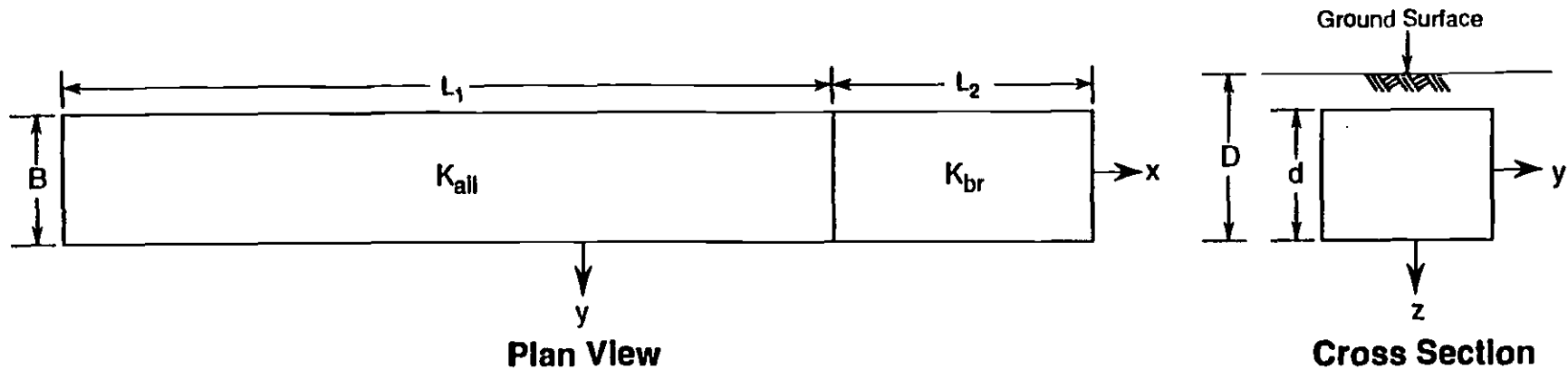
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**Allowable Bearing Capacity for
Spread Footing in Compacted
Granular Fill (Compacted to 95% of
Maximum Dry Density)**

**TABLE 5-1: DESIGN VALUES OF GEOTECHNICAL
PARAMETERS FOR UNDERGROUND STRUCTURES
(FIRST/BOYLE STATION)**

Parameter	Design Value		
Geologic Unit	Fine-Grained Alluvium	Coarse-Grained Alluvium	Fernando/Puente Formation Bedrock
Unit Weight of Soil (pcf)	130		125
Void Ratio	0.63	0.48	0.72
Cohesion (psf)	400	0	1400
Angle of Internal Friction of Soil (degrees)	28	35	28
Soil Pressure Coefficient			
At Rest (K_0)	0.48		0.50
Active (K_a)	0.32		0.27
Groundwater Level ⁽¹⁾	50 feet above station invert		
For Support of Station Mat Foundation:			
Footing Length (ft) x Footing Width(ft)	676 x 60		200 x 60
Coefficient of Static Subgrade Reaction, Estimated Range, K_n ⁽²⁾ (tons/ft ³) Best Estimate, K_n ⁽²⁾ (tons/ft ³)	15 - 30 18		12 - 24 16
Coefficient of Dynamic Subgrade Reaction, Estimated Range, K_n ⁽²⁾ (tons/ft ³) Best Estimate, K_n ⁽²⁾ (tons/ft ³)	100 - 250 160		120 - 300 200
Seismic Coefficient			
ODE ⁽³⁾ Horizontal (K_h)			0.3g
Vertical (K_v)			0.2g
MDE ⁽³⁾ Horizontal (K_h)			0.6g
Vertical (K_v)			0.4g

- Notes: (1) Assumed maximum groundwater level during the design life of the station. Current groundwater levels are about 10 to 25 feet above station invert (elevations 233 to 237 feet).
- (2) K_n = Coefficient of subgrade reaction for mat foundation of width 60 feet.
An upper bound/lower bound approach is recommended for the structural response analysis of the station structure. The lower bound values of modulus of subgrade reaction should be used for evaluation of settlements while the upper bound values should be used for evaluating stresses in the structure.
- (3) Operating Design Earthquake (ODE) and Maximum Design Earthquake (MDE) are based on Seismic Investigation and Design Criteria for Metro Rail Project prepared by Converse Consultants, Earth Sciences Associates and Geo/Resource Consultants (1983).



L = Length of Station = 876 feet, L_1 = 676 feet, L_2 = 200 feet

B = Width of Station = 60 feet

D = Depth of Station Invert = 69 feet

d = Height of Station Wall = 51 feet

K_{all} = Spring Constant for Alluvium

K_{br} = Spring Constant for Bedrock (T/Tp)

k_x, k_y, k_z = Spring Constants in x, y and z directions, respectively.

Loading Condition	Applicable Condition	ALLUVIUM					BEDROCK (T/Tp)				
		Shear Modulus $G, 10^{+6}$ psf	Poisson's Ratio	Estimated Spring Constant K_{all} (Stiffness), 10^{+6} lb/in			Shear Modulus $G, 10^{+6}$ psf	Poisson's Ratio	Estimated Spring Constant K_{br} (Stiffness), 10^{+6} lb/in		
				K_z	K_y	K_x			K_z	K_y	K_x
Static (high strain)	Estimated Range	0.5 to 1.6	0.3-0.4	750 to 2400	900 to 2900	750 to 2400	0.4 to 1.2	0.40-0.48	300 to 800	350 to 1000	300 to 900
	Best Estimate	0.9	0.35	1300	1600	1300	0.8	0.4	550	700	600
Dynamic * (low strain)	Estimated Range	5 to 12	0.3-0.4	7900 to 19000	9000 to 22000	7000 to 17000	5 to 12	0.40-0.48	4100 to 9700	4500 to 11000	3800 to 9500
	Best Estimate	8	0.35	12000	14000	11000	8	0.48	6500	7100	6200

Note:

* Actual dynamic stiffness is frequency-dependent. Approximate average numbers (over a wide frequency range) are provided for simplification purposes.



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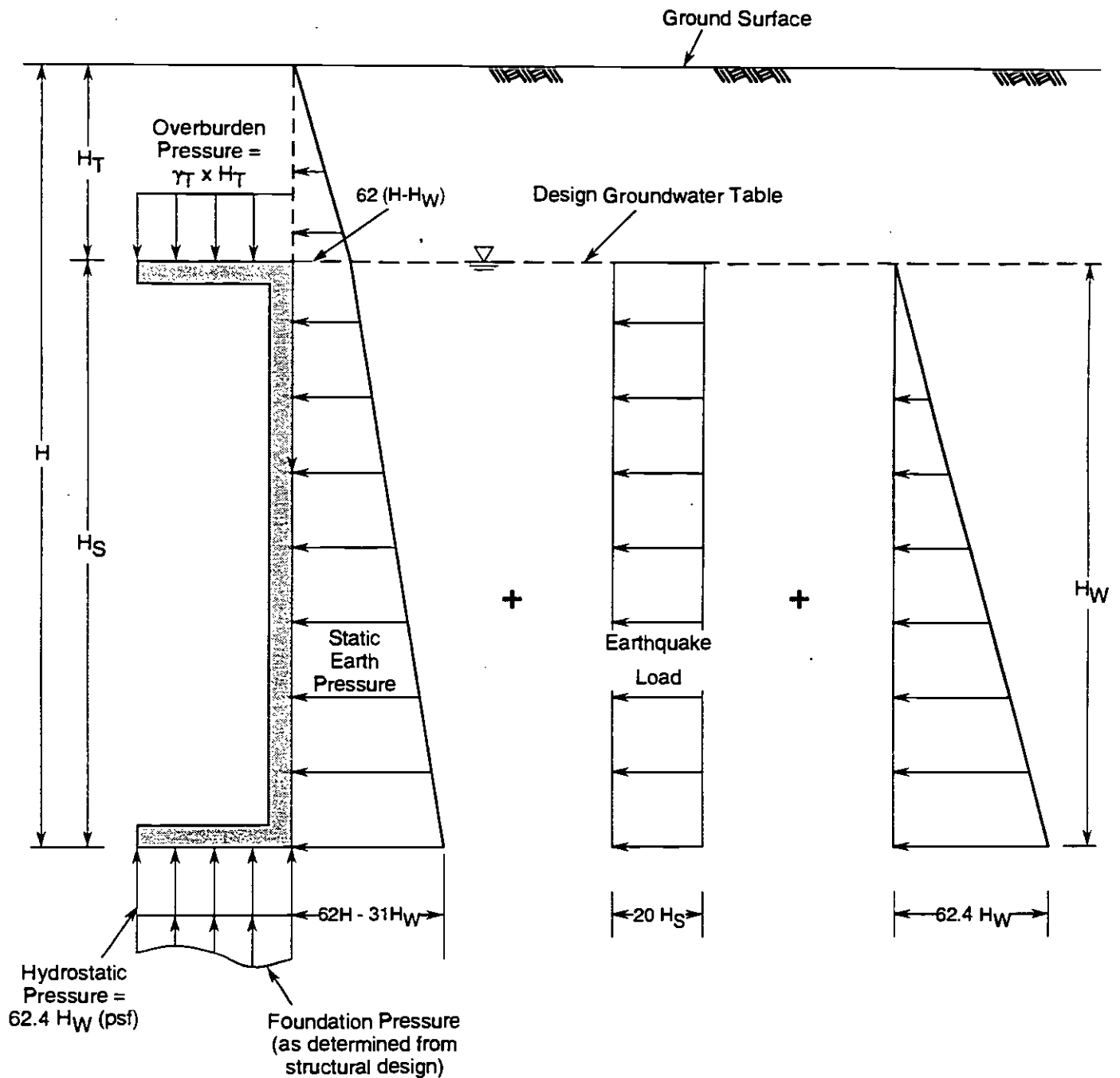
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**Estimated Soil Spring
Constant Values
(First/Boyle Station)**

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Figure 5-7



Notes:

- (1) All pressure in psf
- (2) Station invert elevation is at about 233 to 237 feet.
- (3) Design groundwater level is at about elevation 283 to 287 feet. (about 15 to 30 feet below ground surface).
- (4) H , H_T , H_S , and H_W are in feet.
- (5) γ_T - Total density of soils.
- (6) Drawing is schematic.



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**Earth Pressure on Below-Grade
Permanent Structures
(First/Boyle Station)**

5.6.9.3 Lateral Earth Pressure on Permanent Structures

We understand that the station will be designed and constructed as a relatively rigid, water-tight box. The recommended lateral earth pressures including hydrostatic pressure and earthquake loading are shown in Figure 5-8. The following are noted:

- Assumptions for groundwater levels during the design life of the station and maximum design earthquake (MDE) described in Sections 5.3 and 5.4, respectively, were utilized in developing Figure 5-8.
- The Mononobe-Okabe procedure was utilized for developing earthquake-induced lateral earth pressures. This procedure assumes that the wall yields or rigidly moves sufficiently for active conditions to develop during earthquake loading. In developing the earthquake-induced earth pressure recommendations, the potential effects of vertical ground acceleration were ignored to avoid being too conservative.
- Potential surcharge effects from adjacent buildings which are not underpinned should be considered in the wall pressure diagrams. Lateral surcharge loads on walls can be calculated in accordance with the recommendation shown in Figure 5-3c. Vertical loads from anticipated traffic and other live loads should be determined and added to the roof loading.

5.6.10 Liquefaction Potential

Liquefaction potential of the subsurface soils in the station area was evaluated using the procedures by Seed and Idriss (1982), Seed and others (1984) and recent work done by Fear and McRoberts (1995). The assumed highest groundwater levels described in Section 5.3 were utilized in the analysis to account for the effects of potential groundwater fluctuations on the liquefaction potential of subsurface materials. The results indicate that liquefaction of the site soils under the maximum design earthquake is unlikely.

5.6.11 Earthwork

Based on the subsurface conditions encountered in the investigation, the station excavation can be accomplished relatively rapidly by conventional and readily available excavation technology. Earthwork and site preparation activities are expected to consist of an excavation for subterranean structures; subgrade preparation for the station floor; foundation preparation 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 5.6.5. Other minor excavations, subgrade preparation and backfill placement should be done in accordance with the guidelines presented in Appendix E. All work should be in compliance with applicable city (Los Angeles), state (California), and federal (Occupational Safety and Health Act) requirements.

In general, the mat foundations must be underlain by a minimum 2-foot thick layer of granular material with an in situ density of at least 95 percent of the maximum dry density as per ASTM D1557. In granular alluvium this may be achieved by proof rolling the excavated subgrade with a heavy vibratory roller, or by overexcavating and compacting the 2-foot thick zone below the foundation in 8-inch thick lifts. In fine-grained soils, the subgrade must be overexcavated a minimum of 2 feet below design grade and replaced with granular material compacted to required specifications. If the mat is directly placed on the native materials, rock fragments larger than 6 inches are not allowed in the exposed subgrade. The compacted fill blanket should extend a minimum of 5 feet beyond the foundation perimeter.

Materials excavated from non-contaminated granular alluvium (sand, silty sand, gravelly sand, sandy gravel, and gravel) could be stockpiled to be reused as backfill material. Excavated fine-grained alluvium or bedrock is not suitable as backfill material. If there is insufficient material available for backfill, imported granular material could be used for fill subject to the approval of a geotechnical engineer.

5.7 SOIL AND GROUNDWATER CONTAMINATION SUMMARY

5.7.1 Groundwater Contamination

Except for suspended solids, turbidity and some components of dissolved solids (Section 4.3.3.1), available groundwater quality test results detected no contamination of hydrocarbons, hydrogen sulfides and organic and nonorganic constituents. However, some of the groundwater from dewatering or perched water inflows may be contaminated due to the proximity of the project area to the existing Union Station and Boyle Heights oil fields.

No evidence of floating hydrocarbons product was detected during development and groundwater level monitoring of the nine monitoring wells installed in this investigation and two monitoring wells installed in the preliminary engineering program.

5.7.2 Soil Contamination

Available chemical test data on soil samples obtained during the Stage II Environmental Site Assessment (GeoTransit Consultants, 1994b) indicate the majority of the excavated soils are likely to be clean and do not require special handling or disposal. Again, due to the proximity to the Union Station and Boyle Heights oil fields, some of the excavated soils from the station and tunnel areas may locally contain hydrocarbon contamination and, if encountered, will require treatment and disposal at approved facilities.

5.8 GASSY CONDITIONS

The proximity of the station and tunnel areas to the Union Station and Boyle Heights oil fields indicates that the potential for encountering oil field gases (methane, hydrogen sulfide, etc.) during construction exists. This is evident by the significant OVA reading of one soil sample, and noticeable hydrocarbon and sulfur odors encountered in this investigation, and the observed methane concentrations in the gas probes installed and monitored in the project area by Engineering-Science, Inc. (Section 4.3.3.3).

Proper ventilation and monitoring of methane, hydrogen sulfide and other toxic/explosive gases will be necessary to satisfy the U.S. and California Occupational Safety and Health Administration (OSHA) requirements and to provide a safe working environment.

5.9 ABANDONED OIL WELLS

There exist a number of known abandoned oil wells located adjacent to the project area. Due to the proximity of the project area to the Union Station and Boyle Heights oil fields, there is a potential for the presence of undocumented cased or uncased abandoned oil wells within the tunnel envelope and station excavation limits. In addition to requiring considerable time to move the casings, such abandoned wells, if encountered, may contain large quantities of water or even oil under pressure. The abandoned wells may also contain residual accumulations of hydrogen sulfide, methane or other toxic/explosive gases.

5.10 CORROSIVE SOILS

Results of sulfate content tests indicate that the alluvium and bedrock in the project area are mildly corrosive to concrete. Results of available electrical resistivity tests from the preliminary geotechnical investigations (GeoTransit Consultants, 1994) and the current investigation (Table 3-5) indicate that most of the subsurface soils are moderately corrosive (5,000 to 10,000 ohm-cm) to very corrosive (less than 2,000 ohm-cm) to metals.

5.11 FAULT CROSSING

The results of a project-specific fault investigations performed by GeoTransit Consultants to delineate and characterize the Coyote Pass escarpment and to assess its seismic capability are presented in a fault-investigation report (GeoTransit Consultants, 1996a). The results indicate that the Coyote Pass escarpment is active and that deformation is primarily in the form of a fold rather than the result of surface faulting. The estimated magnitudes of deformation for scenario earthquakes are provided in the fault investigation report (1996a). As summarized in Section 4.2.2, the Coyote Pass escarpment appears to intersect the project area approximately at Station CR 109 + 00 (about 300 feet east of the eastern terminus of the First/Boyle Station). The location of the axial surface of the folding associated with the escarpment is not well defined. The station structure, however, appears to be located on the southern part of the fold and could be subject to

deformation, most likely in the form of tilting, during an earthquake on the blind thrust fault that underlies the area.

6.0 REFERENCES

- Blake, T.F., 1992. EQSEARCH - A Computer Program for the Estimation of Peak Horizontal Acceleration from California Historical Earthquake Catalogs. IBM-PC Version 2.0.
- Bullard, T.F., and Lettis, W.R., 1993. Quaternary Fold Deformation Associated with Blind Thrust Faulting, Los Angeles Basin, California. *Journal of Geophysical Research*, Vol. 98, No. B-5, pp. 8349-8369.
- California Department of Water Resources, Southern District, 1961. Planned Utilization of The Groundwater Basins of the Coastal Plain of Los Angeles County. Appendix A - Groundwater Geology, Bulletin No. 104.
- Converse, Davis and Associates, 1975. Geologic Investigation, City Terrace Trunk Sewer Section 1 (Tunnel), HUD Project No. WS California - 394, Contract No. H-602-4069. Prepared for Los Angeles County Sanitation District No. 2, dated May 14, 1975.
- Converse Consultants, Earth Sciences Associates, and Geo/Resource Consultants, 1984. Geotechnical Report, Metro Rail Project, Design Unit A100. Prepared for Metro Rail Transit Consultants, dated February 1984.
- Converse Consultants, Inc., Earth Sciences Associates and Geo/Resource Consultants, 1983. Seismological Investigation and Design Criteria. Prepared for Southern California Rapid Transit District Metro Rail Project, dated May 1983.
- Converse, Ward, Davis, Dixon, Earth Science Associates, Geo/Resource Consultants, 1981. Southern California Rapid Transit District, Metro Rail Project, Geotechnical Investigation Report, Volumes I and II. Prepared for Southern California Rapid Transit District, dated December 21, 1981.
- Davis, T. L., Namson, J., and Yerkes, R. F., 1989. A Cross Section of the Los Angeles Area: Seismically Active Fold and Thrust Belt, the 1987 Whittier Narrows Earthquake, and Earthquake Hazard. *Journal of Geophysical Research*, V. 94, p 9644-9664.
- Dolan, J.F. and Sieh, K., 1992a. Paleoseismology and Geomorphology of the Northern Los Angeles Basin: Evidence for Holocene Activity on the Santa Monica Fault and Identification of New Strike-Slip Faults through Downtown Los Angeles, in EOS, Transactions of the American Geophysical Union, Vol. 73, p. 589.
- Dolan, J.F. and Sieh, K., 1992b. Tectonic Geomorphology of the Northern Los Angeles Basin: Seismic Hazards and Kinematics of Young Fault Movement, in Engineering Geology Field Trips, Orange County, Santa Monica Mountains and Malibu. Association of Engineering Geologists, Southern California Section, 35th Annual Meeting, p. B-20 to B-26.
- Engineering-Science, Inc., 1994. Subsurface Gas Investigation, Metro Red Line - Eastside Extension. Report Prepared for Engineering Management Consultant, dated December 7, 1994.

- Fear, C.E., and McRoberts, E.C., 1995. Reconsideration of Initiation of Liquefaction in Sandy Soils. *J. Geotech. Engrg., ASCE*. 121(3), 249-261.
- GeoTransit Consultants, 1996a. Investigation of the Coyote Pass Escarpment, Eastside Extension, Metro Red Line, Volumes I and II, Prepared for Engineering Management Consultant, April 1996.
- GeoTransit Consultants, 1996a. Results of Aquifer Pump Testing at Mission Road and E. Fourth Street, Eastside Extension, Metro Red Line, Los Angeles, California. Prepared for Engineering Management Consultants, May 1996.
- GeoTransit Consultants, 1996c. Final Geotechnical Investigation Report for Union-Little Tokyo Tunnels and Little Tokyo Station, Eastside Extension, Metro Red Line Project, Volumes I and II, Prepared for Engineering Management Consultant, May 1996.
- GeoTransit Consultants, 1996d. Final Geotechnical Investigation Report for First/Lorena Station and Tail Track Tunnels, Eastside Extension, Metro Red Line Project. Prepared for Engineering Management Consultant, May 1996.
- GeoTransit Consultants, 1996e. Final Geotechnical Investigation Report for Chavez/Soto Station and adjacent tunnels, Eastside Extension, Metro Red Line Project. Prepared for engineering Management Consultant, June 1996.
- GeoTransit Consultants, 1994a. Geotechnical Investigation for Preliminary Engineering Program, Eastside Extension, Metro Red Line Project, Volumes 1 and 2. Prepared for Engineering Management Consultant, dated February 14, 1994.
- GeoTransit Consultants, 1994b. Stage II Environmental Site Assessment, Eastside Extension, Metro Red Line project, Prepared for Engineering Management Consultant, dated January 1994.
- Hart, E.W., 1994. Fault Rupture Hazard Zones in California, Revised 1994. California Division of Mines and Geology, Special Publication 42.
- Jennings, C.W., 1994. Fault Activity Map of California and Adjacent Areas. California Division of Mines and Geology, Geologic Data Map No. 6.
- Lamar, D.L., 1970. Geology of the Elysian Park - Repetto Hills Area, Los Angeles County, California. California Division of Mines and Geology, Special Report 101, 45p.
- LeRoy Crandall and Associates, 1970. Final Report of Geological Investigation, City Terrace Trunk Sewer, Section 1, Project No. 72-223-NH. Prepared for County Sanitation District No. 2 of the County of Los Angeles, dated July 6, 1979.
- Mooney, H., 1984. Handbook of Engineering Geophysics, Vol.1, Bison Instruments, Minneapolis, MN.
- Mualchin, L. and Jones A.L., 1992. Peak Acceleration from Maximum Credible Earthquakes in California (Rock and Stiff Soils). California Division of Mines and Geology, Open-File Report 92-1.

- Seed, H.B., Tokimatsu, K., Harden, L.F., and Chung R.M., 1984. Influence of SPT Procedures in Soil Liquefaction Resistance Evaluation. Report No. UCB/EERG-84/15, Earthquake Engrg. Research Center, University of California, Berkeley, California.
- Seed, H.B., and Idriss, I.M., 1982. Ground Motion and Soil Liquefaction during Earthquake. Monograph No.5, Monograph Series, Earthquake Engrg. Research Center, University of California, Berkeley, CA.
- Treiman, J.A., 1991. Whittier Fault Zone. California Division of Mines and Geology, Fault Evaluation Report, FER-222, 17p.
- U.S. Army Corps of Engineers, 1979. Geophysical Exploration, Engineering Manual No. 1110-1-1802, Department of the Army, Washington, D.C.
- U.S. Department of Interior, Bureau of Reclamation, undated. Engineering Geology Field Manual.
- Ziony, J.I. and Yerkes, R.F., 1985. Evaluating Earthquake and Surface-Faulting Potential, in Evaluating Earthquake Hazards in the Los Angeles Region - An Earth-Science Perspective. U.S. Geological Survey, Professional Paper 1360, p. 43-91.

7.0 LIMITATIONS

The conclusions and professional opinions presented in this report were developed by GeoTransit Consultants for Engineering Management Consultant (EMC). GeoTransit Consultants makes no warranty, either expressed or implied, as to its findings, opinions, recommendations, specifications, or professional advice except that these were developed after being prepared in accordance with generally accepted standards of care and diligence normally practiced by recognized consulting firms performing services of a similar nature.

Subsurface conditions are, by their nature, uncertain and may vary from those tested in the laboratory, documented in historical documents or encountered at the locations where visual inspections, borings, soundings, test pits, surveys, or other explorations were made by GeoTransit Consultants. The data, interpretations, and recommendations of GeoTransit Consultants are based solely on such information or from information obtained by others in the area covered by this report, and or observations from borings in the area covered by this report.

The data and conclusions contained herein should be considered to relate only to the specific project and location discussed herein. GeoTransit Consultants is not responsible for any conclusions that may be made from these data by others unless we have been given an opportunity to review such conclusions and concur in writing. This report has not been prepared for use by parties other than EMC or its consultants. It may not contain sufficient information for the purposes of other uses.

If any changes are made in the project as outlined in this report, the conclusions contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are modified and approved in writing by GeoTransit Consultants.

Respectfully submitted,

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EXPLANATION

GEOLOGIC UNITS	
Qya YOUNGER ALLUVIUM	Q ₁ and Q ₂ of Suess and Lettis (1905)
Qoa₁ Qoa₂ Qoa₃ OLDER ALLUVIUM	Q ₁ , Q ₂ and Q ₃ of Suess and Lettis (1905)
Qop OLDER GRAVEL	
T1 TERRAZZO FORMATION	
Tp PUENTE FORMATION	

SYMBOLS

- FLUID ENCLOSURE
- TUNNEL ALIGNMENT; cross ticks are 1,000-foot apart
- STRIKE AND DIP OF BED
- STRIKE OF VERTICAL BED
- STRIKE AND DIP OF OVERTURNED BED
- AXIS OF ANTICLINE; short dashed in older alluvium, dotted where buried; queried where uncertain or construction unknown
- AXIS OF OVERTURNED ANTICLINE
- AXIS OF SYNCLINE; short dashed in older alluvium, dotted where buried; queried where uncertain or construction unknown
- GEOLOGIC CONTACT; short dashed between subunits of older alluvium
- POSSIBLE FAULT; dotted where buried

Q Project-Specific Geotechnical Borings; Tunnel Borings Denoted by DD;
Boring Borings Denoted by BD;
Borings from Preliminary Engineering Program Denoted by PB.

26182 Water Well, monitored by L.A. Co. Dept. Public Works

SEWER TUNNEL ALIGNMENT

Bedding attitude in tunnel by Leroy Crandall and Associates (1979); circled
massive indicates amount of dip in Post-Pliocene deposits

Shear zone in tunnel

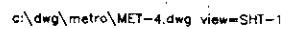
Geology Adopted and Modified from Lerner
(1972) and Bullard and Lettis (1905).
Base Map: U.S. Geological Survey, Los Angeles
7.5 Minute Quadrangle, dated 1960, photorevised 1981.

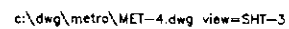
	Project No. 95-8347-24
City of Los Angeles Department of Public Works	Geotechnical Investigation Eastside Extension Metro Red Line

Key Plans and Geology

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APPENDIX A
FIELD EXPLORATION

FIELD EXPLORATION

GENERAL

The field exploration program, consisted of eighteen rotary wash/hollow-stem auger borings (DD-13, DD-13S, DD-14, DD-15, DD-17, DD-51, DD-52, DD-54A, DD-54-B, DD-54C, DD-55, DD-56-1, DD-57, SD-6, SD-7, SD-8, SD-9 and SD-10) and one bucket auger boring (DD-16) was conducted from October 24 to November 21, 1995. Prior to this investigation, four geotechnical borings (PE-21, PE-24, PE-25 and PE-26) were drilled from November 22 to December 6, 1993. The mud rotary, hollow-stem auger and bucket auger drilling was performed by the drilling subcontractors C & L Drilling, Inc., A & W Drilling, Inc. and A & R Drilling, Inc. Logging of borings and soil samples was performed by geologists and engineers supervised by a Registered Geotechnical Engineer (RGE) or a Certified Engineering Geologist (CEG) from GeoTransit Consultants. Nine monitoring wells were installed during this investigation and two other monitoring wells were installed previously to monitor groundwater levels. The boring locations were established in the field by a GeoTransit Consultants' engineer by tape measurements from adjacent street curbs and other fixed features. The approximate locations of the exploration points along the alignment are shown in Plate 2.

BOREHOLE DRILLING, SAMPLING AND MONITORING WELL INSTALLATION

Exploratory borings were drilled using truck-mounted MAYHEW-1000 and Midway-1300 mud rotary rigs, and a CME-75 hollow-stem auger rig. The mud rotary/hollow stem auger borings for the geotechnical exploration ranged in diameter from approximately 5 to 8 inches and their depths ranged from 71.5 feet to 140.5 feet below the ground surface (BGS). In general, soil samples were obtained at 5-foot-depth intervals and at significant changes in stratigraphy by alternately using a standard split-spoon sampler (Standard Penetration Test Method) and a 2.4-inch inner diameter California-type drive sampler lined with 1-inch high brass rings. A cone-type plastic catcher and a sample catcher assembly consisting of a brass ring containing 8 metallic teeth and a rubber donut were used with the split-spoon samplers and California drive samplers, respectively. The bucket auger boring was drilled using an EZ bore bucket auger. The borehole was 18 to 24 inches in diameter and approximately 55 feet deep.

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 with a 140-pound hammer falling 30 inches. Blow counts were recorded for each 6-inch driving increment. The number of blows required to drive a standard split-spoon sampler for the last 12 of 18 inches is called the standard penetration resistance.

The blows was terminated when one of the following occurred:

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

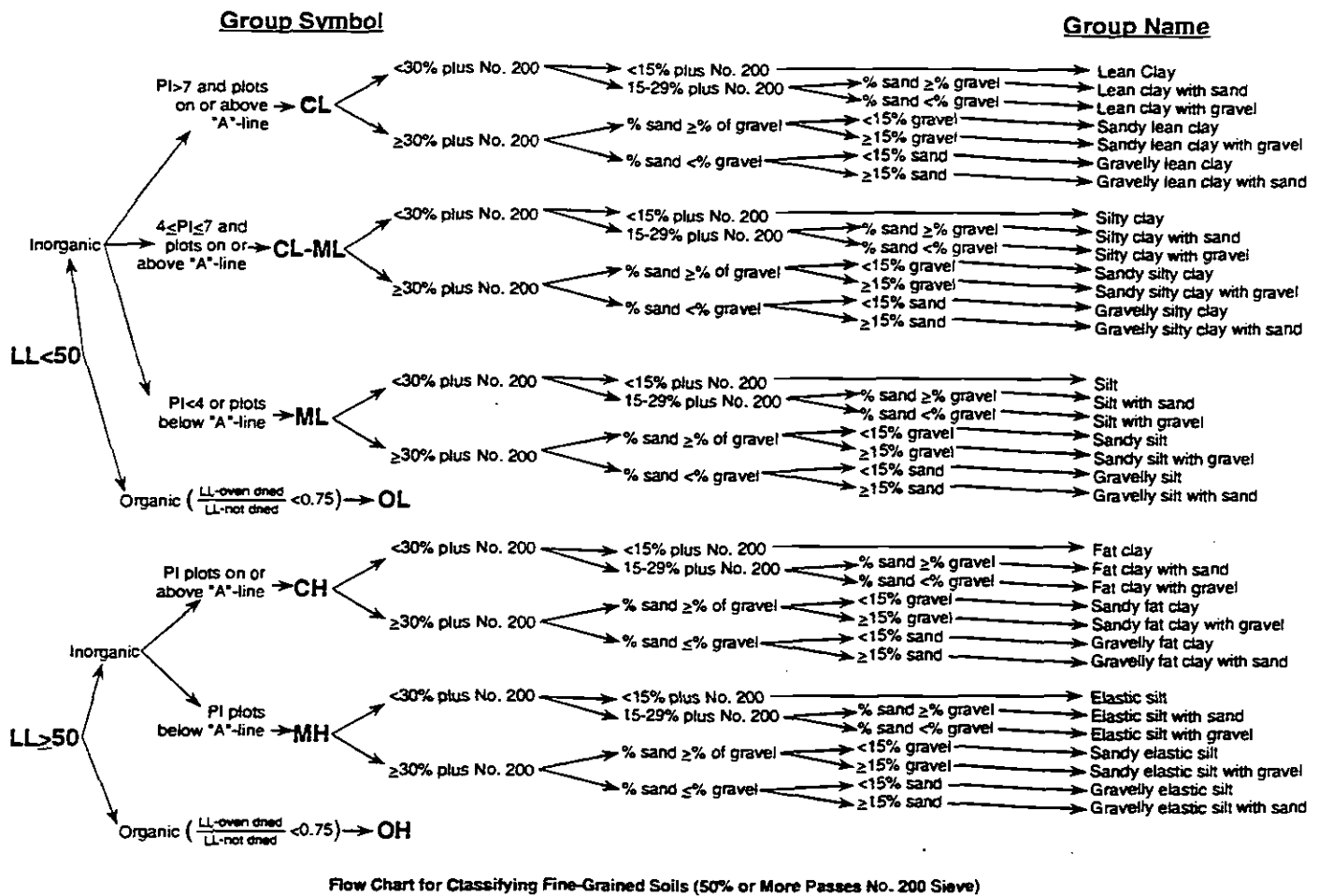
Split spoon samples were examined and carefully removed from the sampler, logged, sealed and transported to the laboratory for testing.

Relatively undisturbed soil samples were obtained with the California-type drive sampler by driving the sampler with a 300-, 380- or 400-pound downhole hammer falling 18 inches. Hammer weights and the corresponding drop heights used for driving the sampler are indicated in the boring logs. Blow counts were recorded for each 6-inch driving increment. The recovered samples were examined and the middle six rings were placed in a plastic tube for transportation to the laboratory for testing. In order to compare the blow counts on a uniform basis, the California sampler's downhole hammer blow counts were corrected for sampler dimensions, different hammer weights, height of fall, and buoyancy and viscous drag in the bentonite drilling mud in accordance with the procedure detailed in sheet 2 of 4 and sheet 3 of 4, Figure A-2. The corrected blow counts designated as "Equivalent SPT Value" are presented in Table 3-6.

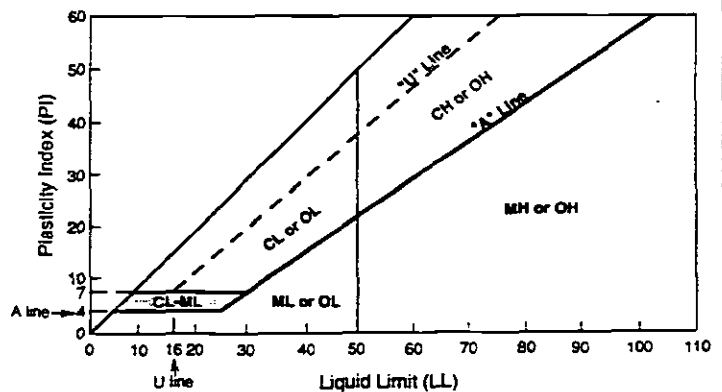
Nine monitoring wells were installed during this investigation after the completion of soil sampling at selected locations to monitor groundwater levels. Two monitoring wells were installed previously. Observation of groundwater levels during rotary wash drilling is generally not possible since the borings are filled with drilling fluid. Estimates of the groundwater level were, however, made in some of the borings by observing the moisture condition of the samples.

Potable water, from permitted hydrants, was used to flush each boring to remove or thin the drilling fluid prior to monitoring well installation. Backfill sand (#2/12 Monterey) up to 11 feet was placed at the bottom of borings. Following this, the PVC casing assembly was inserted into the boring, backfill sand was placed to about 2 to 8 feet above the top of the screened interval of the casing assembly, and 1/2-inch size bentonite pellets were then dropped to form a 3- to 8-foot thick bentonite transition plug. Cement-bentonite grout was then poured into the annulus from the top of the bentonite plug to within 12 to 18 inches of the ground surface. A circular 8-inch diameter, metal traffic box was installed nearly flush with the ground surface. Monitoring well installation diagrams are presented in Figures A-3B, A-5B, A-6B, A-8B, A-11B, A-15B, A-18B, A-20B, and A-22B.

The logs of borings accompany this appendix. Stratification lines on the logs represent approximate boundaries between predominant soil types. Geologic and engineering descriptions and material classifications used on the boring logs are in general accordance with the Unified Soil Classification System (USCS) and the American Society for Testing and Materials (ASTM D2487 and D2488) Methods. The material was visually classified in the field and independently verified, revised, if necessary, in the laboratory using the general guidelines presented in ASTM D-2488. For samples on which laboratory classification (gradation and/or Atterberg Limits) were performed, material classification was done in general accordance with ASTM D-2487. Figure A-1 presents the Laboratory and Field Soil Classification Systems used in material classification, as presented on the logs. Figure A-2 presents an explanation for the log symbols and terminology.



Laboratory Classification Criteria	
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: Loss than 5% More than 5% to 12% 5% to 12% GW, GP, SW, SP GM, GC, SM, SC Borderline cases requiring use of dual symbols	$Cu = \frac{D_{60}}{D_{10}}$ Greater than 4 $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for GW Atterberg limits plot below "A" line or PI less than 4 Atterberg limits plot above "A" line and PI greater than 7 $Cu = \frac{D_{60}}{D_{10}}$ Greater than 6 $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 Not meeting all gradation requirements for SW Atterberg limits plot below "A" line or PI less than 4 Atterberg limits plot above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
	Atterberg limits plot above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
	Atterberg limits plot above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
	Atterberg limits plot above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols



Plasticity Chart for Laboratory Classification of Fine Grained Soils



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Consultants

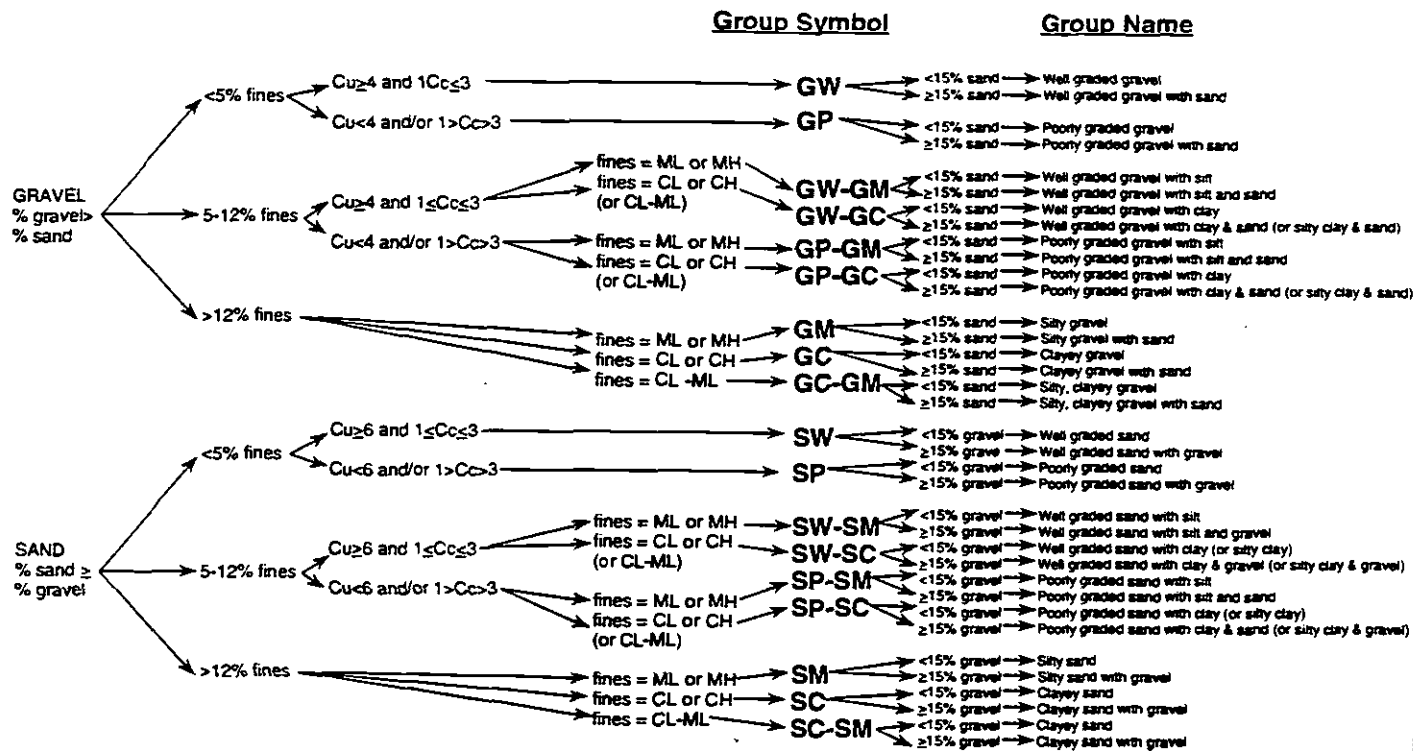
Project No.: 95-6347-04

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Eastside Extension
Metro Red Line

**Laboratory Soil
Classification System
(Sheet 1 of 4)**

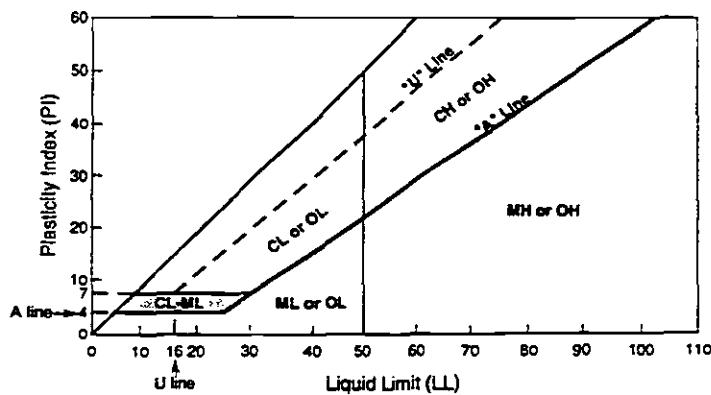
4-96

Figure A-1



Flow Chart for Classifying Coarse-Grained Soils (More Than 50% Retained on No. 200 Sieve)

Laboratory Classification Criteria	
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% More than 5% 5% to 12% More than 12% Borderline cases requiring use of dual symbols	$Cu = \frac{D_{60}}{D_{10}}$ Greater than 4 $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
	Not meeting all gradation requirements for GW
	Atterberg limits plot below "A" line or PI less than 4 Atterberg limits plot above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
	$Cu = \frac{D_{60}}{D_{10}}$ Greater than 6 $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
	Not meeting all gradation requirements for SW
	Atterberg limits plot below "A" line or PI less than 4 Atterberg limits plot above "A" line with PI greater than 7
	Atterberg limits plot below "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols
	Atterberg limits plot above "A" line with PI less than 4 Atterberg limits plot above "A" line with PI greater than 7
	Atterberg limits plot below "A" line or PI less than 4 Atterberg limits plot above "A" line with PI greater than 7
	Atterberg limits plot below "A" line or PI less than 4 Atterberg limits plot above "A" line with PI greater than 7



Plasticity Chart for Laboratory Classification of Fine Grained Soils



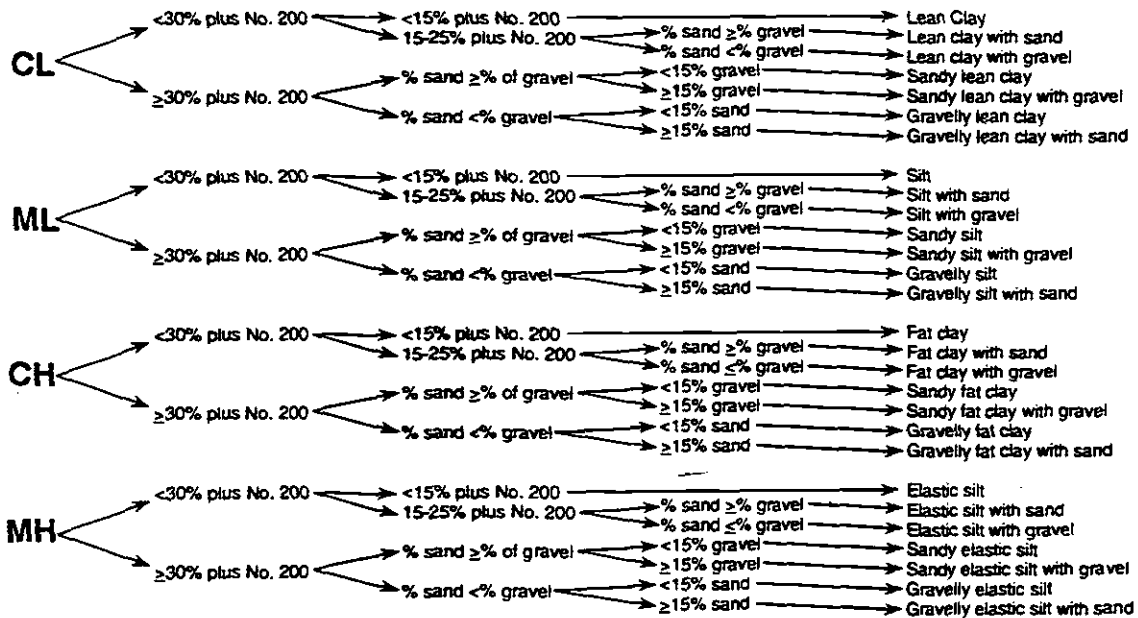
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 Metro Red Line

Laboratory Soil Classification System (Sheet 2 of 4)

Group Symbol

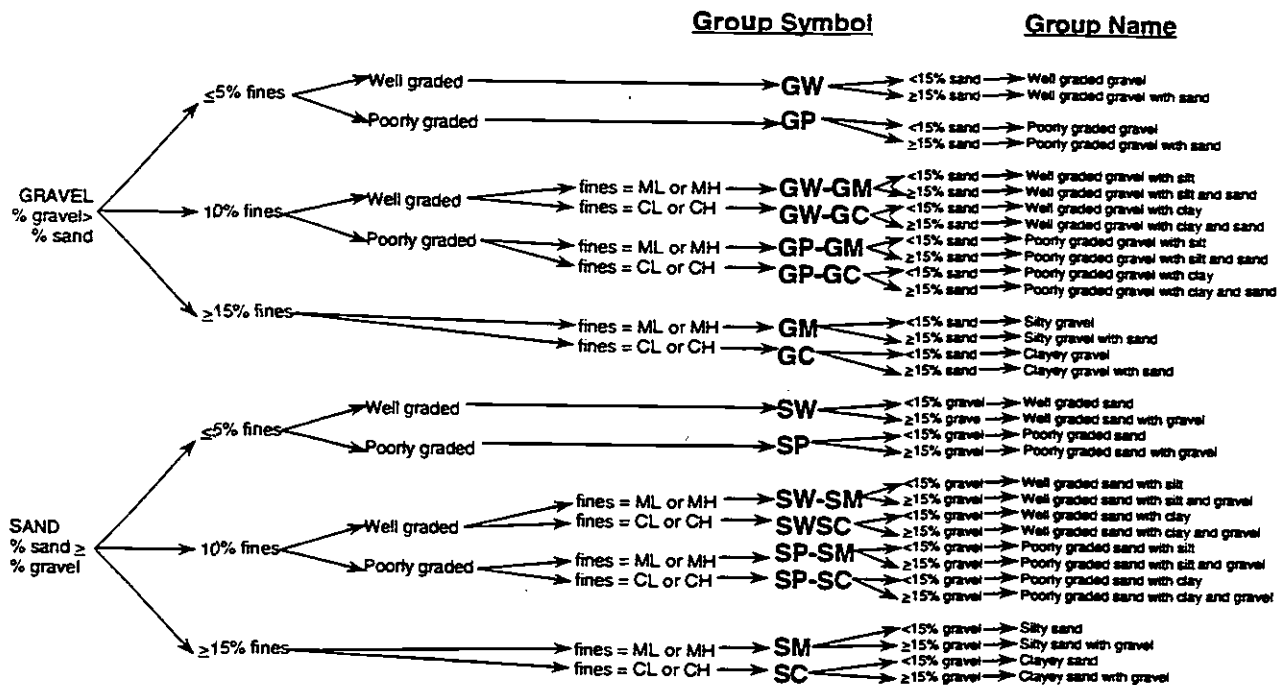
Group Name



Note: Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%

Flow Chart for Identifying Fine-Grained Soils (More than 50% Fines)

	GeoTransit Consultants	Project No.: 95-8347-04 Geotechnical Investigation Eastside Extension Metro Red Line
	Field Soil Classification System (Sheet 3 of 4)	



Note: Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5%

Flow Chart for Identifying Coarse-Grained Soils (Less than 50% Fines)



SAMPLE/TYPE

- S** STANDARD SPLIT SPOON SAMPLE
- D** 2½" DIA., 12" DRIVE SAMPLE
- P** 27/8" DIA., 38" PITCHER SAMPLE
- B** BAG SAMPLE

SIZE PROPORTIONS

FINE-GRAINED SOILS (50% or more passes no. 200 sieve)		COARSE-GRAINED SOILS (more than 50% retained on no. 200 sieve)	
<u>Coarse-grained Proportions</u>		<u>Fine-grained Proportions</u>	
TRACE	<5%	TRACE	<5%
SOME	5 TO 15%	WITH	5 TO 15%
WITH	15 TO 30%	USE MODIFIER	≥15%
USE MODIFIER	>30%		

SOIL MOISTURE

DRY - ABSENCE OF WATER, DRY TO TOUCH

MOIST - DAMP BUT NO VISIBLE WATER

WET - VISIBLE FREE WATER, USUALLY
SOIL IS BELOW WATER TABLE

EXPLANATIONS

BLOW COUNT (PENETRATION RESISTANCE)

- BLOW COUNTS FOR 6" INTERVALS EXCEPT AS NOTED

BLOW COUNTS FOR THE CALIFORNIA DRIVE SAMPLER ARE OBTAINED WITH EITHER A 300-, A 380- OR A 400- POUND DOWNHOLE HAMMER FALLING 18 INCHES. EQUIVALENT SPT VALUES ARE OBTAINED BY APPLYING APPROPRIATE CORRECTIONS, AS INDICATED ON FIGURE A-2 (SHEETS 2 OF 4 AND 3 OF 4)

RECOVERY (INCHES RECOVERED/INCHES TOTAL SAMPLE)

MOISTURE CONTENT (%) - LABORATORY DETERMINED MOISTURE CONTENT

PMT- PRESSURE METER TEST
 PPM - PARTS PER MILLION
 PCF - POUNDS PER CUBIC FOOT
 OVA - ORGANIC VAPOR ANALYZER
 [BACKGROUND] - BACKGROUND OVA READING
 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)

TERMS FOR THE DESCRIPTION OF BEDROCK (SHEET 4 OF 4)



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 Metro Red Line

Explanation of Boring Logs (Sheet 1 of 4)

EQUIVALENT SPT BLOWCOUNTS FOR CALIFORNIA DRIVE SAMPLES

FOR CALIFORNIA DRIVE SAMPLES, EQUIVALENT SPT VALUES ARE OBTAINED BY APPLYING THE APPROPRIATE CORRECTIONS FOR DIFFERENT HAMMER WEIGHTS, HAMMER DROP, SAMPLER DIMENSIONS, AND BUOYANCY AND VISCOUS DRAG WITHIN THE DRILLING MUD. THESE CORRECTIONS ARE INDICATED BELOW:

FINE-GRAINED SOILS

EQUATION 1

$$N_{SPT} = N_x \frac{W \times H (2.0^2 - 1.375^2)}{4200 (D_o^2 - D_i^2)}$$

WHERE:

- R_c = SAMPLER HAMMER RATIO (FT/LB)
 W = WEIGHT OF DOWNHOLE HAMMER (300 LBS, 380 LBS OR 400 LBS)
 H = HAMMER DROP (18-INCHES)
 D_o, D_i = OUTER (3.25 INCHES) AND INNER (2.41 INCHES) DIAMETERS OF THE CALIFORNIA DRIVE SAMPLER

EQUATION 2 (for Standard Penetration Hammer)

$$R_c = 4.185 \times 10^{-5}$$

BASED ON EQUATIONS 1 AND 2 AND SHEAR STRENGTH OF SOIL (FOUNDATION ENGINEERING HANDBOOK, WINTERKORN & FANG, FIGURE 1-22); AND ASSUMING A 20% REDUCTION FOR THE BUOYANCY AND VISCOUS DRAG WITHIN THE DRILLING MUD, EQUIVALENT SPT VALUES ARE OBTAINED AS FOLLOWS:

FOR 300 LBS DOWNHOLE HAMMER:	$N_{SPT} = 0.65 N (N \leq 48)$	$N_{SPT} = 0.50 N (N > 48)$
FOR 380 LBS DOWNHOLE HAMMER:	$N_{SPT} = 0.75 N (N \leq 39)$	$N_{SPT} = 0.63 N (N > 39)$
FOR 400 LBS DOWNHOLE HAMMER:	$N_{SPT} = 0.77 N (N \leq 37)$	$N_{SPT} = 0.66 N (N > 37)$

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	Geotechnical Investigation Eastside Extension Metro Red Line	

Explanation of Boring Logs (Sheet 2 of 4)

EQUIVALENT SPT BLOWCOUNTS FOR CALIFORNIA DRIVE SAMPLES (CONTINUED)

FOR CALIFORNIA DRIVE SAMPLES, EQUIVALENT SPT VALUES ARE OBTAINED BY APPLYING THE APPROPRIATE CORRECTIONS FOR DIFFERENT HAMMER WEIGHTS, HAMMER DROP, SAMPLER DIMENSIONS, AND BUOYANCY AND VISCOUS DRAG WITHIN THE DRILLING MUD. THESE CORRECTIONS ARE INDICATED BELOW:

COARSE-GRAINED SOILS

EQUATION 1

$$N_{SPT} = N_x \frac{W \times H (2.0^2 - 1.375^2)}{4200 (D_o^2 - D_i^2)}$$

WHERE:

- N_{SPT} = EQUIVALENT SPT BLOW COUNTS
 N = DOWNHOLE HAMMER BLOW COUNTS FOR 12" PENETRATION OF CALIFORNIA DRIVE SAMPLER
 W = WEIGHT OF DOWNHOLE HAMMER (300 LBS, 380 LBS OR 400 LBS)
 H = HAMMER DROP (18-INCHES)
 D_o, D_i = OUTER (3.25 INCHES) AND INNER (2.41 INCHES) DIAMETERS OF THE CALIFORNIA DRIVE SAMPLER

ASSUMING A 20% REDUCTION FOR THE BUOYANCY AND VISCOUS DRAG WITHIN THE DRILLING MUD, EQUIVALENT SPT VALUES OBTAINED FROM EQUATION 1 ARE AS FOLLOWS:

FOR 300 LBS DOWNHOLE HAMMER:

$$N_{SPT} = 0.46 N$$

FOR 380 LBS DOWNHOLE HAMMER:

$$N_{SPT} = 0.58 N$$

FOR 400 LBS DOWNHOLE HAMMER:

$$N_{SPT} = 0.61 N$$



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Metro Red Line

Explanation of Boring Logs
(Sheet 3 of 4)

Terms for the Description of Bedrock

ROCK STRENGTH

DESCRIPTOR	CRITERIA
Extremely Hard	Core, fragment, or exposure cannot be scratched with knife or sharp pick, can only be chipped with repeated heavy hammer blows.
Very Hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated hammer blows.
Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
Moderately Hard	Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.
Moderately Soft	Can be grooved 1/16 inch (2mm) deep by knife or sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very Soft	Can be readily indented, grooved with fingernail, or carved with a knife. Breaks with light manual pressure.

Any bedrock unit softer than H7, very soft, is to be described using USBR 5000 consistency descriptors.

Note: Although "sharp pick" is included in these definitions, descriptions of ability to be scratched, grooved or gouged by a knife is the preferred criteria.

DISCONTINUITY ROUGHNESS

CLASSIFICATION	DESCRIPTION
Smooth	Appears smooth and is essentially smooth to the touch. May be slickensides.
Slightly Rough	Asperities (undulations) on the fracture surfaces are visible and can be distinctly felt.
Medium Rough	Asperities are clearly visible and fracture surface feels abrasive.
Rough	Large angular asperities can be seen. Some ridges and high angular steps evident.
Very Rough	Near-vertical steps and ridges occur on the fracture surface.

FRACTURE FILLING

DESCRIPTION	DEFINITION
Clean	No film or coating
Very Thin	0 - 1 mm
Moderately Thin	1 - 3 mm
Thin	3 - 10 mm
Moderately Thick	10 - 30 mm
Thick	> 30 mm

Note:

- 1) Terminology adopted and modified from Engineering Geology Field Manual, U.S. Department of the Interior Bureau of Reclamation.
- 2) Color description from the Geological Society of America's Rock Color Chart.
- 3) For descriptions of weak sedimentary rocks also see key to soil definitions.

WEATHERING

DESIGNATION	ABBREVIATION	DESCRIPTION
Fresh	W1	Rock shows no discoloration, loss of strength or other effects due to weathering.
Slightly Weathered	W3	Rock is partly discolored, notably near fracture surfaces. Fractures may be open and stained. Intact rock is not noticeably weaker than fresh rock.
Moderately Weathered	W5	Rock is predominately discolored. Fractures are open, contain filling and may have greater discoloration with alteration penetrating inwards. Intact rock is noticeably weaker than fresh rock.
Intensely Weathered	W7	Rock is discolored throughout. Fractures discolored and contain thick filling. Rock is partly friable but lithorelicts are present. Original rock fabric is mainly preserved.
Decomposed	W9	Discolored or oxidized throughout, resistant minerals such as quartz may be unaltered, complete separation of grain boundaries, resembles soil but remnant rock structure may be preserved.
Residual Soil	RS	Rock is completely weathered to soil and original structure, and texture is completely destroyed.

DISCONTINUITY SPACING

SPACING	FRACTURE	BEDDING & FOLIATION
Less than 1/2 inch (<12 mm)	Extremely Close	Laminated
0.05 to 0.1 foot (12 mm to 30 mm)	Very Close	Very Thin
0.1 foot to 0.3 foot (30 mm to 1 cm)	Close	Thin
0.3 foot to 1 foot (1 cm to 30 cm)	Moderately Close	Medium
1 foot to 3 feet (30 cm to 1 m)	Wide	Thick
More than 3 feet (>1 m)	Very Wide	Very Thick

SEPARATION OF FRACTURE WALLS (FRACTURE OPENNESS)

DESCRIPTION	SEPARATION OF WALL (mm)
Tight	0
Slightly Open	1.0
Moderately Open	1.0 - 3.0
Open	3.0 - 10.0
Moderately Wide	10.0 - 30.0
Wide	> 30.0



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Eastside Extension
Metro Red Line

Explanation of Boring Logs (Sheet 4 of 4)

12-95

Figure A-2

BORING LOGS

M E M O R A N D U M

95-8347

Date: June 20, 1995
To: Bomi Ghadiali, EMC
From: Suji Somasundaram, Geotransit Consultants
Subject: Hammer Weight Calibration
Eastside Extension

Attached please find calibration certificates for the two 140 pound hammers (serial numbers MW8701 and MW8702) submitted to us by C & L Drilling, for the borings within the Union Station to Little Tokyo station segment. We understand that Class F - tolerance indicates ± 2.3 grams.

C & L DRILLING CO.

Contractors License #568520

600 E. LAMBERT RD.
LA HABRA, CALIFORNIA 90631
(310) 691-3533 FAX (310) 690-0264

FAX TRANSMITTAL

DATE

6-6-95

COMPANY

Earth Technology

ATTENTION

Grant Miller

FAX#

714-724-1557

OF PAGES TRANSMITTED

Cover + 2

REMARKS

Calibration - SPT hammer

IF YOU DO NOT RECEIVE ALL OF THE PAGES INDICATED ABOVE, PLEASE CALL
(310) 691-3533, AND WE WILL RE-TRANSMIT THE MISSING PAGES.

EMPIRE *Scale Co.*

12055 CLARK STREET
SANTA FE SPRINGS, CA 90670

(310) 946-0761
FAX (310) 944-0770

June 5, 1995

C & L Drilling
600 E. Lambert Rd
La Habra, CA 90631

Service Order # 22556
P.O.# Verbal - Odell
S/N M88701

CERTIFICATION OF GUARANTEED CALIBRATION

This is to certify that the Drill Head
was thoroughly tested before packing and shipment using
weights directly traceable to National Institute of
Standards and Technology. This equipment guaranteed
accurate to within Class 'F' Tolerance.
Complies to Mil-Spec. 45662A
MS-12572

ACTUAL WEIGHT: 140.0 Lbs.

Service Technician
[Signature]



12055 CLARK STREET
SANTA FE SPRINGS, CA 90670

(310) 948-0761
FAX (310) 944-0770

June 5, 1995

C & L Drilling
600 E. Lambert Rd.
La Habra, CA 90631

Service Order # 22556
P.O.# Verbal - Odell
S/N 1448702

CERTIFICATION OF GUARANTEED CALIBRATION

This is to certify that the Drill Head
was thoroughly tested before packing and shipment using
weights directly traceable to National Institute of
Standards and Technology. This equipment guaranteed
accurate to within Class "F" Tolerance.
Complies to MLI-Spec. 45662A
MS-12572

ACTUAL WEIGHT: 140.0 Lbs.

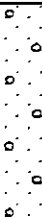
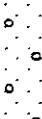
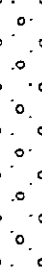
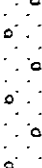
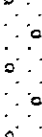
Service Technician



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN														
Project Number:		95-8347		Boring Number:		DD-13		Sheet		1		of		4		
Boring Location:		MTA Yard/S. Vehicle Shop Bldg.				Elevation and Datum(feet):264 MSL										
Health and Safety:				Level D		Date Started:			10/26/95		Date Finished:				10/26/95	
Drilling Equipment:				Mayhew 1000		Total Depth (feet):			106.0		Depth to Bedrock(feet):			None		
Drilling Method:				Rotary Wash		Number of Samples:			28		Depth to Water (feet):			76.2		
Boring Diameter:				5 inches		Completion Information:			Installed Monitoring Well							
Hammer Information:				SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop		Logged By:			R. Jie		Checked By:				K.Kabilamany	
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples								Drilling Time			
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)					
5		Reinforced concrete slab		af									8:00			
		ALLUVIUM GRAVEL with SAND	GP	Qa									8:25			
		SAND; dark brown, moist, dense, fine- to coarse-grained sand, some gravel to 3/8" in size	SP													
		SILTY SAND; brown, moist, medium dense, fine-grained sand, trace gravel to 3/8" in size, trace mica	SM		1	D	14 22	7/12	4.2 [3.6]	114	12	8:40				
10					2	S	8 10 11	12/18	5.0 [3.4]				8:46			
15		GRAVEL with SAND; light brown, dry, dense, subangular gravel to 2-1/2" in size, fine- to coarse-grained sand [rig chatter from 13' to 30']	GP		3	D	18 30	7/12	3.6 [3.4]	126	10	8:54				

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-13				Sheet 2 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content (%)	
25		SAND with GRAVEL; light brown, dry, dense, fine- to coarse-grained sand, angular to subangular gravel to 5/8" in size	SP	Qa	4	S	10 15 17	8/18	4.8 [3.6]			9:05
											9:11	
		5			D	24 26	5/12	4.8 [3.4]	133	7	9:36	
30		reduced gravel content, SAND; brown, very dense, gravel to 1" in size			6	S	30 30 37	13/18	4.4 [3.4]			10:00
35		GRAVEL with SAND; brown, moist, very dense, angular gravel to 1" in size, fine- to coarse-grained sand, [rig chatter from 32' to 45']	GP		7	D	100	5/6	3.4 [3.2]	116	21	10:21
												10:43
40		GRAVEL/SAND; brown, moist, very dense, angular to subangular gravel to 1-1/2" in size, fine- to coarse-grained sand, trace silt	GP/SP		8	S	23 77	9/12	4.0 [3.2]			10:49
45		[rig chatter from 45' to 55']			9	D	125	5/6	3.4 [3.2]	127	14	11:06
		[see next page]	SP		10	S	33 67/5"	8/11	4.4 [3.2]			11:19

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-13			Sheet 3 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SAND with GRAVEL; brown, moist, very dense, fine- to coarse-grained sand, subangular gravel to 1" in size, trace silt	SP	Qa	11	D	46 51	5/12	3.2 [3.2]	118	12	11:33
55		decreased gravel content, SAND; dry, trace fine gravel to 1/2" in size										
		GRAVEL with SAND; light brown, wet, very dense, gravel to 1" in size, fine- to coarse-grained sand [rig chatter from 55' to 57.5']	GP		12	S	100/5"	2/5	4.0 [4.0]			11:55
		SILT with SAND; brown, moist, very stiff to hard, nonplastic, fine-grained sand, trace mica	ML		13	D	17 19	11/12	4.0 [4.0]	102	23	12:05
60					14	S	9 15 16	18/18	4.4 [4.0]			12:19
		SILTY SAND; brown, moist, dense, fine-grained sand, nonplastic silt, trace mica	SM		15	D	20 39	8/12	5.0 [4.0]	101	23	12:31
65		3-1/2" interval of SANDY SILT (ML)			16	S	9 23 17	16/18	4.0 [4.0]			12:43
		5" interval of SANDY SILT (ML); brown to olive brown with rusty iron-oxide stains, hard, slightly plastic, trace siltstone fragments										
70		olive brown			17	D	14 35	9/12	4.0 [4.0]	113	17	12:54
		SAND/SILT; olive brown, moist, very dense/hard, fine-grained sand, trace mica, lens of 1/4" thick silt, light olive brown, rusty iron oxide stains, trace gravel to 1/4" in size	SP/ML		18	S	36 35 58	15/18	4.5 [4.0]			13:04
75		SAND; brown, moist, very dense, fine- to medium-grained sand, becomes coarser with increasing depth	SP		19	D	50 75	7/12	4.0 [4.0]	109	16	13:25
		SILT with SAND; brown and gray, moist, hard, non plastic, fine-grained sand, trace mica	ML		20	S	21 23	18/18	6.0 [4.2]			13:35

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-13				Sheet 4 of 4					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
		[see previous page]	ML	Qa			37					
		decreasing silt content, SANDY SILT/SILTY SAND (ML/SM); medium dense			21	D	17 25	9/12	5.5 [4.2]	104	23	13:48
85		6" interval of SAND (SP), fine- to medium-grained sand	SM		22	S	30 55 40	18/18	5.8 [4.2]			13:57
		SILTY SAND; light gray, moist, very dense, fine-grained sand										
		GRAVEL with SAND; gray, moist to wet, very dense gravel to 1-1/2" in size, fine- to coarse-grained sand, trace silt	GP		23	D	100	2/6	4.2 [3.0]			14:13
90		dark gray, gravel to 5/8" in size			24	S	100/3"	2/3	4.3 [3.0]			14:32
												14:14
		SILTY SAND; dark gray, moist, very dense, fine-grained sand	SM		25	D	55 70	8/12	3.7 [3.0]	108	21	14:48
95		SAND with GRAVEL; dark gray, moist, very dense, fine- to coarse-grained sand, subangular to subrounded gravel to 5/8" in size, trace silt	SP		26	S	100/5"	3/5	3.9 [3.4]			15:09
100		GRAVEL/SAND; dark gray, wet, very dense, subrounded gravel to 1-1/2" in size, fine- to coarse-grained sand, trace silt	GP/SP		27	D	100/5"	3/5	4.0 [3.4]			15:34
105		angular to subangular gravel to 5/8" in size			28	S	100/4"	2/4	4.2 [3.4]			16:07
		Boring terminated at 106 feet. Groundwater was measured at a depth of 76.2 feet on 11/21/95 before well development.										16:12

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S. SANTA FE AVE.

Fence Separating MTA Yard
from S. Santa Fe Ave.

Existing Metro Red Line
Vehicle Shop Building

33'

10'

DD-13

23'



North

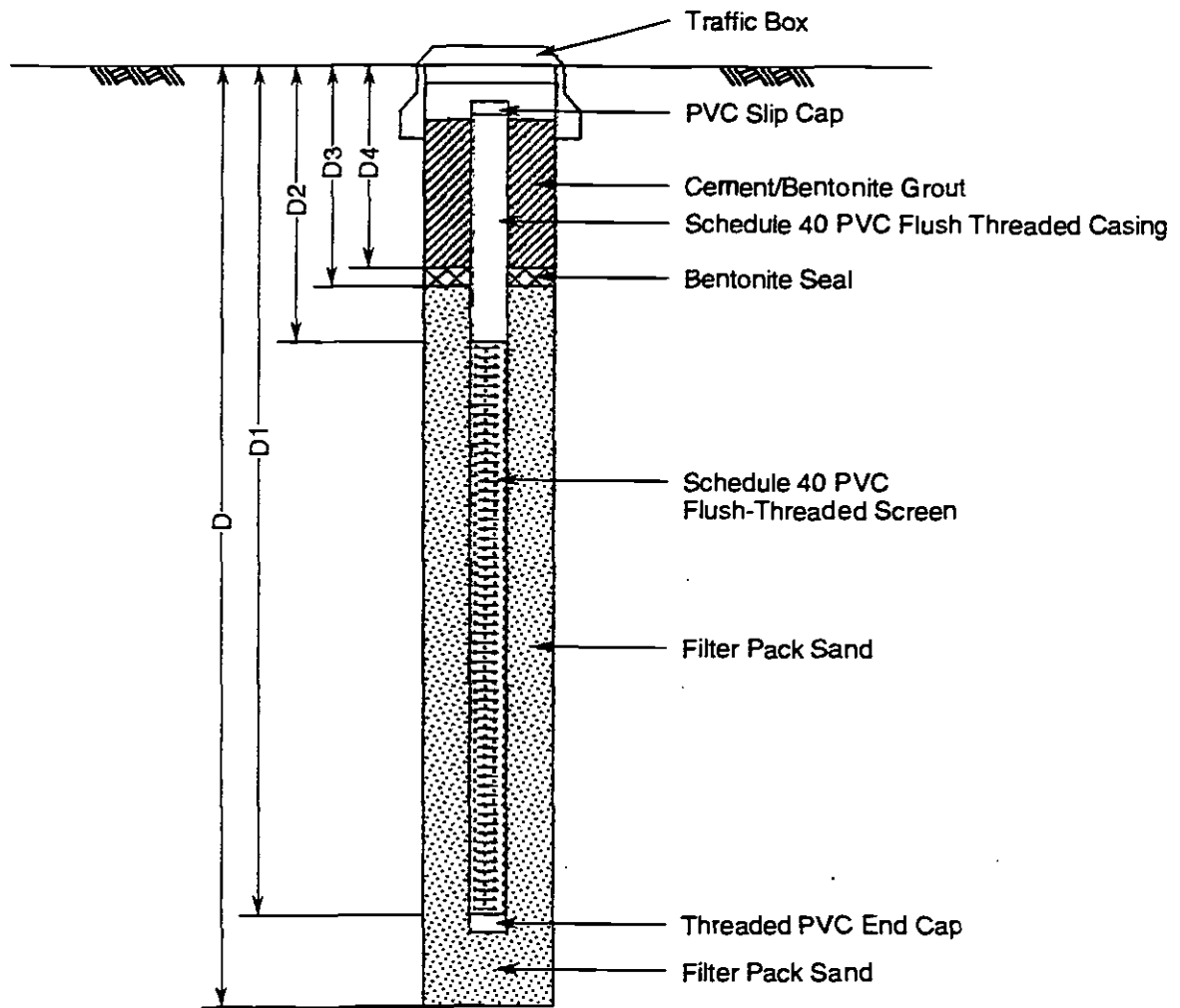
Not to Scale



GeoTransit
Consultants

Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Location of Boring
DD-13



Total Depth (D)	=	106	Feet
Total Depth of Casing (D1)	=	105.4	Feet
Depth to Top of Well Screen (D2)	=	35.4	Feet
Depth to Bottom of Top Seal (D3)	=	32	Feet
Depth to Top of Top Seal (D4)	=	27	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.02	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/2	Inch Chips

	Project No.	95-8347
	Geotechnical Investigation	
	Eastside Extension Metro Red Line	

Monitoring Well Installation Schematic DD-13



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN										
Project Number:		95-8347		Boring Number:		DD-13S		Sheet 1 of 5				
Boring Location:		MTA Yard/E. 4th St. & L.A. River				Elevation and Datum(feet):263 MSL						
Health and Safety: Level D				Date Started:10/27/95			Date Finished: 10/31/95					
Drilling Equipment: Mayhew 1000				Total Depth (feet): 115.0			Depth to Bedrock(feet): None					
Drilling Method: Rotary Wash				Number of Samples: 31			Depth to Water (feet):Unknown					
Boring Diameter: 5 inches				Completion Information: Grouted to Surface								
Hammer Information: SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop				Logged By: R. Jie			Checked By: K. Kabilamany					
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content(%)	
		Asphalt	SP-SM	af Qa								08:00
		ALLUVIUM										
		SAND with SILT and GRAVEL; dark brown, dry to moist, medium dense, fine- to coarse-grained sand, nonplastic silt, gravel to 3/4" in size										
		[rig chatter from 1' to 56']										
5		asphalt chips			1	D	10 12	7/12	4.4 [4.4]	102	12	08:12
		[reduced rig chatter]										
10		light brown, dry, fine-grained sand, gravel to 1/2" in size			2	S	7 12 14	12/18	5.0 [4.2]			08:18
		[increased rig chatter]										
15		gravel to 2-1/2" in size			3	D	23 26	7/12	4.9 [4.1]	103	14	08:27

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-13S				Sheet 2 of 5					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OWA (ppm) [Background]	Dry Density (pcf)	Moisture Content (%)	
		SAND with SILT and GRAVEL: light brown, dry, dense, fine- to coarse-grained sand, gravel to 1-1/2" in size, nonplastic silt	SP-SM	Qa	4	S	12 22 23	10/18	5.2 [3.8]			08:40
25		GRAVEL with SILT and SAND; light brown, wet, very dense, gravel to 3" in size, nonplastic silt, fine- to coarse-grained sand	GP-GM		5	D	35 50	7/12	4.2 [3.8]	117	9	08:54
30		SAND with SILT and GRAVEL; light brown, wet, very dense, fine- to coarse-grained sand, nonplastic silt, gravel to 5/8" in size [rig chatter]	SP-SM		6	S	17 33 35	12/18	5.4 [3.8]			09:03
35		[reduced rig chatter] SAND with SILT (SP); moist, dense, fine-grained sand, trace fine gravel to 1/2" in size			7	D	25 40	7/12	4.8 [3.8]	109	13	09:25
40		GRAVEL with SAND; brown, wet, very dense, gravel to 1" in size, fine- to coarse-grained sand, trace nonplastic silt [rig chatter from 40' to 55'] slow drilling	GP		8	S	44 100/3"	7/9	4.4 [3.8]			09:45
45		light brown, gravel to 1-1/2" in size			9	D	125/4"	0/4				10:10
		slow drilling			10	D	50 100/5"	8/11	4.2 [4.2]	119	13	10:25
												10:39

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Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN										
Project Number:		95-8347		Boring Number:		DD-13S		Sheet 3 of 5				
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		GRAVEL with SAND; brown to very dark brown, moist, very dense, gravel to 5/8" in size, fine- to coarse-grained sand, trace nonplastic silt	GP	Qa	11	S	100/5"	4/5	4.8 [4.2]			10:48
55		SAND with GRAVEL (SP); brown with dark brown spots, wet, dense, gravel to 1" in size	ML		12	D	45 30	8/12	4.4 [4.2]	109	16	11:08
		SANDY SILT; brown with occasional thin lines of light brown, moist, hard, low plasticity, fine-grained sand			13	S	12 16 18	2/18	4.2 [4.2]			11:18
60		increased sand content with depth, very stiff			14	D	16 25	7/12	4.8 [4.2]	101	23	11:32
65		SANDY SILT/SILTY SAND (ML/SM); olive brown to light brown, moist, hard/very dense	SM		15	S	21 33 34	14/18	4.8 [4.2]			11:49
		SILTY SAND; olive brown, moist, dense to very dense, fine-grained sand, nonplastic silt, trace mica			16	D	20 35	7/12	4.2 [4.2]	107	17	12:01
70		wet, fine- to coarse-grained sand, trace reddish brown clay			17	S	45 100	5/12	4.4 [3.0]			12:09
		SAND with SILT; dark yellowish brown, moist to wet, dense, fine-grained sand, nonplastic silt, trace mica	SP-SM		18	D	25 40	6/12	4.8 [3.0]	105	20	12:25
75		SANDY SILT/SILTY SAND; dark yellowish brown to gray, moist, hard/dense, low plasticity silt, fine-grained sand	ML/SM		19	S	11 30 18	18/18	5.8 [3.0]			12:45

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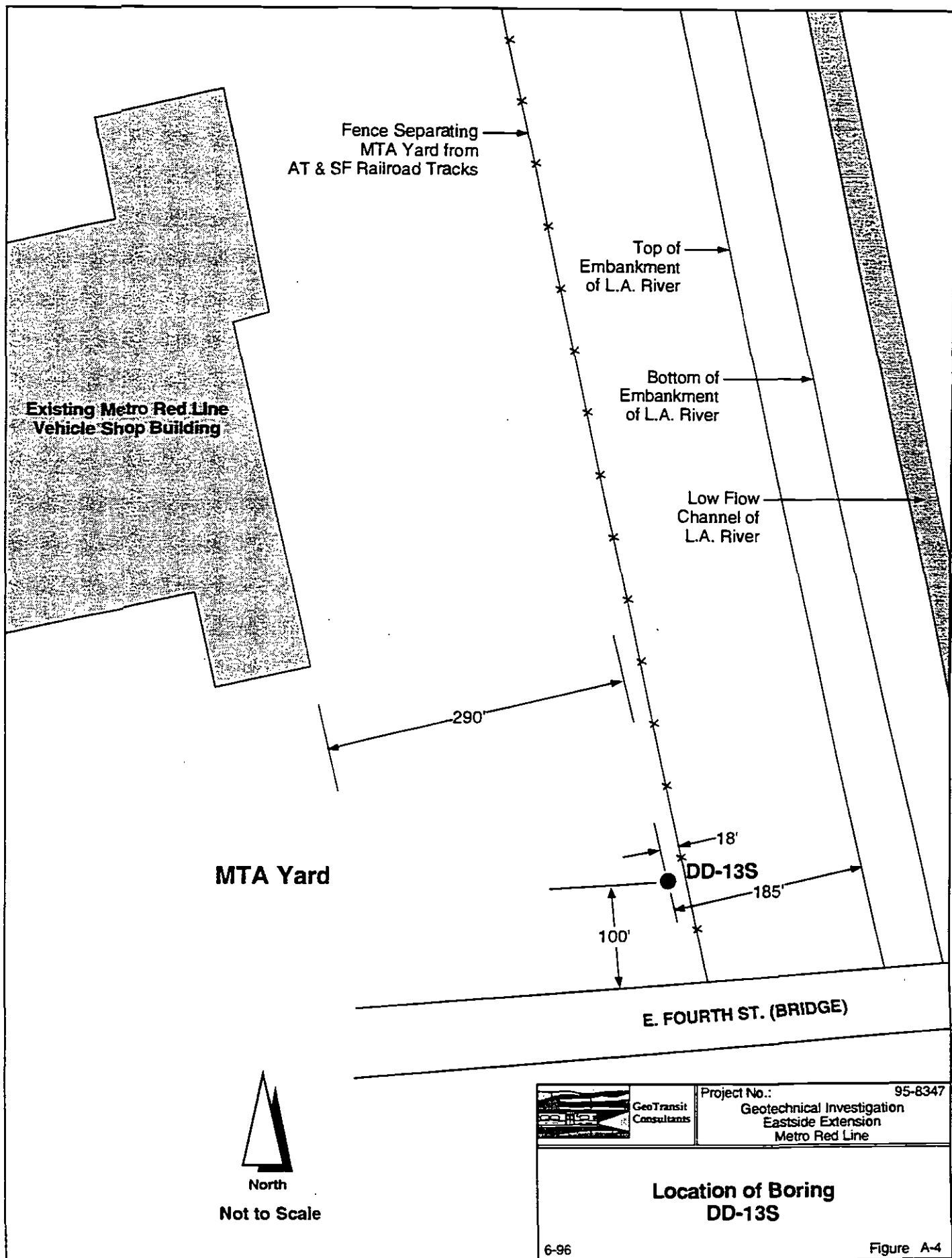
Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-13S				Sheet 4 of 5					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OWA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
85		SANDY SILT/SILTY SAND; dark gray, moist, very stiff/medium dense, low to medium plasticity clayey silt, fine-grained sand, trace mica	ML/SM	Qa	20	D	16 25	9/12	3.5 [3.0]	98	28	12:50
		hard/very dense			21	S	17 45 40	12/18	5.2 [3.0]			13:03
90		SANDY LEAN CLAY; dark gray, moist, very stiff, medium plasticity, fine-grained sand, trace mica	CL		22	D	12 16	11/12	3.8 [3.0]	100	25	13:17
		SILTY SAND/SANDY SILT; dark gray, moist, very dense, fine-grained sand, nonplastic to low plasticity silt, trace mica			23	S	27 50 52	12/18	5.6 [3.4]			13:25
95		SANDY LEAN CLAY; dark gray, moist, very stiff, low to medium plasticity, fine-grained sand, trace mica	CL		24	D	9 12	10/12	5.0 [3.4]	103	23	13:36
		SILTY SAND/SANDY SILT; dark gray, moist, very dense/hard, fine- to medium-grained sand, trace gravel to 1/4" in size, trace mica			25	S	30 75 25/2"	8/14	3.8 [3.4]			13:47
100		GRAVEL with SAND; dark gray, moist to wet, very dense, gravel to 1-1/2" in size, fine- to coarse-grained sand [rig chatter, slow drilling]	GP		26	D	100/5"	2/5	3.4 [3.0]		10	14:00 14:18
		SAND with GRAVEL; gray, wet, very dense, fine- to medium-grained, trace coarse-grained sand, gravel to 5/8" in size, trace nonplastic silt [occasional rig chatter, relatively easy drilling]			27	S	61 39/2"	6/8	3.8 [3.0]			15:53 07:55
105		SILTY SAND; gray, moist, very dense, fine-grained sand, nonplastic silt, trace mica [rig chatter]	SM		28	D	125	6/6	--	107	23	08:05
		SAND with SILT and GRAVEL; gray, wet, very dense, fine- to coarse-grained sand, nonplastic silt, gravel to 1/2" in size [rig chatter]			29	S	100	2/6	--			08:30

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-13S				Sheet 5 of 5					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
		GRAVEL with SILT and SAND; gray, wet, very dense, gravel to 2-1/2" in size, fine- to coarse-grained sand, nonplastic silt [rig chatter]	GP-GM	Qa	30D		40 110/4"	5/10	--	124	12	08:49
115		SAND with GRAVEL to 1/2" in size End of Boring at 115 feet.	SW		31S		100/5"	2/5	--			09:24
120												
125												
130												
135												
140												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.





Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN									
Project Number:		95-8347		Boring Number:		DD-14		Sheet 1 of 4			
Boring Location:		NW LA River near 4th St. Bridge				Elevation and Datum(feet): 247 MSL					
Health and Safety:		Level D		Date Started:		10/24/95		Date Finished:		10/24/95	
Drilling Equipment:		Mayhew 1000		Total Depth (feet):		80.5		Depth to Bedrock(feet):		None	
Drilling Method:		Rotary Wash		Number of Samples:		23		Depth to Water (feet):		30.9	
Boring Diameter:		5 inches		Completion Installed Monitoring Well Information:							
Hammer Information: SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop				Logged By:		R. Jie		Checked By: K.Kabilamany			

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)		
		Reinforced concrete slab		af									8:00
		ALLUVIUM SAND/GRAVEL; brown, dry, dense, fine- to coarse-grained sand, angular gravel to 1" in size, trace low plasticity fines [rig chatter right below the slab]	SP/GP	Qa									8:15
5		light brown, medium-grained sand, trace fine- to coarse-grained sand, gravel to 2-1/2" in size [rig chatter from 8' to 20'] increased gravel content			1	D	16 50	9/12	7.8 [4.2]	132	7		8:35
10		SAND with GRAVEL; light brown, very dense	SP		2	S	32 39 24	13/18	5.0 [4.2]				9:12
15					3	D	75 25/2"	5/8	4.2 [4.2]	126	11		9:29
													9:58

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-14			Sheet 2 of 4							
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	QVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
25		SAND with SILT and GRAVEL; light brown, dry, very dense, fine- to medium-grained sand, occasional coarse-grained sand, gravel to 1-1/2" in size, nonplastic silt [rig chatter] reduced gravel content, SAND; moist, trace gravel to 1/4" in size	SP	Qa	4	S	24 54 43	12/18	5.2 [4.2]			10:08
					5	D	43 69	8/12	4.6 [3.8]	112	12	10:26
30		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		6	S	7 12 15	13/18	4.5 [3.8]			10:39
					7	D	14 25	12/12	4.6 [3.6]	110	18	10:43
		1' interval of SILT with SAND (ML); low plasticity	SM		8	S	11 25 40	18/18	50 [3.6]			10:53
					9	D	20 45	6/12	4.2 [3.6]	98	23	11:03
35		SAND with SILT; light olive brown, dense	SP-SM		10	S	30 42 43	12/18	4.6 [3.6]			11:11
					11	D	27 30	8/12	4.2 [3.2]	113	19	11:19
40		1-1/2" thick SILT with SAND (ML); light gray, fine- to coarse-grained sand, 1/4" lens of rusty iron-oxide stained fine- to medium-grained sand			12	S	20 18 18	15/18	4.0 [3.6]			11:37
					13	D	16 30	10/12	4.8 [3.6]	103	26	11:43
45		dark olive gray, fine-grained sand			14	S						
					15	D						
		4" interval of SILT (ML); dark greenish gray, low plasticity			16	S						
					17	D						
		SILT with SAND (ML); light gray, fine- to coarse-grained sand, 1/4" lens of rusty iron-oxide stained fine- to medium-grained sand			18	S						
					19	D						
		dark olive gray, fine-grained sand			20	S						
					21	D						
		4" interval of SILT (ML); dark greenish gray, low plasticity			22	S						
					23	D						
		SAND with SILT; light olive brown, dense	SP-SM		24	S						
					25	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		26	S						
					27	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		28	S						
					29	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		30	S						
					31	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		32	S						
					33	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		34	S						
					35	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		36	S						
					37	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		38	S						
					39	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		40	S						
					41	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		42	S						
					43	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		44	S						
					45	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		46	S						
					47	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		48	S						
					49	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		50	S						
					51	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		52	S						
					53	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		54	S						
					55	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		56	S						
					57	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		58	S						
					59	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		60	S						
					61	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		62	S						
					63	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		64	S						
					65	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		66	S						
					67	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		68	S						
					69	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		70	S						
					71	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		72	S						
					73	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		74	S						
					75	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		76	S						
					77	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		78	S						
					79	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		80	S						
					81	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		82	S						
					83	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		84	S						
					85	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		86	S						
					87	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		88	S						
					89	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		90	S						
					91	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		92	S						
					93	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		94	S						
					95	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		96	S						
					97	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		98	S						
					99	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		100	S						
					101	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		102	S						
					103	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		104	S						
					105	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		106	S						
					107	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		108	S						
					109	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		110	S						
					111	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		112	S						
					113	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		114	S						
					115	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		116	S						
					117	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		118	S						
					119	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		120	S						
					121	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		122	S						
					123	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		124	S						
					125	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		126	S						
					127	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		128	S						
					129	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		130	S						
					131	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		132	S						
					133	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		134	S						
					135	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		136	S						
					137	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		138	S						
					139	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		140	S						
					141	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		142	S						
					143	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		144	S						
					145	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		146	S						
					147	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		148	S						
					149	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		150	S						
					151	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		152	S						
					153	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		154	S						
					155	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		156	S						
					157	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		158	S						
					159	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		160	S						
					161	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		162	S						
					163	D						
		SANDY SILT; yellowish brown, moist, very stiff, low plasticity, fine- grained sand, trace mica	ML		164	S						
					165	D						



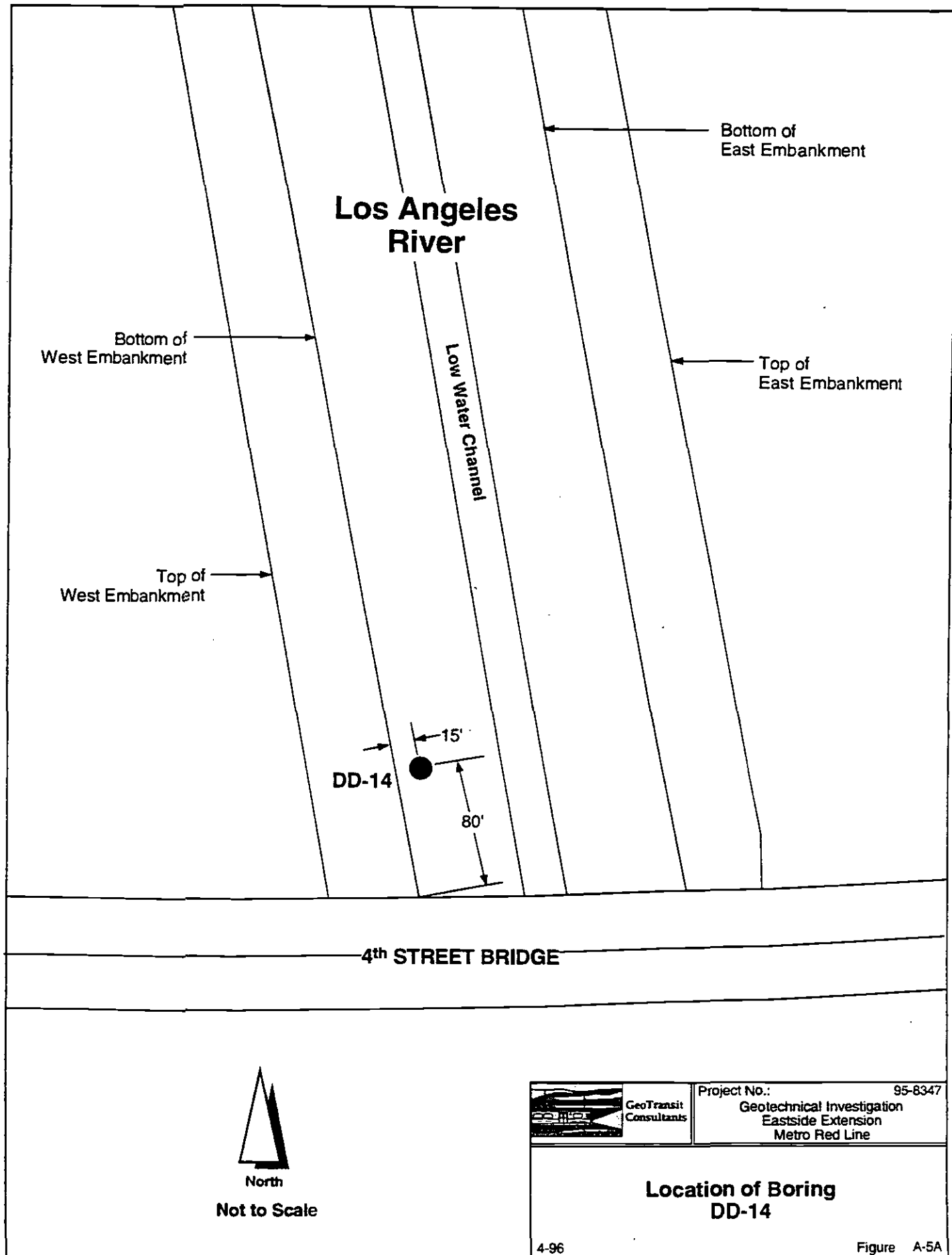
Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-14				Sheet 3 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		SILTY SAND; dark olive gray, moist, very dense, fine-grained sand, trace mica	SM	Qa	14S	25 36 19	18/18	4.8 [3.6]			11:53	
		SILT; dark olive gray, moist, hard, low plasticity, trace fine-grained sand	ML									
55		increased sand content, SANDY SILT	SP/GP	15D	25 45	9/12	5.6 [3.6]	99	28	12:03		
		SAND/GRAVEL; light gray, moist, very dense, fine- to coarse-grained sand, gravel to 1" in size. [rig chatter from 54.5' to 65']										
60		gravel to 2" in size		16S	60 50/3"	5/9	4.9 [3.6]			12:24		
		17D		60 40/3"	6/9	4.8 [3.6]	135	9	12:37 12:44			
65		GRAVEL with SAND; gray, moist to wet, very dense, angular to subangular gravel to 2" in size, medium- to coarse-grained sand [rig chatter]	GP	18S	50 50/3"	5/9	4.7 [3.4]			12:52		
		SANDY SILT; dark gray, moist, hard, nonplastic, fine-grained sand, trace mica	ML	19D	20 40	10/12	4.3 [3.4]	106	21	13:15		
70				20S	20 25 30	18/18	4.5 [3.4]			13:25		
		5" interval of SILTY SAND (SM); moist to wet, dense, fine- to medium-grained sand, trace mica		SP	21D	25 40	8/12	3.8 [3.4]	102	26	13:34	
75		SAND with GRAVEL; gray, wet, very dense, fine- to coarse-grained sand, trace silt, gravel to 1-1/2" in size [rig chatter from 72' to 80']		22S	80 20/1"	5/7	3.9 [3.4]			13:50		
		increased gravel content, SAND/GRAVEL (SP/GP), gravel to 2-1/2" in size		23D	60 50/3"	5/9	7.5 [3.4]	125	13	14:00 14:10		

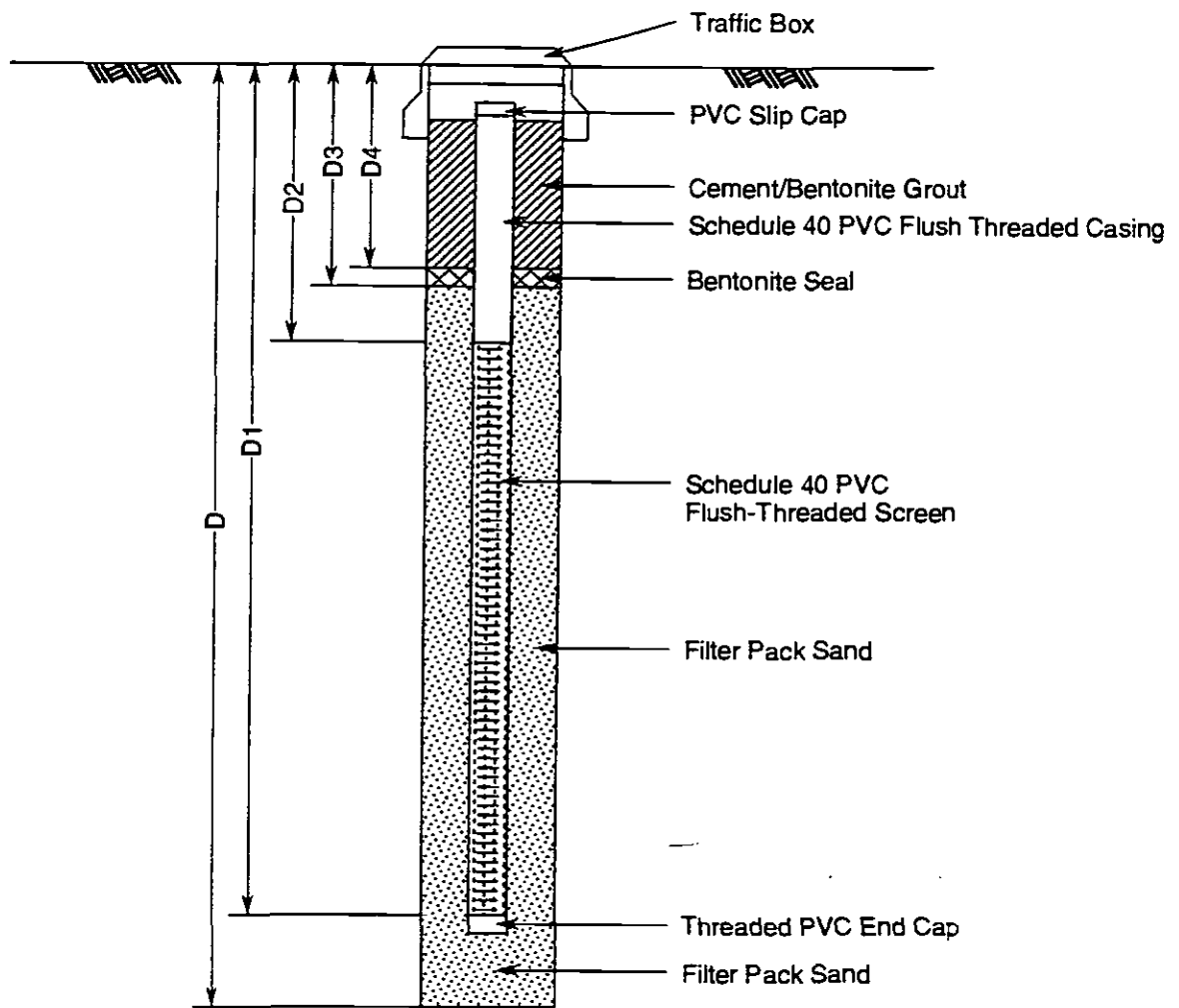
Note: This boring log is based on field classification and visual soil description and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:		95-8347		Boring Number:				DD-14		Sheet 4 of 4			
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		End of boring at 80.5 feet. Groundwater was measured at a depth of 30.9 feet on 11/21/95.		Qa									
85													
90													
95													
100													
105													

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.





Total Depth (D)	=	80.5	Feet
Total Depth of Casing (D1)	=	80	Feet
Depth to Top of Well Screen (D2)	=	20	Feet
Depth to Bottom of Top Seal (D3)	=	17	Feet
Depth to Top of Top Seal (D4)	=	13	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.02	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/4	Inch Pellets



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Project No. 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Monitoring Well Installation Schematic DD-14



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:		95-8347		Boring Number:		DD-15		Sheet 1 of 4					
Boring Location:		Artemus near Anderson				Elevation and Datum(feet):256 MSL							
Health and Safety:		Level D			Date Started:		10/30/95		Date Finished:			10/30/95	
Drilling Equipment:		Mayhew 1000			Total Depth (feet):		91.0		Depth to Bedrock(feet):		None		
Drilling Method:		Rotary Wash			Number of Samples:		25		Depth to Water (feet):		52.4		
Boring Diameter:		5 inches			Completion Information:		Installed Monitoring Well						
Hammer Information:		SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop			Logged By:		R. Jie		Checked By: K. Kabilamany				
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content(%)		
		Reinforced Cement Concrete		af									07:00
		ALLUVIUM SAND; light brown, dry, loose, fine-grained sand, trace gravel	SP	Qa									
5		SAND with GRAVEL; gravel to 2" in size [occasional rig chatter from 5' to 15']			1	D	5 5	4/12	3.0 [3.0]				07:06
10		medium dense, fine- to coarse-grained sand, gravel to 1-1/2" in size			2	S	5 6 8	8/18	3.9 [3.0]				07:10 07:11
15		gravel to 5/8" in size [rig chatter from 15' to 20']			3	D	18 30	6/12	3.2 [3.0]	115	10		07:23

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-15				Sheet 2 of 4					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
25		SAND with GRAVEL; light brown, dry, dense, fine-grained sand, some medium- grained sand, gravel to 5/8" in size [occasional rig chatter from 20' to 32.5'] reduced gravel content	SP	Qa	4	S	9 18 23	13/18	3.4 [3.0]			07:35
					5	D	20 35	8/12	3.2 [3.0]	108	10	07:40
					6	S	23 28 25	10/18	4.8 [4.6]			07:50
30		very dense										
35		SAND/GRAVEL; dry, dense to very dense, fine- to medium-grained sand, gravel to 1-1/2" in size, trace nonplastic silt [rig chatter from 32.5' to 47.5'] [increased rig chatter] increased gravel content to 1" in size, fine- to coarse-grained sand	SP/GP		7	D	30 45	6/12	4.8 [4.6]	122	10	08:00
					8	S	70 30/1"	6/7	5.1 [4.6]			08:12
					9	D	30 35	6/12	4.7 [4.6]	103	17	08:27
40												
45		fine- to coarse-grained sand, gravel to 1-1/2" in size fine- to medium-grained sand, trace coarse-grained sand, gravel to 5/8" in size			10	S	46 54/4"	8/10	5.0 [4.6]			08:36
					11	D	25 35	8/12	4.6 [4.6]	114	16	08:48
					12	S	28 55 45/4"	11/16	5.0 [4.6]			08:54
		SILTY SAND; brown, moist, very dense, fine-grained sand, nonplastic silt	SM									

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



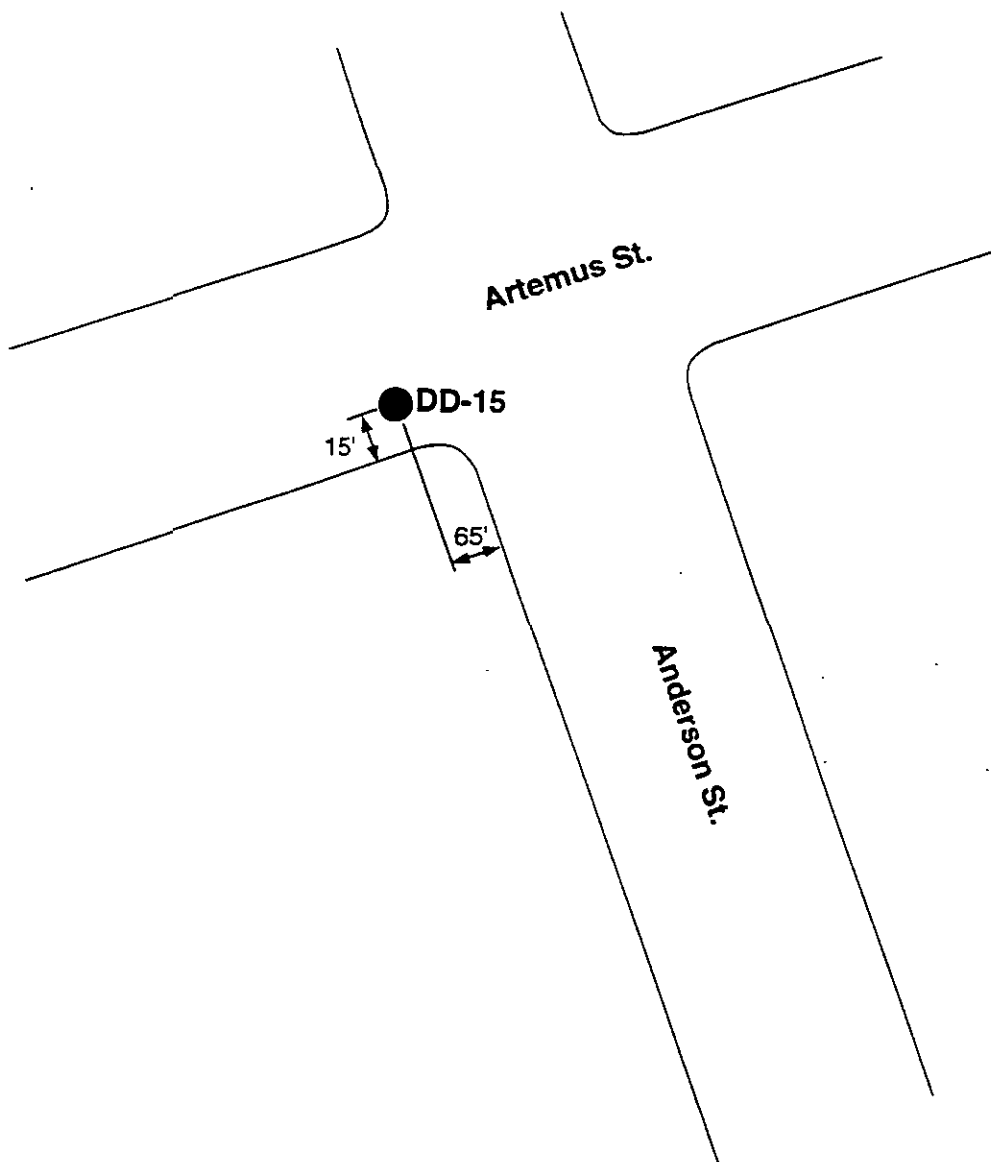
Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-15				Sheet 3 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
55		SAND; brown, moist, medium dense, fine- to medium-grained sand, some coarse-grained sand, some gravel to 1/2" in size, trace mica [occasional rig chatter]	SP	Qa	13	D	30 16	7/12	4.8 [4.6]	106	18	09:04
		brown to olive brown, wet, very dense, fine-grained sand, reduced gravel content			14	S	47 53/5"	8/11	5.8 [4.6]			09:16
		medium dense			15	D	34 5	10/12	4.6	114	11	09:23
60		SILTY SAND; olive brown, wet, very dense, fine-grained sand, nonplastic silt, trace mica	SM		16	S	20 40 48	12/18	5.1 [4.6]			09:34
		trace medium grained sand, trace mica			17	D	26 41	7/12	6.2 [5.0]			09:42
65		SAND; olive brown, wet, dense to very dense, fine- to coarse-grained sand, nonplastic silt, some gravel to 1" in size	SP		18	S	72 28/2"	5/8	5.8 [5.0]			09:49
		[occasional rig chatter]										
		fine- to medium-grained sand, trace coarse-grained sand, trace gravel to 1/2" in size			19	D	25 50	7/12	5.5 [5.0]	112	19	10:01
70		lens of silt										
		ELASTIC SILT/FAT CLAY; gray, moist, hard, medium to high plasticity, trace mica, some fine-grained sand	MH/CH		20	S	34 28 45	15/18	5.3 [5.0]			10:14
75		SILTY SAND; gray, wet, dense to very dense, fine-grained sand, trace medium-grained sand, nonplastic silt	SM		21	D	18 37	6/12	5.2 [5.0]	109	19	10:26
		[rig chatter]			22	S	56 44/3"	6/9	5.2 [4.4]			10:43

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-15				Sheet 4 of 4					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
		SILTY SAND; gray with purple stains, wet, very dense, fine- to medium-grained sand, trace coarse-grained sand, nonplastic silt, fine gravel to 1/4" in size	SM	Qa	23	D	35 60	7/12	5.1 [4.2]	118	14	10:5'
85		GRAVEL with SAND; gray with black pocket, wet, very dense, fine- to coarse-grained sand, gravel to 1" in size [rig chatter from 82' to 91']	GP		24	S	105	4/6	6.4 [4.2]			11:11
90		[increased rig chatter] gravel to 2" in size			25	D	89 11/1"	5/7	5.0 [4.2]	119	15	11:35
		End of Boring at 91 feet. Groundwater was measured at a depth of 52.4 feet on 11/21/95.										
95												
100												
105												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



North

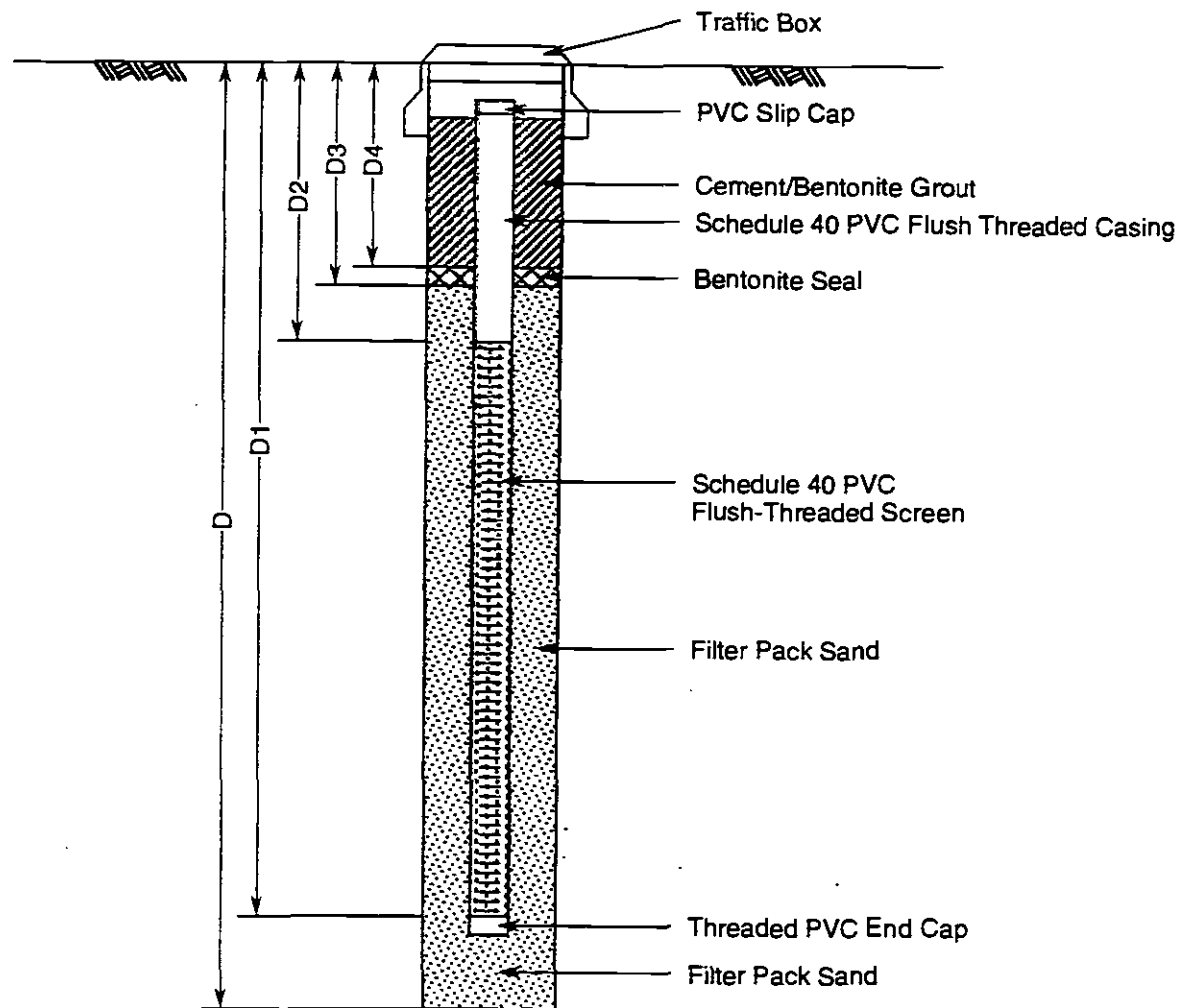
Not to Scale



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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

**Location of Boring
DD-15**



Total Depth (D)	=	91	Feet
Total Depth of Casing (D1)	=	89.2	Feet
Depth to Top of Well Screen (D2)	=	29.2	Feet
Depth to Bottom of Top Seal (D3)	=	26	Feet
Depth to Top of Top Seal (D4)	=	22	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.02	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/2	Inch Pellets

	Project No.	95-8347
	Geotechnical Investigation	
	Eastside Extension	
	Metro Red Line	

Monitoring Well Installation Schematic DD-15



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN										
Project Number:		95-8347		Boring Number:		DD-16		Sheet <u>1</u> of <u>3</u>				
Boring Location:		Clarence near 3rd St.				Elevation and Datum(feet):257 MSL						
Health and Safety:		Level D			Date Started:11/21/95			Date Finished: 11/21/95				
Drilling Equipment:		Earth Drill			Total Depth (feet): 55.0			Depth to Bedrock(feet): None				
Drilling Method:		Earth Drill			Number of Samples: 15			Depth to Water (feet): 53.5				
Boring Diameter:		18 inches			Completion Information:			Grouted to Surface				
Hammer Information:		None Used			Logged By:			Checked By:				
					Greg Renfrew			K. Kabilamany				
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		Asphalt		af								
		ALLUVIUM	SP	Qa	1	B			9.4 [8.7]			07:50
		SAND; olive brown, dry to moist, fine- to medium-grained sand, trace coarse gravel to 2-1/2" in size										
		fine- to coarse-grained sand	SP/SW									
5		clumps of silt with fine-grained sand, light olive brown, moist, medium stiff, micaceous			2	B			9.2 [8.5]			07:58
		SAND/GRAVEL; dense, fine to coarse gravel, cobbles from 3.5" to 7" in size, micaceous, trace nonplastic silt [switched bucket auger size from 24" to 18" at 7']	SP/GP									
10					3	B			9.5 [8.5]			08:00
15					4	B			9.8 [8.5]			08:13
		subangular cobble to 8" in size										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



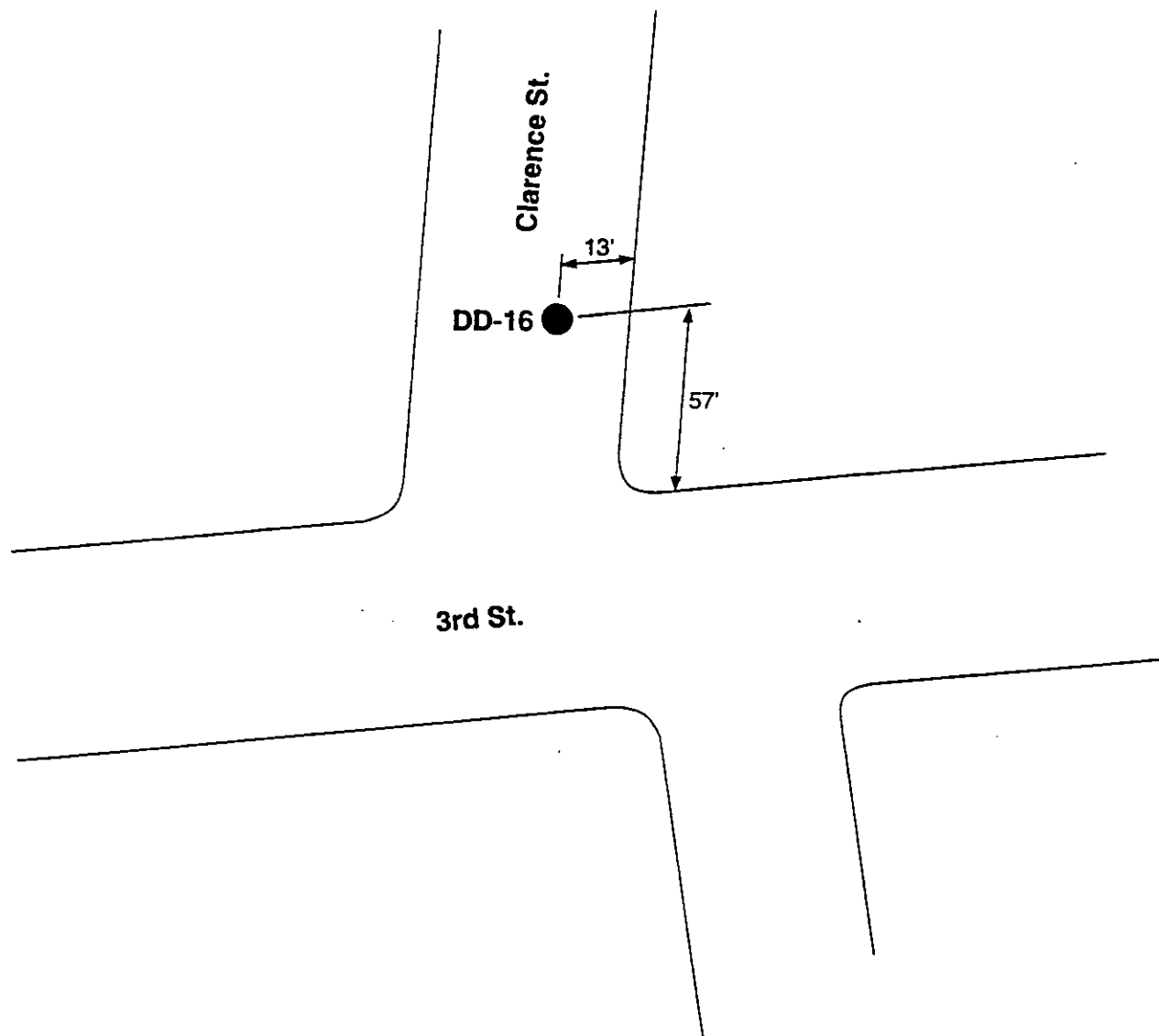
Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number: 95-8347		Boring Number: DD-16			Sheet 2 of 3						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples						
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)
		SAND with SILT and GRAVEL; olive brown, dry to moist, dense, fine- to coarse-grained sand, nonplastic silt, fine to coarse gravel subrounded cobble to 7-1/2" in size	SP-SM SW-SM	Qa	5	B			10.0 [8.7]		08:25
		2' interval of SILT with SAND (ML); moist, medium stiff, fine- to medium-grained sand, micaceous			6	B			9.7 [8.5]		
25					7	B			14 [9.2]		08:36
		2' interval of SILTY SAND (SM); moist, dense, fine- to medium-grained sand, trace coarse-grained sand, trace fine gravel			8	B			14.0 [9.2]		08:56
		cobble to 6" in size reddish and yellowish gravel			9	B			14.0 [9.0]		09:00
		cobble to 10" in size, boulder 20" long and 6" thick			10	B			16.0 [11.0]		09:31
40		SANDY LEAN CLAY; pale olive, moist, micaceous, iron oxide streaks, sand lenses (fine- to coarse-grained), trace fine to coarse gravel, small cobble locally, medium plasticity whitish clay seams poorly laminated	CL		11	B			14.0 [11.0]		09:50
		2' interval of SANDY SILT (ML); olive, stiff, fine-grained sand, micaceous			12	B			14.0 [11.0]		10:20
					13	B			12.0 [11.0]		11:00
		[see next page]	SP-SM		14	B			12.0 [11.0]		11:11

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-16				Sheet 3 of 3						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
55		SAND with SILT; pale olive, moist, very dense, fine- to medium-grained sand, trace fine to coarse subangular gravel, micaceous	SP-SM SW-SM	Qa								
		light olive brown, wet, fine- to coarse-grained sand, hornblende grained, trace coarse gravel, subangular to subrounded cobble to 6" in size			15	B			13.0 11.0			11:20
		End of Boring at 55 feet. Groundwater encountered at a depth of 53.5 feet.										
60												
65												
70												
75												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



North

Not to Scale



GeoTransit
Consultants

Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

**Location of Boring
DD-16**



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Consultants

Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:		95-8347		Boring Number:		DD-17		Sheet		1 of 3			
Boring Location:		Gless St. near 1st St.				Elevation and Datum(feet):262 MSL							
Health and Safety:		Level D		Date Started:		11/15/95		Date Finished:				11/15/95	
Drilling Equipment:		Midway 1300		Total Depth (feet):		71.5		Depth to Bedrock(feet):		None			
Drilling Method:		Rotary Wash		Number of Samples:		21		Depth to Water (feet):		55.4			
Boring Diameter:		5 inches		Completion Information:		Installed Monitoring Well							
Hammer Information:		SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop				Logged By:		Greg Renfrew		Checked By: K. Kabilamany			

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples								
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	Drilling Time	
		Asphalt and Base Course		af									
		SAND; olive, moist, fine- to medium-grained sand, trace subangular gravel to 1-1/2" in size, micaceous [hand augered to 5']	SP		1	B				14.0 [13.0]			
5		ALLUVIUM GRAVEL with SILT and SAND; light olive brown, moist, medium dense, fine to coarse subangular gravel, nonplastic silt, fine- to coarse-grained sand [rig chatter from 5.2' to 44.5']	GW-GM	Qa									
10		SAND with SILT and GRAVEL; light olive brown, moist, dense, fine- to coarse-grained, nonplastic silt, micaceous	SW-SM		2	D	6 8	10/12	12.0 [12.0]	106	12	11:15	
15					3	S	16 24 18	10/18	13.0 [12.0]			11:20	
		1' interval of subangular SILTY GRAVEL (GM); gravel to 1" in size			4	D	12 12	10/12	13.0 [13.0]	114	16	11:30	

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN													
Project Number: 95-8347		Boring Number: DD-17					Sheet 2 of 3						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
25		SAND with SILT and GRAVEL; light olive brown, moist, very dense, fine- to coarse-grained, micaceous	SW-SM	Qa	5	S	3 28 40	10/18	12.0 [12.0]				11:4
		SILTY GRAVEL/SILTY SAND; light olive brown, moist, medium dense, fine to coarse gravel to 1-1/2" in size, fine- to coarse-grained sand, trace medium-grained sand	GM/SM		6	D	9 7	5/12	13.0 [12.0]	--	5		11:5
30		very dense			7	S	11 25 32	11/18	13.0 [12.0]				12:0
		[vigorous rig chatter]											
		dark olive brown, medium dense			8	D	12 22	6/12	12.0 [12.0]	107	18		12:0
35		[vigorous rig chatter] gravel to 1" in size, very dense			9	S	24 42 57	13/18	13.0 [12.0]		9		12:2
		GRAVEL with SILT/SAND with SILT; dark gray, moist, very dense, fine- to medium-grained sand, gravel to 2-1/4" in size	GW-GM SP-SM		10	D	20 59/4"	7/10	12.0 [12.0]	110	16		12:3
40		[vigorous rig chatter] cobble to 8" in size											
		SILTY SAND/SILTY GRAVEL; olive brown, moist, very dense, fine- to coarse-grained, cobble to 8" in size	SM/GM		11	S	40	4/6	9.8 [9.6]				13:0
45					12	D	35 115/5"	6/11	9.6 [9.6]	110	3		13:2
		SILT with SAND; greenish gray, moist, hard, fine-grained sand, laminated, calcareous, caliche nodules	ML		13	S	15 29 25	3/18	9.7 [9.6]				13:3
		increased sand content, SANDY SILT			14	D	12 16	11/12	9.7 [9.7]	106	22		13:4

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-17				Sheet 3 of 3						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		SILT with SAND; greenish gray, moist, hard, fine-grained sand, laminated calcareous, caliche nodules	ML	Qa								
		SAND with SILT; gray, wet, very dense, fine- to medium-grained sand	SP-SM		15S	24 65 35/3"	11/15	9.8 [9.7]				14:00
55					16D	35 40	10/12	9.8 [9.7]	101	20		14:10
		interval of medium-grained sand, light olive brown, trace fine gravel			17S	27 48 39	14/18	9.9 [9.7]				14:19
60		1-1/2' interval of SILTY SAND (SM); gray, fine- to medium-grained sand			18D	35 50	5/12	9.7 [9.7]	110	16		14:27
					19S	26 45 42	16/18	9.4 [8.5]				14:44
65		fine- to medium-grained sand, trace coarse-grained sand 2" thick SILT layer fine-grained, grades to fine- to coarse-grained, trace angular fine gravel			20D	40 55	9/12	8.7 [8.5]	107	21		14:57
70					21S	24 52 51	16/18	8.7 [8.4]				15:12
		End of Boring at 71.5 feet. Groundwater was measured at a depth of 55.4 feet on 11/21/95.										
75												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.

First St.

450'

Gless St.

Alley

14.5'

DD-17

Alley



North

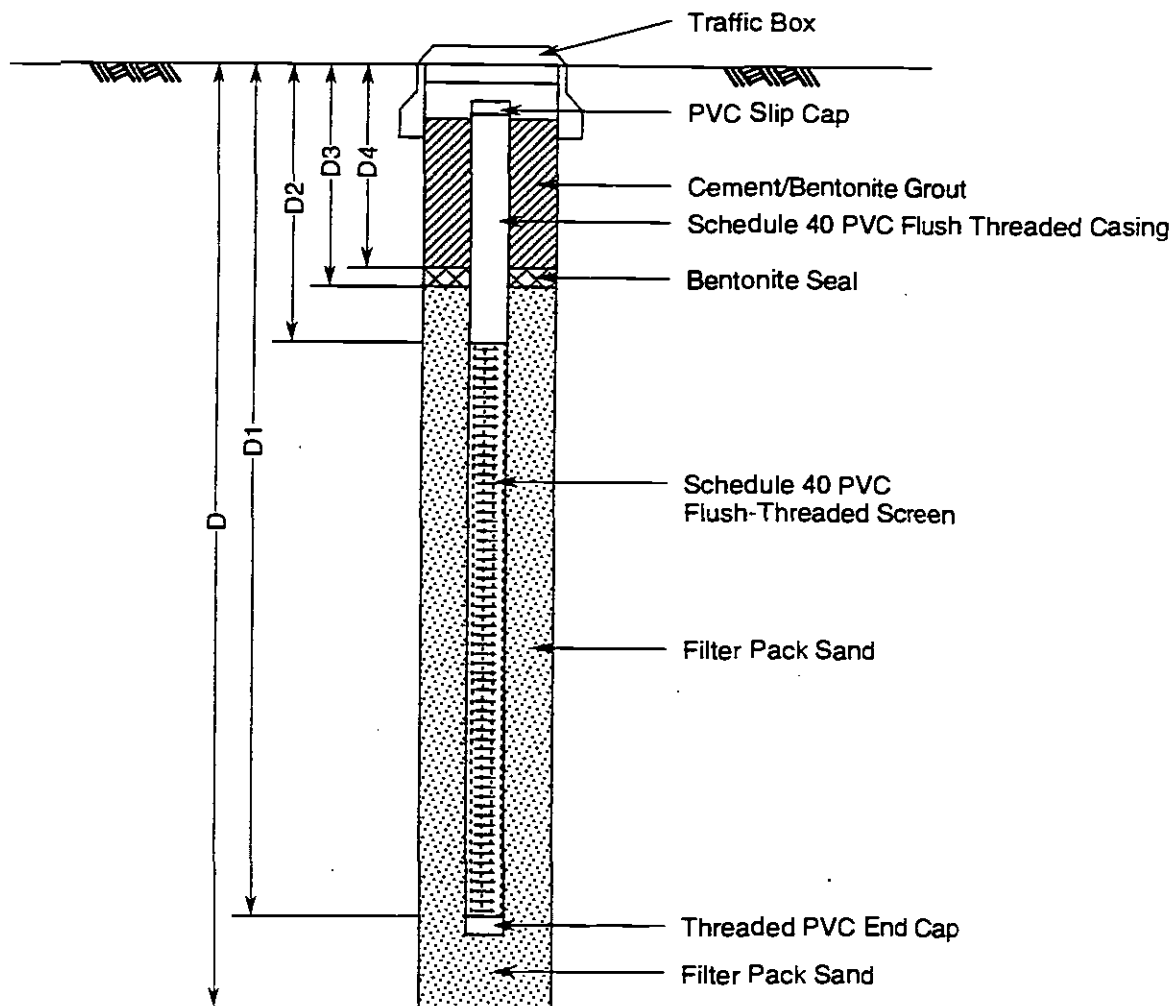
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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Location of Boring
DD-17



Total Depth (D)	=	71.5	Feet
Total Depth of Casing (D1)	=	70	Feet
Depth to Top of Well Screen (D2)	=	30	Feet
Depth to Bottom of Top Seal (D3)	=	28	Feet
Depth to Top of Top Seal (D4)	=	25	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.02	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/2	Inch Chips



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Project No. 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Monitoring Well Installation Schematic DD-17



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:		95-8347		Boring Number:		DD-51		Sheet		1 of 4			
Boring Location:		MTA Yard near S. Santa Fe Ave.				Elevation and Datum(feet):262 MSL							
Health and Safety:		Level D		Date Started:		10/26/95		Date Finished:		10/26/95			
Drilling Equipment:		Midway 1300		Total Depth (feet):		95.3		Depth to Bedrock(feet):		None			
Drilling Method:		Rotary Wash		Number of Samples:		24		Depth to Water (feet):		Unknown			
Boring Diameter:		5 inches		Completion Information:		Grouted to Surface							
Hammer Information: SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop				Logged By:		C. Marshall Payne		Checked By: K.Kabilamany					
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content (%)		
		SAND with GRAVEL; light gray, occasional cobbles, small fragments of brick	SP	af									8:31
5		ALLUVIUM SAND; light yellowish brown, moist, loose, fine- to coarse-grained sand, trace nonplastic silt	SP	Qa	1	D	4 5	5/12	4.9 [5.2]	101	17		8:39
10		dense			2	S	14 20 25	5/18	4.7 [5.0]				8:47
15		SAND/GRAVEL; loose to medium dense, gravel to 2" in size and occasional cobbles	SP/GP		3	D	4 12	6/12	5.0 [4.8]	--	12		9:02

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-51					Sheet 2 of 4					
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
		SAND/GRAVEL; light yellowish brown, dense, 6" to 12" thick sandy and gravelly layers, angular to subrounded gravel, occasional cobbles	SP/GP	Qa	4	S	5 19 24	5/18	4.7 [4.8]			9:12
25					5	D	10 40	6/12	4.6 [4.6]	122	10	9:24
30		no clear layering, becomes gradational, subangular gravel, very dense			6	S	18 50 50/3"	4.5/15	4.5 [4.6]			9:35
35					7	D	35 50/3"	6/9	4.9 [4.6]	112	15	9:52
		cobble to 6" in size [rig chatter from 38' to 48']			8	S	15 75/5"	4/11	4.4 [4.6]			10:03
40		cobble to 8" in size			9	D	50 50/1"	0/7	4.7 [4.2]			10:22
45		subangular coarse gravel, cobble			10	S	65 25/0.5"	1/6.5				10:53
		fine to coarse 2' thick gravel/cobble layer			11	D	75	0/6				11:10

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-51			Sheet 3 of 4							
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
55		SAND/GRAVEL; 6" to 12" thick layers of medium- to coarse-grained sand and olive gray angular to subangular gravel to 2" in size, occasional cobbles, very dense	SP/GP	Qa	12	S	50/4.5"	1/4.5	5.2 [4.1]			11:25
					13	D	50/5"	4/5	4.5 [4.5]	--	16	11:53
					14	S	50/3"	1/3	4.8 [4.2]			12:05
60		SANDY SILT/SILTY SAND; light olive brown, moist, very stiff/dense, low to medium plasticity, micaceous	ML/SM		15	D	12 25	8/12	4.5 [4.5]	102	23	12:37
					16	S	20 22 50/5"	16/17	4.7 [4.2]			11:57
65		CLAYEY SAND; light yellowish brown, moist to wet, very dense, medium- to coarse-grained sand, medium plasticity clay	SC									
70		SANDY SILT/SILTY SAND; olive brown, moist, hard/very dense, medium plasticity silt, fine-grained sand	ML/SM		17	D	30 50/5"	8/11	4.4 [4.4]	101	20	1:16
					18	S	60	4/6	5.2 [4.4]			1:30
75		SILT/SAND/SILTY SAND; gradational 1" to 2" thick layers; olive brown, moist, dense to very dense/hard, low to medium plasticity, micaceous	ML/SP /SM		19	D	16 35	9/12	4.7 [4.3]	107	22	1:47
					20	S	30 50	12/12	5 [4.2]			2:00
		SAND; light olive gray, moist, very dense, fine- to coarse-grained sand	SP		21	D	50	6/6	4.3 [4.3]	--	--	2:20

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-51					Sheet 4 of 4					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SAND; light olive gray, moist, very dense, fine- to coarse-grained sand, gravel to 3/4" in size	SP	Qa	22	S	65	6/6	4.7 [4.2]			2:45
		GRAVEL/SAND; layers of gravel and fine- to coarse-grained sand, very dense [rig chatter from 82' to 86.5']	GP/SP		23	D	65	2/6	4.3 [4.3]	122	13	3:05
85					24	S	25 65/5"	11/11	5.2 [4.2]			3:23
		SANDY SILT; light olive gray, moist, hard, low to medium plasticity, fine-grained sand, micaceous, few thin 1/16" iron-oxide stained fine sand lenses	ML									
		SILTY SAND; olive gray, moist, very dense, fine-grained sand, non plastic silt	SM		25	D	25 50/4"	4/10	4.3 [4.2]	105	24	3:37
90												
		SAND with GRAVEL; olive gray, moist, very dense, coarse-grained sand, gravel and cobbles [rig chatter]	SP									
		SAND; reduced gravel content, trace low plasticity silt			26	S	65/3"	1/3	4.9 [4.1]			4:50
95		Boring terminated at 95.3 feet.										
100												
105												

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E. THIRD ST.

570'

S. SANTA FE AVE.

Yard Entrance Gate

15'

DD-51

Existing
Metro Red Line
Vehicle Shop
Building



North

Not to Scale



GeoTransit
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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Location of Boring
DD-51



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Project Name:	METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN				
Project Number:	95-8347	Boring Number:	DD-52	Sheet	1 of 4
Boring Location:	NE LA River near 4th St. Bridge		Elevation and Datum(feet):227.3 M		
Health and Safety:	Level D	Date Started:	10/25/95	Date Finished:	10/25/95
Drilling Equipment:	Mayhew 1000	Total Depth (feet):	80.5	Depth to Bedrock(feet):	None
Drilling Method:	Rotary Wash	Number of Samples:	23	Depth to Water (feet):	Unknown
Boring Diameter:	5 inches	Completion Information:	Grouted to surface		
Hammer Information:	SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop		Logged By:	Checked By:	
			R. Jie	K.Kabilamany	

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content (%)	
		Reinforced Cement Concrete		af								
		ALLUVIUM SAND/GRAVEL; light brown, dry, very dense, fine- to coarse-grained sand, angular gravel to 1" in size, trace silt [strong rig chatter from 1.3' to 23']	SP/GP	Qa					4.0 [4.0]			9:08
5		gravel to 1-1/2" in size			1	D	44 43	10/12	6.6 [4.8]	124	4	9:12
		increased gravel content, GRAVEL with SAND (GP); gravel 2-1/2" in size										
10		decreased gravel content, SAND with GRAVEL (SP); gravel to 1-1/2" in size			2	S	39 47 28	15/18	6.2 [4.8]			9:36
15		increased gravel content, GRAVEL with SAND (GP); wet, gravel to 1-1/2" in size			3	D	40 65	1/12	5.7 [4.8]			10:20
					4	D	20 35	5/12	7.0 [4.8]	126	11	10:41
									5.0 [5.0]			11:03

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN													
Project Number: 95-8347		Boring Number: DD-52				Sheet 2 of 4							
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples								Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content(%)		
25		SAND with SILT and GRAVEL; brown, moist, dense, fine- to coarse-grained sand, angular to subangular gravel to 1" in size	SP-SM	Qa	5	S	12 18 26	9/18	6.8 [6.8]				11:14
30		reduced gravel content, SAND with SILT; light brown, dry, medium dense			6	D	15 25	5/12	7.2 [6.5]	110	6	11:25	
35		SANDY SILT/SILTY SAND; yellowish brown, with light olive brown, dry, very stiff/medium dense, fine- to coarse-grained sand, nonplastic silt, trace mica, trace gravel	ML/SM		7	S	8 14 15	8/18	6.9 [6.5]			11:34	
40		reduced silt content, SILTY SAND (SM); olive brown, moist, very dense, fine-grained sand, trace mica			8	D	35 50	5/12	6.8 [6.0]	105	19	11:42	
45		increased silt content, SANDY SILT (ML), brown			9	S	15 21 40	15/18	6.5 [6.0]			11:51	
50		SAND with SILT; brown, moist, very dense, fine- to coarse-grained sand, trace subangular to subrounded gravel to 1/4" in size	SP-SM		10	D	50 60	6/12	5.2 [4.6]	119	13	11:59	
55		rusty iron-oxide stains, becomes well graded	SW-SM		11	S	37 65	10/12	6.0 [4.6]			12:15 12:28	
60		SILTY SAND; dark gray, moist, medium dense to dense, fine-grained sand, trace mica	SM		12	D	18 30	8/12	5.5 [4.4]	101	24	12:30	
65		SANDY SILT; dark gray, moist, hard, non plastic, fine-grained sand, trace mica	ML		13	S	15 17 28	18/18	5.3 [4.4]			12:50	
70		SILTY SAND; dark gray, moist, medium dense, fine-grained sand, trace mica	SM		14	D	14 27	9/12	4.6 [4.4]	79	22	13:07	

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:			METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN									
Project Number:			95-8347		Boring Number:			DD-52		Sheet 3 of 4		
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	QVA (ppm) [Background]	Dry Density (pcf)	Moisture Content(%)	
55		SILTY SAND; dark gray, moist, dense, fine-grained sand, some medium-grained sand, reddish brown spots	SM	Qa	15	S	12 38 40	8/18	4.8 [4.2]			13:16
		SAND; gray, wet, very dense, fine- to coarse-grained sand, trace gravel to 3/8" in size, trace silt	SP		16	D	45 60	10/12	5.6 [4.2]	120	14	13:26
		SAND with SILT; gray, moist, very dense, fine- to medium-grained sand, trace coarse grained sand	SP-SM		17	S	18 43 40	18/18	5.0 [4.2] 5.2 [5.2]			13:42 13:48
60		[rig chatter]			18	D	100/5"	1/5	4.6 [4.2]			14:05
		GRAVEL with SAND; gray, wet, dense to very dense, gravel to 1-1/2" in size, fine- to coarse-grained sand [vigorous rig chatter from 59.5' to 61.5']	GP		19	D	17 28	12/12	5.4 [4.0]	103	24	14:22
		4" thick SILT (ML) layer; gray, moist, very stiff	SM		20	S	11 20 29	12/18	4.6 [3.8]			14:35
65		SILTY SAND; dark gray, moist, dense, fine-grained sand, trace mica, dark stains			21	D	25 35	10/12	7.8 [4.5]	99	27	14:45
		very dense			22	S	21 49 49	18/18	5.5 [4.5]			
		[rig chatter]			23	D	100	3/6	9.8 [3.7]	112	16	15:08
75		SAND; gray, wet, very dense, medium grained, trace fine- to coarse-grained sand, trace gravel to 1/2" in size [rig chatter from 75' to 79']	SP		24	S	25 43	0/18			15:40	

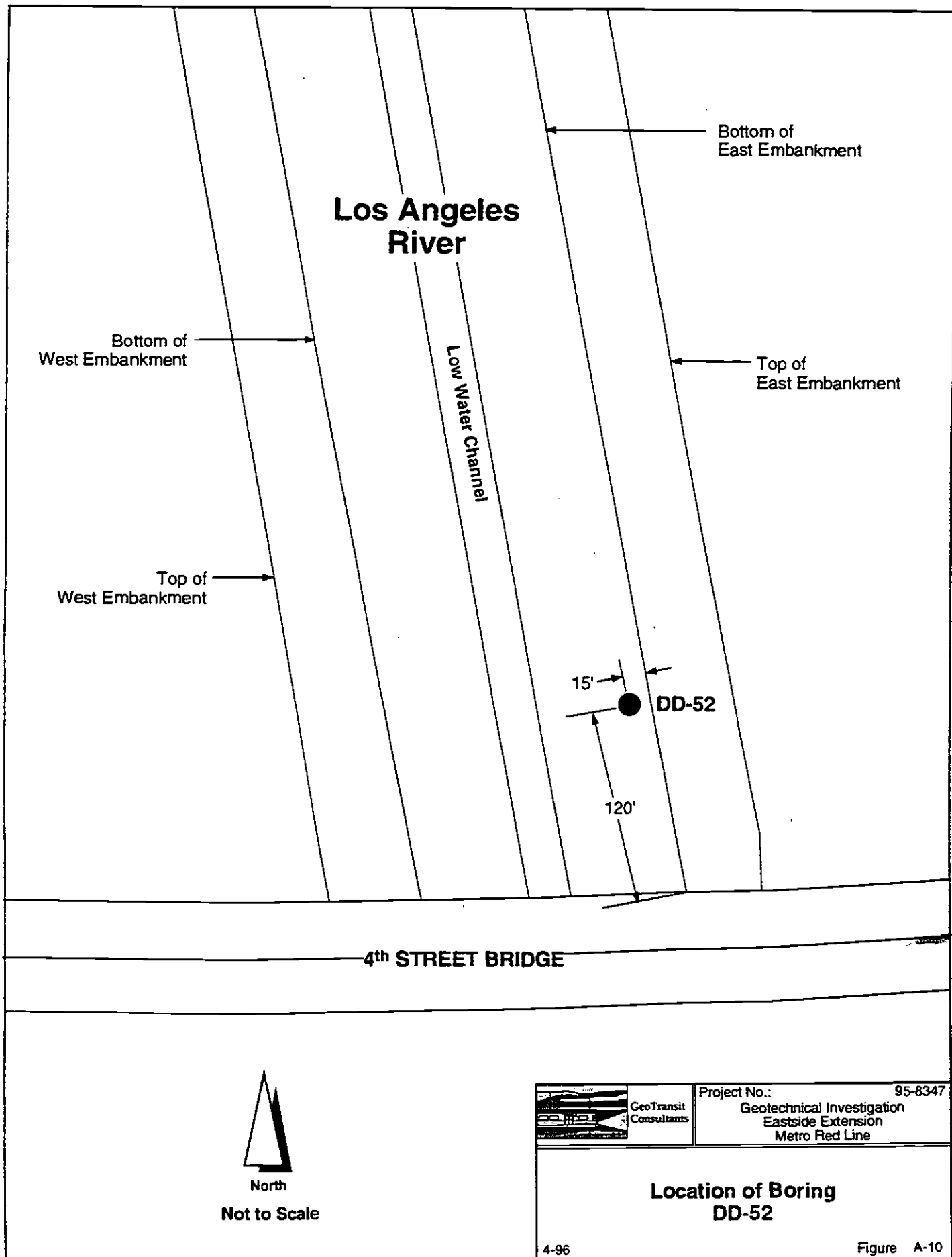
Note: This boring log is based on field classification and visual soil description and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



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Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN										
Project Number:		95-8347		Boring Number:				DD-52		Sheet 4 of 4		
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
		[see previous page] End of boring at 80.5 feet.	SP	Qa			40					
85												
90												
95												
100												
105												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.





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Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:		95-8347		Boring Number:		DD-54A		Sheet		1 of 4			
Boring Location:		Mission near Artemus				Elevation and Datum(feet):256 MSL							
Health and Safety:		Level D		Date Started:		10/31/95		Date Finished:				11/1/95	
Drilling Equipment:		Midway 1300		Total Depth (feet):		101.0		Depth to Bedrock(feet):		None			
Drilling Method:		Rotary Wash		Number of Samples:		17		Depth to Water (feet):		49.7			
Boring Diameter:		5 inches		Completion Information: Installed Monitoring Well									
Hammer Information:				Logged By:				Checked By:					
SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop				C. Marshall Payne				K. Kabilamany					

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)		
		Asphalt and Concrete		af									
5		SAND; dark brown, moist, fine- to medium-grained sand, trace gravel	SP										
10		ALLUVIUM SAND; dark brown, moist, medium dense, fine- to medium-grained sand, trace gravel	SP/SW	Qa	1	D	10 22	4/12	3.7 [3.7]	--	--	11:53	
15		gravel to 3/4" in size, grayish brown, moist, dense			2	S	5 17 18	6/18	4.0 [4.0]			12:00	

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-54A					Sheet 2 of 4					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		SAND with GRAVEL; dark brown, moist, loose, subangular to subrounded gravel, layered (crudely bedded)	SP	Qa	3 D	5 4	0/12	3.7 [3.7]	--	--		
25		becomes dense to very dense			4 S	5 20 30	2/18	3.8 [3.8]				12:27
30		[rig chatter at 29']			D	50/5"	0/5	--	--	--		12:39
35		[rig chatter at 37']			5 S	50/5.5"	1.5/ 5.5	4.0 [3.8]				12:57
40		[rig chatter at 41'] cobble to 8" in size			D	50/3"	0/3	3.7 [3.7]	--	--		13:14
45		[rig chatter at 45']			6 S	25/3"	2/3	3.9 [3.8]				13:25
		SAND with SILT/SILTY SAND, dark brown, moist, medium dense to very dense	SP-SM /SM		7 D	12 22	10/12	3.7 [3.7]	114	9		13:38
		iron-oxide stains, very dense			8 S	25 50	7/12	4.0 [3.8]				13:55

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-54A				Sheet 3 of 4					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
55	olive iron-oxide stains	SAND with SILT/SILTY SAND; dark brown, moist to wet, very dense, fine- to medium-grained sand, nonplastic silt	SP-SM/ SM	Qa	9	D	50/5"	1/5	3.7 [3.7]	104	19	14:08
					10	S	39 50/5"	6/11	3.9 [3.7]			14:17
					11	D	50/5.5"	1/5.5	3.8 [3.7]	--	--	14:30
60		SANDY SILT/SILTY SAND; grayish brown, moist, hard/very dense, fine- to medium-grained sand	ML/SM		12	S	27 49 50/2"	13/14	3.9 [3.7]			14:45
					13	D	20 50	8/12	3.8 [3.7]	117	19	14:55
65	dark gray	SILTY SAND; olive, moist to wet, dense to very dense, fine- to coarse-grained sand, trace gravel to 1-1/4" in size	SM		14	S	50	4/6	4.3 [3.7]			07:25
					15	D	25 50/3"	8/9	3.9 [3.7]	102	25	07:42
70		SANDY SILT; very dark gray, moist, hard	ML		16	S	25 50	9/12	4.0 [3.7]			07:57
					17	D	25 35	10/12	4.0 [3.7]	108	19	08:15
					18	S	30 50/5"	11/11	4.1 [3.7]			08:50
75	very dense	reduced silt content, SANDY SILT/SILTY SAND (ML/SM); dark gray, hard/dense										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN													
Project Number: 95-8347		Boring Number: DD-54A				Sheet 4 of 4							
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		SILTY SAND; dark gray, moist to wet, very dense	SM	Qa									
		SAND; dark gray, moist to wet, very dense, fine- to medium-grained sand [rig chatter]	SP		19	D	50/5"	2/5	--	--	--		09:06
85		trace gravel			20	S	40/4.5"	0/4.5	4.0 [3.7]				09:40
90		SAND/GRAVEL; dark gray, moist to wet, very dense, fine- to coarse-grained sand cobbles [vigorous rig chatter]	SP/GP			D	50/1"	0/1	--	--	--		10:05
95		SILT/LEAN CLAY; very dark gray, moist, hard, thinly laminated and dipping 5 to 10 degrees	ML/CL		21	S	30 50	10/12	4.2 [3.7]				10:33
100		SAND; dark gray, moist, very dense	SP		22	S	40 50	10/12					10:55
105		End of Boring at 101 feet. Groundwater level was measured at a depth of 49.7 feet on 11/21/95.											

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.

Mission Rd.

Artemus St.

DD-54A

90'

5'



North

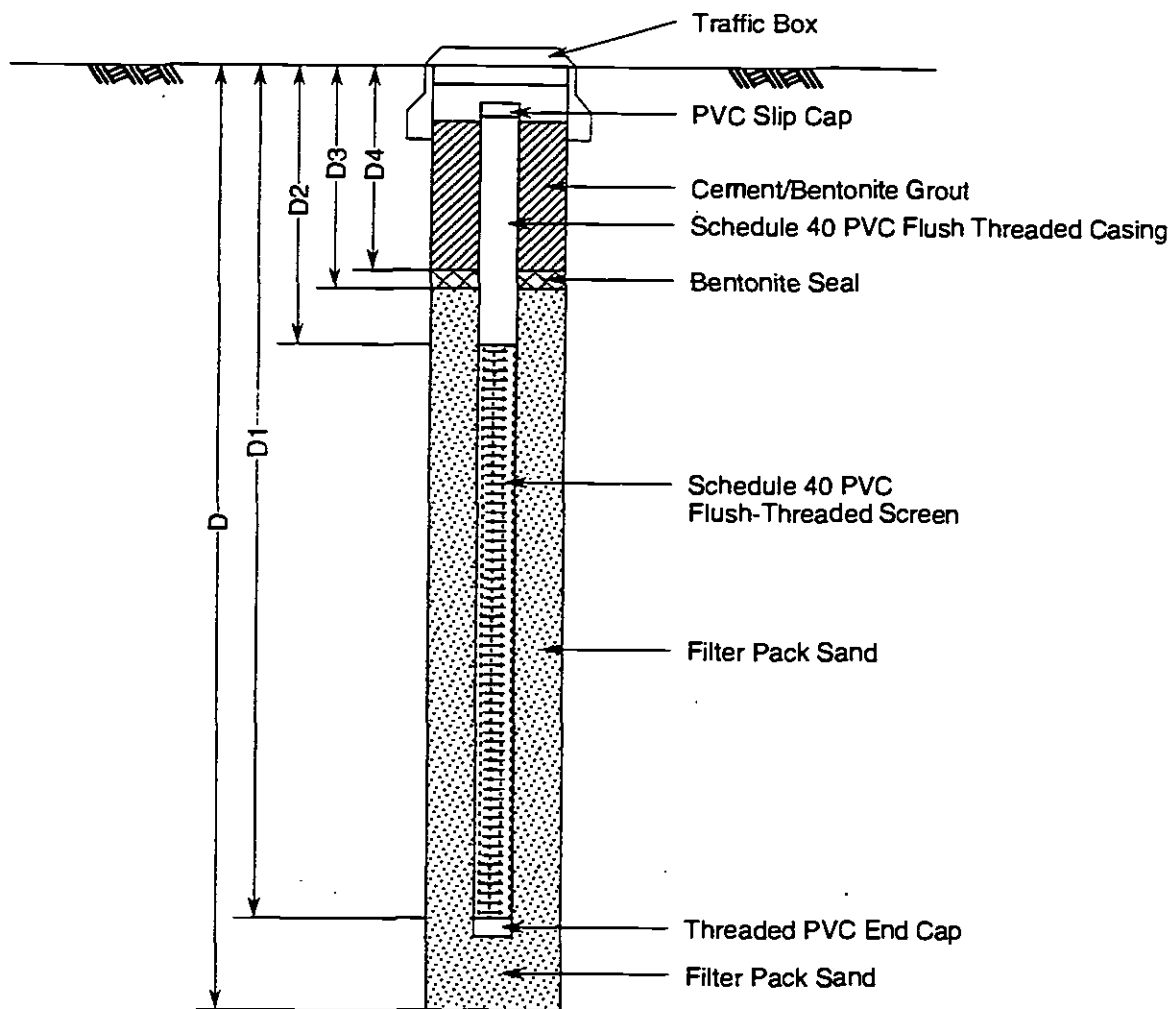
Not to Scale



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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

**Location of Boring
DD-54A**



Total Depth (D)	=	101	Feet
Total Depth of Casing (D1)	=	90	Feet
Depth to Top of Well Screen (D2)	=	35	Feet
Depth to Bottom of Top Seal (D3)	=	27	Feet
Depth to Top of Top Seal (D4)	=	21	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.02	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/2	Inch Chips



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Project No. 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Monitoring Well Installation Schematic DD-54A



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Project Name:		METRO RED LINE - EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:		95-8347		Boring Number:		DD-54B		Sheet		1 of 4			
Boring Location:		Mission and Artemus				Elevation and Datum(feet):256.0							
Health and Safety:		Level D				Date Started:		1/23/96		Date Finished:		1/23/96	
Drilling Equipment:		Mayhew 1000				Total Depth (feet):		102.0		Depth to Bedrock(feet):		None	
Drilling Method:		Rotary Wash				Number of Samples:		11		Depth to Water (feet):		52.0	
Boring Diameter:		5 inches				Completion Information:		Installed Monitoring Well					
Hammer Information:		400 lb. downhole hammer, 30-inch drop				Logged By:		Alan Pace		Checked By:		Grant Miller	

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples								Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)		
0		Asphalt and concrete ARTIFICIAL FILL Poorly graded sand with concrete clasts [No samples were taken between 0 and 50 feet. Descriptions for 0 to 50 feet interval were based on logging of cuttings.]	SP	af									07:00
5		@5'-grades to well graded sand with gravel											
10		ALLUVIUM SAND with GRAVEL; clasts range from 1/4" to 3/4"	SW	Qa									07:45
15													
													08:00

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE - EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-54B					Sheet 2 of 4					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
25		SAND with GRAVEL; clasts range from 1/4" to 3/4"	SW	Qa								08:20
30		SILT; olive	ML									
35		SAND with GRAVEL; clasts range from 1/4" to 3/4"	SW									
40												08:45
45												09:00

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



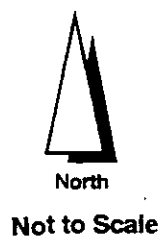
Project Name: METRO RED LINE - EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-54B				Sheet 3 of 4						
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	QVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	Drilling Time
		SAND; gray, moist, very dense, fine-grained sand, some gravel	SW	Qa	1	S	15 20 35	12/18	-			09:3
55		moist to wet, dense, grades to fine- to medium-grained sand, some gravel, scattered orange colored iron-oxide stain			2	S	12 15 18	12/18	-			09:4
60		moist to wet, very dense, grades to medium-grained sand, some coarse-grained sand, scattered orange colored iron-oxide stain			3	S	15 25 50	11/18	-			10:0
65		moist to wet, very dense, increasing coarse-grained sand content			4	S	15 25 30	14/18	-			10:20
70		SILT with SAND; dark greenish gray, moist, very stiff, micaceous	ML		5	S	8 12 16	13/18	-			10:35
75		SAND with SILT; dark greenish gray, moist to wet, dense, very fine-grained sand	SP-SM		6	S	12 15 17	13/18	-			10:45

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE - EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-54B			Sheet 4 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SAND with SILT; gray, moist to wet, very dense, fine- to medium-grained sand	SW-SM	Qa	7	S	17 35 40	9/18	-			10:55
85		SAND with SILT and GRAVEL; gray, moist, to wet, very dense, fine- to coarse-grained sand, fine gravel	SW-SM		8	S	25 40 55	10/18	-			11:15
90		SILT with SAND; dark gray, moist, very stiff	ML		9	S	10 12 17	17/18	-			11:40
95		SAND with SILT; gray, moist, very dense, very fine- to fine-grained sand	SW-SM		10	S	15 25 35	8/18	-			11:55
100		SAND; light gray, moist, very dense, medium- to coarse-grained sand	SW		11	S	75	3/6	-			12:15
105		End of Boring at 102 feet. Groundwater was measured at a depth of 52.0 feet on 2/27/96										

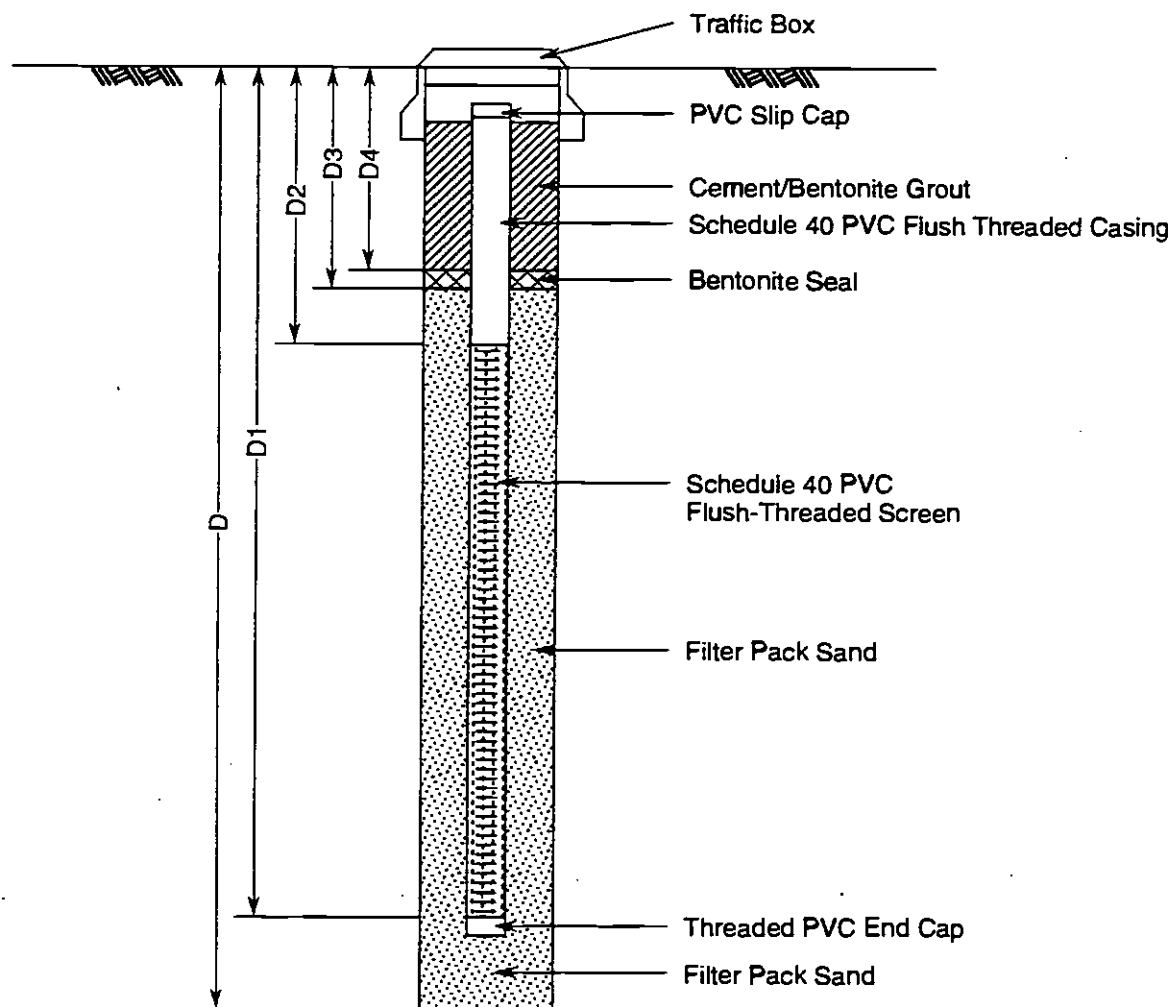
Note: This boring log is based on field classification and visual soil description and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



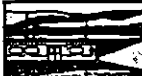
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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

**Location of Boring
DD-54B**



Total Depth (D)	=	102	Feet
Total Depth of Casing (D1)	=	100	Feet
Depth to Top of Well Screen (D2)	=	50	Feet
Depth to Bottom of Top Seal (D3)	=	45	Feet
Depth to Top of Top Seal (D4)	=	35	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.01	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/4	Inch Chips

	Project No.	95-8347
	Geotechnical Investigation	
	Eastside Extension	
	Metro Red Line	

Monitoring Well Installation Schematic DD-54B



Project Name:		METRO RED LINE - EASTSIDE EXTENSION, DETAILED DESIGN			
Project Number:		95-8347	Boring Number:		DD-54C
Sheet		1	of		4
Boring Location:			Mission and Artemus		
			Elevation and Datum(feet):256.0		
Health and Safety:		Level D		Date Started:	1/24/96
Date Finished:		1/25/96			
Drilling Equipment:		Mayhew 1000		Total Depth (feet):	104.0
Depth to Bedrock(feet):		None			
Drilling Method:		Rotary Wash		Number of Samples:	32
Depth to Water (feet):		51.30			
Boring Diameter:		10 inches		Completion Information:	
				Installed Pump Well	
Hammer Information:			Logged By:		Checked By:
400 lb. downhole hammer, 30-inch drop			Alan Pace		Grant Miller

Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content(%)	
		Asphalt and concrete		af								7:00
		ARTIFICIAL FILL SILTY SAND; scattered fragments of wood and asphalt, loose [No samples were taken between 0 and 50 feet. Descriptions for 0 to 50 feet interval were based on logging of cuttings.]	SM									
5												
		ALLUVIUM SAND; fine- to medium-grained	SW	Qa								
10												
15												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



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Project Name: METRO RED LINE - EASTSIDE EXTENSION, DETAILED DESIGN														
Project Number: 95-8347		Boring Number: DD-54C						Sheet 2 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples									
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	Drilling Time		
25		SAND; fine- to medium-grained	SW	Qa										
30											8:45 9:00			
35														
40														
45														

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



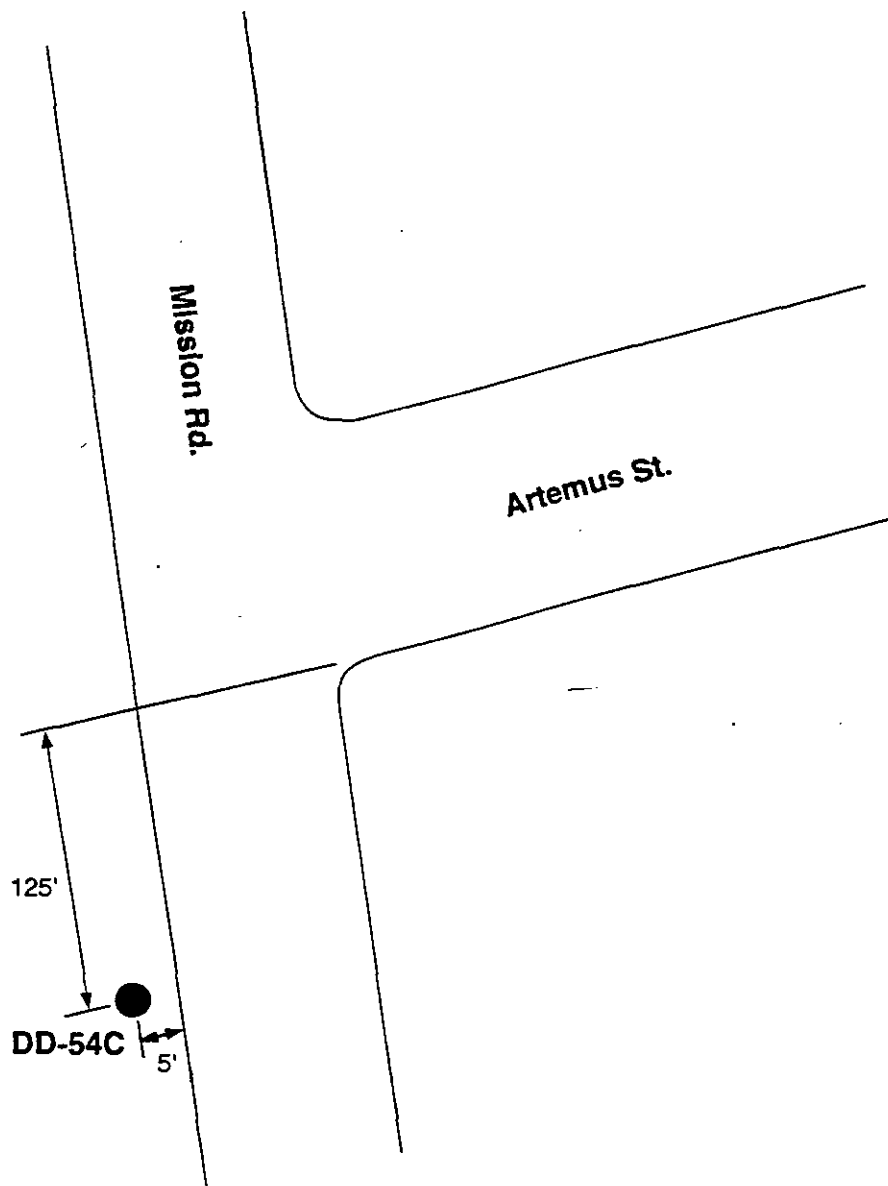
Project Name: METRO RED LINE - EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-54C				Sheet 3 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
55		SAND; light brown, moist to wet, dense to very dense, fine- to coarse-grained, trace very coarse grained sand and gravel grades to no gravel	SW	Qa	1	S	30	6/18	-			9:25
60		scattered gravel			2	S	12	7/18	-			-
		SAND with SILT and GRAVEL; light olive brown, dense, grades to very fine- to medium-grained sand, trace coarse-grained sand, some fine gravel	SW-SM		3	S	15	9/18	-			-
65		5" thick, olive brown, stiff, silt layer at 61 feet			4	S	21	12/18	-			10:10
		Interlayered fine- to coarse- grained SAND and SILT	SW/ML		5	S	15	11/18	-			-
70		SILTY SAND; dark grayish brown, moist to wet, medium dense to dense, very fine-grained sand	SM		6	S	17	13/18	-			10:20
75		SILTY SAND/SANDY SILT; dark grayish brown, moist, dense/very stiff	SM/ML		7	S	20	12/18	-			-
		SAND with GRAVEL; moist, very dense, medium- to coarse-grained sand, some very coarse-grained sand to fine gravel	SW		8	S	7	12/18	-			-
		LEAN CLAY; dark greenish gray, moist, very stiff	CL		9	S	9	12/18	-			10:50
		SAND; moist, medium dense, very fine-grained	SP		10	S	10	13/18	-			-
		SILT with SAND; moist, very stiff to hard	ML		11	S	10	16/18	-			-
					12	S	10	18/18	-			-
					13	S	15	9/18	-			-
					14	S	12	13/18	-			-
					15	S	11	13/18	-			-
					16	S	11	14/18	-			-
					17	S	12	14/18	-			-
					18	S	9	13/18	-			-
					19	S	9	14/18	-			-
					20	S	12	16/18	-			12:45

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE - EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-54C				Sheet 4 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
85		SAND with GRAVEL; gray, moist, very dense	SW	Qa	21	S	18 25 35	10/18	-			13:00
90		Cobble-rich interval at 81.5 feet			22	S	40 80/5"	11/11	-			
95		Color grades to gray with dark reddish gray mottling, grades to fine- to medium-grained sand, trace fine gravel			23	S	20 35 50	8/18	-			13:30
00		cobble-rich interval 86.5 feet			24	S	15 25 35	11/18	-			13:40
05					25	S	25 40 50	13/18	-			13:55
05					26	S	15 25 35	8/18	-			14:15
05					27	S	100/6"	5/6	-			14:30
05					28	S	30 45 50	6/18	-			14:40
05					29	S	10 12 17	18/18	-			14:55
05					30	S	12 18 25	17/18	-			15:10
05					31	S	14 19 23	12/18	-			15:20
05					32	S	20 30 40	10/18	-			15:25
05											15:30	
05		End of boring at 104 feet. Groundwater was measured at a depth of 51.3 feet on 2/27/96.										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



North

Not to Scale

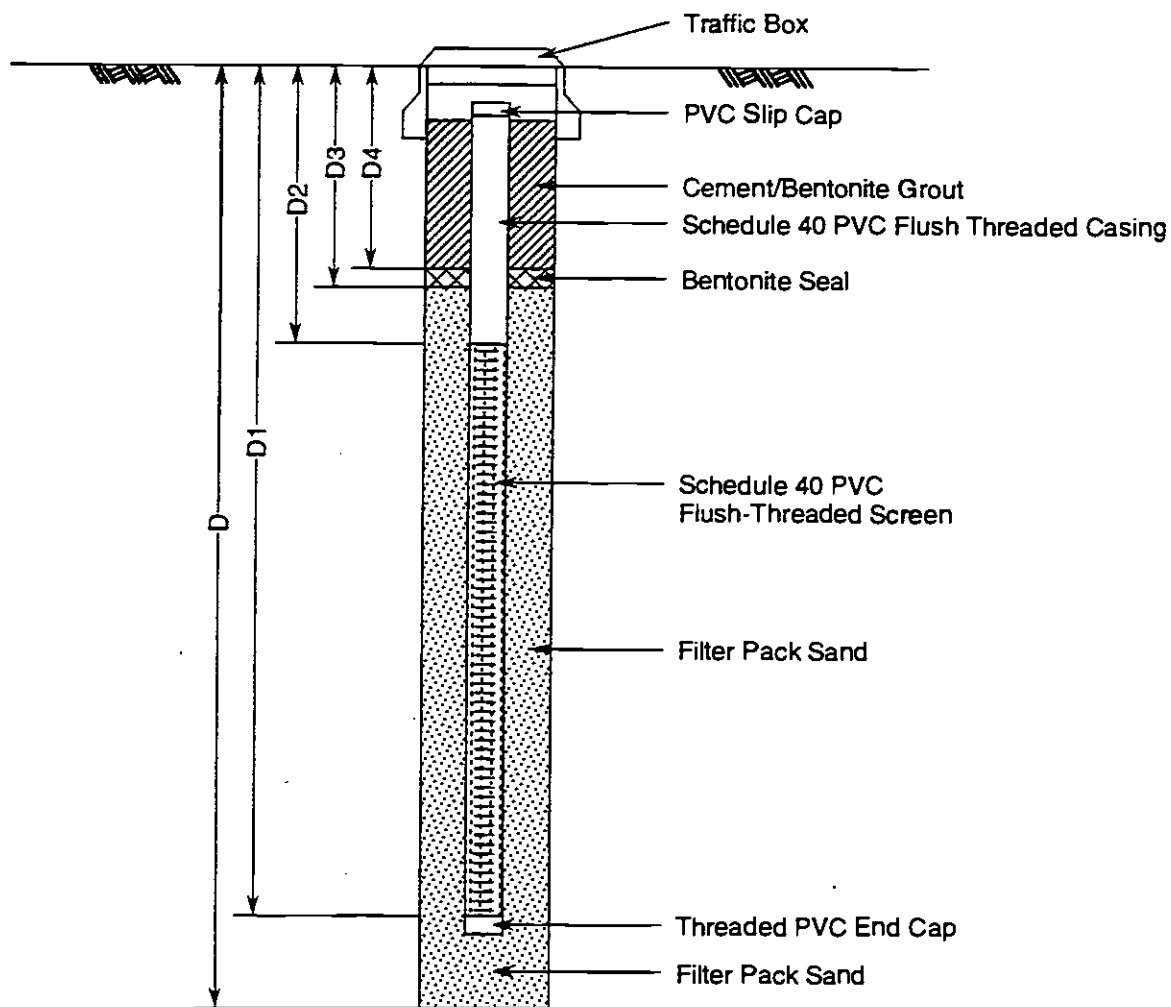


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Project No.: 95-8347

Geotechnical Investigation
Eastside Extension
Metro Red Line

Location of Boring
DD-54C



Total Depth (D)	=	104	Feet
Total Depth of Casing (D1)	=	95	Feet
Depth to Top of Well Screen (D2)	=	55	Feet
Depth to Bottom of Top Seal (D3)	=	50	Feet
Depth to Top of Top Seal (D4)	=	46	Feet
Well Casing Diameter	=	6	Inches
Well Screen Slot Size	=	0.06	Inch
Filter Pack Sand Type	=	#6/16	Monterey
Bentonite Seal Type	=	1/4	Inch Chips

	Project No.	95-8347
	Geotechnical Investigation	
	Eastside Extension Metro Red Line	

Pump Well Installation Schematic DD-54C



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Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN					
Project Number:		95-8347	Boring Number:		DD-55	Sheet <u>1</u> of <u>4</u>	
Boring Location:			Boyd near Anderson		Elevation and Datum(feet):257 MSL		
Health and Safety:			Level D		Date Started: 11/4/95		Date Finished: 11/4/95
Drilling Equipment:			Mayhew 1500		Total Depth (feet): 86.0		Depth to Bedrock(feet): None
Drilling Method:			Rotary Wash		Number of Samples: 25		Depth to Water (feet):Unknown
Boring Diameter:			5 inches		Completion Information: Grouted to Surface		
Hammer Information: SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop				Logged By: Greg Renfrew		Checked By: K. Kabilamany	

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples						Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)		Moisture Content (%)
0	Concrete			af								
5		SAND; light olive brown, moist, fine- to medium-grained sand, micaceous, trace silt [hand augered to 8'] trace coarse gravel to 1-1/2" in size	SP		1	B				4.6 [4.6]		06:33
10		1-1/2" interval of SILTY SAND (SM); dark grayish brown, moist, medium dense, fine- to medium-grained sand										
10	ALLUVIUM	SAND with SILT and GRAVEL; light olive brown, moist, medium dense, fine- to medium-grained sand, nonplastic silt, fine to coarse gravel to 1-1/2" in size	SP-SM	Qa	2	D	9 20	6/12		5.2 [5.0]	--	07:36
15		SAND with SILT/GRAVEL with SILT; light olive brown, moist, very dense, fine- to coarse-grained sand with intervals of fine- to medium-grained, subrounded to subangular gravel to 3" in size	SW-SM /GP-GM		3	S	20 35 26	10/18		5.4 [5.4]		07:45

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-55				Sheet 2 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	QVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
25		GRAVEL/SAND; light olive brown, moist, medium dense, with intervals of gravel to 1" in size, fine- to coarse-grained sand, trace nonplastic silt	GP/SW	Qa	4	D	5 17	7/12	5.6 [5.6]	--	--	08:00
		5			S	28 29 24	13/18	7.5 [6.2]			08:10	
30		SAND/GRAVEL; light olive brown, moist, very dense, fine- to medium-grained sand, trace coarse-grained sand, 1/4" to 1/2" thick quartz laminations, iron-oxide stained becomes medium dense	SP/GP		6	D	9 21	7/12	6.3 [6.3]	--	--	08:30
				7	S	35 39 52	16/18	7.3 [6.3]			08:40	
				8	D	70 75/2"	7/8	6.4 [6.3]	118	13	08:50	
35		SILTY SAND/SILTY GRAVEL; light olive brown, moist, very dense, fine- to medium-grained sand, nonplastic silt, subangular fine to coarse gravel	SM/GM		9	S	100	5/6	7.3 [6.3]			09:10
				10	D	46 105	8/12	6.6 [6.3]	124	12	09:30	
45		SAND/GRAVEL; light yellowish brown, moist, very dense, fine- to medium-grained sand, gravel to 2" in size, micaceous	SP/GP		11	S	10 14 16	15/18	7.4 [6.3]			09:40
				12	D	33 58	8/12	6.3 [6.3]	121	15	10:05	
				13	S	17 24	18/18	6.5 [6.3]			10:10	
		6" interval of SANDY SILT (ML), low plasticity, hard										
		3" thick layer of gravel, very dense cobbles to 3.5" in size										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



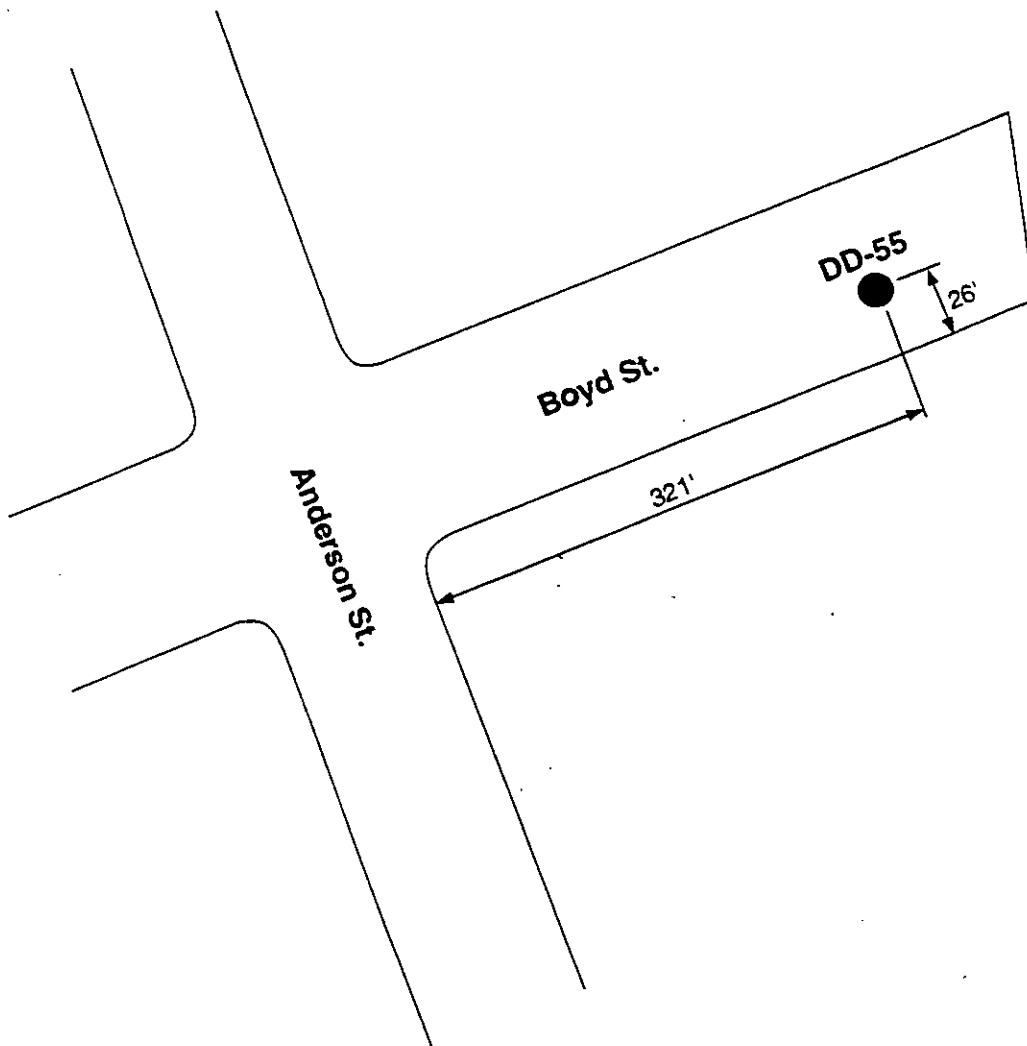
Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:		95-8347		Boring Number:		DD-55		Sheet 3 of 4					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)		
		SAND with SILT; light brown, moist, dense, fine-grained sand, nonplastic silt, micaceous	SP-SM	Qa			26						
					14	D	25 50	10/12	6.6 [6.2]	100	24	10:38	
55		SANDY SILT; light olive brown, moist, very stiff, nonplastic, fine-grained sand	ML		15	D	12 28	12/12	6.6 [6.2]	101	24	10:55	
		SAND with SILT/SILTY SAND; olive gray, moist, very dense, fine- to medium-grained sand, micaceous	SP-SM /SM		16	S	16 37 60	18/18	7.2 [6.2]			11:03	
					17	D	40 61	10/12	6.7 [6.2]	103	25	11:18	
					18	S	38 60 70	18/18	7.3 [6.1]			11:56	
					19	D	35 50	9/12	6.4 [6.1]	110	18	12:07	
65					20	S	39 100	16/18	7.4 [6.1]			12:19	
		subangular gravel to 3/4" in size, trace coarse grained sand			21	D	35 100	10/12	6.6 [6.1]	108	19	12:32	
					22	S	46 100	12/12	7.3 [6.1]			12:46	
75		SILTY SAND; dark greenish gray, moist, dense, fine grained, micaceous	SM		23	D	20 39	11/12	6.2 [6.2]	100	26	13:00	
		increased silt content, SANDY SILT/SILTY SAND (ML/SM), hard/very dense			24	S	29 37	18/18	6.5 [6.2]				

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN										
Project Number:		95-8347		Boring Number:		DD-55			Sheet 4 of 4			
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SAND; light olive brown, moist, very dense, fine- to medium-grained	SP	Qa			80					13:10
85		trace coarse-grained sand and fine gravel 1/8" thick layer of SILTY SAND (SM) End of Boring at 86 feet.			25	D	70 150	11/12	7.3 [7.3]	112	18	13:43
90												
95												
100												
105												

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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

**Location of Boring
DD-55**



Project Name:	METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN				
Project Number:	95-8347	Boring Number:	DD-56-1	Sheet	1 of 3
Boring Location:	3rd near Via Los Santos		Elevation and Datum(feet):257 MSL		
Health and Safety:	Level D	Date Started:	10/30/95	Date Finished:	10/30/95
Drilling Equipment:	Midway 1300	Total Depth (feet):	75.3	Depth to Bedrock(feet):	None
Drilling Method:	Rotary Wash	Number of Samples:	20	Depth to Water (feet):	Unknown
Boring Diameter:	5 inches	Completion Information:	Grouted to Surface		
Hammer Information:	SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop		Logged By:	C. Marshall Payne	
			Checked By:	K. Kabilamany	

Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		Asphaltic Concrete		af								
		ALLUVIUM	SM	Qa								
		SILTY SAND; brown, very dense, gravel to 3" in size										
		SAND; light brownish gray, moist, medium dense, fine- to medium-grained sand	SP									
5					1	S	6 10 13	8/18	4.5 [4.2]			08:21
		[rig chatter]										
10		SAND/GRAVEL; light yellowish brown, moist, medium dense, fine- to coarse-grained sand, gravel to 2" in size	SP/GP		2	D	15 25	6/12	4.3 [4.2]	118	9	08:30
15		SAND (SP); yellowish brown, moist, very dense, 4" to 6" layers of fine- to medium- and medium- to coarse-grained sand	SP		3	S	14 28 30	11/18	5.2 [4.2]			08:40
		[see next page]	SP/GW		4	D	11 30	4/12	4.4 [4.4]	124	5	08:53

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: DD-56-1					Sheet 2 of 3					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	QVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SAND/GRAVEL; pale brown, moist, medium dense, medium- to coarse-grained sand, gravel to 2" in size	SP/GW	Qa								
		SAND; light brownish yellow, very dense, fine- to coarse-grained	SW		5	S	12 30 35	11/18	4.5 [4.4]			09:00
25		[rig chatter], SAND/GRAVEL (SW/GP) medium dense			6	D	7 25	6/12	4.3 [4.2]	--	--	09:11
		SAND and SAND with GRAVEL layers, dark yellowish brown, moist, medium to very dense, fine- to medium-grained sand, coarse gravel [rig chatter at 27']	SP		7	S	6 25 25	8/18	4.9 [4.4]			09:15
30		fine- to medium-grained sand, medium dense			8	D	7 12 12	0/12				09:27
		[rig chatter]			8	D	12 17	5/12		--	--	09:34
35		4" to 6" layers with gradational contacts, very dense			9	S	8 36 50/4.5"	12/16.5	5.0 [4.6]			09:55
		[rig chatter]										
		medium dense			10	D	7 12	0/12				10:07
40		very dense			11	S	50	1/6	5.0 [4.4]			10:25
		[rig chatter]										
45		SILTY SAND; grayish brown, moist, dense, medium-grained sand, nonplastic silt	SM		12	D	17 40	5.5/12	4.2 [4.2]	101	21	10:38
		light brown, very dense, fine- to medium-grained sand			13	S	17 50/3"	9/9	4.7 [4.4]			10:47

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-56-1				Sheet 3 of 3					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SAND with SILT; light brown, very dense, fine- to medium-grained sand, nonplastic silt, faintly bedded	SP-SM	Qa	14	D	35 50/5"	7/11	4.2 [4.2]	105	18	11:03
		trace fine gravel			15	S	30 50	8/12	4.7 [4.4]			11:14
55		LEAN CLAY; olive, moist, hard, medium plasticity, trace fine-grained sand, micaceous	CL		16	D	18 35	7/12	4.2 [4.2]	101	27	11:27
		SILTY SAND; olive, very dense, fine- to medium-grained, trace coarse-grained, nonplastic silt	SM		17	S	50/4"	6/4	4.6 [4.4]			11:45
60					18	D	50 50/5"	7/11	4.2 [4.2]	103	21	11:52
65		dark gray			19	S	50/4"	3/4	4.9 [4.4]			12:05
						D	15 15	0/12	4.6 [4.2]	--	--	12:18
70		SAND/GRAVEL; dark gray, wet, very dense, fine- to medium-grained sand, fine to coarse gravel [intermittent rig chatter from 70' to 75.3']	SP/GP		20	D	50/5"	1.5/5				12:46
75		End of boring at 75.3 feet.			21	S	50/4"	1/4	5.2 [4.4]			13:04

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.

Clarence St.

Alley

DD-56-1

15'

10'

Via Los Santos



North

Not to Scale



GeoTransit
Consultants

Project No.: 95-8347

Geotechnical Investigation
Eastside Extension
Metro Red Line

Location of Boring
DD-56-1



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:		95-8347		Boring Number:		DD-57		Sheet 1 of 3					
Boring Location:		Pecan near 1st				Elevation and Datum(feet):263 MSL							
Health and Safety:		Level D			Date Started:		11/6/95		Date Finished:			11/6/95	
Drilling Equipment:		Midway 1300			Total Depth (feet):		65.0		Depth to Bedrock(feet):		None		
Drilling Method:		Rotary Wash			Number of Samples:		22		Depth to Water (feet):		Unknown		
Boring Diameter:		5 inches			Completion Information:		Grouted to Surface						
Hammer Information:		SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop			Logged By:		Greg Renfrew		Checked By: K. Kabilamany				
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		Asphalt/Concrete		af									
5		SILTY SAND; yellowish brown, dry to moist, medium dense, fine- to medium-grained sand, trace subangular gravel to 3/4" in size [hand augered to 3']	SM		1	B			9.0 (7.6)			07:06	
10		ALLUVIUM SILTY SAND; dark grayish brown, moist, loose, fine- to medium-grained sand, grass roots, calcium carbonate in joints, blocky soil	SM	Qa	2	D	5 9	8/12	9.0	91	12	09:40	
		dense			3	S	9 15 16	18/18	8.0			09:42	
15		medium dense, pin point pores			4	D	11 20	8/12	8.2	105	12	09:56	
		SANDY SILT; yellowish brown/dark grayish brown, moist, hard, fine- to coarse-grained sand, trace angular gravel to 1-1/4" in size	ML		5	S	21 16 17	26/18	8.2			10:02	

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN													
Project Number: 95-8347		Boring Number: DD-57				Sheet 2 of 3							
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples								Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
25		SILTY SAND; yellowish brown, moist, medium dense, fine- to medium-grained sand	SM	Qa	6	D	12 18	10/12	8.4	99	15	10:20	
		1-1/2" interval of SANDY SILT/SILTY SAND (ML/SM); light yellowish brown, dry to moist, very stiff/medium dense, fine-grained sand											
		7			S	13 22 16	16/18	8.2			10:30		
		dark yellowish brown, dense, pocket of coarse sand, gravel to 1-1/2" in size											
		light yellowish brown, dry, fine-grained sand			8	D	16 43	7/12	8.4	102	8	10:46	
30		SAND with SILT; yellowish brown, moist, very dense, fine- to medium-grained sand, trace coarse-grained sand	SP-SM										
35		SAND with SILT and GRAVEL; dry, very dense, subangular to subrounded gravel to 1-1/4" in size, fine- to coarse-grained sand	SW-SM		9	S	22 27 24	17/18	8.0			10:55	
		subrounded gravel											
		10		D	30 150/3"	9/9	8.1	111	19	11:06			
		SAND with SILT; pale olive, moist, trace micaceans	SP-SM		11	S	26 63 70	17/18	8.9			11:16	
40		SAND with SILT and GRAVEL; yellowish brown, fine- to coarse-grained sand, mostly subrounded to subangular fine gravel	SP-SM		12	D	33 60	9/12	8.3	118	14	11:26	
		4" interval of SILT (ML); light olive brown, moist, low plasticity, subrounded gravel to 1" in size											
		13		S	30 54 100/5"	16/17	8.2			11:43			
45		reddish yellow staining locally			14	D	35 100	9/12	8.1	121	14	11:58	
		ELASTIC SILT; dark greenish gray, moist, hard, high plasticity, trace fine-grained sand, laminated	MH		15	S	11 34 33	18/18	8.7			12:43	

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: DD-57			Sheet 3 of 3						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
55		ELASTIC SILT; dark greenish gray, moist, hard, high plasticity, white fine sand lenses, reacts strongly with HCl, trace white fossils	MH	Qa	16	D	22 41	12/12	8.1	96	27	13:00
		calcareous nodules			17	S	11 20 20	18/18	8.2			13:06
					18	P		26/36	8.5			13:40
60		calcareous nodules slickensided surface, trace fossils	SM		19	D	11 15 20 30 35	12/12	7.9	90	32	13:50
		SILTY SAND; dark greenish gray, wet, very dense/hard, laminated, calcareous, fine-grained sand			20	S		18/18	8.0			14:00
					21	P		29/36	8.2			14:15
65		End of Boring at 65 feet.			22	D	40 40	12/12	8.0	103	23	14:29
70												
75												

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E. First St.

Pecan St.

205'

DD-57

6'



North

Not to Scale



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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Location of Boring
DD-57



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN									
Project Number:		95-8347		Boring Number:		SD-6		Sheet 1 of 4			
Boring Location:		Alley on 1st St. near Boyle Ave.				Elevation and Datum(feet):310 MSI					
Health and Safety:				Level D		Date Started:10/27/95		Date Finished: 10/27/95			
Drilling Equipment:				Midway 1300		Total Depth (feet): 90.5		Depth to Bedrock(feet): None			
Drilling Method:				Rotary Wash		Number of Samples: 22		Depth to Water (feet): 57.8			
Boring Diameter:				5 inches		Completion Information:		Installed Monitoring Well			
Hammer Information: SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop						Logged By: C. Marshall Payne		Checked By: K.Kabilamany			
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples						Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	
		Asphaltic Concrete		af							07:15
		ALLUVIUM SAND; dark brown, moist, dense to very dense, fine- to medium-grained sand, trace gravel to 1" in size cobble to 6" in size	SP	Qa							
5		increased gravel content, SAND with GRAVEL, very dense			1	S	12 35 50/5"	8/17	6.6 [5.8]		08:47
10		SILTY SAND/SANDY SILT; brownish yellow, moist, medium dense/very stiff, fine-grained sand, nonplastic silt, trace gravel to 1-1/2" in size, micaceous	SM/ML		2	D	10 20	4/12	5.2 [5.0]	112 18	09:10
15		decreased silt content, SILTY SAND (SM); very dense			3	S	15 25 32	12/18	6.5 [5.8]		09:20
		increased silt content, SANDY SILT/SILTY SAND (ML/SM); light olive brown									

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: SD-6			Sheet 2 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SANDY SILT; light olive brown, moist, very stiff, nonplastic silt, micaceous	ML	Qa	4	D	10 25	8/12	5.9 [5.2]	94	27	09:30
25		SANDY LEAN CLAY; light olive brown, moist, stiff, fine- to coarse-grained sand, low to medium plasticity	CL		5	S	9 17 25	18/18	6.6 [6.0]			09:41
30		SILTY SAND; medium dense, fine- to medium-grained sand	SM									
		CLAYEY SAND (SC)			6	D	10 25	6/12	5.4 [5.2]	116	16	09:53
35		very dense, (SC-SM), fine- to medium-grained sand			7	S	25 45 25	18/18	6.5 [6.0]			10:03
40		SAND with SILT; light olive brown, moist, very dense, fine- to coarse-grained sand, gravel to 2-1/2" in size	SP-SM		8	D	22 50/5"	5/11	5.4 [5.2]	106	13	10:14
45		LEAN CLAY with SAND; olive brown, moist, hard, low plasticity, fine-grained sand, micaceous	CL		9	S	20 23 24/2"	11/14	6.7 [6.1]			10:29

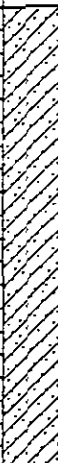
Note: This boring log is based on field classification and visual soil description and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



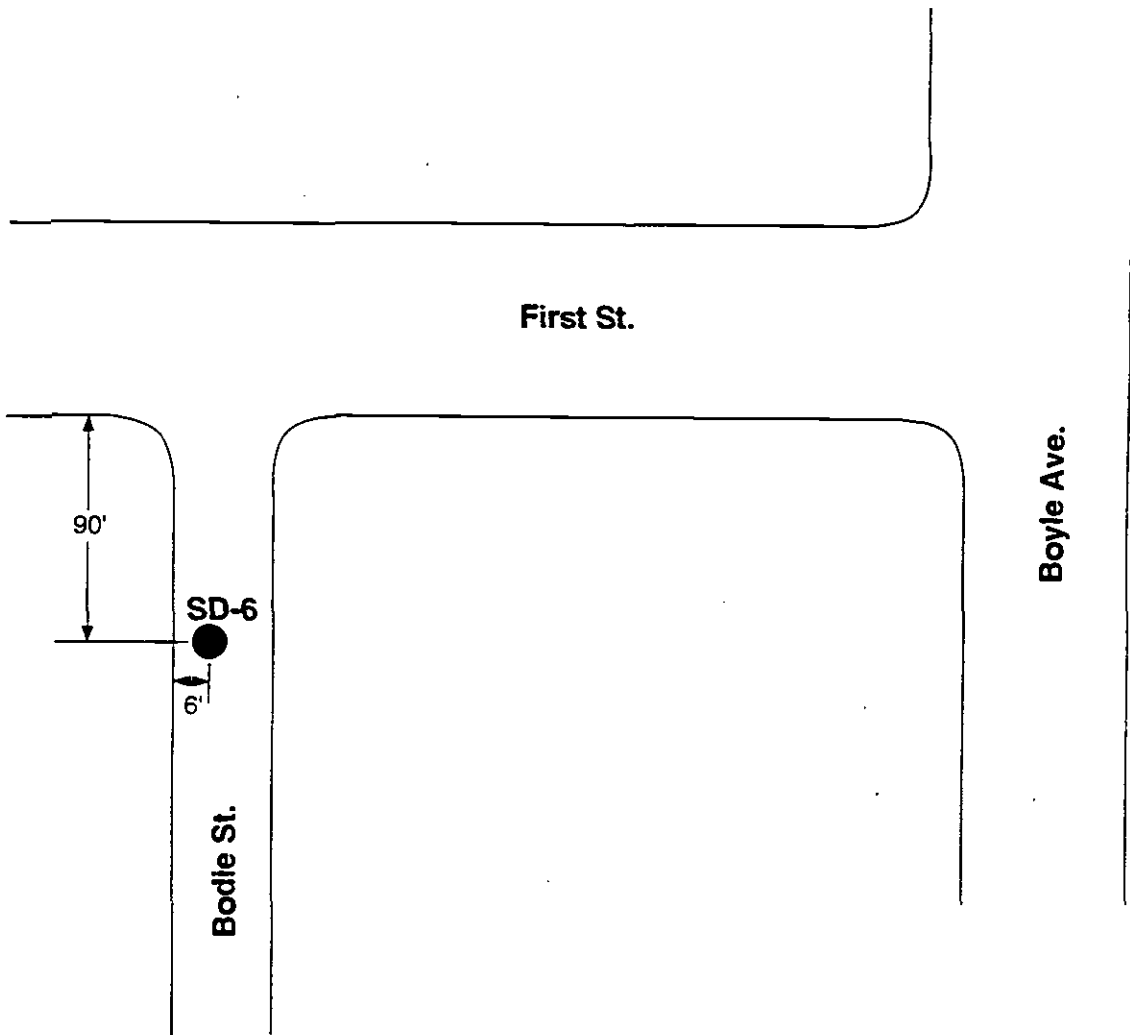
Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: SD-6			Sheet 3 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content (%)	
		LEAN CLAY with SAND; see previous page	CL	Qa	10D		15 25	10/12	5.7 [5.3]	110	18	10:42
		SANDY LEAN CLAY; light brown, moist, very stiff to hard, with 1" to 2" thick silt layer, micaceous	CL									
55					11S		12 20 25	18/18	7.2 [6.2]			10:55
					12D		15 25	8/12	5.6 [5.2]	119	15	11:00
60		LEAN CLAY; olive brown, moist, hard, medium plasticity	CL		13S		18 21 25	18/18	6.7 [6.2]			11:18
		very stiff			14D		12 20	12/12	5.6 [5.4]	100	25	11:30
65		SANDY LEAN CLAY/CLAYEY SAND; olive brown, moist, hard/very dense, low plasticity clay, fine- to medium-grained sand, local iron-oxide stains	CL/SC		15S		25 40 40	18/18	8.3 [6.2]			11:50
		decreased silt content			16D		25 50	10/12	5.9 [5.6]	113	20	12:00
70		6" interval of SILTY SAND (SM), local iron-oxide stains										
		interbedded, 2" to 3" thick layers, poorly defined gradational contact			17S		38 50	12/12	8.0 [6.6]			12:15
		fine-grained sand			18D		20 30	8/12	6.1 [5.6]	112	19	12:30
75		reduced plasticity, CLAYEY SILT/LEAN CLAY (ML/CL)										
		increased sand content, CLAYEY SAND (SC)			19S		50 20/0.5"	6.5/ 6.5	8.8 [6.6]			12:42

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN													
Project Number: 95-8347		Boring Number: SD-6			Sheet 4 of 4								
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)		
		CLAYEY SAND; olive brown, moist, very dense, fine- to coarse-grained sand, low to medium plasticity clay [rig chatter at 80']	SC	Qa	200		25 50/3"	4/9	5.8 [5.6]	119	16	12:59	
85			[rig chatter from 87' to 88']			215		50/3"	1/3	7.8 [6.6]			13:15
90			SAND, olive brown, moist, very dense, fine- to coarse-grained sand, trace silt End of boring at 90.5 feet. Hole drilled to 93 feet during well construction Groundwater level was measured at a depth of 57.8 feet on 11/21/95.	SP		220		60	2/6	5.7 [5.6]	113	17	13:33
95													
100													
105													

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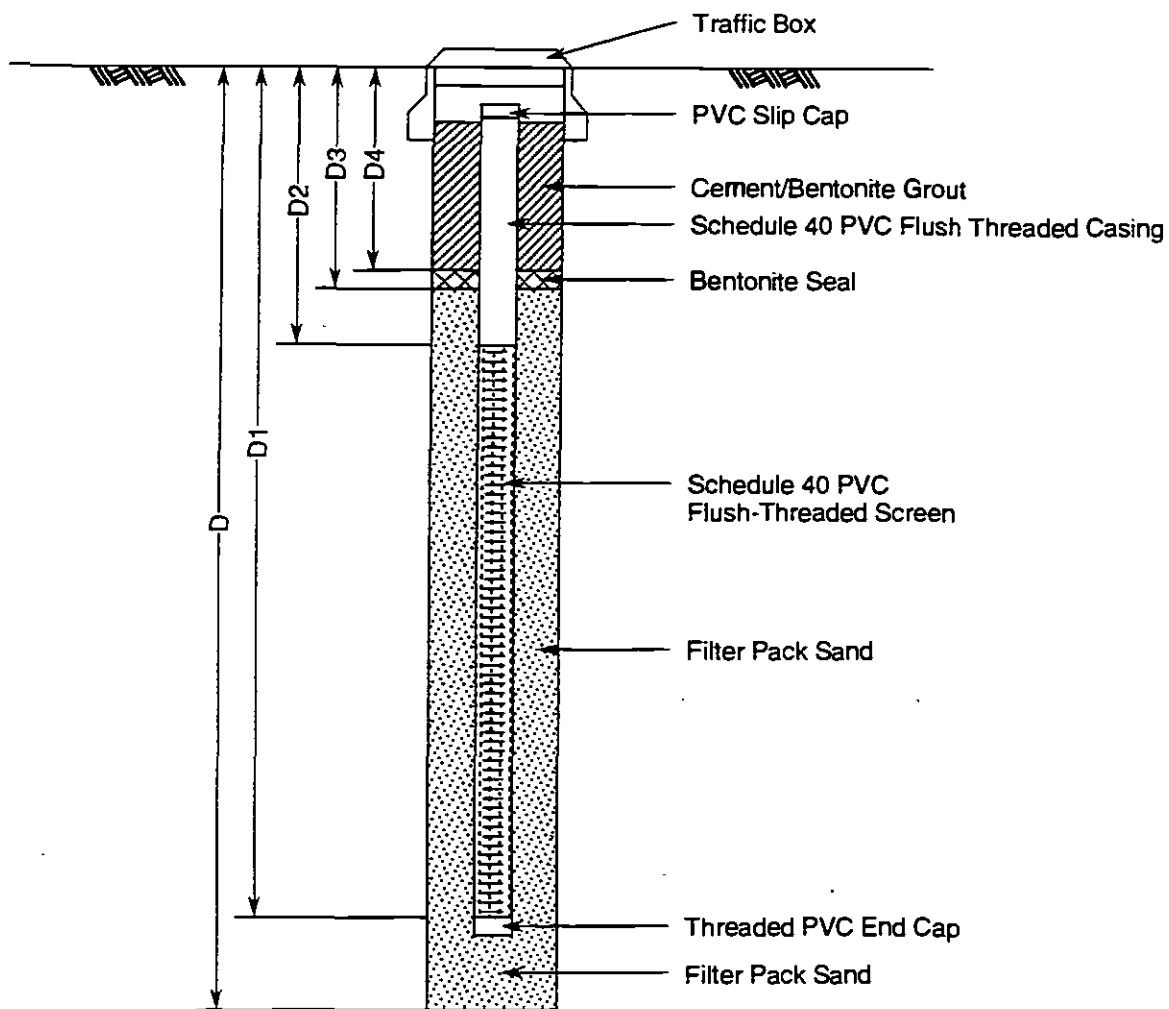
North
Not to Scale



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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

**Location of Boring
SD-6**



Total Depth (D)	=	93	Feet
Total Depth of Casing (D1)	=	90	Feet
Depth to Top of Well Screen (D2)	=	25	Feet
Depth to Bottom of Top Seal (D3)	=	23	Feet
Depth to Top of Top Seal (D4)	=	15	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.02	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/2	Inch Chips

	Project No.	95-8347
	Geotechnical Investigation	
	Eastside Extension Metro Red Line	

Monitoring Well Installation Schematic SD-6



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN					
Project Number:		95-8347	Boring Number:		SD-7	Sheet <u>1</u> of <u>5</u>	
Boring Location:			Boyle near First Street		Elevation and Datum(feet): 311 MSL		
Health and Safety:			Level D		Date Started: 11/4/05		Date Finished: 11/4/95
Drilling Equipment:			Mayhew 1000		Total Depth (feet): 109.7		Depth to Bedrock(feet): None
Drilling Method:			Rotary Wash		Number of Samples: 22		Depth to Water (feet): Unknown
Boring Diameter:			5 inches		Completion Information: Grouted to Surface		
Hammer Information: SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop			Logged By: R.Jie		Checked By: K. Kabilamany		

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples						Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)		Moisture Content (%)
		Asphalt and Reinforced Concrete		af								06:25
		ALLUVIUM CLAYEY SAND; brown, fine- to medium-grained sand, trace coarse-grained sand, low to medium plasticity clay	SC	Qa								07:00
5		trace gravel to 1/2" in size										
10		SANDY LEAN CLAY; brown, moist, medium dense, low plasticity, fine-grained sand	CL		1	D	15 20	6/12	5.8 [5.2]	111	17	07:33
15		strong brown, dense			2	S	12 18 23	16/18	5.4 [5.2]			07:40

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: SD-7				Sheet 2 of 5					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OWA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SILTY SAND; dark brown, moist, medium dense, fine-grained sand, low plasticity silt	SM	Qa	3	D	12 16	6/12	5.6 [5.2]	109	14	07:4
25		olive brown, dense			4	S	9 20 21	14/18	6.2 [5.2]			07:51
30		very dense			5	D	16 33	7/12	5.4 [5.2]	109	11	08:01
					6	S	23 40 39	12/18	6.4 [5.2]			08:07
35		SILT; light olive brown, moist, hard, trace fine-grained sand, trace rusty iron-oxide stains	ML		7	S	13 19 29	14/18	6.0 [5.2]			08:18
40		LEAN CLAY with SAND; brown with olive brown, moist, stiff, medium plasticity, fine-grained sand, trace mica	CL		8	D	7 9	9/12	5.8 [5.2]	101	23	08:25
		drilling mud loss from 43' to 45'										
45		SAND with SILT; light olive brown, moist, very dense, fine- to medium- grained sand, nonplastic silt, trace mica, trace angular gravel to 1/2" in size	SW-SM		9	S	39 45 38	16/18	5.4 [5.2]			08:45

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Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: SD-7				Sheet 3 of 5					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
		CLAYEY SAND; dark olive brown, moist, medium dense, fine- to medium-grained sand, low plasticity clay, trace mica, rusty iron-oxide stains	SC	Qa	10	D	12 16	11/12	6.0 [5.2]	113	17	09:05
55		increased fines content, CLAYEY SAND/SANDY LEAN CLAY (SC/CL); olive brown, dense, trace gravel, occasional sand			11	S	13 20 23	18/18	6.0 [5.2]			09:13
60		increased sand content, CLAYEY SAND (SC), medium dense			12	D	12 16	12/12	5.2 [5.2]	113	18	09:20
									5.2 [5.2]			09:25
65		CLAYEY SAND with GRAVEL, yellowish brown/light olive brown, moist, very dense, fine- to coarse-grained, decomposed gravel to 5/8" in size			13	S	26 52 48	18/18	5.4 [5.2]			09:32
		clay lens at 68.5 feet										
70		SAND with SILT/SILTY SAND; olive brown, moist, medium dense, fine- grained sand, trace mica, fracture filled with rusty color	SP-SM /SM		14	D	12 30	7/12	5.4 [5.2]	97	28	09:43
75		brown, moist to wet, very dense, fine- to coarse-grained sand, gravel to 1/2" in size			15	S	50 50/4"	6/9	6.4 [5.2]			09:53
		GRAVEL with SAND; gravel to 2" in size, [see next page]	GP		16	D	30 37	7/12	6.0 [5.4]	117	14	10:05

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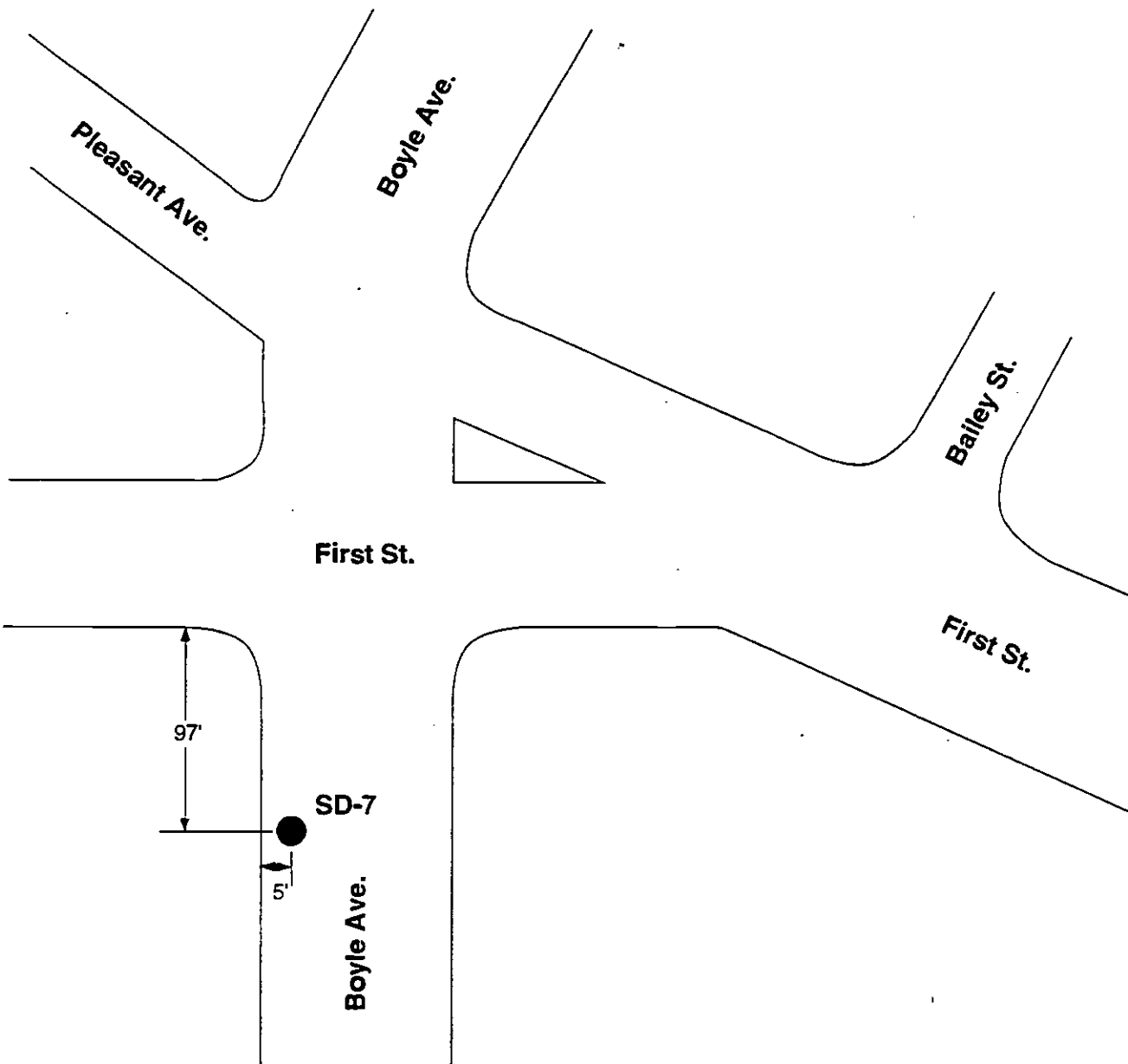
Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: SD-7			Sheet 4 of 5						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content (%)	
		GRAVEL with SAND/SAND with GRAVEL; olive brown/yellowish brown/reddish brown, moist, dense, fine gravel, fine- to coarse-grained sand [rig chatter]	GP/SP	Qa								
85		SILTY SAND; olive brown/reddish brown, moist, very dense, fine-grained sand, micaceous, nonplastic silt	SM		17	S	39 61/1"	6/7	6.9 [5.4]			10:15
90		rust iron-oxide stains, trace fine gravel to 1/4" in size			18	D	35 115/3"	8/9	5.8 [5.4]	106	24	10:30
95		olive brown with extensive oxidation			19	S	57 43/4"	8/10	6.2 [5.4]			10:40
100		SAND with SILT/SILTY SAND; olive brown, moist, very dense, fine-grained sand, trace medium-grained sand	SP-SM /SM		20	D	45 85	7/12	7.0 [5.4]	106	20	11:00
									5.4 [5.2]			11:10
105		laminated bedding dipping approximately 30 degrees			21	S	67 33/2"	6/8	6.4 [5.4]			11:13
		increased sand content, oxidized yellowish red/olive brown, moist, very dense,			22	D	78 72/3"	5/9	6.5 [5.4]	112	16	11:30

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Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:		95-8347		Boring Number:				SD-7		Sheet 5 of 5			
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		fine to medium grained, micaceous End of Boring at 109.7 feet.											
15													
20													
25													
30													
35													
40													

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Location of Boring SD-7



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Consultants

Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN										
Project Number:		95-8347		Boring Number:		SD-8		Sheet 1 of 6				
Boring Location:				1st St. between Boyle and Bailey		Elevation and Datum(feet): 314 MSL						
Health and Safety:				Level D		Date Started:		11/2/95				
Date Finished:				11/3/95		Drilling Equipment:		Midway 1300				
Total Depth (feet):				140.7		Depth to Bedrock(feet):		None				
Drilling Method:				Rotary Wash		Number of Samples:		32				
Depth to Water (feet):				Unknown		Boring Diameter:						
5 inches				Completion Information:		Grouted to surface						
Hammer Information:				Logged By:		Checked By:						
SPT Hammer: 140-lb and 30-inch drop				Greg Renfrew		K. Kabilamany						
Downhole Hammer: 400-lb and 18-inch drop												
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	Drilling Time
		Asphalt and Concrete		af								
5		ALLUVIUM SILTY CLAY/SILT with SAND; dark yellowish brown, hard, dry to moist, low to medium plasticity, fine- to medium-grained sand, trace coarse grained sand, micaceous	CL-ML/ML	Qa	1	B				7.3 [3.4]		
10		SANDY LEAN CLAY; dark yellowish brown, moist, hard, medium plasticity, fine-grained sand, some medium-grained sand, trace subrounded gravel to 3/4" in size, micaceous	CL		2	D	26 46	12/12		3.0 [2.7]	110	18 08:13
15		reduced sand content, LEAN CLAY with SAND, fine-grained sand			3	S	11 25 30	18/18		3.6 [3.4]		08:23

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: SD-8				Sheet 2 of 6					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	QVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SANDY LEAN CLAY; dark yellowish brown, dry to moist, hard, medium plasticity, fine- to medium-grained sand, dark stain	CL	Qa	4	D	20 45	10/12	3.2 [2.9]	117	15	08:25
25		LEAN CLAY with SAND; light yellowish brown, indication of polished surfaces, trace dark staining			5	S	12 26 46	18/18	3.7 [3.6]			09:09
30		CLAYEY SAND; light yellowish brown, moist, dense, fine- to medium- grained sand, low to medium plasticity clay, roots	SC		6	D	14 35	10/12	2.9 [2.7]	115	14	09:26
35		CLAYEY SAND/SANDY LEAN CLAY (SC/CL), fine-grained sand			7	S	7 15 18	17/18	3.6 [3.5]			09:35
40		fine- to coarse-grained sand			8	D	34 75/4"	9/10	3.1 [3.0]	127	9	09:49
		CLAYEY SAND with GRAVEL; light gray to light yellowish brown, moist, very dense, fine- to coarse-grained, low plasticity clay										
45		yellowish brown, carbonaceous deposit			9	S	30 52 56	18/18	140 [4.0]			10:25
		[rig chatter]										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347			Boring Number: SD-8			Sheet 3 of 6						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content(%)	
		SANDY LEAN CLAY/CLAYEY SAND; dark yellowish brown, moist, hard/very dense, low to medium plasticity clay, fine- to medium-grained sand, mottled orange iron oxide stains	CL/SC	Qa	10D		20 75/5"	10/11	2.8 [2.5]	114	9	10:10
		SILTY SAND; light yellowish brown to pale olive, moist, very dense, fine- to medium-grained sand, micaceous	SM		11S		30 47 64	18/18	3.8 [3.7]			
55		[rig chatter at 53'] pale olive laminated, orange stained laminations common trace subrounded gravel to 1-1/4" in size			12D		30 75/5"	7/11	3.0 [2.7]	99	16	10:35
60		mottled pale olive/yellowish brown, fine- to coarse-grained sand, trace subrounded to rounded gravel to 3/4" in size			13S		73 25/1"	5/7	4.2 [4.0]			11:05
65		reddish yellow stains			14D		35 45	8/12	4.0 [3.8]	106	19	11:17
		SAND; pale olive, moist, dense, fine- to medium-grained sand, orange stains, micaceous	SP									
		[rig chatter at 69']			15S		19 25 36	16/18	4.0 [3.8]			11:35
70		CLAYEY SILT/LEAN CLAY; olive, moist, hard, low to medium plasticity, fine- to medium-grained sand, rounded gravel to 2" in size, laminated, iron-oxide stained	ML/CL									
75		[rig chatter at 75']			16D		45 75/4"	7/10	4.5 [2.6]	110	12	12:11
		SAND with SILT; yellowish brown, moist, very dense, fine- to medium- grained sand, micaceous, nonplastic silt	SP-SM									

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: SD-8					Sheet 4 of 6					
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content%	
		[see previous page], iron-oxide stained, laminated	SM-SM	Qa	17	S	22	17/18	4.8			12:2
		LEAN CLAY/FAT CLAY/SILT; olive, moist, hard, laminated, no reaction to HCl range stains	CL/CH/ML				28		[4.8]			
							48					
85					18	D	20	8/12	2.7	88	35	12:29
							50		[2.6]			
		trace medium-grained sand, yellowish brown			19	S	65	7/8	4.4			
			SP-SM				35/2"		[4.4]			
		SAND with SILT/SILTY SAND; light yellowish brown, moist, very dense, fine- to coarse-grained, iron-oxide stains, trace gravel	/SM									13:16
90		reddish stains			20	D	75	4/6	2.9	97	15	13:39
									[2.8]			
					21	S	72	6/7	3.6			
							28/1"		[3.6]			
95		orange stains			22	D	55	6/10	3.0	103	16	13:55
							75/4"		[3.0]			14:14
					23	S	88/4"	3/4	3.8			14:37
100									[3.4]			
105		light gray			24	D	94	8/9	2.9	111	10	15:15
							56/3"		[2.9]			
		occasional 2" to 3" thick clay layers										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: **METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN**
 Project Number: **95-8347** Boring Number: **SD-8** Sheet **5** of **6**

Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OWA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
115		5" interval of LEAN CLAY; pale olive, moist, hard, trace fine- grained sand	CL	Qa	25	S	40	8/8	4.6 [4.0]			08:10
		SAND with SILT/SAND; pale olive, moist, very dense, fine- to medium- grained sand, some coarse-grained sand trace to few subangular gravel to 1-1/2" in size, reddish yellow stain	SP-SM /SP				60/2"					
120		LEAN CLAY; olive, moist, hard, interbedded with SAND with GRAVEL (SW), olive, moist, very dense, fine- to coarse-grained sand, fine subrounded gravel, reddish yellow iron oxide stained sand grains, laminations roughly horizontal, but convoluted adjacent to sand grains, gravel to 1-1/2" in size, reddish stains on gravel	CL		26	D	55 57	12/12	2.8 [2.6]	81	41	08:42
125		SANDY SILT; pale olive, moist, hard, fine- to medium-grained sand, laminated, iron oxide stained locally, near horizontal dips	ML		27	S	19 31 39	15/18	4.4 [3.8]			09:05
130		SANDY SILT; pale olive, moist, hard, fine- to medium-grained sand, laminated, iron oxide stained locally, near horizontal dips	ML		28	D	18 35	10/12	3.0 [2.6]	96	26	09:25
135		SILTY GRAVEL/SILTY SAND; white gravel and pale olive sand, moist, very dense, subrounded to angular gravel to 1" in size, fine- to medium- grained sand [rig chatter at 125.5']	GM/SM		29	S	40/0.5"	0/0.5	3.0 [2.6]			10:00
					30	D	75/3"	3/3	3.0 [2.6]	--	--	10:12
140		SAND with SILT; pale olive, moist, very dense, fine- to medium-grained sand, trace coarse-grained sand, thin silt layers, trace subangular fine gravel	SP-SM		31	D	50 100/5"	7/11	2.9 [2.6]	98	25	10:32
140		[rig chatter]			32	S	100/5"	5/5	4.8 [4.1]			11:02
		reddish brown										
140		[rig chatter]										
		CLAYEY GRAVEL with SAND; light yellowish brown, moist, very dense, fine to coarse subrounded to	GC									

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.

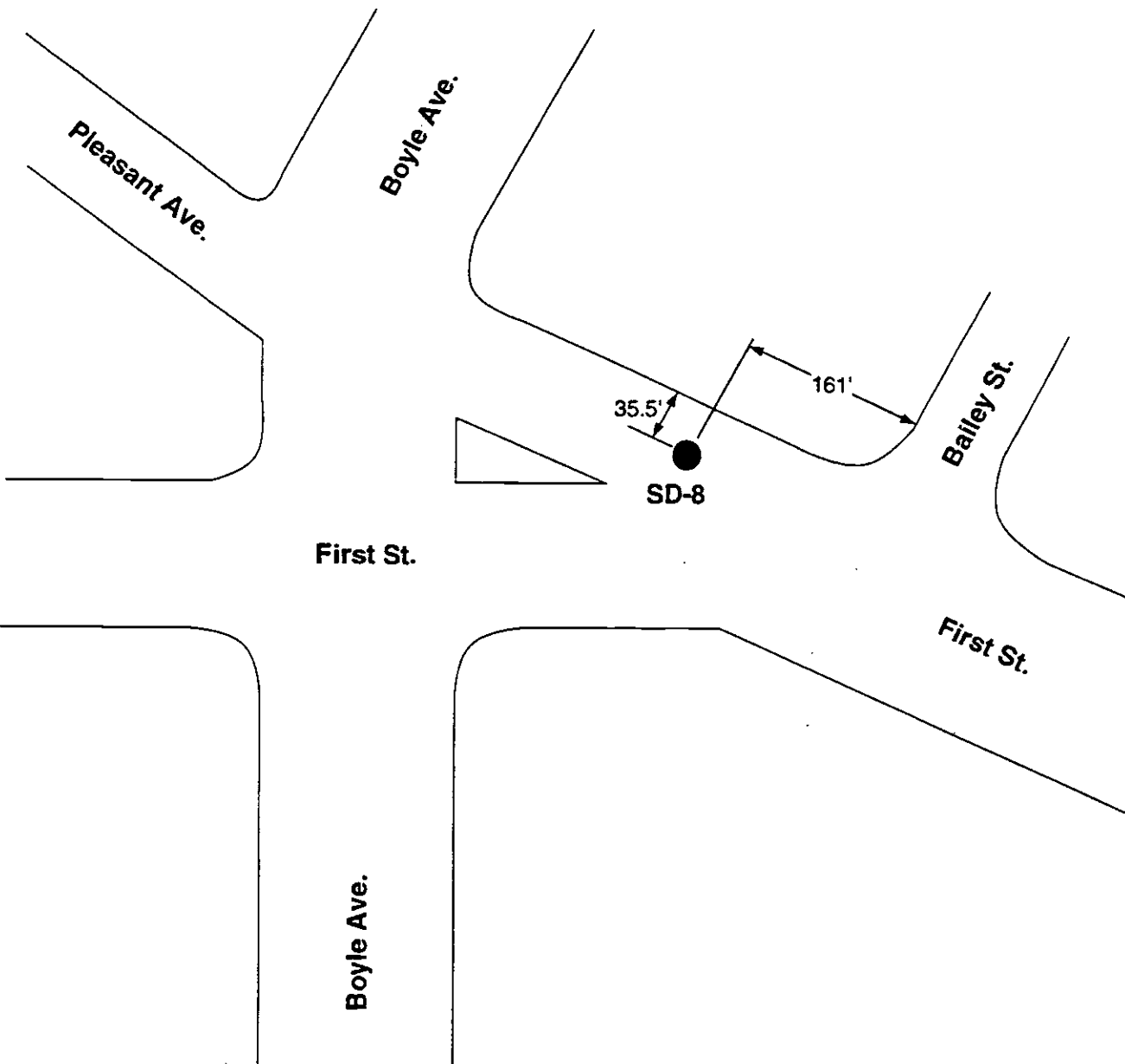


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Project Name: **METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN**
Project Number: **95-8347** Boring Number: **SD-8** Sheet **6** of **6**

Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
	///	subangular gravel, fine- to coarse-grained sand End of boring at 140.7 feet.	GC	Qa	33D	50 100/2"	4/8	2.8 [2.7]	119	13	11:32	
145												
150												
155												
160												
165												
170												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Location of Boring
SD-8



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Project Name:	METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN				
Project Number:	95-8347	Boring Number:	SD-9	Sheet	1 of 5
Boring Location:	Bailey near First Street		Elevation and Datum(feet): 312 MSL		
Health and Safety:	Level D	Date Started:	11/10/95	Date Finished:	11/10/95
Drilling Equipment:	Mayhew 1000	Total Depth (feet):	112.5	Depth to Bedrock(feet):	54
Drilling Method:	Rotary Wash	Number of Samples:	30	Depth to Water (feet):	56.2
Boring Diameter:	5 inches	Completion Information:	Installed Monitoring Well		
Hammer Information:	SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop		Logged By:	Checked By:	
			R. Jie	K. Kabilamany	

Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content(%)	
		Asphalt and Base		af								07:15
		ALLUVIUM CLAYEY SILT; dark brown, trace fine-grained sand	ML/CL	Qa								
		SILTY SAND; strong brown, moist, fine- to medium-grained, low plasticity silt, trace gravel to 2" in size	SM									
5		micaceous			1	B				12 [12]		
10		SANDY LEAN CLAY; dark olive gray, moist, stiff, medium plasticity, fine- to medium-grained sand, trace mica	CL		2	D	9 10	6/12	12 [12]	120	13	07:30
15		SANDY LEAN CLAY/SANDY SILT; olive gray, very stiff, low to medium plasticity, fine-grained sand	CL/ML		3	S	8 10 10	12/18	13 [12]			07:44
		[see next page]	SP-SM		4	D	15 20	6/12	12 [12]	110	17	07:55

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: SD-9				Sheet 2 of 5						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content%	
		SAND with SILT; gray, moist to wet, medium dense, fine- to medium-grained sand, trace coarse grained, subrounded fine gravel to 1/2" in size	SP-SM	Qa								
25		LEAN CLAY with SAND; olive brown/light olive gray, moist, hard, medium plasticity, trace mica	CL		5	S	11 14 19	18/18	12 [12]			08:17
		SANDY LEAN CLAY; fine- to medium-grained sand										
	stiff				6	D	8 10	2/12	13 [12]	114	15	08:25
30												
		CLAYEY SAND/SANDY LEAN CLAY; brown/light olive gray, moist, dense/hard, fine- to medium-grained sand, trace coarse-grained sand, medium plasticity clay, subrounded gravel to 1/2" in size, trace mica	SC/CL		7	S	7 15 20	12/18	13 [12]			08:30
35												
		SAND; yellowish brown, dry, very dense, fine- to medium-grained sand, occasional coarse-grained sand, interbedded with SAND with GRAVEL; fine to coarse grained, subrounded gravel to 3/4" in size [occasional rig chatter]	SP		8	D	26 44	9/12	13 [12]	119	12	08:40
40												
		[rig chatter]										
		SILTY SAND; yellowish brown with light olive gray, dry to moist, very dense, fine-grained sand, trace coarse-grained sand, trace fine subrounded gravel to 1/2" in size, trace mica	SM		9	S	28 41 50	18/18	12 [12]			09:08
45												
		SAND with SILT; light olive brown/light olive gray, dry to moist, very dense, fine- to medium-grained sand, trace mica, oxidized	SP-SM		10	D	25 35	7/12	15 [12]	113	12	09:17

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Project Name:			METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN											
Project Number:			95-8347		Boring Number:				SD-9		Sheet 3 of 5			
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples								Drilling Time	
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)			
		SILTY SAND; light olive gray, dry, very dense, fine-grained sand, micaceous, very slight oxidized lenses	SM	Qa	11	S	31 65 35/2"	12/14	14 (12)				09:26	
55		FERNANDO/PUENTE FORMATION SILTY CLAYSTONE/CLAYEY SILTSTONE; light olive gray, moist, soft, micaceous, oxidized, weathered	CL/ML	Tf/Tp	12	D	15 25	10/12	14 (12)	96	28		09:37	
60		trace organic, scattered white specks			13	S	12 15 18	18/18	13 (12)				09:48	
					14	P	---	26/30	8.4 [8.4]					
65		dark greenish gray, fresh, increased oxidation, sulfur odor very soft, micaceous, fresh, trace shell fragments, strong sulfur odor, trace light gray streaks, laminated bedding dipping approximately 10 degrees			15	D	12 20	9/12	14 (12)	99	26		10:25	
					16	P	---	30/30	---					
70					17	D	14 20	10/12	13 (12)					
					18	P	---	1/30	---					
75		olive brown, moist, very soft, slightly to moderately weathered, slightly oxidized, micaceous			19	D	10 17	7/12	12 (12)	97	27		10:57	
					20	P	---	16/30	---					
					21	D	14 18	10/12	12 (12)	97	27		11:50	
		dark greenish gray, very soft, fresh, micaceous			22	P	---	15/30	---					

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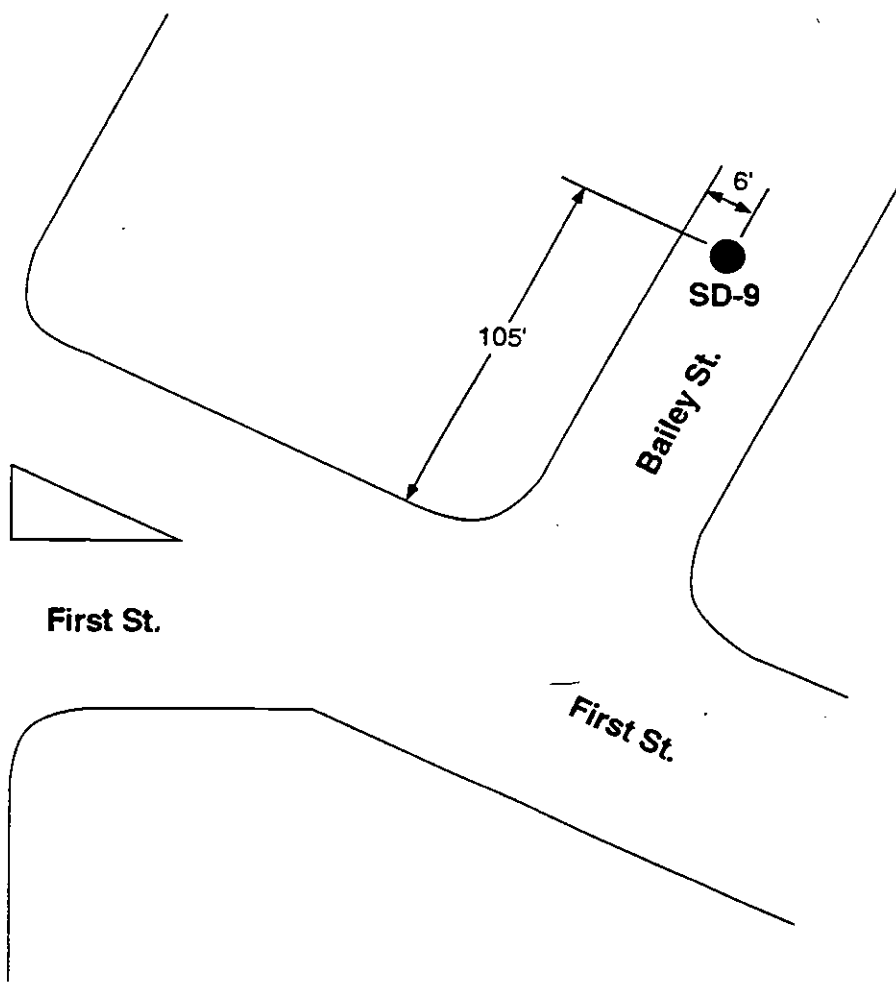
Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN										
Project Number:		95-8347		Boring Number:				SD-9		Sheet 4 of 5		
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		SILTY CLAYSTONE/CLAYEY SILTSTONE; dark greenish gray, moist, soft, medium plasticity, fresh, micaceous, shell fragments	CL/ML	Tf/Tp	23D	15 20	7/12	13 [12]	99	25	12:08	
85					24P	---	30/30	---			12:26	
		trace light gray silt streaks, shell fragments, no apparent bedding			25S	15 24 27	18/18	12 [12]				
90					26P	---	30/30	---			12:53	
95					27D	25 30	10/12	13 [12]	97	26	13:03	
100	very soft				28P		30/30	---			13:20	
105	soft to very soft				29D	20 25	7/12	12 [12]	99	25	13:35	

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



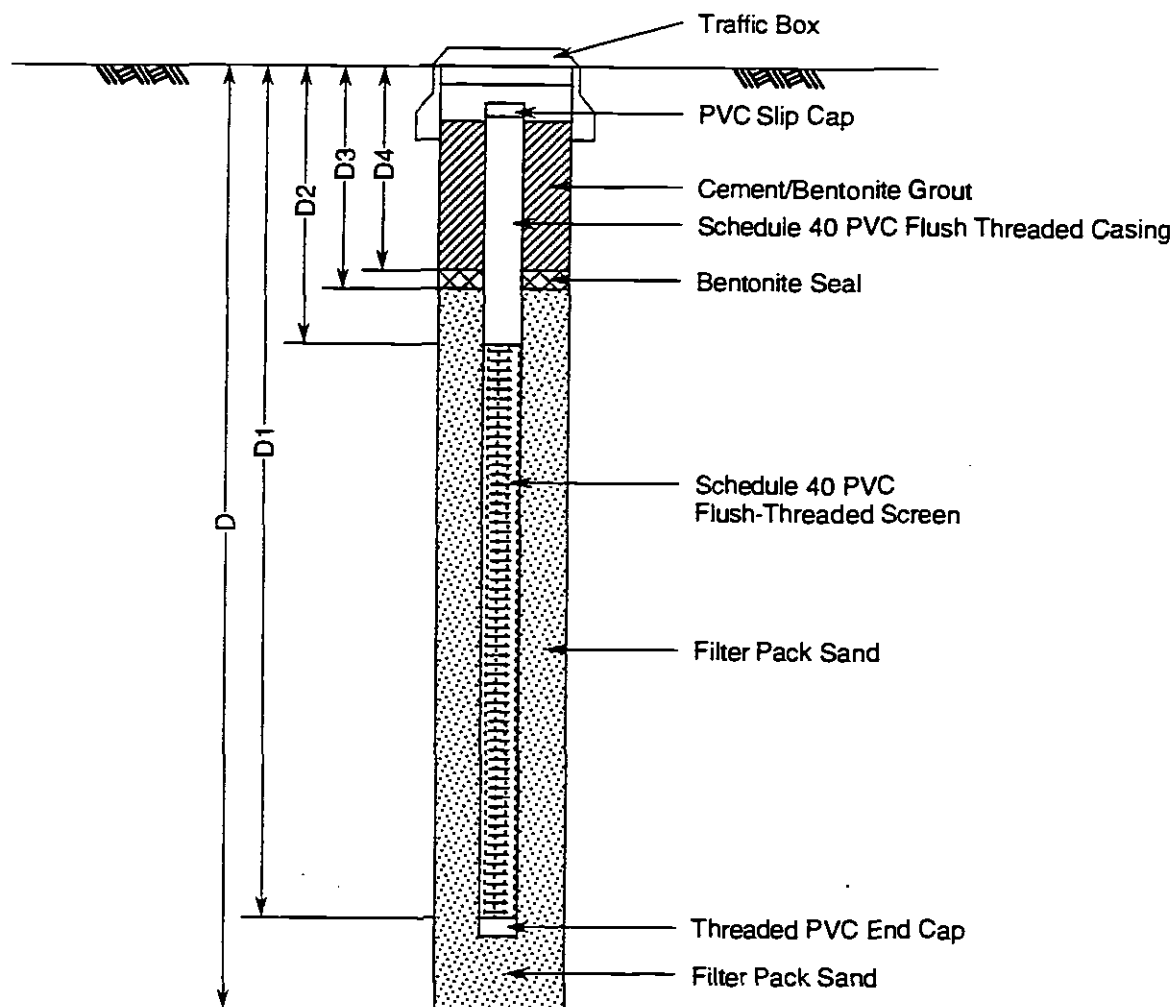
Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: SD-9				Sheet 5 of 5						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	QVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SILTY CLAYSTONE/CLAYEY SILTSTONE; dark greenish gray, moist, soft to very soft, medium plasticity, fresh, micaceous	CL/ML	Tf/Tp	30	P	---	13/30	---			13:5
115		End of Boring at 112.5 feet. Groundwater level was measured at a depth of 56.2 feet on 11/21/95.										
120												
125												
130												
135												
140												

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	Project No.: 95-8347
	Geotechnical Investigation Eastside Extension Metro Red Line
Location of Boring SD-9	
4-96	Figure A-18A



Total Depth (D)	=	112.5	Feet
Total Depth of Casing (D1)	=	110.4	Feet
Depth to Top of Well Screen (D2)	=	30.4	Feet
Depth to Bottom of Top Seal (D3)	=	26	Feet
Depth to Top of Top Seal (D4)	=	22.5	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.02	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/2	Inch Chips

	Project No.	95-8347
	Geotechnical Investigation	
	Eastside Extension Metro Red Line	

Monitoring Well Installation Schematic SD-9



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: SD-10				Sheet 1 of 5						
Boring Location: Alley between Baily and State				Elevation and Datum(feet):318 MSL								
Health and Safety: Level D				Date Started:11/16/95				Date Finished: 11/21/95				
Drilling Equipment: CME 75				Total Depth (feet): 110.0				Depth to Bedrock(feet): 64.5				
Drilling Method: Hollow-Stem Auger				Number of Samples: 29				Depth to Water (feet): 54.0				
Boring Diameter: 8 inches				Completion Information: Grouted to Surface								
Hammer Information: SPT Hammer: 140-lb and 30-inch drop				Logged By: R. Jie				Checked By: K. Kabilamany				
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		Asphalt and Concrete		af								15:45
		ALLUVIUM		Qa								
		LEAN CLAY with SAND; strong brown, moist, low plasticity, fine-grained sand, trace medium-grained sand, trace angular gravel to 3/8" in size	CL		1	B			12 [11]			16:15
5												08:05
10		SILTY SAND; yellowish brown, dry, dense, fine- to medium-grained sand, nonplastic silt	SM		2	D	16 28	4/12	11 [11]	113	9	08:37
		LEAN CLAY with SAND; strong brown mottled with dark olive brown, moist, very stiff, medium plasticity, fine-grained sand, trace mica	CL		3	S	4 10 16	18/18	11 [11]			08:53
15												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: SD-10				Sheet 2 of 5						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	Drilling Time
		LEAN CLAY with SAND; strong brown mottled with dark olive brown, moist, stiff, medium plasticity, fine-grained sand, trace mica	CL	Qa	4	D	4 11	6/12	12 [11]	106	19	09:12
		lens of sand										
25		4" thick SILTY SAND (SM), light brown, fine- to medium-grained sand, trace coarse-grained sand and rounded gravel to 1/2" in size			5	S	4 9 13	18/18	13 [11]			09:26
30		medium stiff to stiff, SANDY LEAN CLAY; strong brown mottled with light brown			6	D	4 7	12/12	14 [11]			09:44
35		very stiff, lens of fine-grained sand, trace rounded to subrounded gravel to 1" in size			7	S	6 8 11	18/18	13 [11]			10:10
		6" interval of gravel layer										
40		stiff, trace subrounded gravel to 1/4" in size			8	D	4 9	6/12	13 [11]	113	11	10:30
		[harder drilling]										11:27
45		CLAYEY SAND; dark yellowish brown, moist, medium dense, fine- to coarse-grained sand, medium plasticity clay, trace subangular to subrounded gravel to 3/4" in size, trace mica	SC		9	S	7 12 17	18/18	12 [11]			10:45
		SAND with SILT (SP-SM) interbedded with CLAYEY SAND (SC); yellowish brown, moist, very dense, fine-grained sand, trace subangular gravel to 1" in size			10	D	34 47	12/12	11 [11]	105	8	

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: SD-10				Sheet 3 of 5						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	Drilling Time
		SANDY LEAN CLAY; brown, moist, very stiff, medium plasticity, fine- grained sand, trace subangular to subrounded gravel to 1/2" in size, trace mica	CL	Qa	11	S	6 8 11	18/18	11 [11]			11:52
55		CLAYEY SAND; dark yellowish brown, moist to wet, medium dense, fine- to medium-grained sand, trace coarse-grained sand, low to medium plasticity clay, subangular to subrounded fine gravel to 1/2" in size, trace mica	SC		12	D	3 19	10/12	13 [11]	115	15	12:15
		3" thick layer of gravel	SM		13	S	7 13 16	18/18	15 [12]			12:34
60		SILTY SAND; dark yellowish brown, wet, medium dense, fine-grained sand, low plasticity silt, some subrounded gravel to 1/2" in size, trace mica			14	D	21 31	11/12	12 [12]	119	15	13:21
		brown, fine- to medium-grained sand, trace coarse-grained sand			15	S	25 34 22	18/18	13 [12]			13:43
65		SILTY SAND with GRAVEL; brown, wet, very dense, fine- to coarse-grained, subrounded gravel to 3/4" in size			16	D	11 25	12/12	12 [12]	96	28	14:02
		FERNANDO/PUENTE FORMATION SILTY CLAYSTONE/CLAYEY SILTSTONE; olive brown, slightly weathered, moist, very soft, medium plasticity, trace mica, trace white silt specks, oxidized	CL/ML	Tf/Tp	17	S	7 13 18	18/18	12 [12]			14:24
70					18	D	13 35	12/12	12 [12]	97	27	14:50
75					19	S	5 11 16	18/18	13 [12]			15:11
		fresh, dark greenish gray			20	D	5 7	4/12	12 [12]	96	27	15:39

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



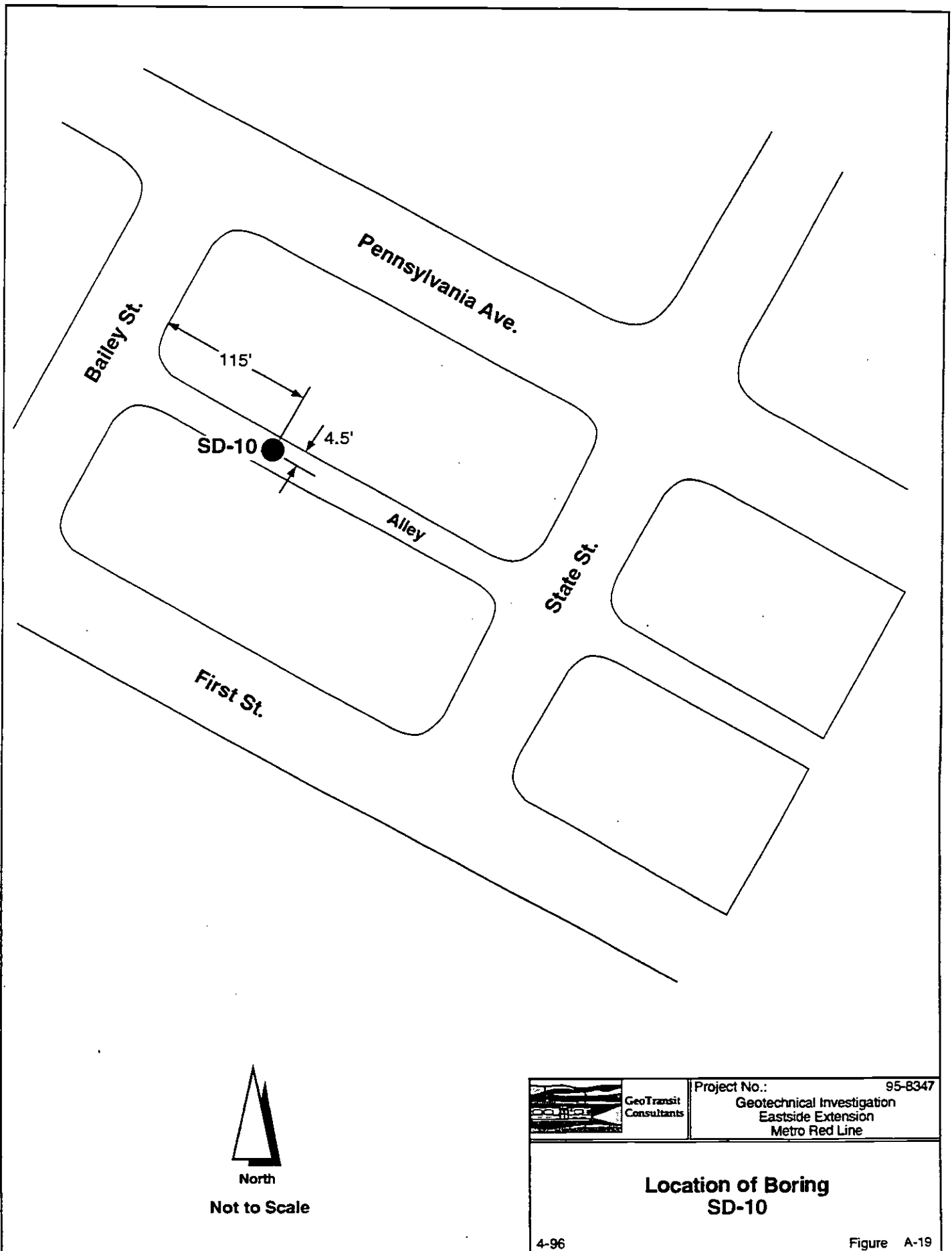
Project Name: METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number: 95-8347		Boring Number: SD-10				Sheet 4 of 5						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
85		SILTY CLAYSTONE/CLAYEY SILTSTONE; dark greenish gray, fresh, moist, very soft, medium plasticity, trace mica, trace shell fragments, light gray silt streaks, no apparent bedding	CL/ML	Tf/Tp	21	S	9 14 20	18/18	12 [10]			07:20
												07:55
					22	D	4 15	10/12	13 [10]	101	25	08:15
					23	S	7 14 17	18/18	12 [10]			08:36
					24	D	9 41	12/12	11 [10]	101	24	08:56
95		lenses of greenish black			25	S	10 17 22	18/18	15 [12]			09:19
					26	D	26 70/3"	9/9	15 [12]	99	24	09:45
												09:54
100		round cemented nodules 2-1/2" in size, strong reaction to HCl, hard, trace light gray streaks of silt	ML		27	S	7 17 25	18/18	14 [12]			10:20
105		SILTSTONE; dark greenish gray, fresh, moist, very soft, low to medium plasticity, trace mica, no apparent bedding										
					28	D	3 9	12/12	13 [12]	96	26	10:56
			29	S	9 18	12/12	14 [12]			11:33		
		medium plasticity										
		trace shell fragments										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:		METRO RED LINE- EASTSIDE EXTENSION, DETAILED DESIGN												
Project Number:		95-8347		Boring Number:					SD-10			Sheet 5 of 5		
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time		
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)			
115		End of Boring at 110 feet. Groundwater was measured at a depth of 54.0 feet on 11/21/95.					15/0"							
120														
125														
130														
135														
140														

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



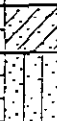
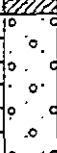


Project Name: Metro Rail: Eastside Extension - Metro Red Line			
Project Number: 94-1100		Boring Number: PE-21	Sheet 1 of 5
Boring Location: First/Boyle		Elevation and Datum(feet): 313 MSL	
Health and Safety: Level D		Date Started: 11/22/93	Date Finished: 11/23/93
Drilling Equipment: Mayhew 1000		Total Depth (feet): 110.5	Depth to Bedrock(feet): None
Drilling Method: Rotary Wash		Number of Samples: 22	Depth to Water (feet): 59.0
Boring Diameter: 5 inches		Completion Information: Installed Monitoring Well	
Hammer Information: SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 300-lb and 18-inch drop		Logged By: Greg Renfrew	Checked By: Grant Miller

Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		FILL Concrete to 9" and base		af								
5		ALLUVIUM CLAY; dark yellowish brown, moist, very stiff, medium plasticity, some fine to medium grained sand	CL	Qa	1	D	15 27	6/12	8.1 [6.4]	118	15	0830
10		increased sand content, SANDY CLAY, hard, trace subangular to angular gravel to 3/4" in size, slightly porous			2	S	12 15 20	16/18	8.6 [6.4]			0845
15		very stiff, fine to coarse grained sand			3	D	9 20	8/12	7.4 [6.9]	115	15	0855
		increased sand content										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:		Metro Rail: Eastside Extension - Metro Red Line										
Project Number:		94-1100		Boring Number:				PE-21		Sheet 2 of 5		
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./8 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
25		CLAYEY SAND; dark yellowish brown, moist, very dense, fine grained, low plasticity clay, trace subangular to angular gravel to 3/4" in size, slightly porous	SC	Qa	4	S	20 50/5"	11/11	7.4 [6.9]			0905
		SILTY SAND; dark yellowish brown, moist, dense, fine grained, low plasticity silt, few angular gravel to 1" in size, slightly porous, mica flakes	SM									
30		yellowish brown, very dense, nonplastic silt			5	D	30 34	6/12	7.1 [7.1]	108	18	0915
35					6	S	35 48	12/12	7.4 [7.0]			0930
40		CLAY with SAND; yellowish brown, moist to wet, very stiff, medium plasticity, fine grained sand, infrequent intervals with medium to coarse grained sand	CL		7	D	25 28	10/12	8.4 [7.2]	114	19	0940
		increased sand content, SANDY CLAY			8	S	19 20 24	16/18	8.6 [7.6]			0950
45		[vigorous rig chatter]										
		SAND with GRAVEL/GRAVEL with SAND; grayish brown, moist to wet, very dense, fine to coarse grained sand, subrounded to angular gravel to 2" in size, trace low plasticity silt	SW/GW		9	D	80/4"	< 1/4	8.8 [7.6]	130	9	1008
		SANDY CLAY; grayish brown to yellowish brown, moist to wet, hard, low plasticity, fine grained sand, laminated, micaceous	CL									

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:		Metro Rail: Eastside Extension - Metro Red Line										
Project Number:		94-1100		Boring Number:				PE-21		Sheet 3 of 5		
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SANDY CLAY; grayish brown to yellowish brown, moist to wet, hard, low plasticity, fine grained sand, laminated, micaceous	CL	Qa	10	S	20 50	9/12	9.8 [7.4]			1020
55		SAND with GRAVEL, olive gray, moist, very dense, fine to coarse grained, subangular gravel to 1-1/4" in size	SW		11	D	80/3"	1/3	8.6 [7.5]	109	12	1034
		SANDY CLAY, strong brown, wet	CL									
60		SAND with SILT and GRAVEL; olive gray, moist, very dense, fine to coarse grained, nonplastic silt, gravel to 1-1/4" in size	SW-SM		12	S	50/5"	2.5/5	9.5 [7.6]			1050
65		yellowish brown, gravel to 1" in size, clayey interbedded			13	D	80/4"	< 1/4	8.6 [8.1]		11	1110
70		decreased silt			14	S	45/5.5"	4/5.5	8.7 [7.8]			1125
75		rounded gravel to 1-1/4" in size			15	D	60/3"	< 1/3	8.4 [7.8]		17	1143
		[very hard drilling] [see next page]		GW/SW								

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Project Name: Metro Rail: Eastside Extension - Metro Red Line												
Project Number: 94-1100			Boring Number: PE-21			Sheet 4 of 5						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
		GRAVEL with SAND/SAND with GRAVEL; brownish yellow, wet, very dense, fine -to coarse-grained sand, boulders to 1 1/2" in size	GW/SW	Qa	16	S	20/0.5"	0/0.5				1200
		SAND with SILT; yellowish brown, wet, very dense, fine-grained sand, nonplastic silt	SP-SM									
85					17	D	86/3"	< 1/3	8.5 [7.8]		21	1245
		SANDY SILT/SILTY SAND, fine- to coarse-grained, possibly sand and silt interbedded	ML/SM									
90		FAT CLAY; olive, moist to wet, very hard, high plasticity, laminated	CH		18	S	18 50	10/12	7.9 [7.9]			1345
		[resumed drilling at 0730 on 11/23/93]										
95					19	D	50	5/6	7.8 [6.2]	89	34	0815
		[rig chatter]										
100		SAND; brownish yellow, wet, very dense, well graded, some fine gravel interbedded with SILT (ML), subrounded to angular gravel to 3/4" in size	SW		20	S	50/3"	0/3	6.2 [5.6]			0835
105		iron-oxide stained, gravel to 1-1/4" in size			21	D	87	2/6	7.8 [6.6]	105	17	0915

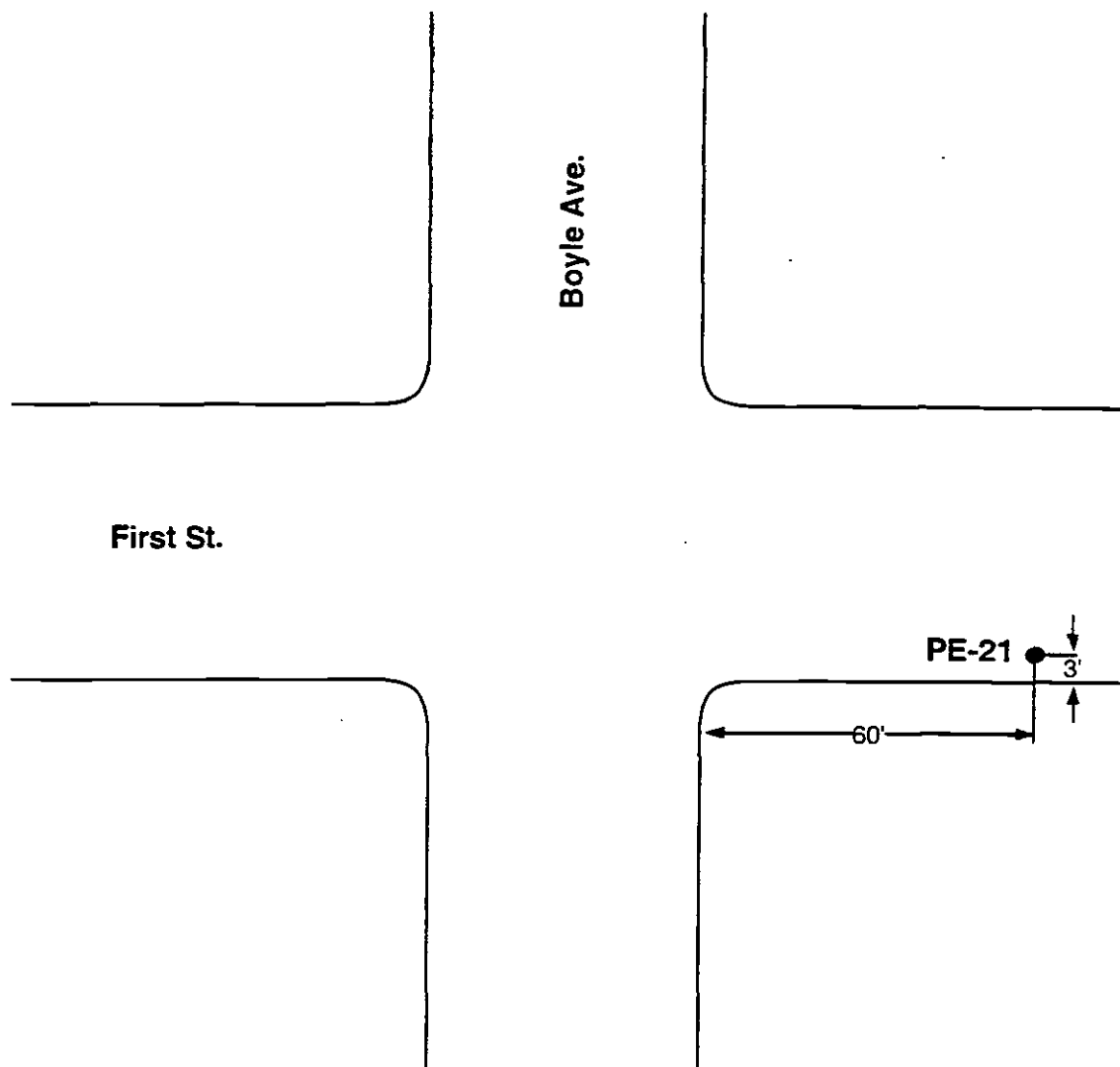
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Project Name: **Metro Rail: Eastside Extension - Metro Red Line**
 Project Number: **94-1100** Boring Number: **PE-21** Sheet **5** of **5**

Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
115		SAND; brownish yellow, wet, very dense, well graded, some fine gravel interbedded with SILT (ML), subrounded to angular gravel to 1/4" in size Boring terminated at 110.5 feet. Groundwater measured on 1/11/94 at 58.4 feet below surface.	SW	Qa	22D		100/ 4.5"	1/4.5	8.1 [7.0]		18	0937
120												
125												
130												
135												
140												

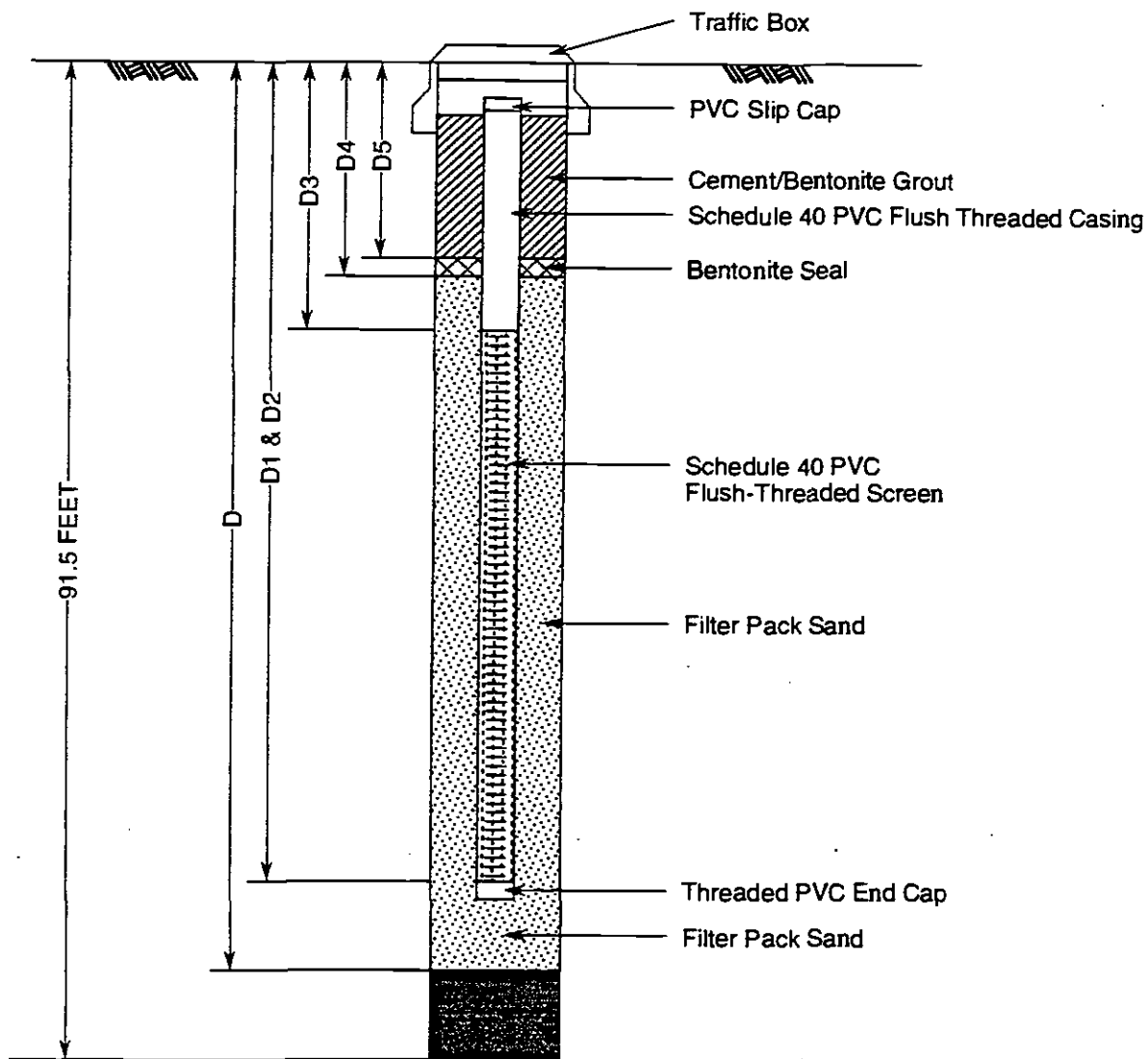
Note: This boring log is based on field classification and visual soil description and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

**Location of Boring
PE-21**



Total Depth (D)	=	92.5	Feet
Total Depth of Casing (D1)	=	90	Feet
Depth to Bottom of Well Screen (D2)	=	90	Feet
Depth to Top of Well Screen (D3)	=	25	Feet
Depth to Bottom of Top Seal (D4)	=	25	Feet
Depth to Top of Top Seal (D5)	=	17.5	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.01	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/2	Inch Pellets



GeoTransit
Consultants

Project No. 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Monitoring Well Installation Schematic PE-21



Project Name: Metro Rail: Eastside Extension - Metro Red Line												
Project Number: 94-1100		Boring Number: PE-24			Sheet 1 of 4							
Boring Location: Fourth/Mission					Elevation and Datum(feet): 257 MSL							
Health and Safety: Level D					Date Started: 11/24/93			Date Finished: 11/24/93				
Drilling Equipment: Mayhew 1000					Total Depth (feet): 85.3			Depth to Bedrock(feet): ---				
Drilling Method: Rotary Wash					Number of Samples: 17			Depth to possible Water (feet): 60				
Boring Diameter: 5 inches					Completion Information: Grouted to surface							
Hammer Information: SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 400-lb and 18-inch drop					Logged By: Hossein Rashidi			Checked By: Grant Miller				
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	
		FILL Asphaltic Concrete and Base		af								
5		ALLUVIUM SAND with SILT; moderate olive brown, moist, very loose to loose, fine to medium grained, trace coarse grained, nonplastic silt, trace rounded gravel to 3/4" in size [frequent loud rig chatter, from 7' to 12']	SP-SM	Qa	1	D	3 4	8/12	5.1 [4.2]	91	20	0735
10		SAND with GRAVEL; moderate olive brown, moist, medium dense, fine to coarse grained, rounded gravel to 3" in size light brown, rounded to subangular gravel to 2" in size	SP		2	S	7 12 8	3/18				0749
15					3	D	15 23	5/12	5.3 [5.2]	119	11	0804

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Project Name: Metro Rail: Eastside Extension - Metro Red Line												
Project Number: 94-1100		Boring Number: PE-24				Sheet 2 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) [Background]	Dry Density (pcf)	Moisture Content (%)	Drilling Time
		SAND with SILT; light brown, moist, very dense, fine to coarse grained, nonplastic silt, some rounded to subangular gravel to 3/4" in size	SP-SM	Qa	4	S	9 33 35	-	6.6 [5.2]			0812
25		SILTY SAND; olive brown, wet, medium dense, low plasticity silt, some gravel to 2" in size	SM		5	D	20 33	8/12	6.8 [5.4]	112	18	0825
30		GRAVEL with SAND; olive brown, wet, very dense, fine to coarse grained sand [constant rig chatter]	GW		6	S	25 50 25/3"	6/15	6.6 [5.5]			0840
35					7	D	40 60/5"	5/11	6.2 [5.6]	118	11	0900
40		[very strong rig chatter at 39'], increased gravel content			8	S	30 60 10/1"	8/13	6.6 [5.2]			0925
45		gravel to 1/2" in size			9	D	50 50/4"	6/10	6.2 [5.4]		8	0945
		cobbles to 8" in size										
		interval of SILTY CLAY (CL/ML)										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



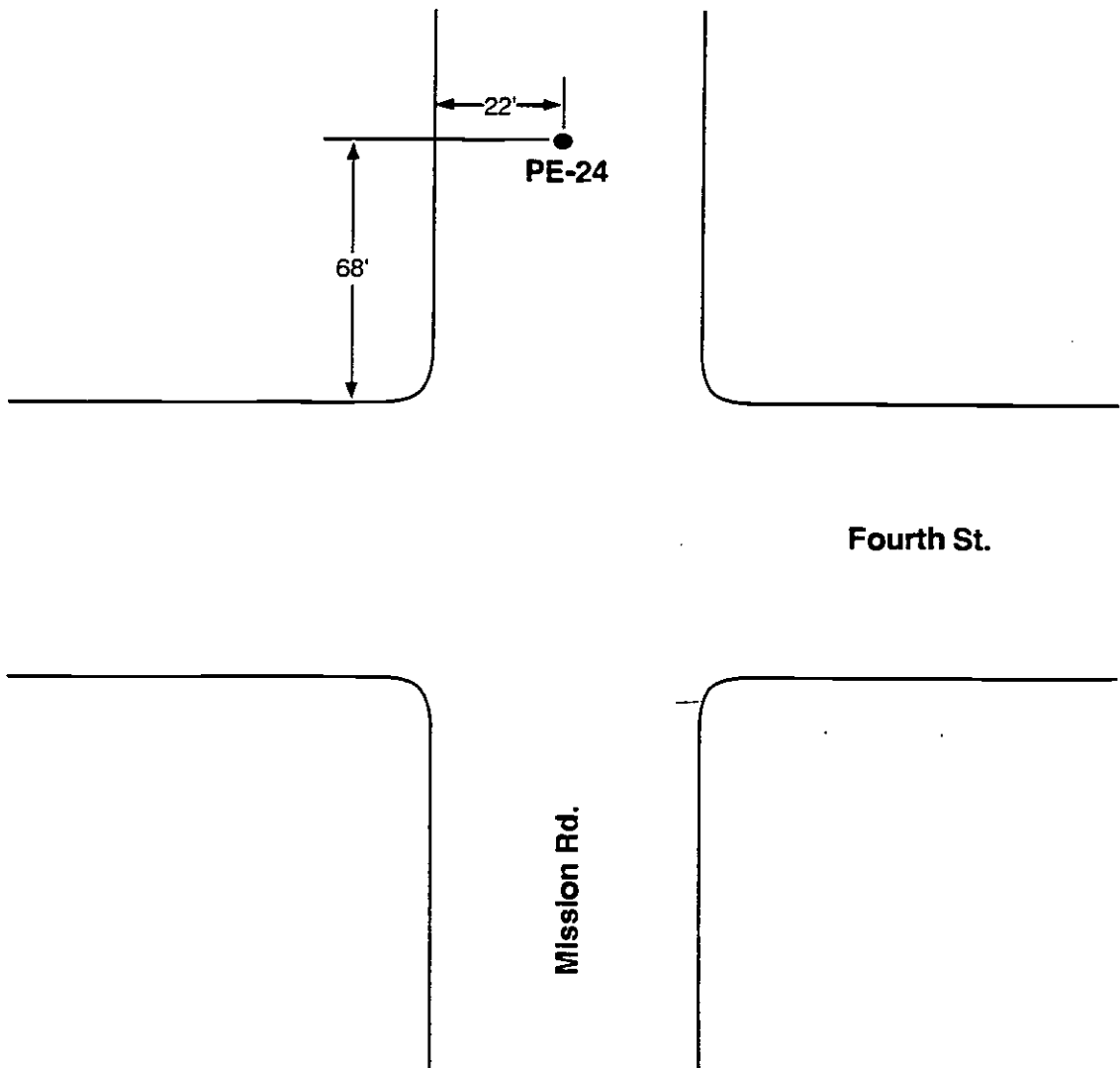
Project Name:		Metro Rail: Eastside Extension - Metro Red Line											
Project Number:		94-1100		Boring Number:				PE-24		Sheet 3 of 4			
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples								
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	QVA (ppm) [Background]	Dry Density (pcf)	Moisture Content(%)	Drilling Time	
		SAND with SILT; yellowish brown, moist, very dense, fine to coarse grained, nonplastic silt, some subangular to subrounded gravel to 1/2" in size	SP-SM	Qa	10	S	40 60	6/12	6.8 [5.4]				1014
55		medium to coarse grained, trace gravel			11	D	80	3/6	6.6 [5.5]	109	21		1030
60		SILTY SAND; light brown, moist, very dense, fine to medium grained, nonplastic silt	SM		12	S	27 50 25/3"	12/15	7.2 [6.4]				1042
		interval of SILT (ML) light brown and yellowish brown, wet, very dense, trace coarse grained, occasional gravel, layered			13	D	45 55/4"	6/10	7.0 [5.6]	109	19		1105
65													
70		SANDY SILT/SILTY SAND; very dark gray, moist, hard/very dense, nonplastic to low plasticity silt, fine grained sand	ML/SM		14	S	25 30 38	12/18	6.8 [5.6]				1118
75		increased silt			15	D	35 40	7/12	7.4 [6.3]	101	25		1130

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:		Metro Rail: Eastside Extension - Metro Red Line										
Project Number:		94-1100		Boring Number:		PE-24		Sheet 4 of 4				
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
85		SILTY SAND with GRAVEL; very dark gray, moist, very dense, fine grained, trace medium grained, nonplastic silt, subangular to subrounded gravel to 1" in size	SM	Qa	16S		60 40/3"	5/9	-			1140
		[rig chatter at 82'] GRAVEL with SAND; medium dark gray, moist, very dense, rounded and angular gravel to 1-1/2" in size, fine to coarse grained sand, trace nonplastic silt	GP									
		Boring terminated at 85.3 feet. Possible groundwater at 60 feet below surface.			17D		100/4"	< 1/4	7.5 [6.8]		5	1202
90												
95												
100												
105												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



	Project No.: 95-8347
	Geotechnical Investigation Eastside Extension Metro Red Line
Location of Boring PE-24	
2-96	Figure A-21



Project Name:		Metro Rail: Eastside Extension - Metro Red Line							
Project Number:		94-1100		Boring Number:		PE-25		Sheet <u>1</u> of <u>4</u>	
Boring Location:				Inside MTA yard		Elevation and Datum(feet):262 MSL			
Health and Safety:				Level D		Date Started:		12/6/93	
Date Finished:				12/7/93					
Drilling Equipment:				Mayhew 1000		Total Depth (feet):		86.0	
Depth to Bedrock(feet):				---					
Drilling Method:				Rotary Wash		Number of Samples:		17	
Depth to Water (feet):				72.3					
Boring Diameter:				5 inches		Completion Information:			
Installed Monitoring Well									
Hammer Information:				SPT Hammer: 140-lb and 30-inch drop		Logged By:		Checked By:	
Downhole Hammer: 400-lb and 18-inch drop						Greg Renfrew		Grant Miller	

Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples								
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content (%)	Drilling Time	
		FILL Asphaltic Concrete and Base, crushed rock		af									
5		ALLUVIUM SILTY SAND; light olive brown to olive brown, moist to wet, loose to medium dense, fine to medium grained, nonplastic silt	SM	Qa	1	D	8 9	7/12	4.7 [4.3]	96	18	0935	
10		SANDY SILT; olive brown, wet, soft, low plasticity, fine to coarse grained sand, subangular gravel to 1" in size	ML		2	S	1 2 2	3/18	5.1 [4.8]			0940	
15		SAND; light olive brown, moist, medium dense, fine to coarse grained, some subangular to subrounded gravel to 1-3/4" in size	SW		3	D	11 12	--	7.1 [5.1]	119	13	0945	
		[rig chatter], see next page	GP-GM / SP-SM										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:		Metro Rail: Eastside Extension - Metro Red Line										
Project Number:		94-1100		Boring Number:		PE-25		Sheet 2 of 4				
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	Drilling Time
		GRAVEL with SILT and SAND/SAND with SILT and GRAVEL; light olive brown, moist to wet, dense, subrounded to angular gravel to 1-1/2" in size, fine to coarse grained sand, nonplastic silt	GP-GM / SP-SM	Qa	4	S	3 14 17	7/18	5.6 [5.4]			0955
25		decreased silt content, gravel to 3" in size, subangular gravel of 1" to 1-1/2" common			5	D	14 25	4/12	5.5 [5.5]		10	1010
30		wet, very dense, gravel to 1-1/2" in size			6	S	16 23 40	5/18	6.4 [5.6]			1025
		SAND with GRAVEL, subrounded to subangular gravel to 1-1/4" in size	SW									
35		decreased sand content, GRAVEL with SILT and SAND; light olive brown, fine to coarse gravel to 2-1/4" in size	GP-GM		7	D	40 60/5"	4/11	--	125	11	1050
40					8	S	34 67/4"	6/10	6.5 [5.8]			1125
45		GRAVEL and COBBLE with SAND; cobbles to 4" in size	GP		9	D	100/7"	3/7	--		9	1150
		boulder approximately 12" in size										

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: Metro Rail: Eastside Extension - Metro Red Line												
Project Number: 94-1100		Boring Number: PE-25				Sheet 3 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		GRAVEL and COBBLE with SAND; olive brown, wet, very dense, angular gravel to 1-1/2" in size, fine- to coarse-grained sand, trace nonplastic silt [resumed drilling at 0735 on 12/7/93]	GP	Qa	10S	110/9"	7/9	4.8 [4.6]			1355	
55		light olive brown to strong brown (iron-oxide stained)			11D	40 60	7/12	4.9 [4.8]	131	9	0820	
60		LEAN CLAY; light yellowish brown, wet, hard, low to medium plasticity, trace fine-grained sand, laminated, low angle laminations, slightly porous, increasing fine sand content with depth	CL		12S	7 14 20	12/18	5.4 [5.0]			0845	
65		SILTY SAND/SANDY SILT; yellowish brown, wet, dense/hard, fine-grained sand, trace medium-grained sand, nonplastic silt	SM/ML		13D	15 23	10/12	5.7 [5.1]	115	17	0905	
70		high gravel content										
		SAND with SILT; light olive brown, very dense, fine- to medium-grained sand, some biotite mica	SP-SM		14S	33 70	10/12	6.4 [5.3]			0925	
75		SAND with GRAVEL; light olive brown to strong brown (iron-oxide stained), wet, very dense, fine- to coarse-grained sand, fine to coarse subangular gravel to 1" in size	SP		15D	60 40/4"	6/10	6.1 [5.3]	111	18	0940	
		SILT with SAND; see next page	ML									

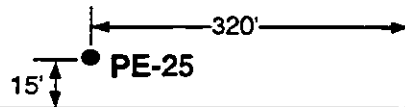
Note: This boring log is based on field classification and visual soil description and is further modified to include results of laboratory classification tests, where available. This summary applies only at the location of this boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:		Metro Rail: Eastside Extension - Metro Red Line										
Project Number:		94-1100		Boring Number:		PE-25			Sheet 4 of 4			
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SILT WITH SAND; olive gray, wet, hard, nonplastic, fine grained sand	ML	Qa	16	S	6 29 43	17/18	6.1 [5.4]			1000
85		increased silt content, very thinly laminated			17	D	30 67	7/12	5.9 [5.6]	105	21	1020
		Boring terminated at 86.0 feet. Groundwater measured on 1/11/94 at 72.3 feet below surface.										
90												
95												
100												
105												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.

MTA
Raolroad Yard



E. Fourth St.

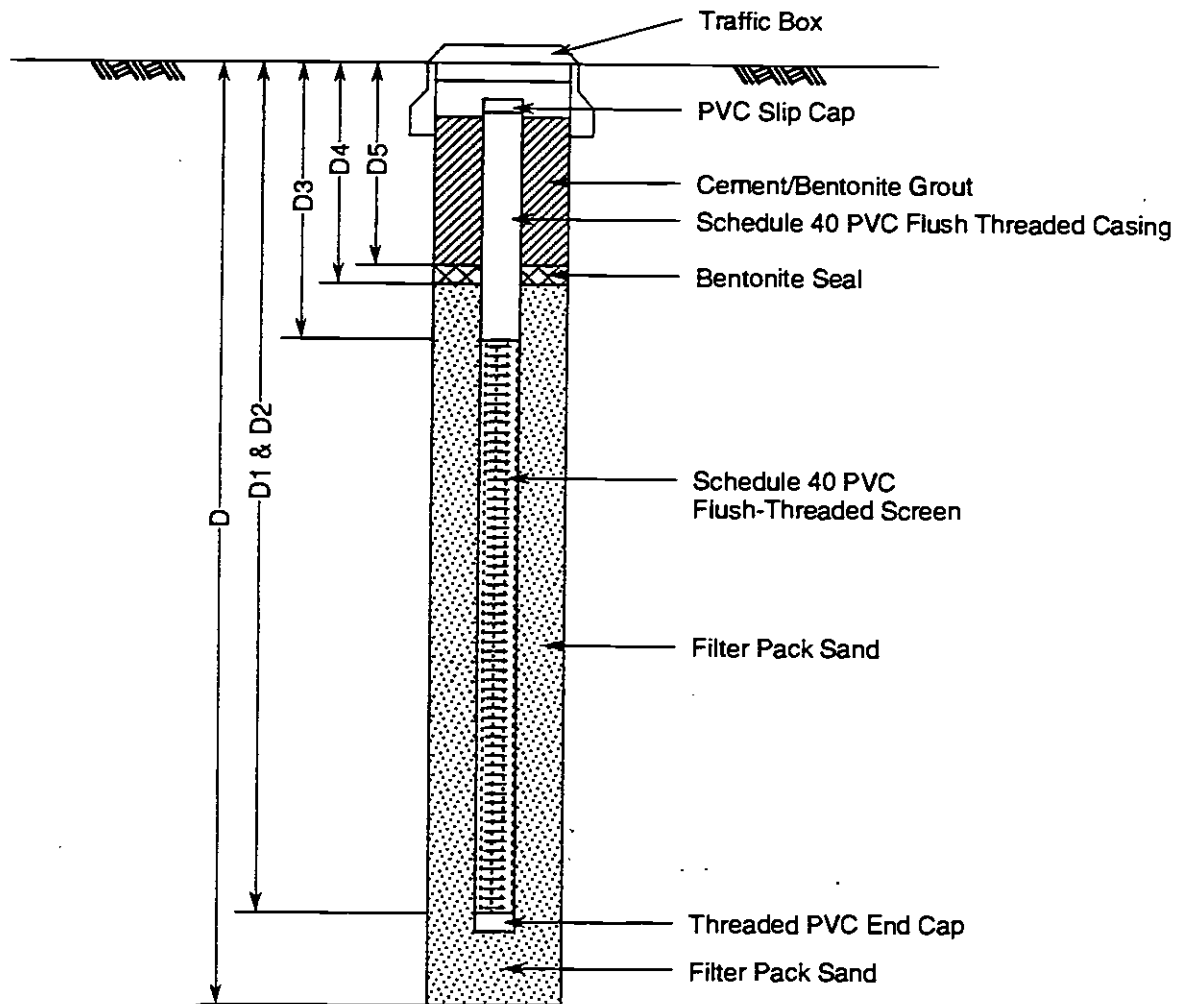
Los Angeles River



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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

Location of Boring
PE-25



Total Depth (D)	=	86	Feet
Total Depth of Casing (D1)	=	85	Feet
Depth to Bottom of Well Screen (D2)	=	85	Feet
Depth to Top of Well Screen (D3)	=	25	Feet
Depth to Bottom of Top Seal (D4)	=	22.5	Feet
Depth to Top of Top Seal (D5)	=	18	Feet
Well Casing Diameter	=	2	Inches
Well Screen Slot Size	=	0.01	Inch
Filter Pack Sand Type	=	#2/12	Monterey
Bentonite Seal Type	=	1/2	Inch Pellets

	Project No.	95-8347
	Geotechnical Investigation Eastside Extension Metro Red Line	

Monitoring Well Installation Schematic PE-25



Project Name:		Metro Rail: Eastside Extension - Metro Red Line											
Project Number:		94-1100		Boring Number:		PE-26		Sheet 1 of 4					
Boring Location:		Inside MTA yard				Elevation and Datum(feet):262 MSL							
Health and Safety:		Level D			Date Started:		12/6/93		Date Finished:			12/7/93	
Drilling Equipment:		Mayhew 1000			Total Depth (feet):		85.4		Depth to Bedrock(feet):		85		
Drilling Method:		Rotary Wash			Number of Samples:		13		Depth to possible Water (feet):		80		
Boring Diameter:		5 inches			Completion Information:		Grouted to surface						
Hammer Information:		SPT Hammer: 140-lb and 30-inch drop Downhole Hammer: 300-lb and 18-inch drop			Logged By:		Hossein Rashidi		Checked By: Grant Miller				
Depth (feet)	Lithology	Description	USCS Classification	Geologic Unit	Samples								Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
5		FILL SAND with SILT and GRAVEL; olive brown, moist, fine to coarse grained, nonplastic silt, some rounded to subangular gravel to 3" in size and cobbles [continuous rig chatter from 5' to 9'], shells and brick fragments	SP-SM	af	1	B				4.6 [4.4]			0935
10		ALLUVIUM SANDY SILT with GRAVEL; very dark gray, moist, very stiff, nonplastic, fine grained sand, gravel to 3" in size and cobbles	ML	Qa	2	D	25 15	3/12		4.5 [4.2]		14	1100
15		SAND with SILT and GRAVEL; dark gray, moist, loose, fine to coarse grained, nonplastic silt, rounded to subangular gravel to 1" in size high gravel content	SP-SM		3	S	4 5 4	2/18		4.8 [4.8]			1120

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name: Metro Rail: Eastside Extension - Metro Red Line												
Project Number: 94-1100			Boring Number: PE-26			Sheet 2 of 4						
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	QVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SAND with SILT; brown, moist to wet, very dense, fine to coarse grained, nonplastic silt, some angular to subrounded gravel to 1" in size	SP-SM	Qa	4	D	50	3/6	4.7 [4.6]		18	1130
25		GRAVEL with SILT and SAND; brown mixed with light gray to dark gray, moist, very dense, gravel to 1-1/2" in size, nonplastic silt, fine to coarse grained sand [strong rig chatter at 27']	GP-GM		5	S	30 60	4/12	5.0 [4.8]			1150
30		interval of SILTY SAND (SM), dark olive brown medium- to coarse-grained sand [constant rig chatter]			6	D	30 50/3"	8/9	4.9 [4.8]	115	12	1215
35		[bit change at 36'] [extremely slow drilling], possible cobbles										
40					7	B						1305
45		[up to 3/4" fragments of cemented gravel and sand in cuttings, possible concrete] [resumed drilling at 0730 on 12/7/93]					D 100/1"	0/1				1405
												1600

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



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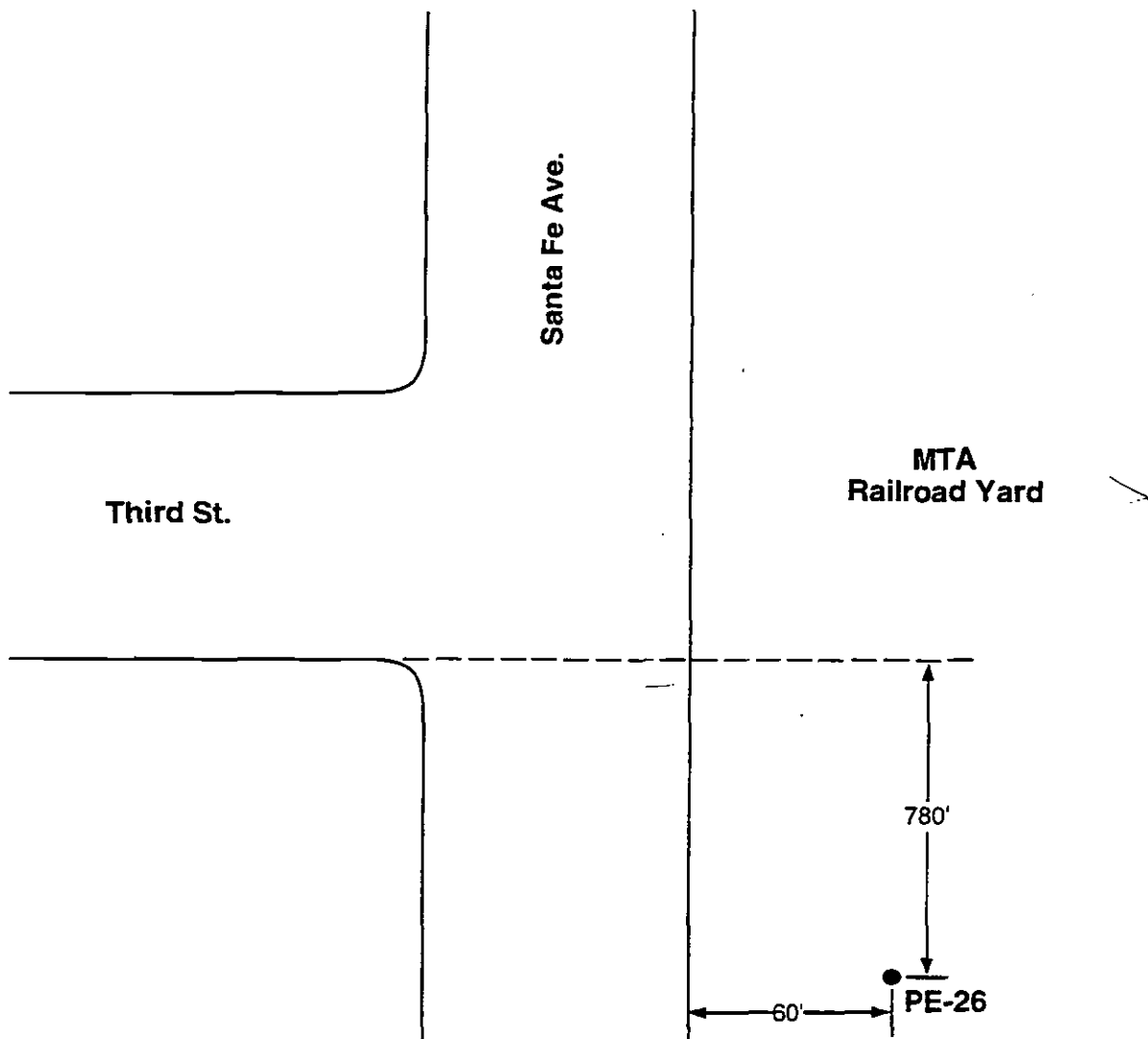
Project Name: Metro Rail: Eastside Extension - Metro Red Line													
Project Number: 94-1100		Boring Number: PE-26				Sheet 3 of 4							
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples								Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)		
		GRAVEL with SILT and SAND; dark olive brown, moist, very dense, rounded to subangular gravel to 1" in size, medium- to coarse-grained sand, possible cobbles [slow drilling]	GP-GM	Qa	8	B							0820
		[hole caved while attempting to sample]											0845
55		[smooth drilling]											
		LEAN CLAY with SAND; olive brown, moist, hard, low plasticity, fine-grained sand	CL		9	D	27 73/5"	10/11	4.0 [3.6]	102	23	1015	
60													
		mottled with light gray			10	S	19 68	10/12	4.0 [3.6]			1107	
65		[rig chatter], high gravel content trace medium- to coarse-grained sand											
70		iron-oxide staining, increased sand content			11	D	29 55/5"	8/11	4.0 [3.6]	100	27	1130	
75		GRAVEL with SAND; olive, coarse-grained sand, possible cobbles	GP			S	67	0/6	4.0 [3.6]			1153	

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



Project Name:		Metro Rail: Eastside Extension - Metro Red Line										
Project Number:		94-1100		Boring Number:		PE-26			Sheet 4 of 4			
Depth (feet)	Lithology	Description	USCS Classi- fication	Geologic Unit	Samples							Drilling Time
					Number	Type	Blow Count (no./6 inches)	Recovery (inches/inches)	OVA (ppm) (Background)	Dry Density (pcf)	Moisture Content(%)	
		SILTY SAND; olive, wet, very dense, fine to medium grained, trace coarse grained	SM	Qa	12D		100/5"	4/5	4.0 [3.8]	105	19	1220
85		FERNANDO/PUENTE FORMATION CLAYSTONE; dark olive brown, moist, soft rock, horizontal bedding, moderately weathered Boring terminated at 85.4 feet.	CL	Tf/Tp	13D		90/5"	5/5	4.0 [3.8]	106	22	-
90												
95												
100												
105												

Note: This boring 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 the passage of time. The data presented are a simplification of the actual conditions encountered. Lithologic patterns are generalizations and necessarily imprecise. Lithologic contacts indicated represent approximate boundaries between subsurface material types and the transitions may be gradual.



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Project No.: 95-8347
Geotechnical Investigation
Eastside Extension
Metro Red Line

**Location of Boring
PE-26**

APPENDIX B

GEOTECHNICAL LABORATORY TEST RESULTS

LABORATORY TESTING

GENERAL

The results of laboratory testing performed in conjunction with this project are presented in this appendix. The laboratory tests were performed on representative samples in accordance with the latest applicable American Society for Testing Materials (ASTM) and California Department of Transportation (Caltrans) standards. Laboratory test results are summarized in Tables 3-5 and 4-3.

CLASSIFICATION

Soils were classified visually in accordance with ASTM Test Method D2488-90. Where laboratory test results were available classification was in accordance with ASTM Test Method D2487-90. The soil classifications are presented in the test data and boring logs.

MOISTURE AND IN PLACE DENSITY

The field moisture content and in place dry density determinations were performed on relatively undisturbed California Drive samples obtained from test borings. The moisture content was obtained in accordance with ASTM Test Method D2216. The in place dry density was computed using the net weight of the entire (ring) sample. The results of these tests are presented in the boring logs.

PARTICLE SIZE ANALYSIS

Grain size distributions of soil samples were obtained in accordance with ASTM Test Method D422. Laboratory test results for the grain size analysis are summarized in Table B-1. Figures B-1 through B-105 present the grain size distribution curves.

FINES CONTENT ANALYSIS

Fines content (percent passing #200 sieve) of soil samples was obtained in accordance with ASTM Test Method D1140. Laboratory test results for the fines content analysis are summarized in Table B-1.

ATTERBERG LIMITS

Tests for Atterberg Limits (Liquid Limit and Plasticity Index) were performed according to ASTM Tests Method D4318. Laboratory test results for the Atterberg Limits are summarized in Table B-2. These results are also presented along with grain size distribution curves.

SPECIFIC GRAVITY

Specific gravity tests were performed on fine-grained (passing #4 sieve) soil samples in accordance with ASTM Test Method D854.

UNCONFINED COMPRESSION TESTS

Unconfined compression tests were performed on selected relatively undisturbed soil samples in accordance with procedures outlined in ASTM Test Method D2168. The soil samples (height/diameter ratio of about 2) were subjected to a constant strain rate of 1 percent per minute. Laboratory test results for the unconfined compression tests are summarized in Table B-3 and graphically presented in Figures B-106 through B-108.

DIRECT SHEAR TESTS

Direct shear tests were performed on selected relatively undisturbed soil samples which were saturated under surcharge equal to the applied normal force during testing. The apparatus used is in conformance with the requirements outlined in ASTM Test Method D3080. The test specimens, 2.4 inches in diameter and 1 inch in height, were subjected to shear along a plane mid-height after allowing time for pore pressure dissipation prior to application of shearing force.

The samples were tested under normal loads from 1.5 to 10 ksf with a different specimen being used for each normal load. Drained and undrained direct shear tests were performed on coarse- and fine-grained soil samples, respectively. The samples were sheared at constant rates of 0.0025 inches per minute. Shearing of each specimen was continued until the shear stress became essentially constant or until a deformation of approximately 10 percent of the original diameter had been reached. Laboratory test results for the direct shear tests are summarized in Table B-4, and are graphically presented in Figures B-109 through B-118.

TRIAXIAL COMPRESSION TESTS

Consolidated undrained triaxial compression tests were performed on selected undisturbed bedrock samples in accordance with procedures outlined in ASTM D4767. The samples were saturated by the application of back pressure and tested under effective confining pressures of 20, 40, and 80 psi. The samples were sheared at constant rates of 0.008 in/min. Pore pressure was measured during shearing of each specimens. Shearing of each specimens was continued until a deformation of approximately 20 percent of the original sample height had been reached. Laboratory test results for the triaxial compression tests are summarized in Table B-5 and graphically presented in Figure B-119.

CONSOLIDATION AND COLLAPSE TESTS

Consolidation tests were performed on selected relatively undisturbed soil samples in accordance with procedures outlined in ASTM Test Method D2435. The samples were placed in a consolidometer and loads were applied incrementally in geometric progression. The samples (2.4 inches in diameter and 1 inch in height) were permitted to consolidate under each load increment until the slope of the characteristic linear secondary compression portion of the thickness versus log of time plot was apparent.

The percent consolidation for each load cycle was recorded as the ratio of the amount of vertical compression to the original 1-inch height. Hydroconsolidation (collapse) and/or expansion characteristics were also evaluated by monitoring the change in volume with the addition of water while the specimen was confined under a constant normal stress. The consolidation test results are summarized in Table B-6 and are graphically presented in Figures B-120 through B-126.

TRIAxIAL PERMEABILITY TESTS

Triaxial permeability tests were performed on selected relatively undisturbed soil samples in accordance with procedures outlined in ASTM D5084. The samples were saturated by the application of back pressure and tested under an effective confining pressure equivalent to the in situ vertical stress. Water flow between the top and bottom of the sample was measured by applying a pressure head difference of 2 psi. Laboratory test results for the permeability tests are summarized in Tables 3-5 and B-7 and are tabular presented in Tables B-9 and B-12.

pH, CHLORIDE CONTENT, SULFIDES CONTENT, SULFATE CONTENT AND ELECTRICAL RESISTIVITY TESTS

The concentrations of water soluble sulfate ions of selected soil samples were determined in accordance with the Caltrans Method No. 417-B. Soil pH values were determined in accordance with USEPA Method 9045. Sulfides content was determined in accordance with USEPA Method 9030. Chloride content was determined in accordance with Caltrans Method No 422. Tests to determine the electrical resistivity were conducted in general accordance with Caltrans Method No. 532. Electrical resistivity tests were conducted at in situ moisture content on all samples. The results of pH, chloride content, soluble sulfate content and electrical resistivity evaluations are presented in Table B-8.

TABLE B-1 RESULTS OF GRAIN SIZE AND FINES CONTENT TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Grain-Size Distribution ASTM D422 GR:SA:FI * (%)	Percent Passing #200 Sieve ASTM D1140 (%)
DD-13	S-8	40	(SW-SM)	Qa	34:57:9	
	S-14	61	ML			84
	S-18	73	SM		1:56:43	
	S-20	79	ML		0:19:81	
	S-22	85	SM		0:78:22	
	D-23	88	(GM)		52:35:13	
	S-26	97	(SM)		18:67:15	
	S-28	105	(SM)		34:52:14	
DD-13S	S-8	40	(SP-SM)	Qa	40:54:6	
	S-11	50	(SP-SM)		36:59:5	
	S-15	64	SM			51
	S-17	70	SM		4:83:13	
	S-21	83	ML		0:49:51	
	S-23	89	SM		0:52:48	
	S-25	95	SM		2:51:47	
	S-27	101	SP-SM			11
	S-29	107	SM			13
DD-14	S-4	20	(SP-SM)	Qa		9
	S-6	26	ML		0:36:64	
	S-8	32	ML		0:19:81	
	S-10	38	(SW-SM)		13:77:10	
	S-12	44	(ML)		0:30:70	
	D-13B	47	SM			45
	S-14	50	SM		0:71:29	

TABLE B-1 RESULTS OF GRAIN SIZE AND FINES CONTENT TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Grain-Size Distribution ASTM D422 GR:SA:FI * (%)	Percent Passing #200 Sieve ASTM D1140 (%)
DD-14	S-16	56	(SW-SM)	Qa	40:51:9	
	S-18	62	(GW-GM)		56:36:8	
	S-20	68	ML			65
DD-15	S-8	36	(SP-SM)	Qa	38:54:8	
	S-10	42	(SP-SM)		40:53:7	
	S-12	47	SM		2:79:19	
	S-14	54	(SM)		0:87:13	
	S-16	59	SM		0:79:21	
	D-17	62	(SP-SM)			9
	S-18	65	(SW-SM)		3:85:12	
	S-20	71	CL/ML			63
	S-22	77	SM		0:83:17	
	S-24	85	(SW-SM)		34:57:9	
DD-16	B-3	10	(SP)	Qa	32:65:3	
	B-4	15	(GP)		58:38:4	
	B-5	20	(GP)		50:46:4	
	B-7	25	(SP-SM)		41:51:8	
	B-9	35	(GP-GM)		49:46:5	
	B-10	39	(SP)		48:48:4	
	B-11	41.5	CL			70
	B-13	47	CL		0:36:64	
	B-14	49	SP-SM		2:90:8	
	B-15	53.5	SP-SM		4:90:6	
DD-17	S-3	15	SW-SM	Qa	12:78:10	

TABLE B-1 RESULTS OF GRAIN SIZE AND FINES CONTENT TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Grain-Size Distribution ASTM D422 GR:SA:FI * (%)	Percent Passing #200 Sieve ASTM D1140 (%)
DD-17	S-5	21	SW-SM	Qa	13:75:12	
	S-7	27	(SW-SM)		17:74:9	
	S-9	33	(SW-SM)		35:55:10	
	D-14	48	ML			59
	D-16	54	SP-SM			5
	S-17	57	(SM)		0:86:14	
	S-19	63	(SW-SM)		2:90:8	
	S-21	70	SW-SM		0:88:12	
DD-51	S-6	30	(SW-SM)	Qa	30:62:8	
	S-8	38	(GP-GM)		65:29:6	
	S-10	44	(GW-GM)		48:47:5	
	S-12	50	(GW-GM)		49:45:6	
	S-14	56	GP		59:37:4	
	D-15	59	ML			70
	S-16	62	ML		7:41:52	
	S-18	68	SM		5:75:20	
	D-19	71	ML			55
DD-52	S-5	20	SP-SM	Qa	39:46:15	
	S-7	26	ML		0:43:57	
	S-9	32	ML		0:14:86	
	D-10	35	SP-SM			6
	S-11	38	SW-SM		11:80:9	
	S-13	44	ML		0:33:67	
	S-15	50	SM			31

TABLE B-1 RESULTS OF GRAIN SIZE AND FINES CONTENT TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Grain-Size Distribution ASTM D422 GR:SA:FI * (%)	Percent Passing #200 Sieve ASTM D1140 (%)
DD-52	D-16B	53	(SP-SM)	Qa		6
	S-17	56	SP-SM		0:92:8	
	S-20	63	(ML)		0:28:72	
DD-54A	S-8	49	SM	Qa	4:83:13	
	S-10	55	SM		0:86:14	
	S-12	61	(ML)		1:45:54	
	D-13	64	SM			44
	S-14	67	SM		0:83:17	
	S-16	73	ML		0:34:66	
	S-18	79	ML		4:41:55	
DD-54B	S-2	55	(SM)	Qa	9:75:16	
	S-4	65	(SM)		4:83:13	
	S-5	70	ML		0:19:81	
	S-7	80	SW-SM		7:82:11	
	S-8	85	SW-SM		33:56:11	
	S-9	90	ML		0:18:82	
	S-10	95	(SM)		0:28:18	
DD-54C	S-4	55	SW-SM	Qa	16:72:12	
	S-10	63.5	SM		6:63:31	
	S-13	68	(SM)		35:52:13	
	S-18	75.5	ML		0:29:71	
	S-25	87	(SM)		33:52:15	
	S-29	93	ML		0:29:71	
DD-55	D-6	28	GP	Qa	68:30:2	

TABLE B-1 RESULTS OF GRAIN SIZE AND FINES CONTENT TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Grain-Size Distribution ASTM D422 GR:SA:FI * (%)	Percent Passing #200 Sieve ASTM D1140 (%)
DD-55	S-9	37	(GW-GM)	Qa	59:35:6	
	S-11	43	ML		6:33:61	
	S-13	49	SP-SM		4:87:9	
	S-16	56	(ML)		1:47:52	
	S-18	61	(SM)		0:85:15	
	S-20	67	(SM)			13
	S-22	73	SP-SM			10
	S-24	79	ML			52
DD-56-1	S-9	35	(SW-SM)	Qa	30:63:7	
	S-13	47	SM		0:74:26	
	S-15	53	SP-SM		3:85:12	
	D-16	56	CL			94
	S-17	59	SM		0:85:15	
DD-57	S-3	12	SM	Qa	1:57:42	
	S-5	18	ML		3:35:62	
	S-7	24	ML		5:41:54	
	D-8	27	SP-SM			7
	S-9	30	(SW-SM)		4:86:10	
	S-11	36	(SM)		2:84:14	
	D-14	45	SW-SM		9:80:11	
	S-20	59.5	SM			46
	D-21	64	SM			19
SD-6	S-3	15.0	SM	Qa	0:76:24	
	S-5	25.0	CL		0:33:67	

TABLE B-1 RESULTS OF GRAIN SIZE AND FINES CONTENT TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Grain-Size Distribution ASTM D422 GR:SA:FI * (%)	Percent Passing #200 Sieve ASTM D1140 (%)
SD-6	D-6	30	(SC)	Qa		36
	S-7	35	(SC-SM)		0:61:39	
	D-8	40	SP-SM			11
	S-9	45	CL			75
	S-11	53	CL		0:33:67	
	D-12	56	CL			58
	S-15	65	CL		0:46:54	
	D-16	68	SM			38
	S-17	71	CL		0:46:54	
	S-19	77	SC		0:59:41	
	S-21	85	SC			20
SD-7	S-2	15	CL	Qa	0:40:60	
	S-6	31	SM			34
	S-7	35	ML		0:10:90	
	D-8	40	CL			85
	S-9	45	SW-SM		3:89:8	
	S-11	55	(CL)		2:47:51	
	D-12	60	SC			40
	S-15	74	(SM)		13:73:14	
	S-17	84	SM		4:70:26	
	D-18	89	SM			25-35
	S-19	94	SM		0:68:32	
SD-8	S-3	15	CL	Qa		58
	S-5	25	CL		0:12:88	

TABLE B-1 RESULTS OF GRAIN SIZE AND FINES CONTENT TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Grain-Size Distribution ASTM D422 GR:SA:FI * (%)	Percent Passing #200 Sieve ASTM D1140 (%)
SD-8	S-7	34	SC	Qa	0:51:49	
	S-9	45	SC		10:68:22	
	S-11	53	(SM)		2:63:35	
	S-13	60	SM		2:82:16	
	S-15	69	ML/CL		1:26:73	
	D-16	75	(SP-SM)			12
	S-19	87	(SM)		0:72:28	
	S-21	93	(SM)		6:80:14	
	S-23	100	(SM)			16
SD-9	D-4	19	SP-SM	Qa		7
	S-7	33	SC		5:48:47	
	S-9	42	SM		2:80:18	
	S-11	50	SM		0:73:27	
	P-14	61	CL/ML			95
	P-24	84	CL			98
SD-10	D-2	10	SM	Qa		22
	D-6	30	CL			66
	S-9	45	SC		2:59:39	
	S-13	57	SM		4:63:33	
	D-14	60	SM			35
	S-15	63	SM		11:71:18	

NOTES: see next page.

TABLE B-1 RESULTS OF GRAIN SIZE AND FINES CONTENT TESTS

NOTES:

1. USCS Classifications are based on the visual-manual procedure (ASTM) D2488) and laboratory test results (ASTM D2487).
2. Some of the material classifications (identified in parentheses) shown in column 4 of this table are not consistent with the general classification of that interval in the boring logs. This generally occurs in gravelly and cobbly layers where due to presence of gravels and cobbles larger than sampler size (2.4-inch inner diameter), laboratory gradations and classifications only reflect the finer matrix materials in alluvium.
3. * GR:SA:FI = Gravel: Sand : Fines (percent passing #200 sieve)

TABLE B-2 RESULTS OF ATTEBERG LIMITS TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Atterberg Limits ASTM D4318 LL,PL,PI *
DD-13	S-14	61	ML	Qa	37,27,10
DD-13S	D-14	61	ML	Qa	30,25,5
	D-22B	86	CL		38,17,21
DD-15	S-20	71	MH/CH	Qa	50,28,22
DD-16	B-11	41.5	CL	Qa	34,19,15
DD-51	D-17	65	ML	Qa	31,27,4
DD-56-1	D-16	56	CL	Qa	38,23,15
DD-57	P-18	55.5	MH	Qa	57,31,26
SD-6	D-4	20	(ML)	Qa	30,25,5
	S-9	45	CL		30,21,9
	D-14	62	CL		32,19,13
SD-7	D-8	40	CL	Qa	45,20,25
	S-11	55	(CL)		28,16,12
	D-12	60	SC		27,16,11
SD-8	D-4	20	CL	Qa	34,16,18
SD-8	S-17	80	CH	Qa	59,24,35
SD-9	P-14	61	CL/ML	Tf/Tp	47,26,21
	P-24	84	CL		48,25,23
	D-27	95	CL		47,27,20
SD-10	D-6	30	CL	Qa	31,13,18
	D-14	60	SM		24,15,9
	D-22	84	CL	Tf/Tp	42,21,21
	D-24	90	CL		47,24,23
	D-28	105	CH		50,24,26

NOTES:

- USCS Classifications are based on the visual-manual procedure (ASTM D2488)

and laboratory test results (ASTM D2487).

2. Some of the material classifications (identified in parentheses) shown in column 4 of this table are not consistent with the general classification of that interval in the boring logs. This generally occurs in gravelly and cobbly layers where due to presence of gravels and cobbles larger than sampler size (2.4-inch inner diameter), laboratory gradations and classifications only reflect the finer matrix materials in alluvium.
3. * LL, PL, PI = Liquid Limit, Plastic Limit, Plasticity Index

TABLE B-3. RESULTS OF UNCONFINED COMPRESSION TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Unconfined Compressive Strength ASTM D2166 (ksf)
DD-57	P-18	55.5	MH	Qa	8.583
SD-9	P-14	61	CL/ML	Tf/Tp	11.101
	P-26	88.5	CL/ML		18.404

NOTES:

1. USCS Classifications are based on the visual-manual procedure (ASTM D2488) and laboratory test results (ASTM D2487).
2. Some of the material classifications (identified in parentheses) shown in column 4 of this table are not consistent with the general classification of that interval in the boring logs. This generally occurs in gravelly and cobbly layers where due to presence of gravels and cobbles larger than sampler size (2.4-inch inner diameter), laboratory gradations and classifications only reflect the finer matrix materials in alluvium.

TABLE B-4. RESULTS OF DIRECT SHEAR TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Direct Shear ASTM D3080 (Peak Strength)	
					Effective Cohesion (psf)	Effective Friction (Degrees)
DD-13	D-17B	70	SM	Qa	400	38
DD-15	D-17	62	(SP-SM)	Qa	600	38
DD-52	D-16B	53	(SP-SM)	Qa	0	49
DD-56-1	D-14	50	SP-SM	Qa	200	41
SD-6	D-14	62	CL	Qa	900	26
SD-7	D-12	60	SC	Qa	0	36
SD-8	D-6	30	SC	Qa	500	35
SD-9	P-14	61	CL/ML	Tf/Tp	1200	31
SD-10	D-6	30	CL	Qa	400	30
	D-22	84	CL	Tf/Tp	2200	25

NOTES:

1. USCS Classifications are based on the visual-manual procedure (ASTM D2488) and laboratory test results (ASTM D2487).
2. Some of the material classifications (identified in parentheses) shown in column 4 of this table are not consistent with the general classification of that interval in the boring logs. This generally occurs in gravelly and cobbly layers where due to presence of gravels and cobbles larger than sampler size (2.4-inch inner diameter), laboratory gradations and classifications only reflect the finer matrix materials in alluvium.

TABLE B-5. RESULTS OF TRIAXIAL COMPRESSION TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Triaxial Compression ASTM D4767 (Peak Strength)	
					Effective Cohesion (psf)	Effective Friction Angle (Degrees)
SD-9	P-24	84	CL	Tf/Tp	0	35

NOTE:

- 1 USCS Classifications are based on the visual-manual procedure (ASTM D2488) and laboratory test results (ASTM D2487).

TABLE B-6. RESULTS OF CONSOLIDATION TESTS AND COLLAPSE POTENTIAL

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Consolidation Characteristics, ASTM D2435 & Collapse Potential, ASTM D5333				
					Cc'	Cs'	Cx'	Vertical Stress (ksf)	Swell(+)/ Collapse(-) (%)
DD-15	D-5	25	SP	Qa	-	-	-	3	-0.28
SD-6	D-14	62	CL	Qa	0.117	0.017	0.0007	8	0.07
SD-7	D-18	89	SM	Qa	0.05	0.005	0.0004	8	-0.02
SD-9	P-24	84	CL	Tf/Tp	0.057	0.018	0.0006	10	0.15
	D-27	95	CL		0.073	0.130	0.0004	2	0.36
SD-10	D-24	90	CL	Tf/Tp	0.090	0.010	0.0003	2	0.37
	D28	105	CH		0.113	0.017	0.0004	2	0.51

NOTES:

1. USCS Classifications are based on the visual-manual procedure (ASTM D2488) and laboratory test results (ASTM D2487).
2. Some of the material classifications (identified in parentheses) shown in column 4 of this table are not consistent with the general classification of that interval in the boring logs. This generally occurs in gravelly and cobbly layers where due to presence of gravels and cobbles larger than sampler size (2.4-inch inner diameter), laboratory gradations and classifications only reflect the finer matrix materials in alluvium.
3. Compression Index (Cc') and Swelling Index (Cs') are based on vertical strain-log stress plots. Rate of Secondary Compression (Cx') is based on vertical strain-log time plot.

TABLE B-7. RESULTS OF TRIAXIAL PERMEABILITY TESTS

Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487 / ASTM D2488	Geologic Unit	Triaxial Permeability ASTM D5084	
					Effective Confining Stress (psi)	Permeability (cm/sec)
DD-14	D-5	23	SP	Qa	20	7.0E-04
DD-52	D-12A	41	SM	Qa	35	1.9E-07
DD-56-1	D-14	50	SP	Qa	40	3.4E-05
SD-8	D-16	75	(SP-SM)	Qa	65	1.7E-04

NOTES:

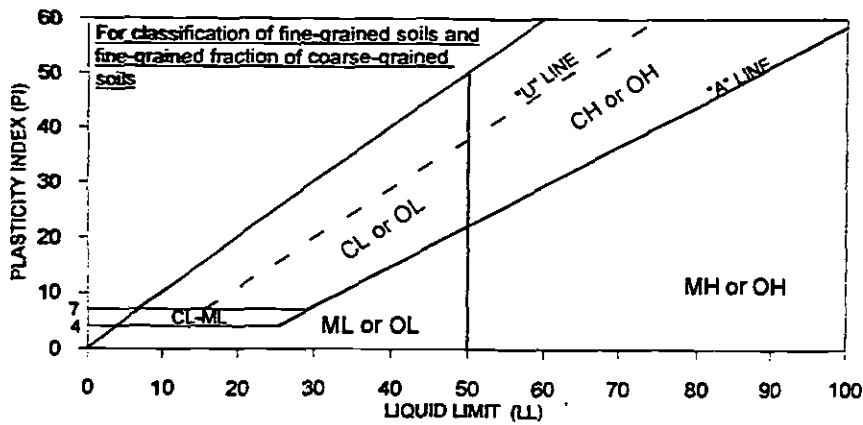
1. USCS Classifications are based on the visual-manual procedure (ASTM D2488) and laboratory test results (ASTM D2487).
2. Some of the material classifications (identified in parentheses) shown in column 4 of this table are not consistent with the general classification of that interval in the boring logs. This generally occurs in gravelly and cobbly layers where due to presence of gravels and cobbles larger than sampler size (2.4-inch inner diameter), laboratory gradations and classifications only reflect the finer matrix materials in alluvium.

TABLE B-8. RESULTS OF CORROSIVITY TESTS

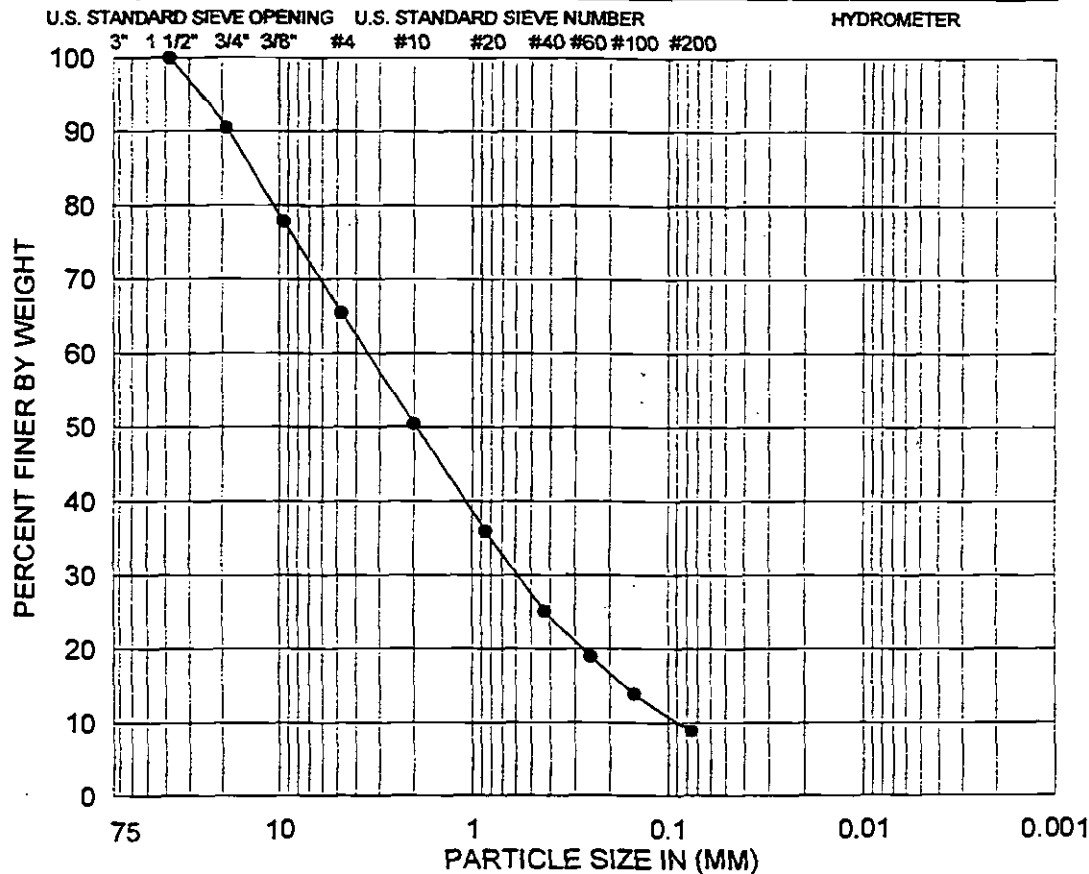
Boring Number	Sample Number	Sample Depth (ft)	USCS Classification ASTM D2487/ ASTM D2488	Geologic Unit	Soil pH USEPA Method 9045	Sulfate Content DOT CA Test 417-B (ppm)	Chloride Content DOT CA Test 422 (ppm)	Electrical Resistivity @ Insitu (Saturated) Moisture Content (ohm-cm)
DD-13	S-18	73	SM	Qa	8.20	152	110	(1389)
DD-13S	S-17	70	SM	Qa	9.20	137	640	(1639)
DD-14	S-10	38	(SW-SM)	Qa	9.17	205	85	3125
DD-15	S-18	65	(SW-SM)	Qa	7.52	161	212	(2778)
DD-17	S-9	33	(SW-SM)	Qa	9.03	73	88	20833
DD-51	D-13	53	SP/GP	Qa	9.4	139	91	4762
DD-52	S-13	44	ML	Qa	8.81	132	53	2011
DD-55	S-13	49	SP-SM	Qa	6.40	280	924	3226
DD-56-1	S-15	53	SP-SM	Qa	9.34	277	237	(2632)
DD-57	S-9	30	(SP-SM)	Qa	8.13	258	135	5882
SD-6	S-15	65	CL	Qa	7.91	97	70	1680
SD-7	S-6	31	SM	Qa	7.84	353	618	7692
SD-8	S-13	60	SM	Qa	8.19	169	106	(2941)
SD-9	P-14	61	CL/ML	Tf/Tp	8.15	79	654	2665

NOTES:

1. USCS Classifications are based on the visual-manual procedure (ASTM D2488) and laboratory test results (ASTM D2487).
2. Some of the material classifications (identified in parentheses) shown in column 4 of this table are not consistent with the general classification of that interval in the boring logs. This generally occurs in gravelly and cobbly layers where due to presence of gravels and cobbles larger than sampler size (2.4 inner diameter), laboratory gradations and classifications only reflect the finer matrix materials in alluvium.



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



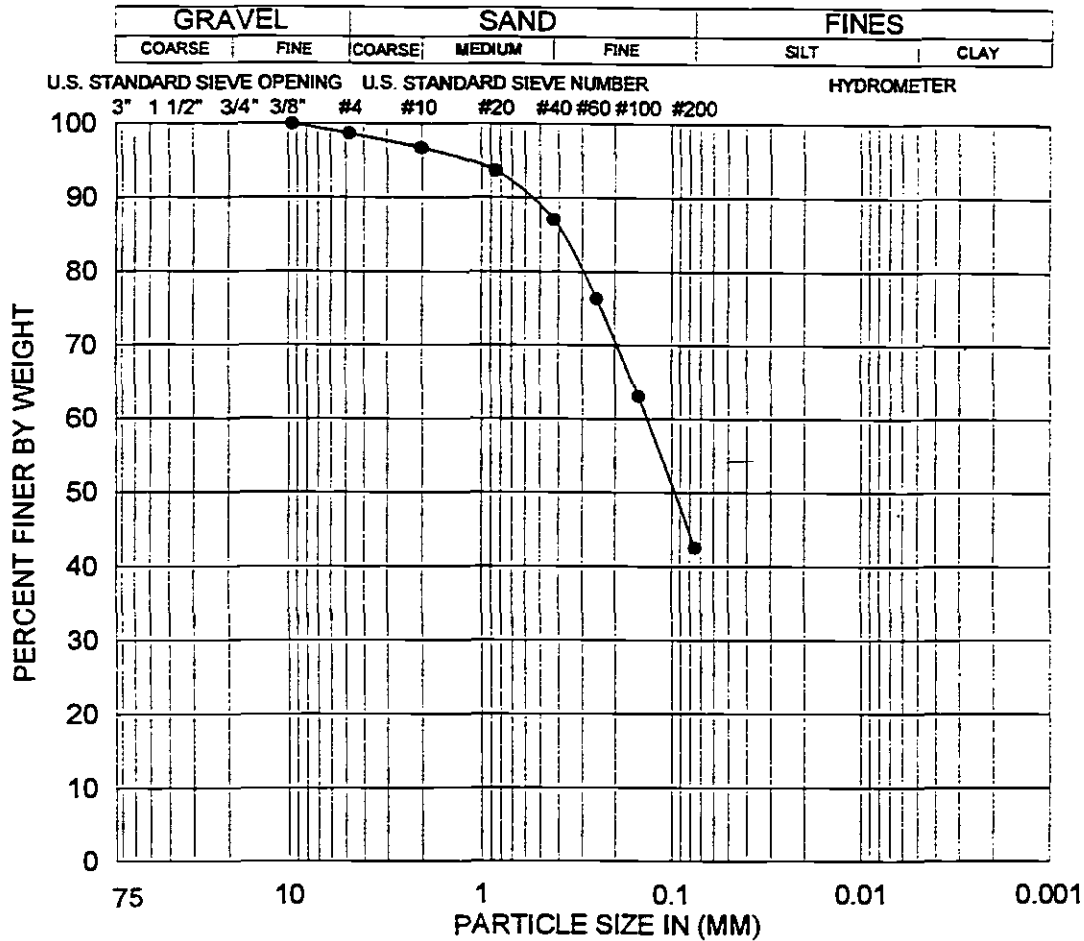
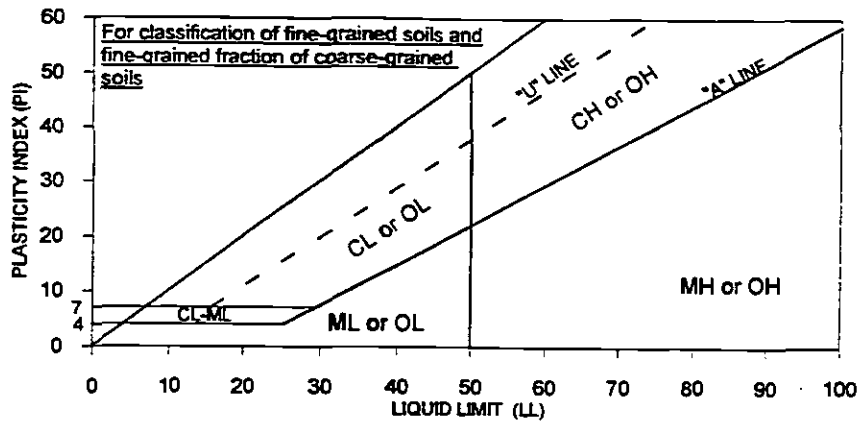
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-13	S-8	40.0	Bag	SW-SM	34:57:9	N/A

Not enough sample to meet ASTM specification



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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



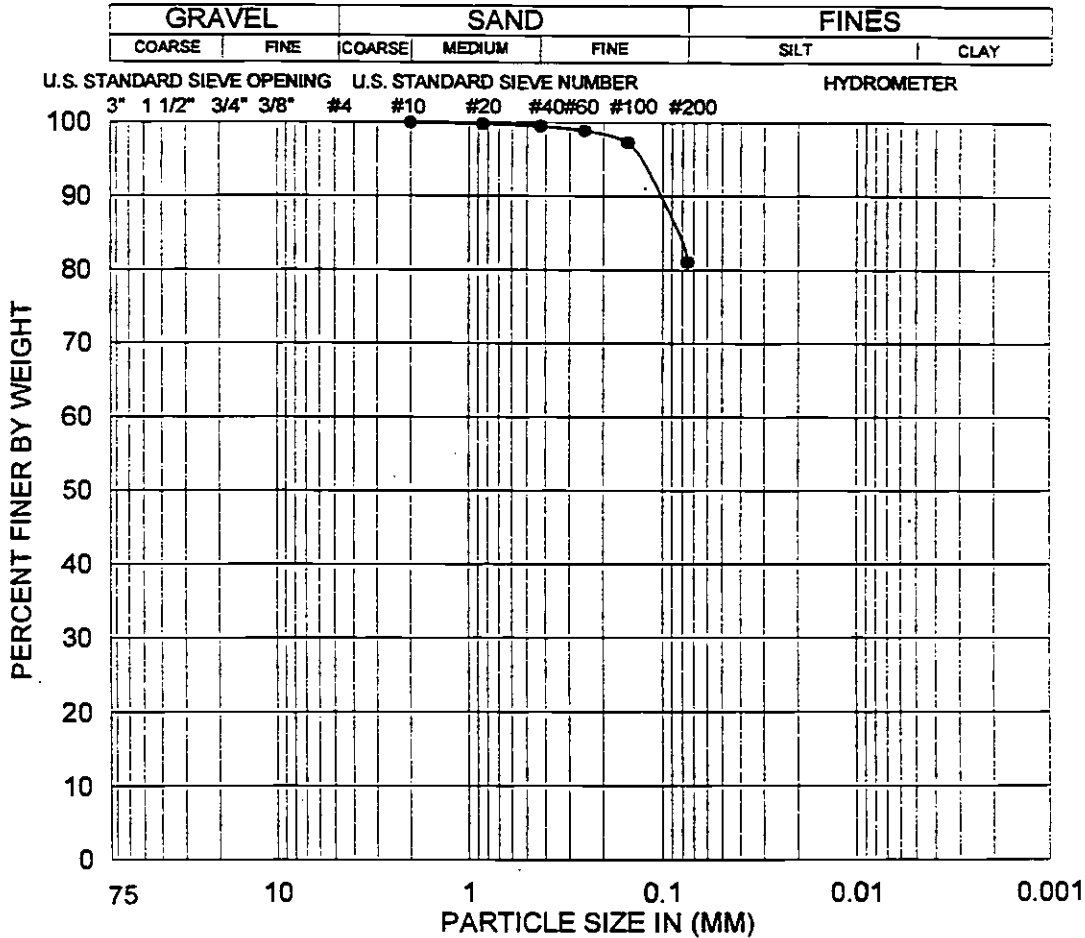
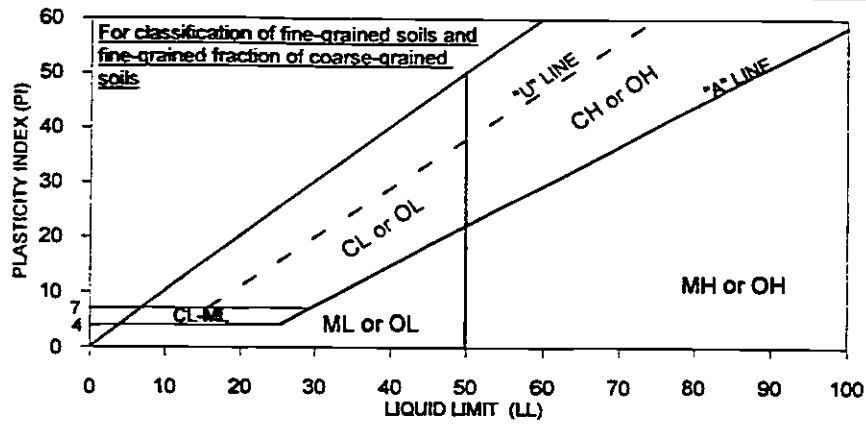
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DD-13	S-18	73.0	Bag	SM	1:56:43	N/A



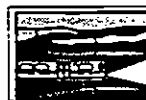
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BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13	S-20	79.0	Bag	ML	0:19:81	N/A



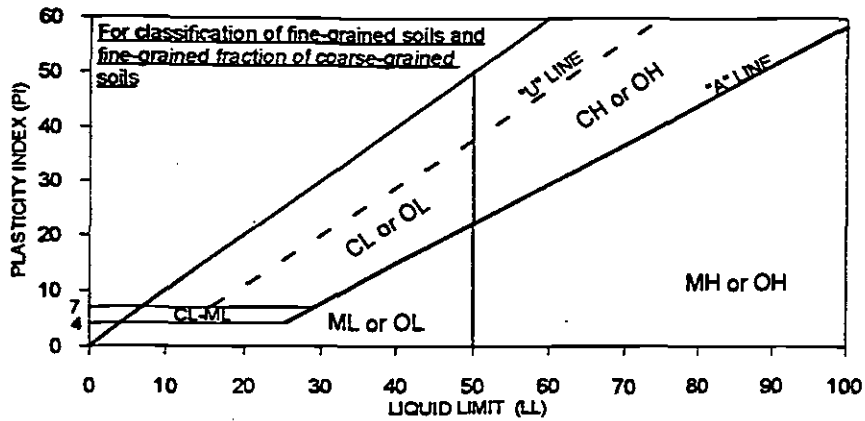
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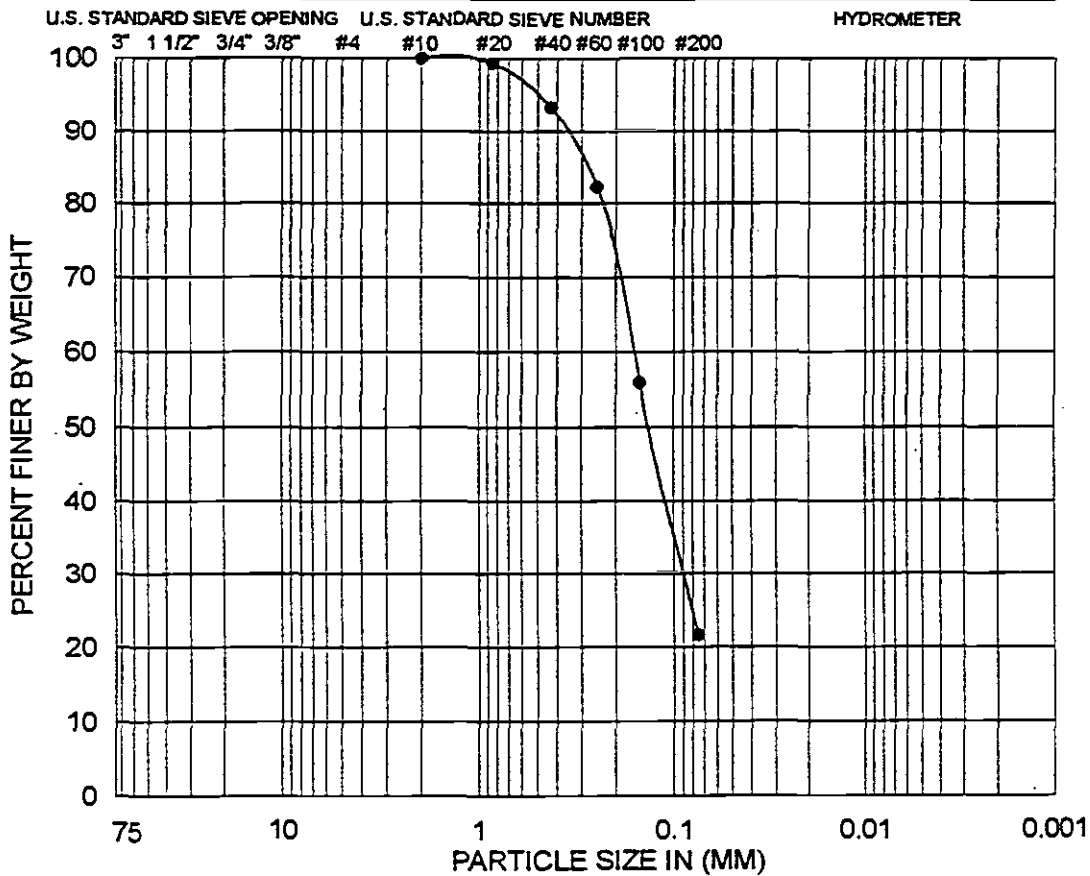
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-3



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13	S-22	85.0	Bag	SM	0:78:22	N/A

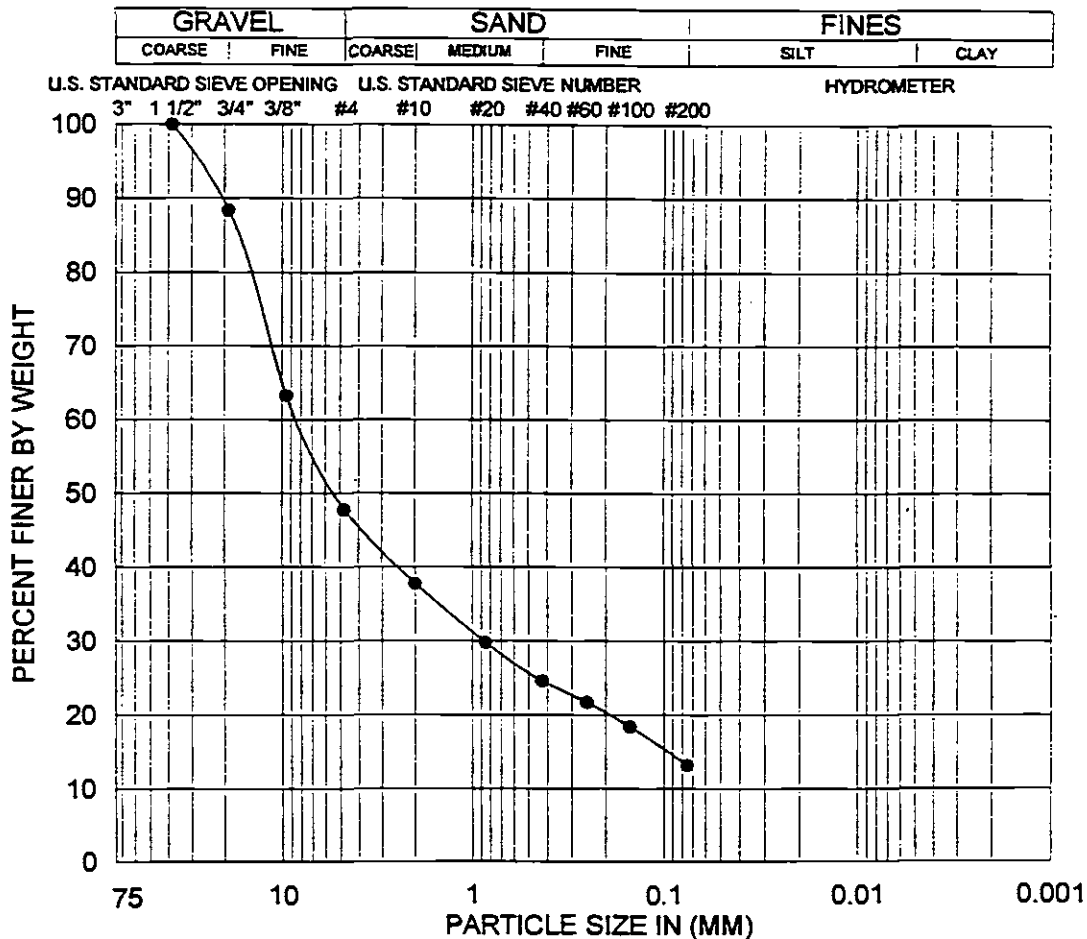
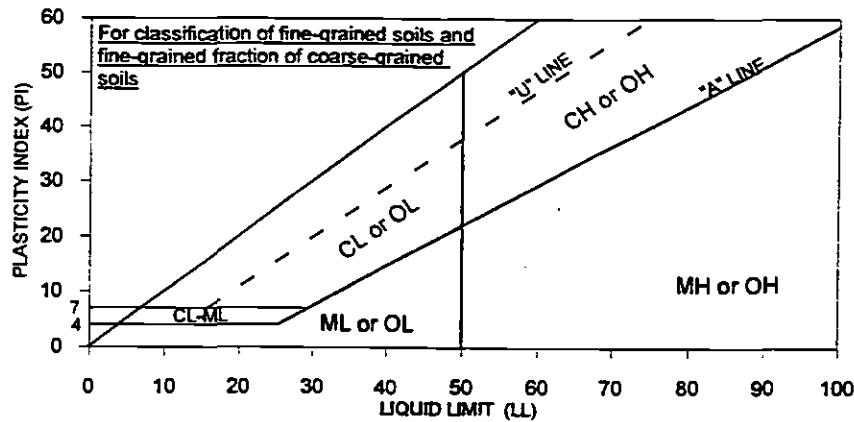


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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318,D422)

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Figure B-4



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13	D-23	88.0	Bag	GM	52:35:13	N/A

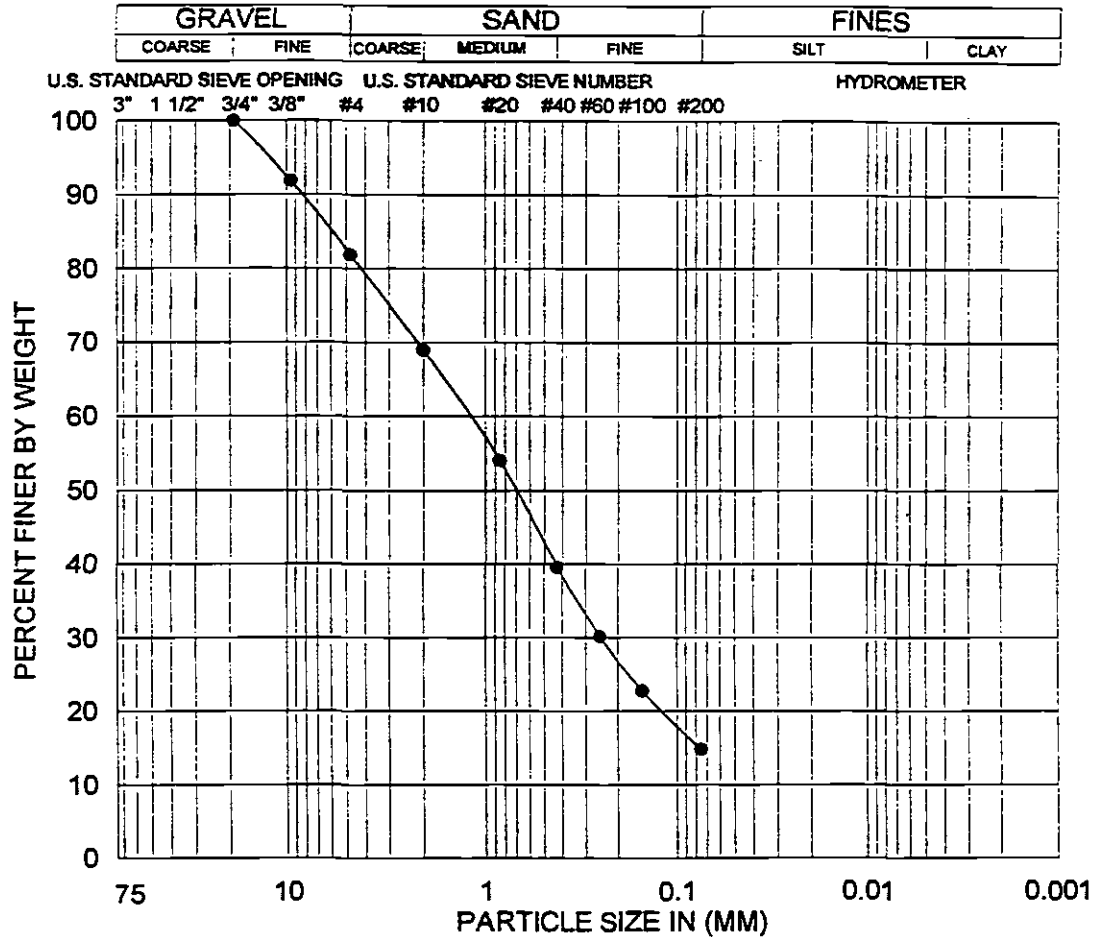
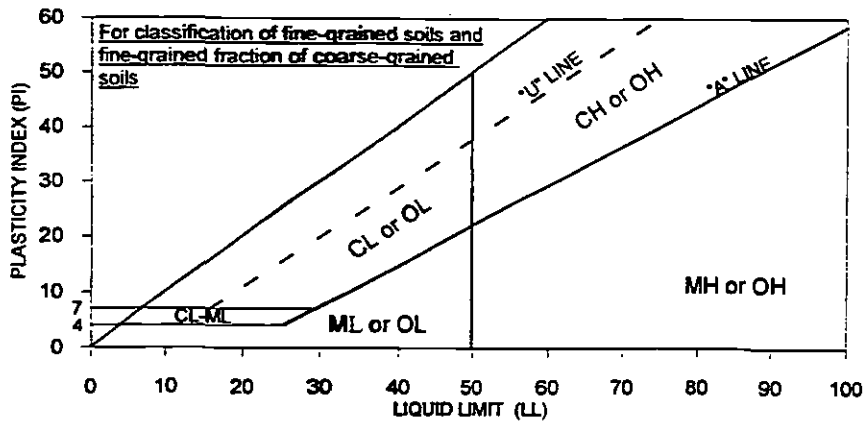
Not enough sample to meet ASTM specification



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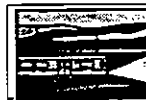
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(ASTM D4318,D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13	S-26	97.0	Bag	SM	18:67:15	N/A

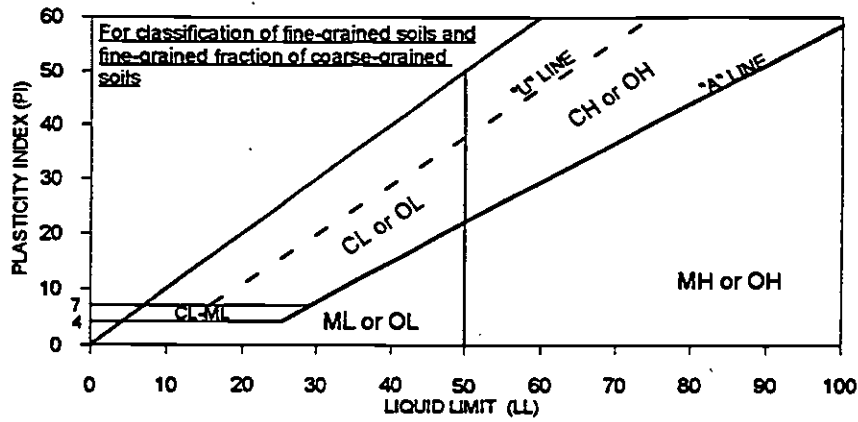
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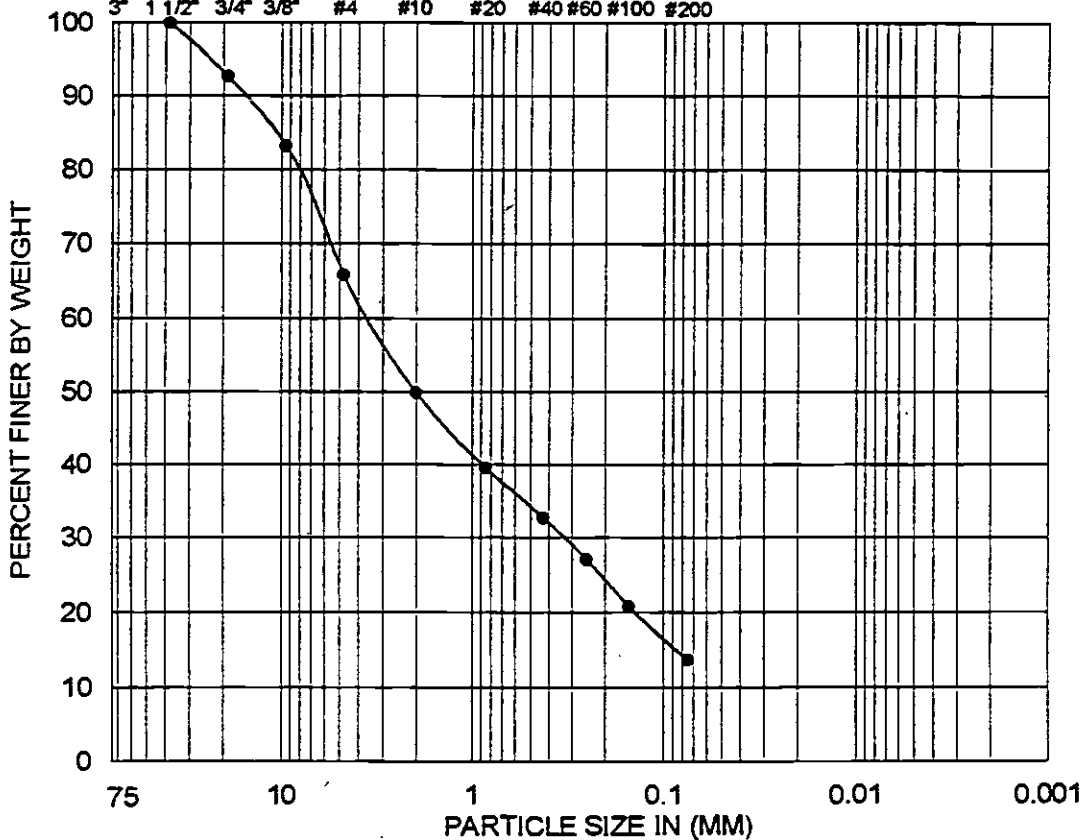
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ATTERBERG LIMITS; PARTICLE-SIZE CURVE
(ASTM D4318,D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER HYDROMETER
 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



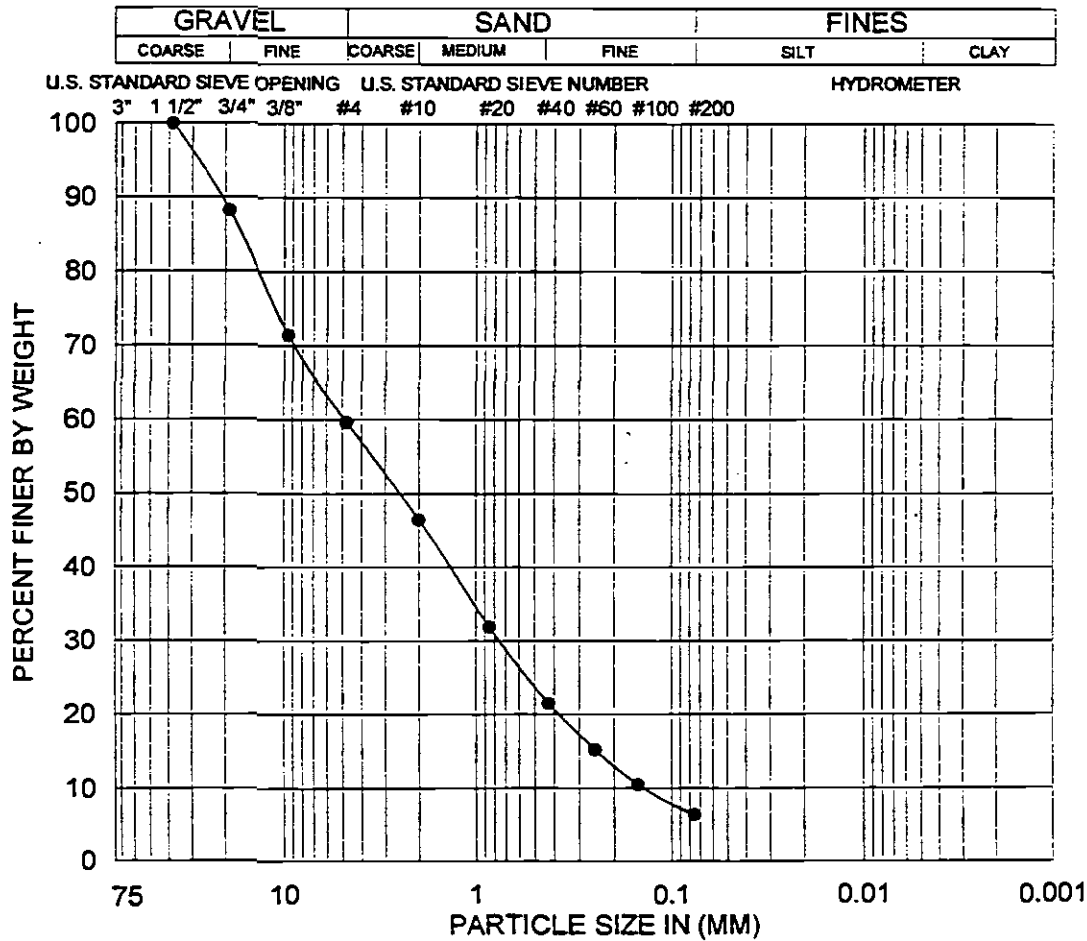
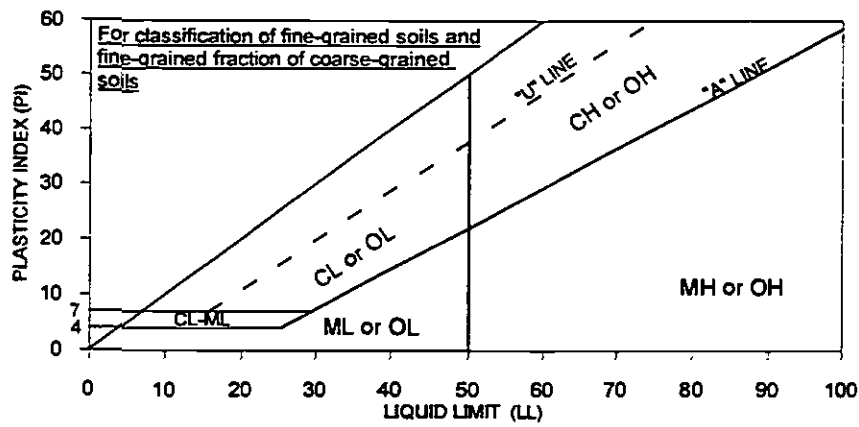
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-13	S-28	105.0	Bag	SM	34:52:14	N/A

Not enough sample to meet ASTM specification



Project No. 95-8347-14
 Eastside Extension
 Metro Redline II

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318, D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13S	S-8	40.0	SP-SM	40:54:6	N/A

Not enough sample to meet ASTM specification



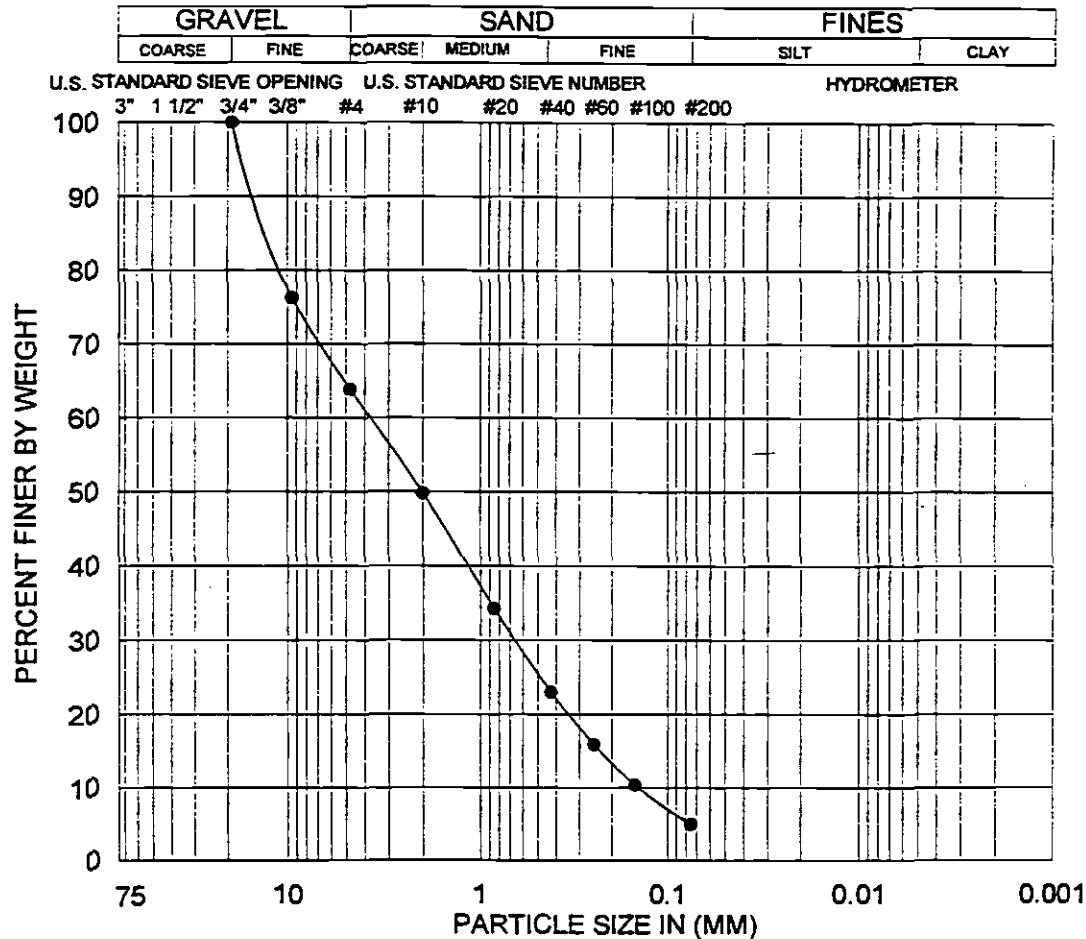
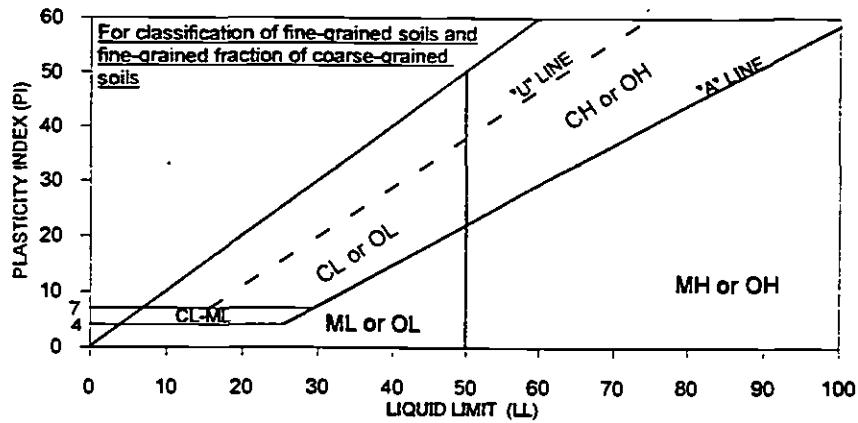
GeoTransit
Consultants

Project No. 95-8347-23
Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

11-95

Figure B-8



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13S	S-11	50.0	SP-SM	36:59:5	N/A

Not enough sample to meet ASTM specification



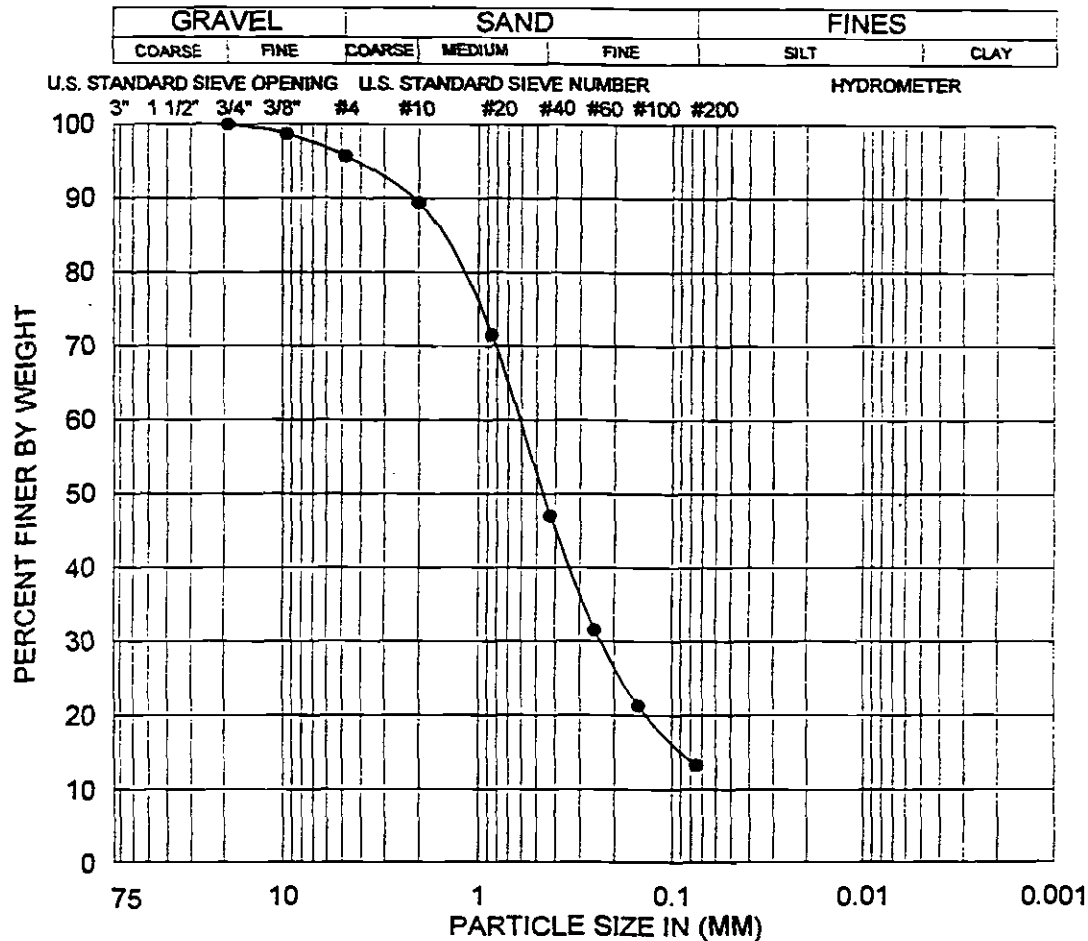
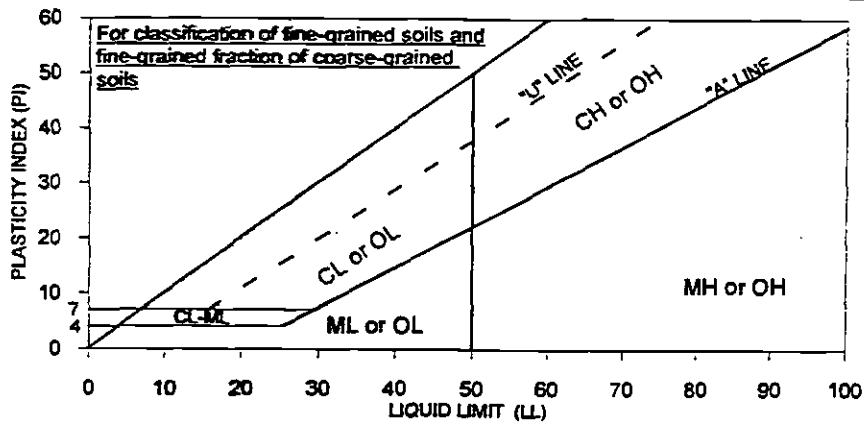
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Consultants

Project No. 95-8347-23
Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-9



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13S	S-17	70.0	SM	4:83:13	N/A

Not enough sample to meet ASTM specification



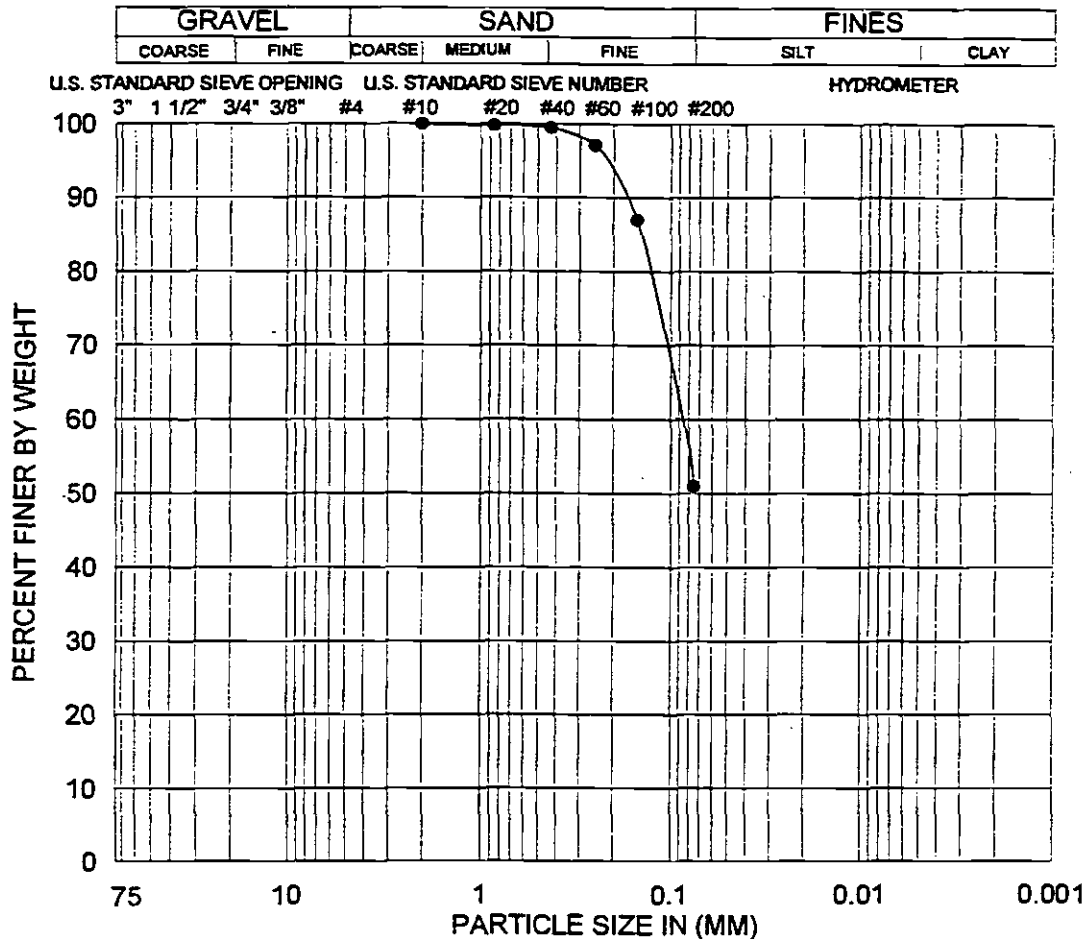
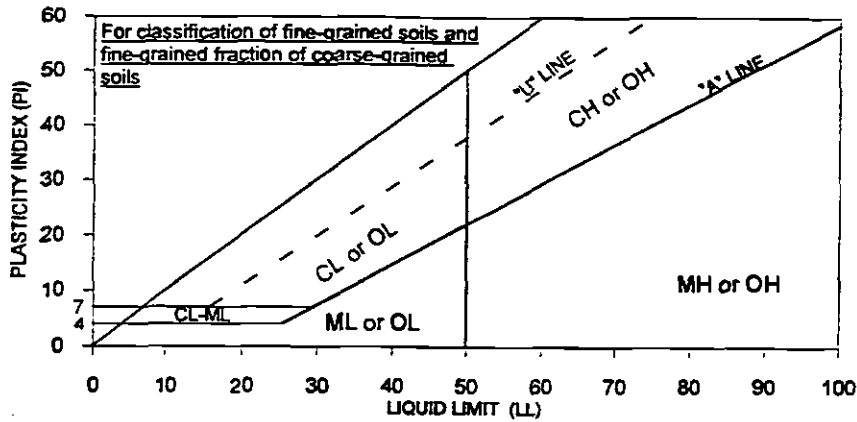
GeoTransit
Consultants

Project No. 95-8347-23
Eastside Extension
Metro Redline III

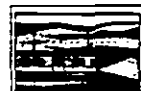
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

11-95

Figure B-10



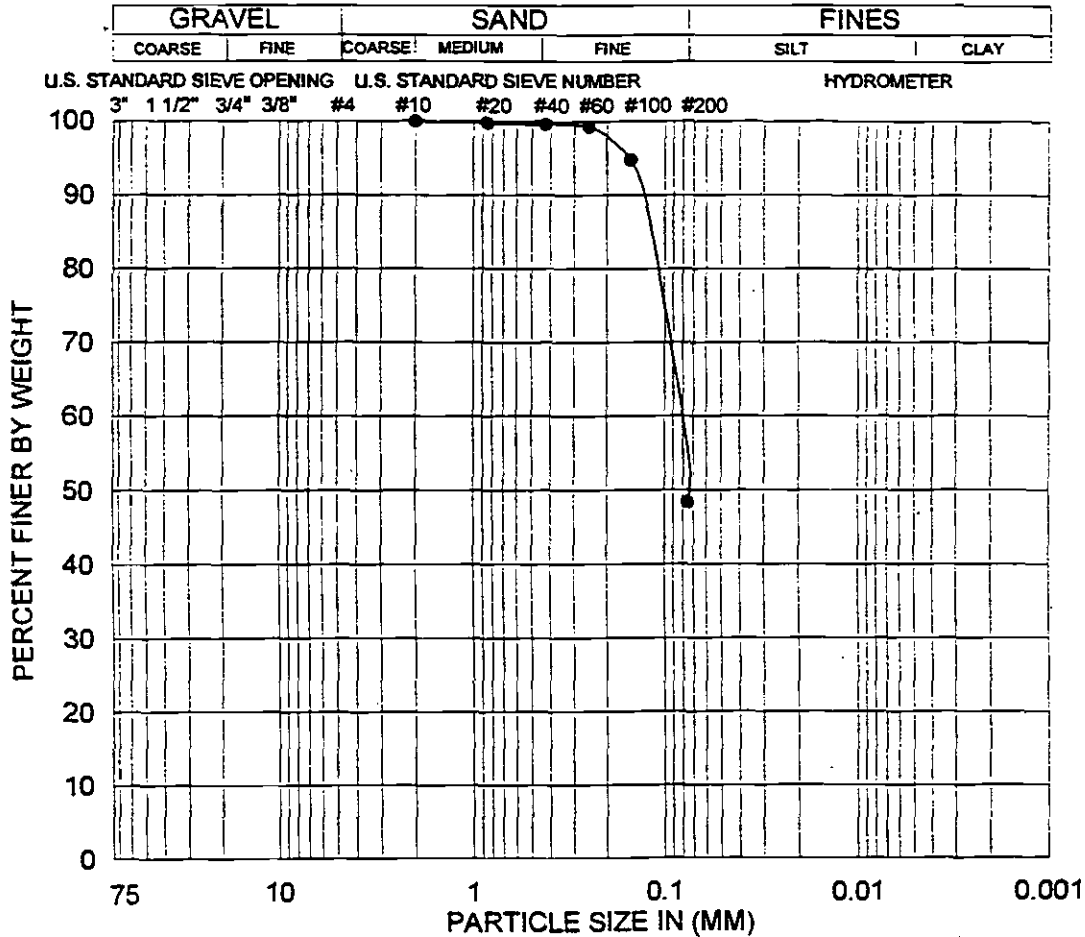
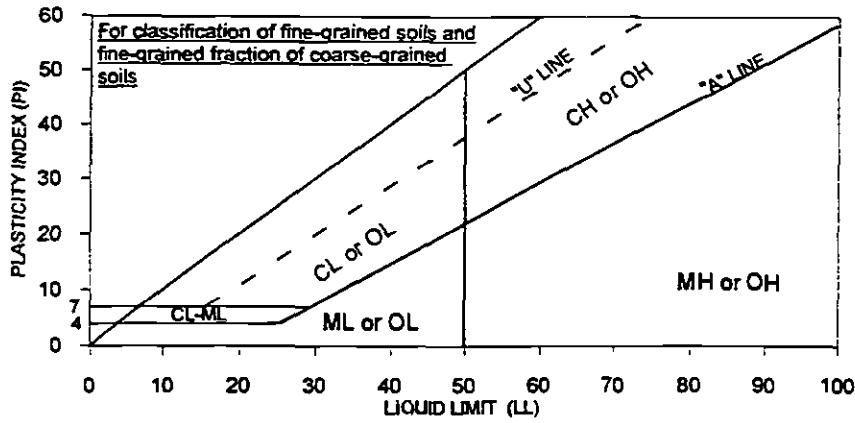
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13S	S-21	83.0	ML	0:49:51	N/A



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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

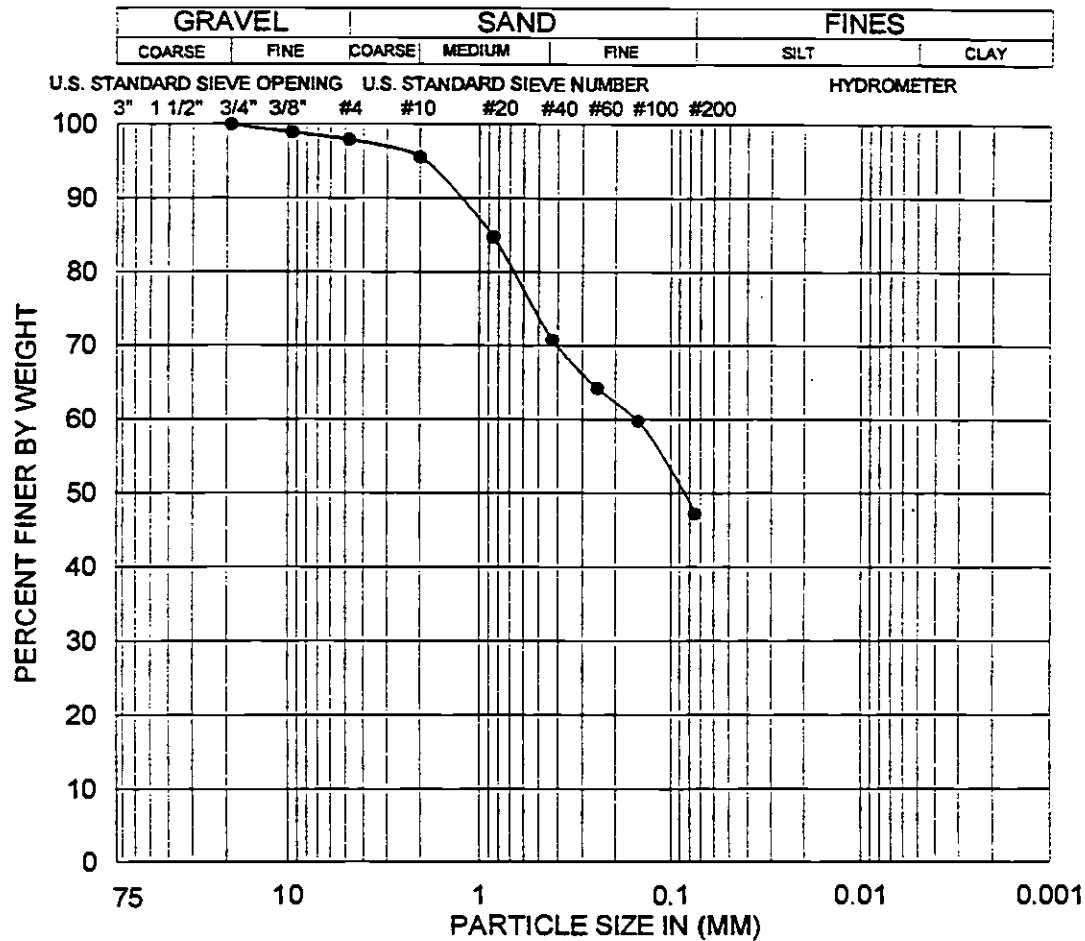
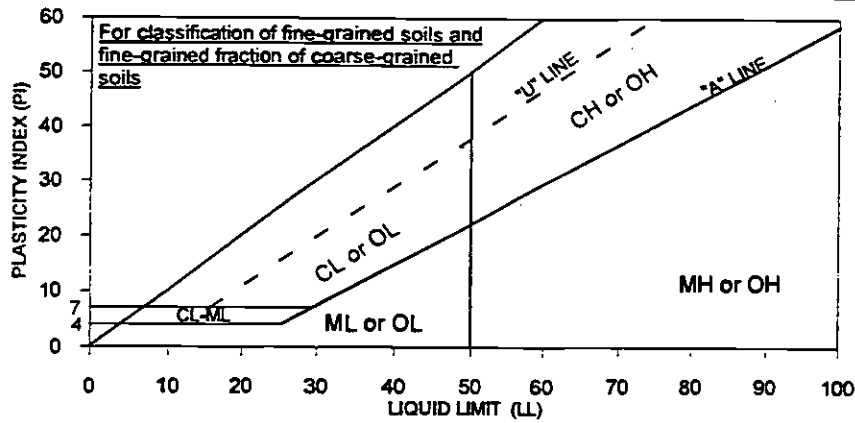


BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13S	S-23	89.0	SM	0:52:48	N/A



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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318,D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-13S	S-25	95.0	SM	2:51:47	N/A

Not enough sample to meet ASTM specification



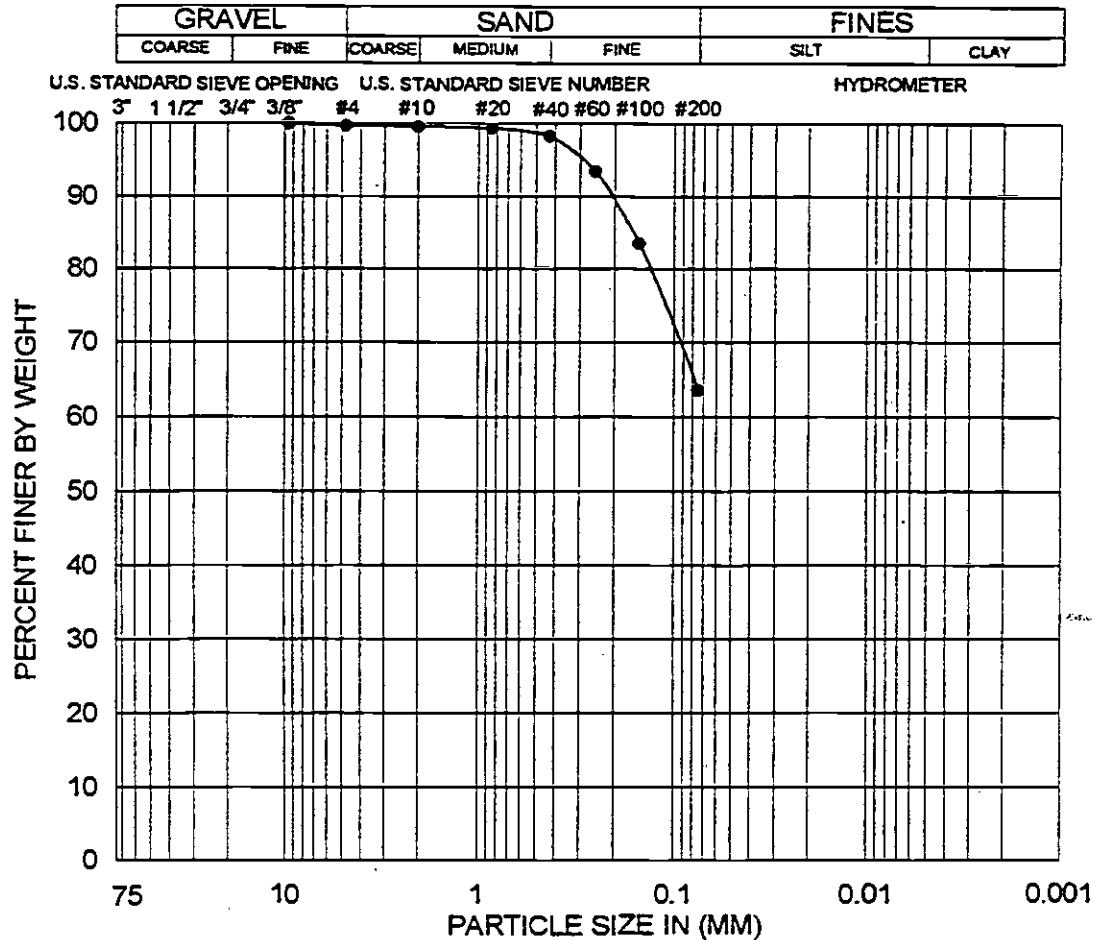
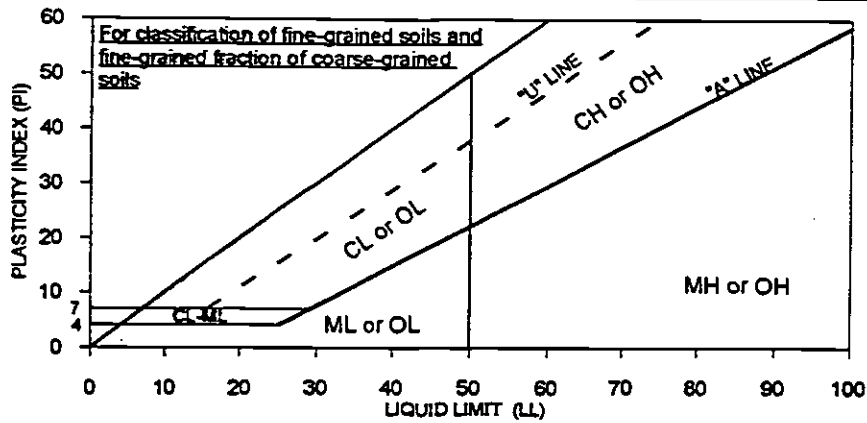
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-13



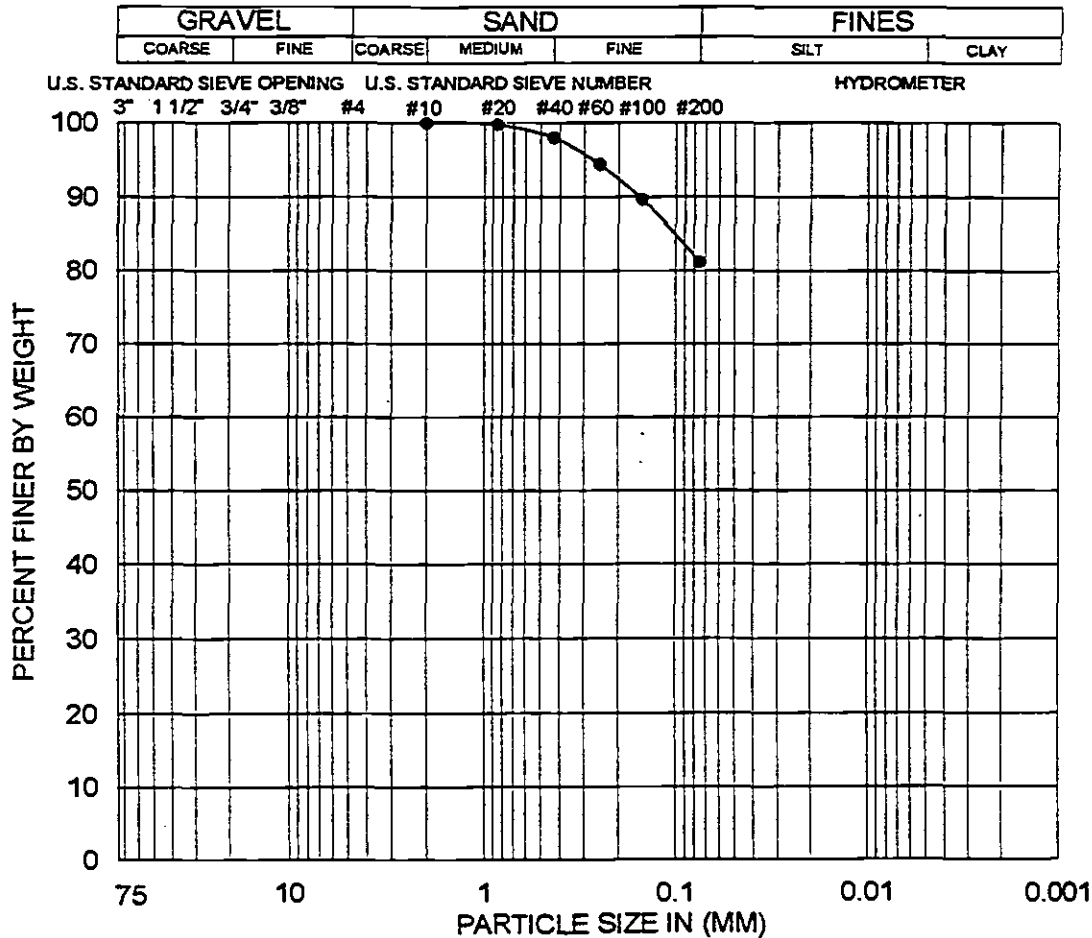
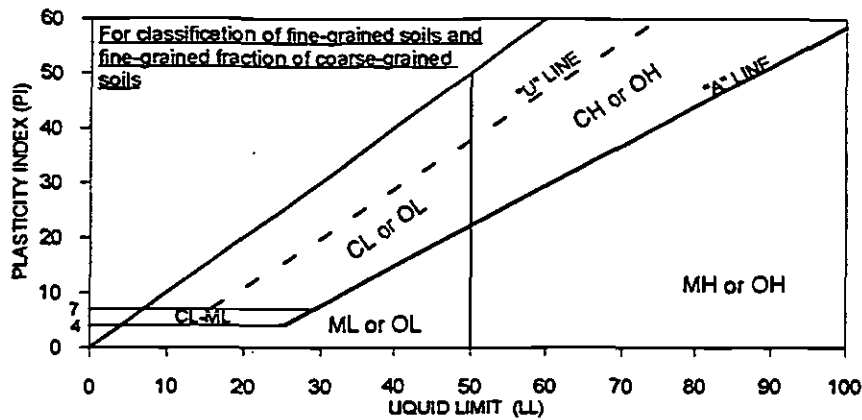
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-14	S-6	26.0	Bag	ML	0:36:64	N/A



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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



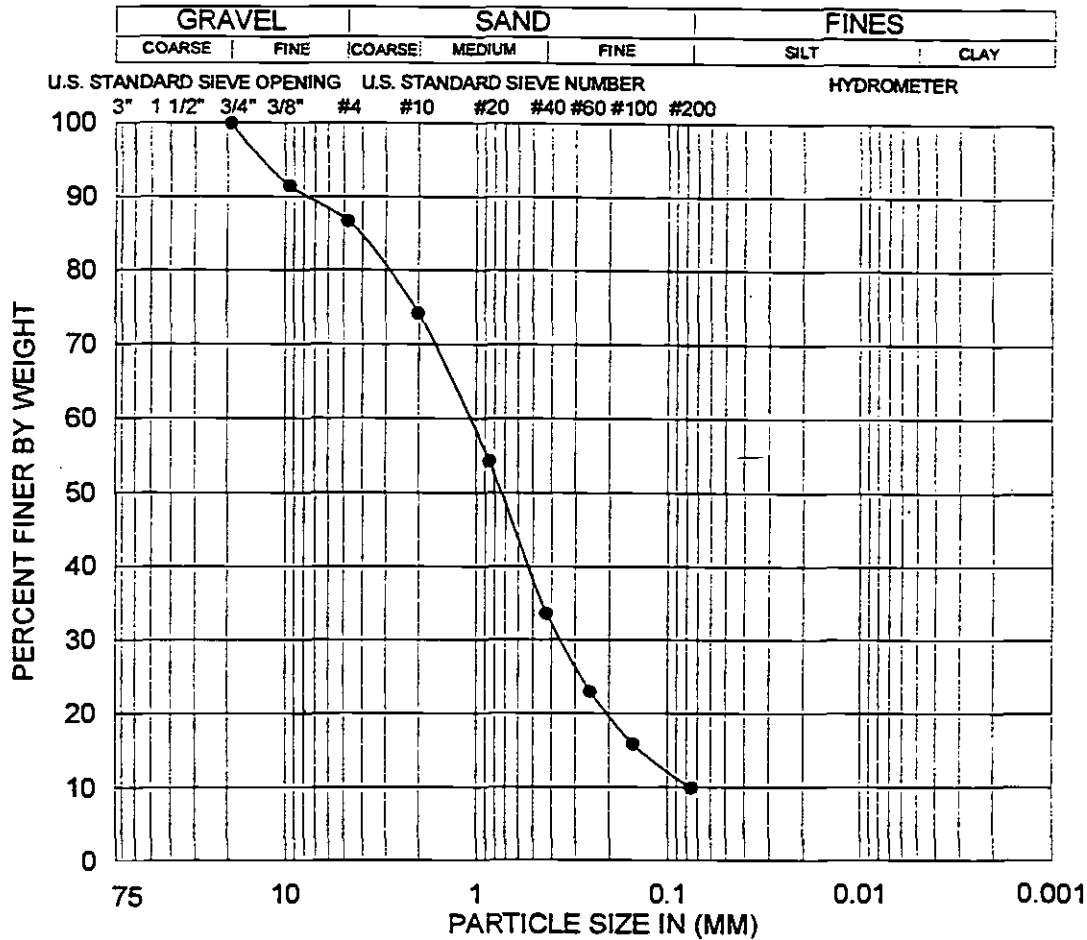
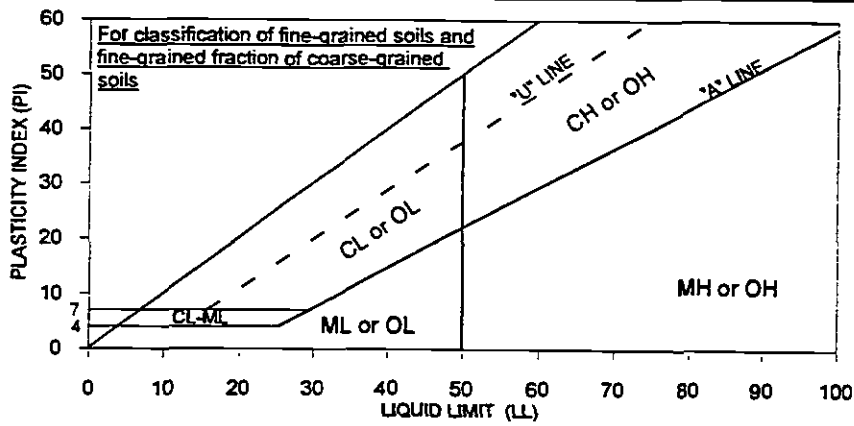
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-14	S-8	32.0	Bag	ML	0:19:81	N/A



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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR-SA-FI (%)	LL,PL,PI
DD-14	S-10	38.0	Bag	SW-SM	13:77:10	N/A

Not enough sample to meet ASTM specification

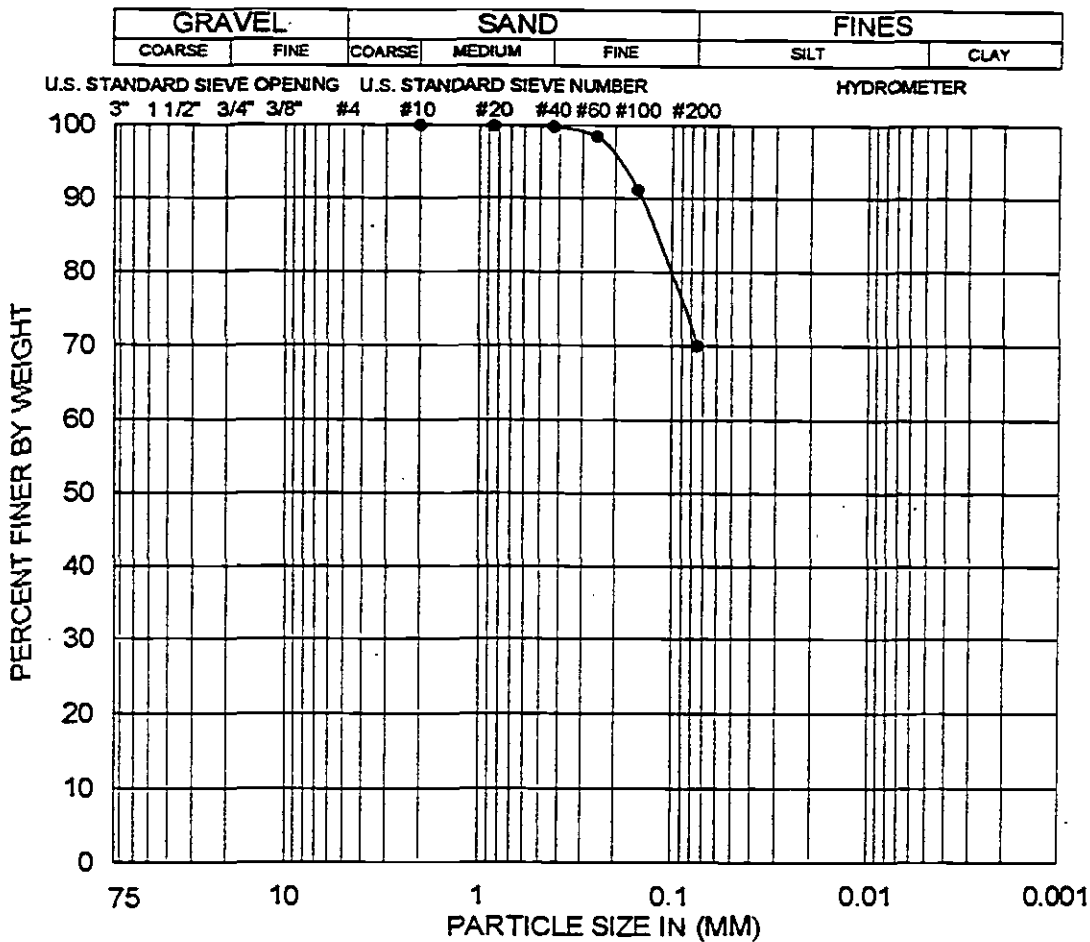
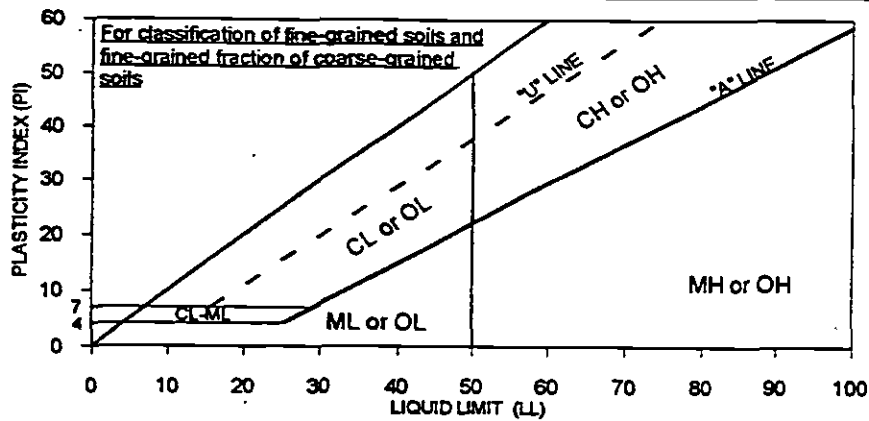


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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-16



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-14	S-12	44.0	Bag	ML	0:30:70	N/A



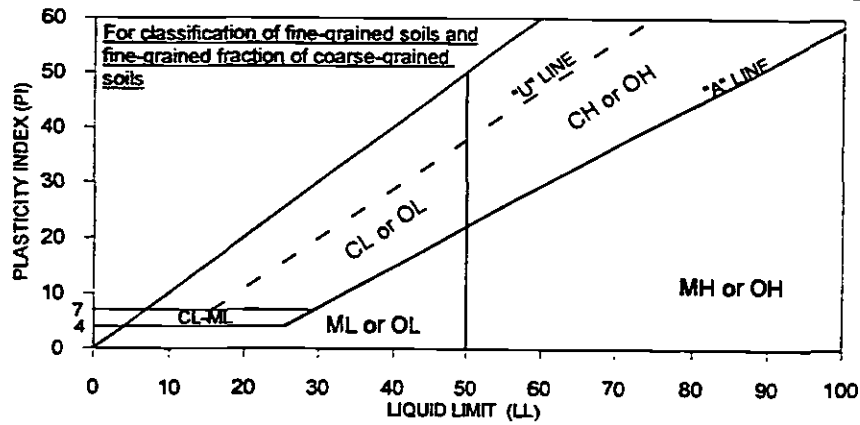
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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

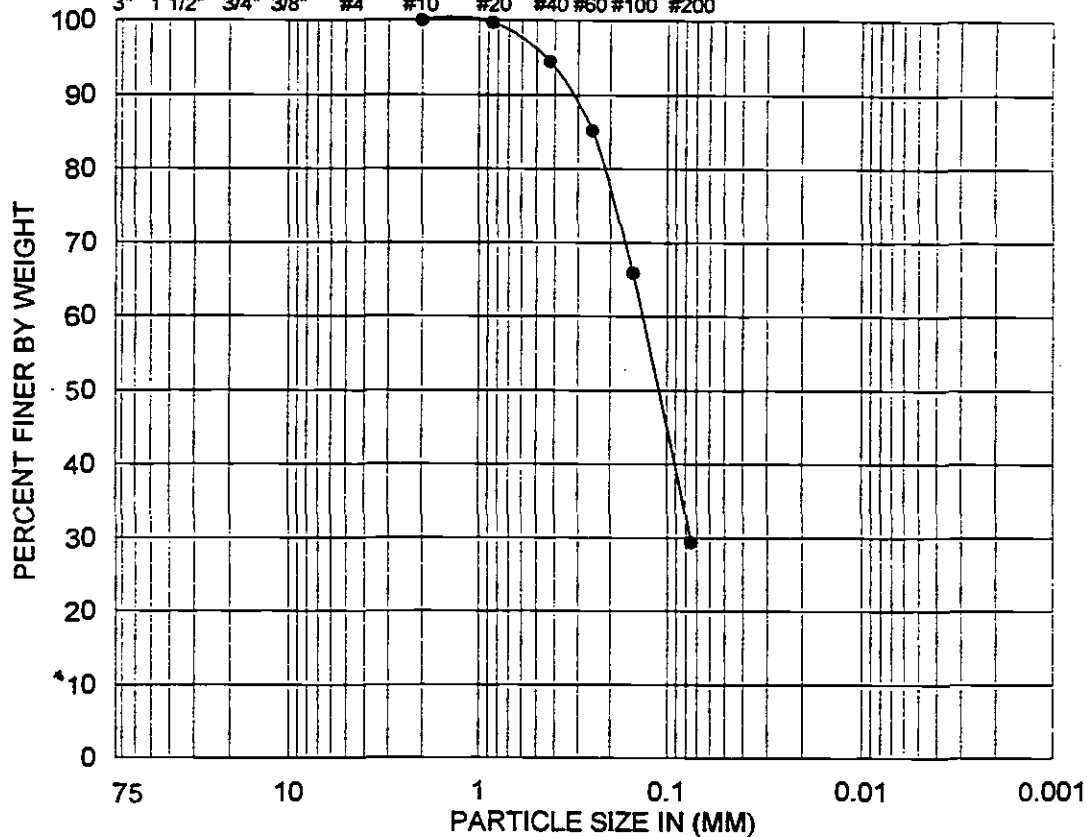
11-95

Figure B-17

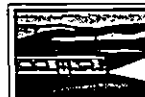


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



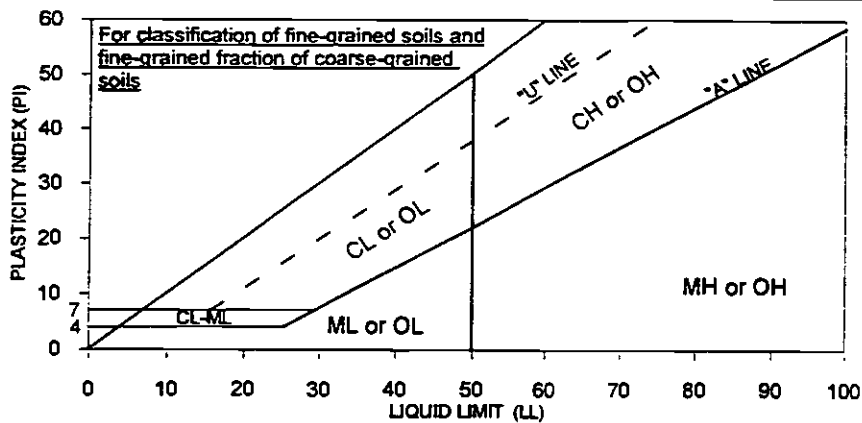
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-14	S-14	50.0	Bag	SM	0:71:29	N/A



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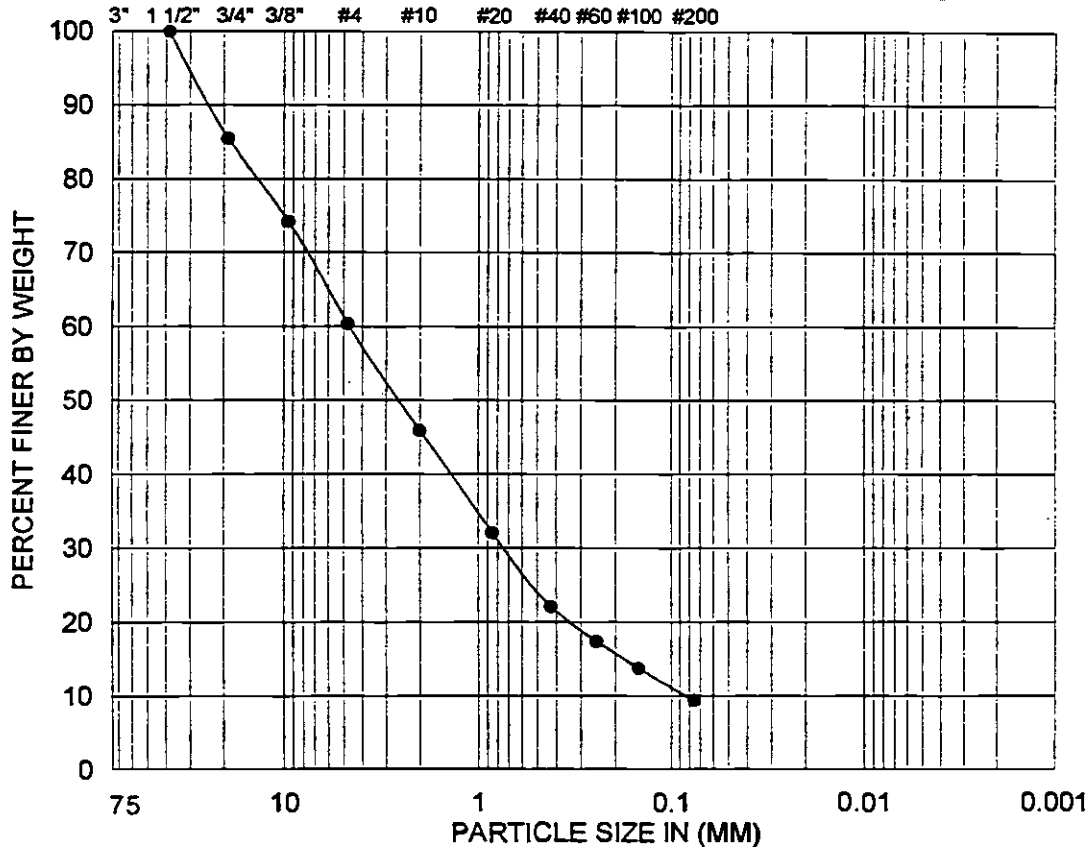
Project No. 95-8347-23
**Eastside Extension
Metro Redline III**

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER HYDROMETER



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-14	S-16	56.0	Bag	SW-SM	40:51:9	N/A

Not enough sample to meet ASTM specification



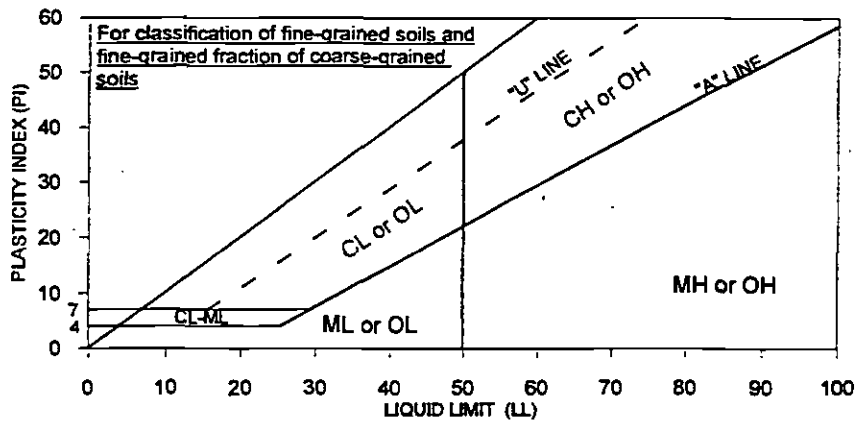
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Eastside Extension
Metro Redline III

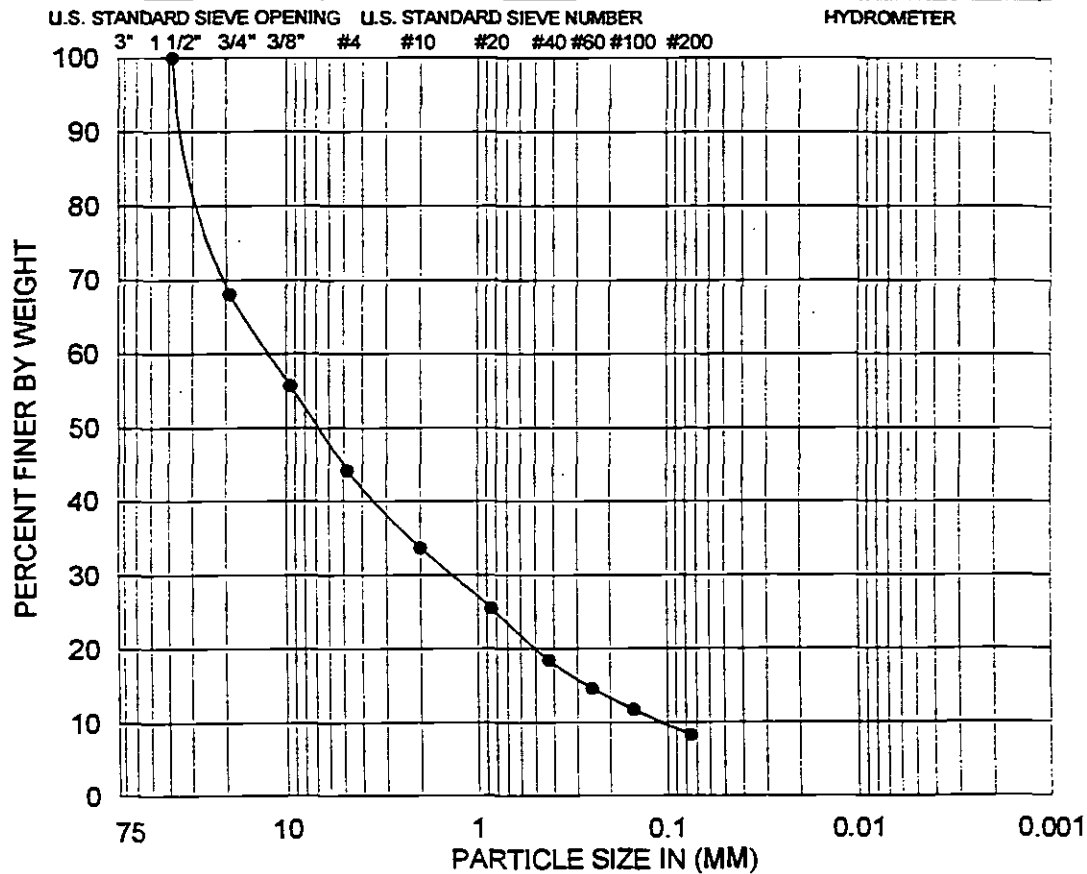
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-19



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-14	S-18	62.0	Bag	GW-GM	56:36:8	N/A

Not enough sample to meet ASTM specification



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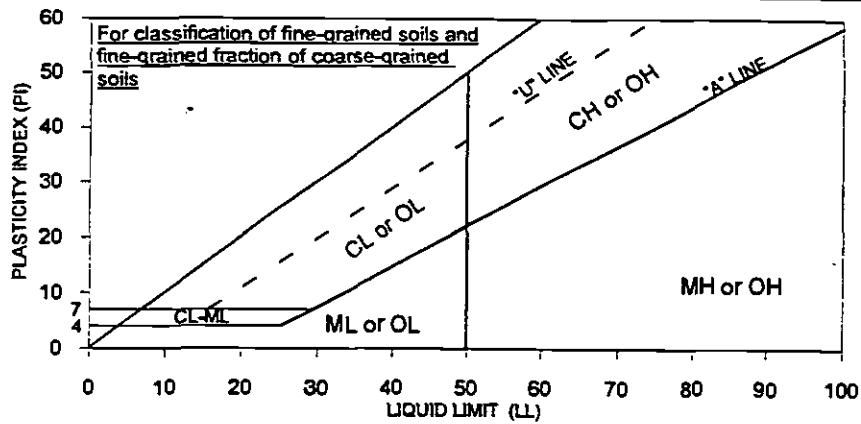
Project No. 95-8347-23

Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-20

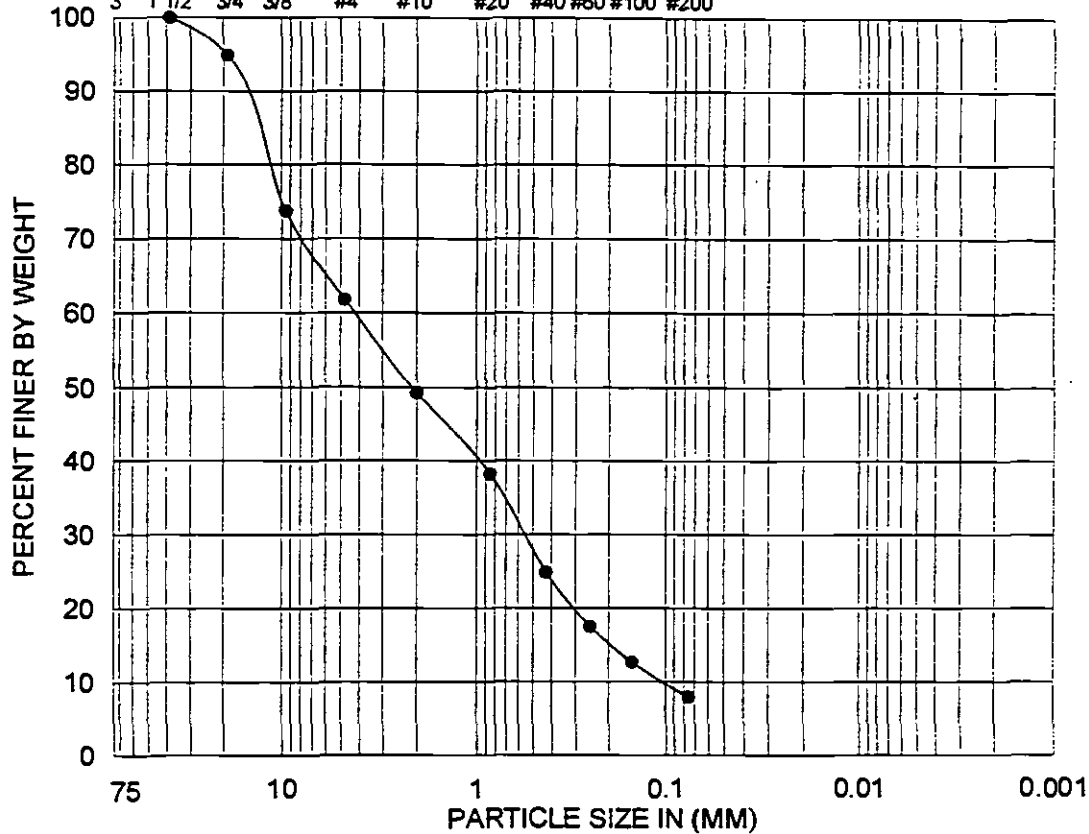


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200

U.S. STANDARD SIEVE NUMBER

HYDROMETER



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-15	S-8	36.0	Bag	SP-SM	38:54:8	N/A

Not enough sample to meet ASTM specification



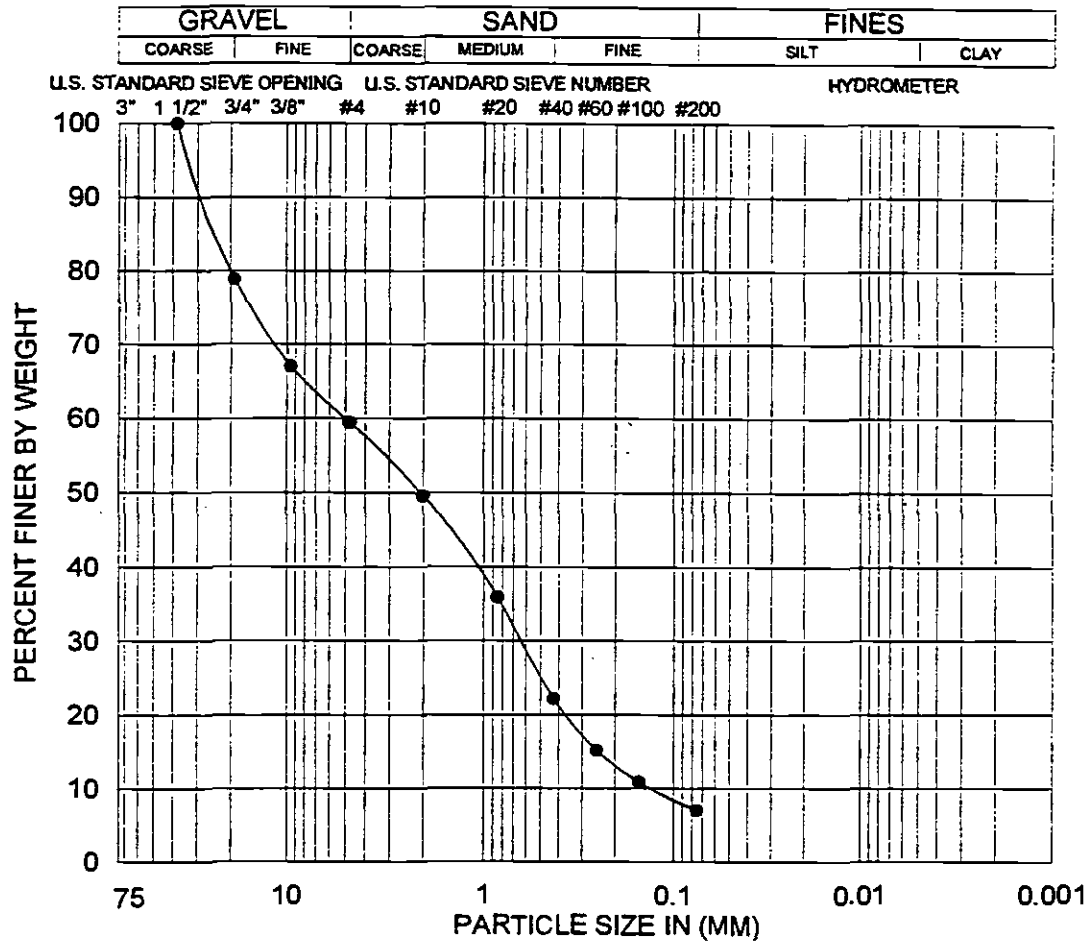
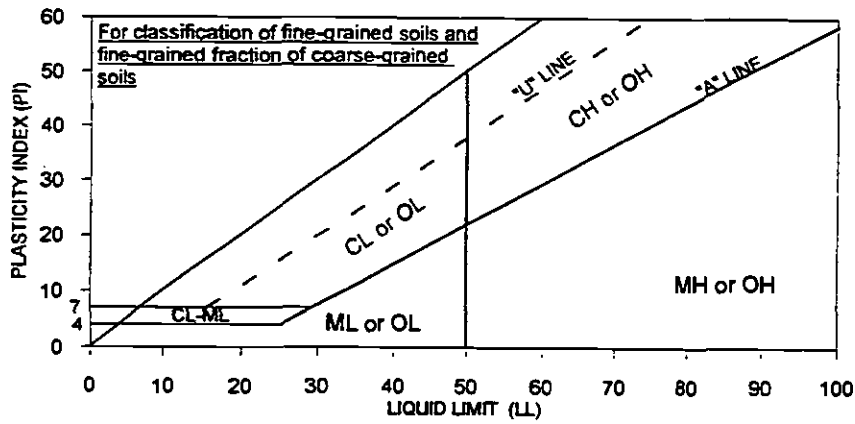
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-21



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-15	S-10	42.0	Bag	SP-SM	40:53:7	N/A

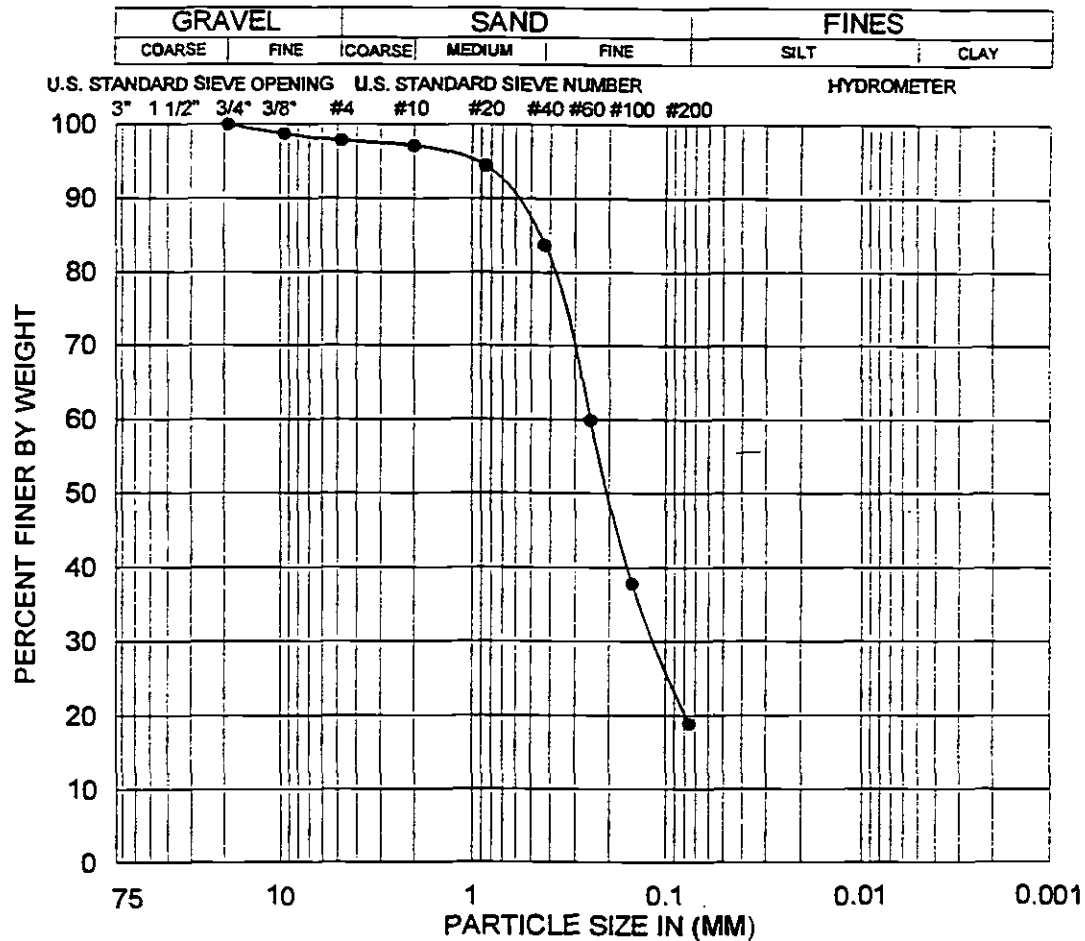
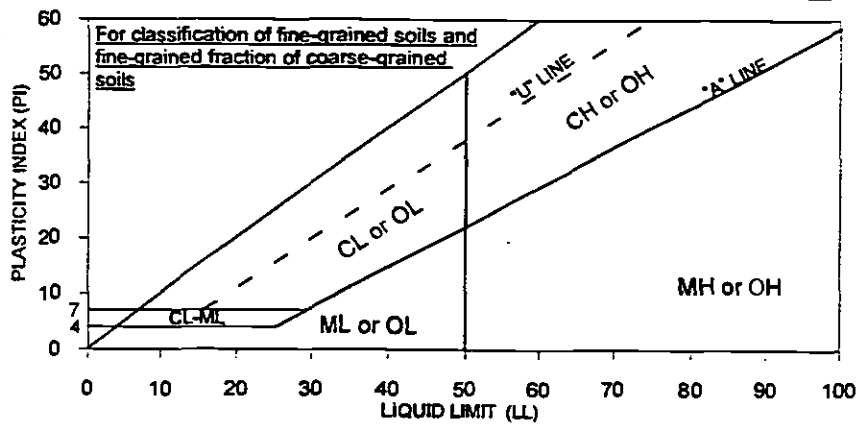
Not enough sample to meet ASTM specification



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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-15	S-12	47.0	Bag	SM	2:79:19	N/A

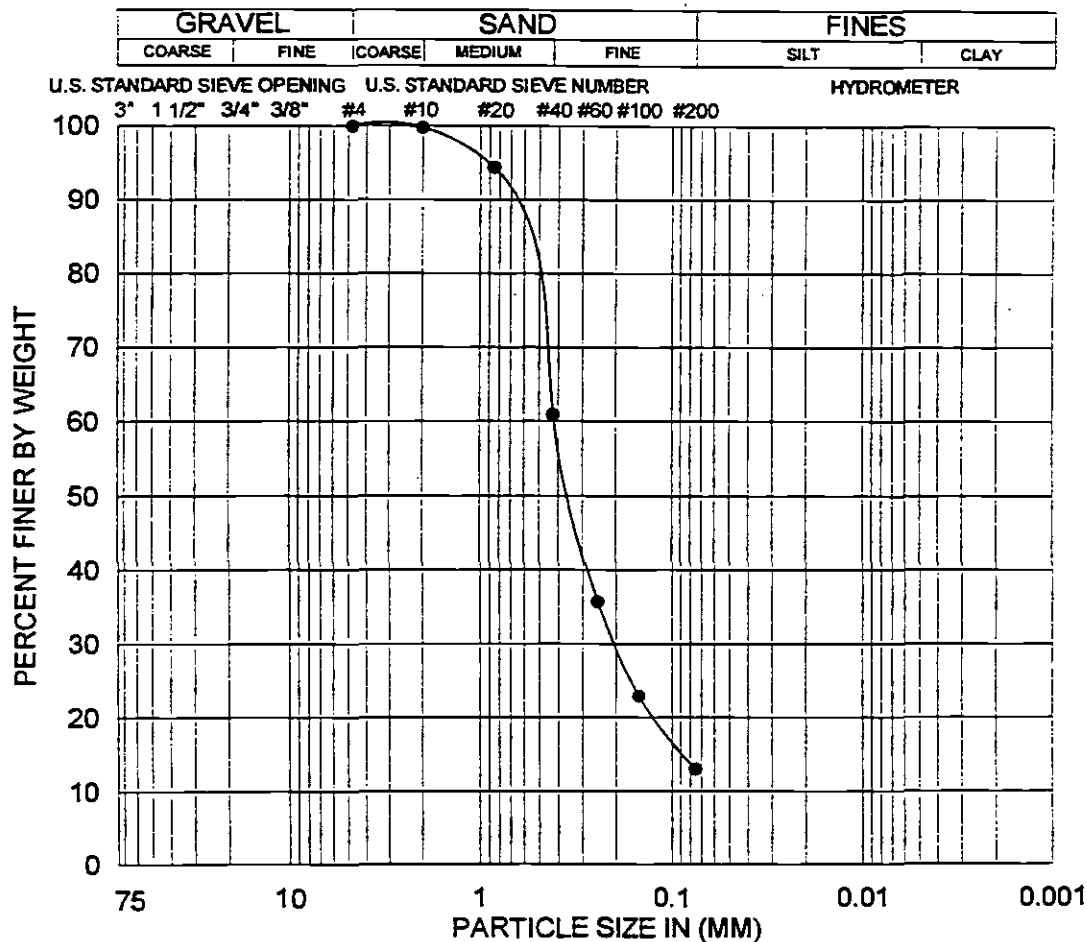
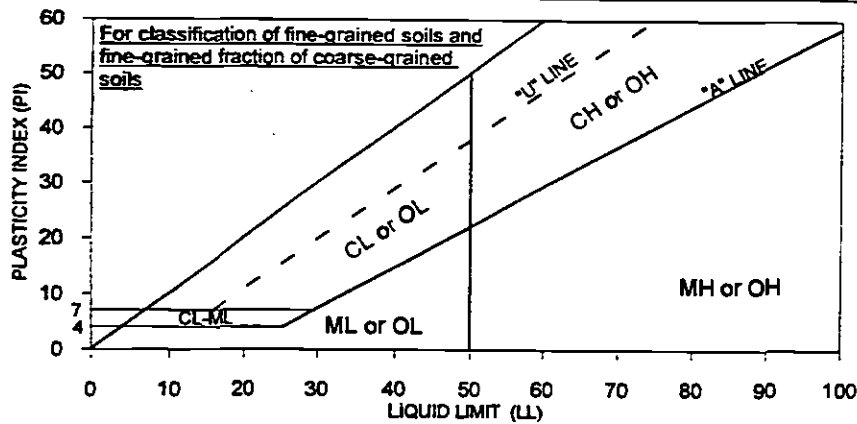
Not enough sample to meet ASTM specification



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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



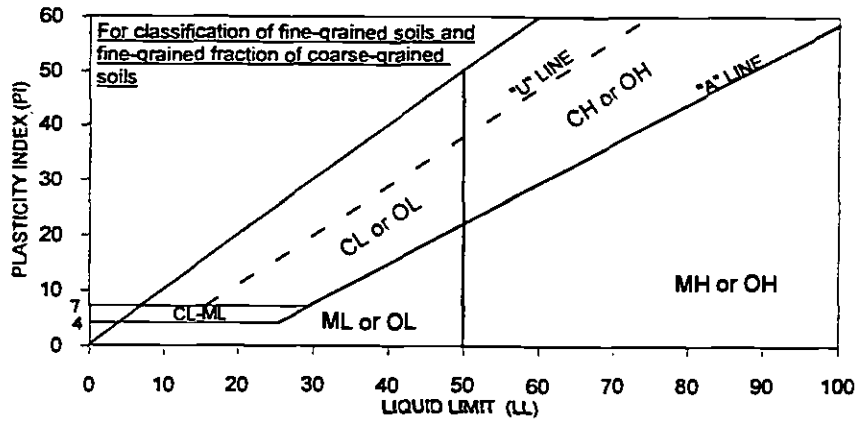
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-15	S-14	54.0	Bag	SM	0:87:13	N/A



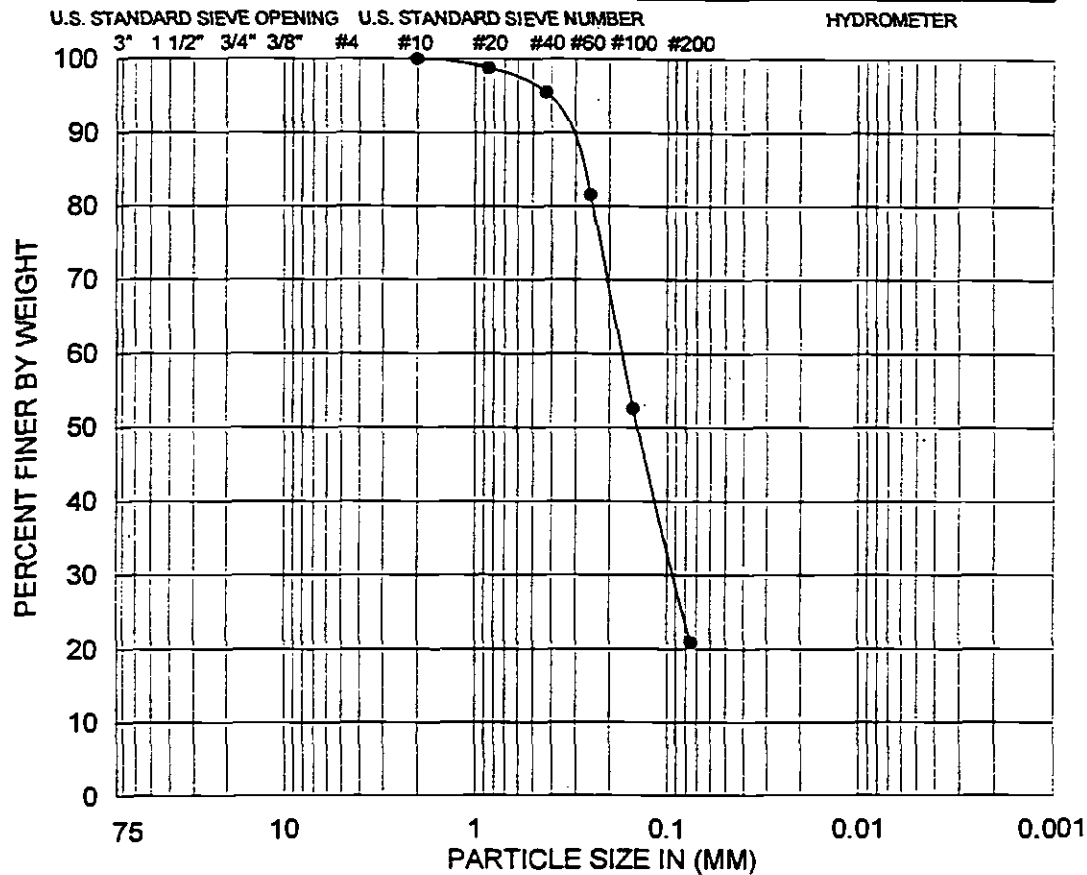
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

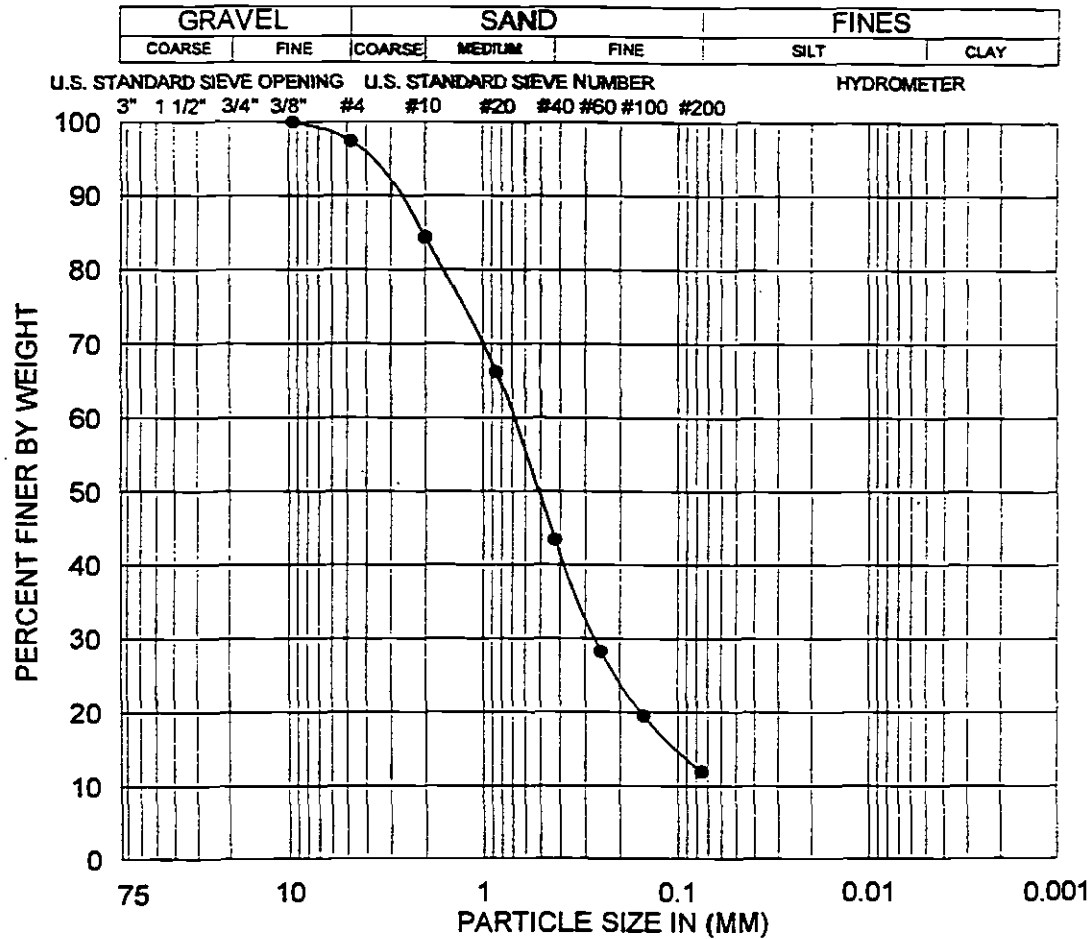
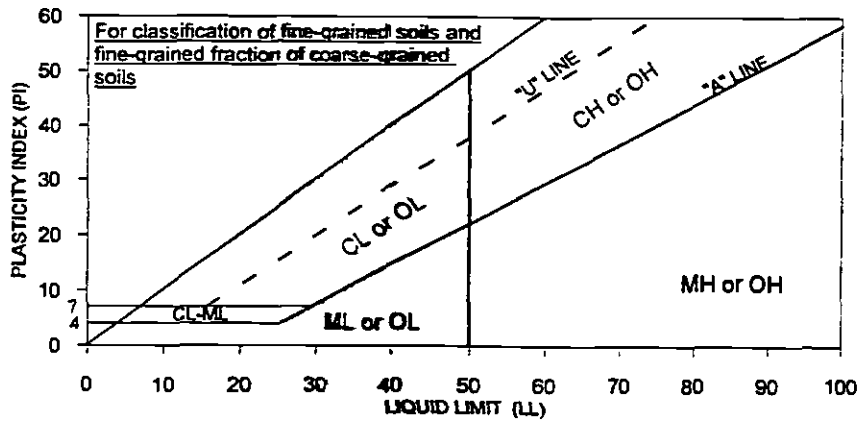


BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-15	S-16	59.0	Bag	SM	0:79:21	N/A



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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318,D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-15	S-18	65.0	Bag	SW-SM	3:85:12	N/A



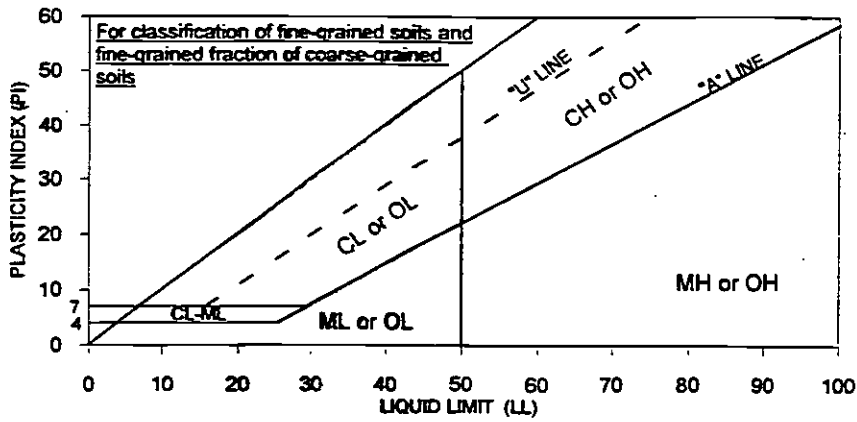
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Eastside Extension
Metro Redline III

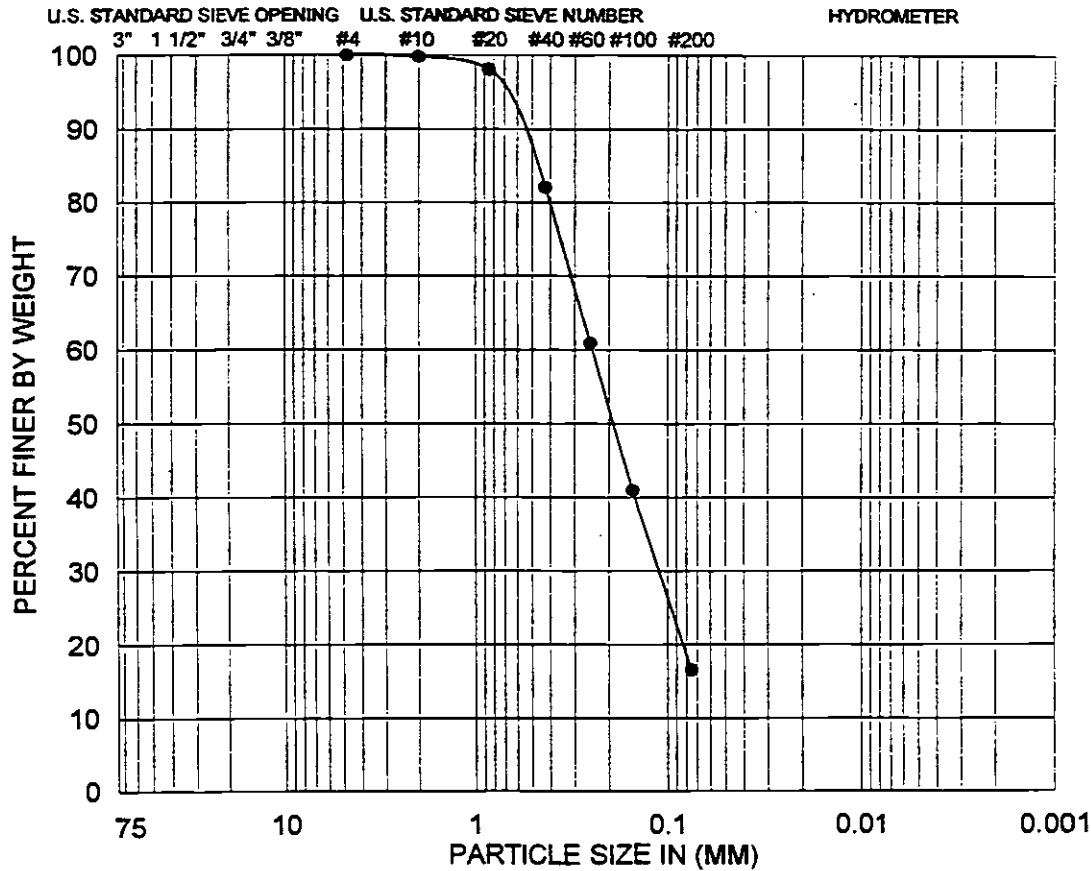
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

11-95

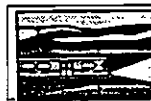
Figure B-26



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-15	S-22	77.0	Bag	SM	0:83:17	N/A



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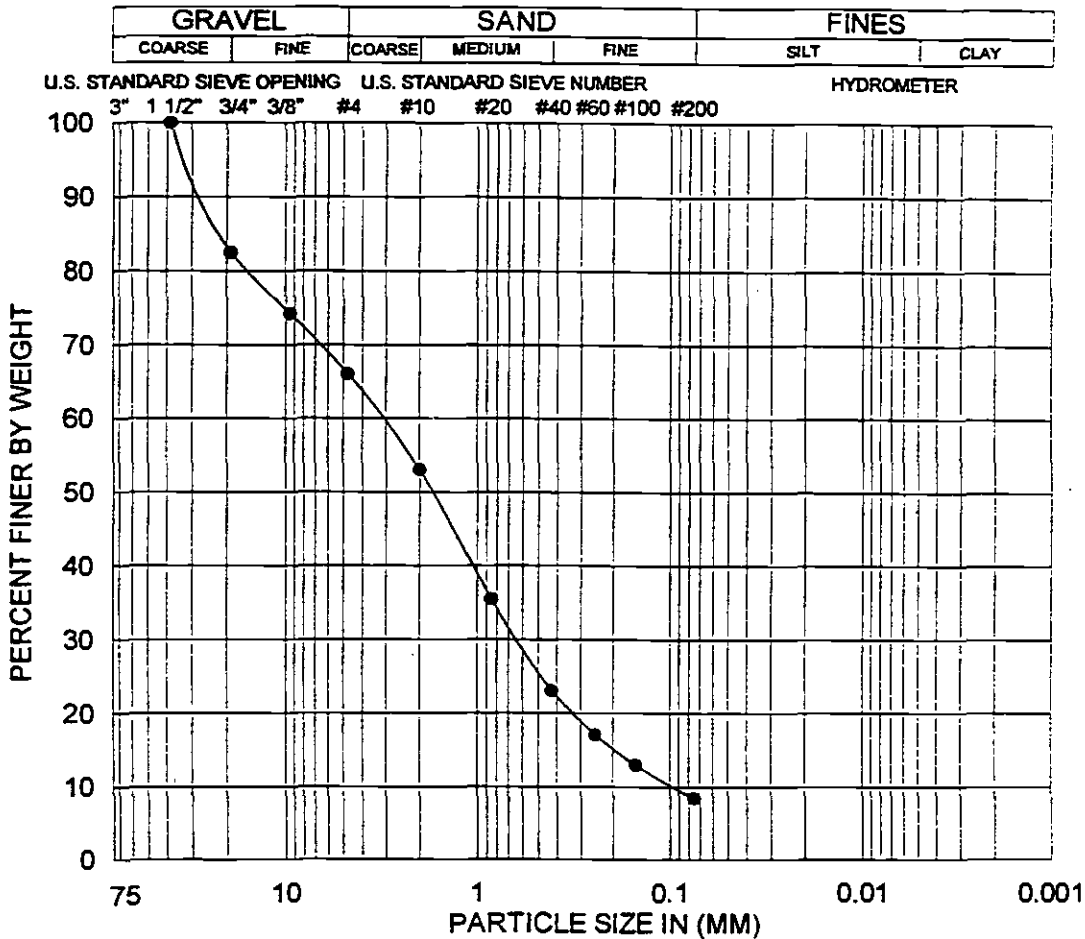
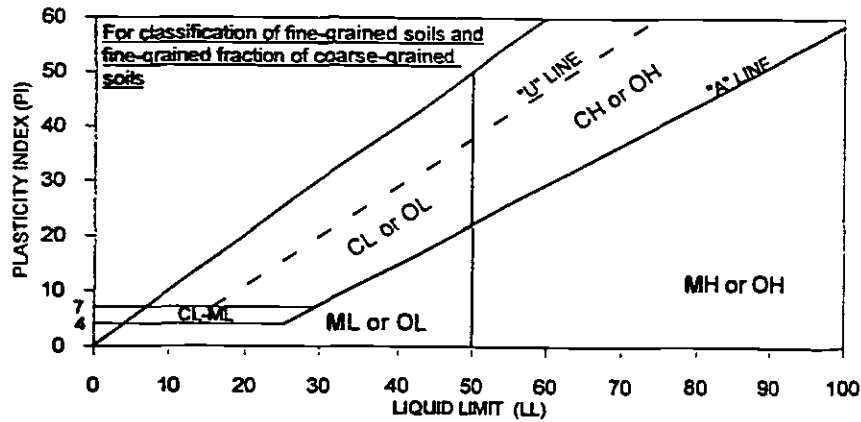
Project No. 95-8347-23

Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

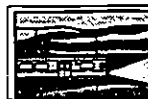
11-95

Figure B-27



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-15	S-24	85.0	Bag	SW-SM	34:57:9	N/A

Not enough sample to meet ASTM specification



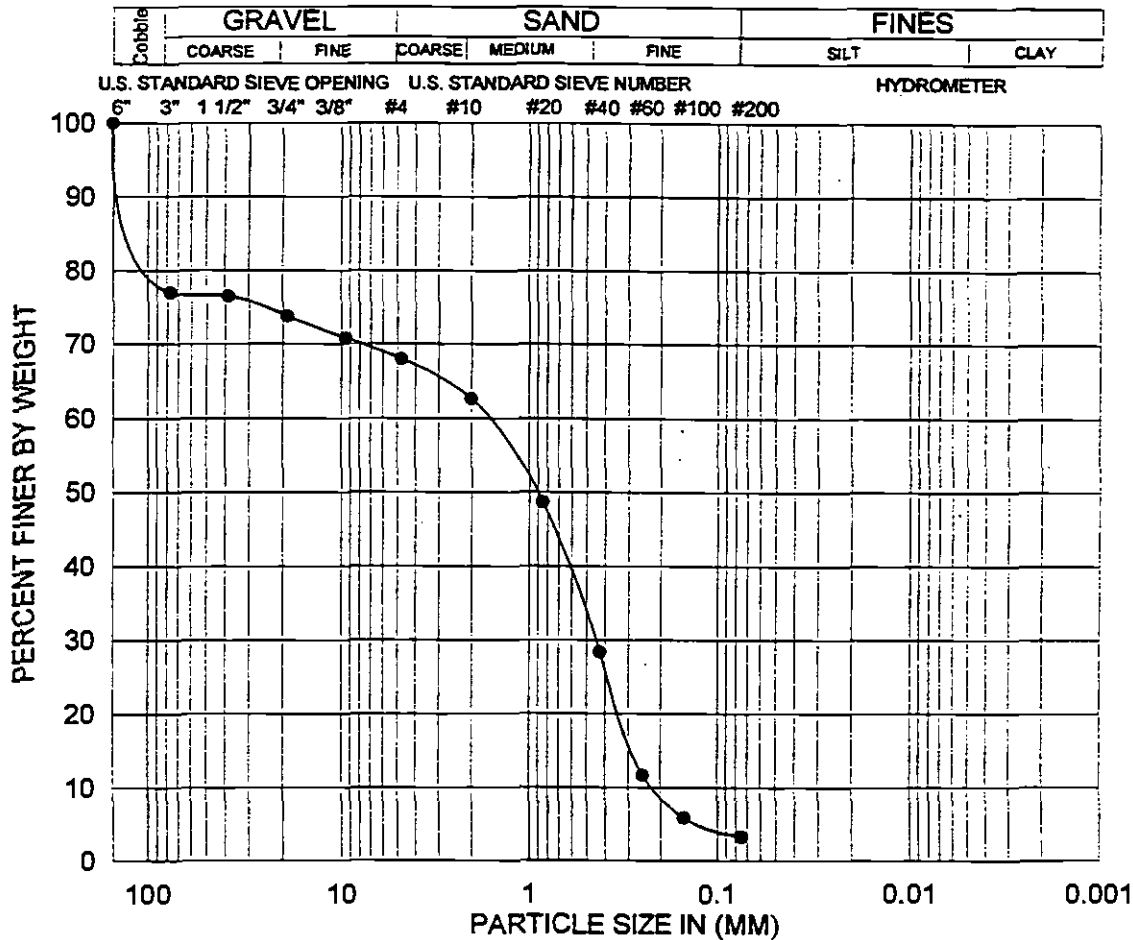
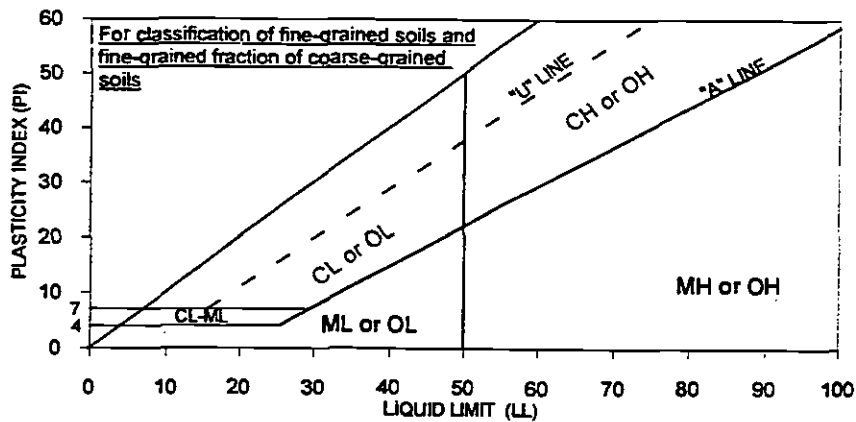
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-28

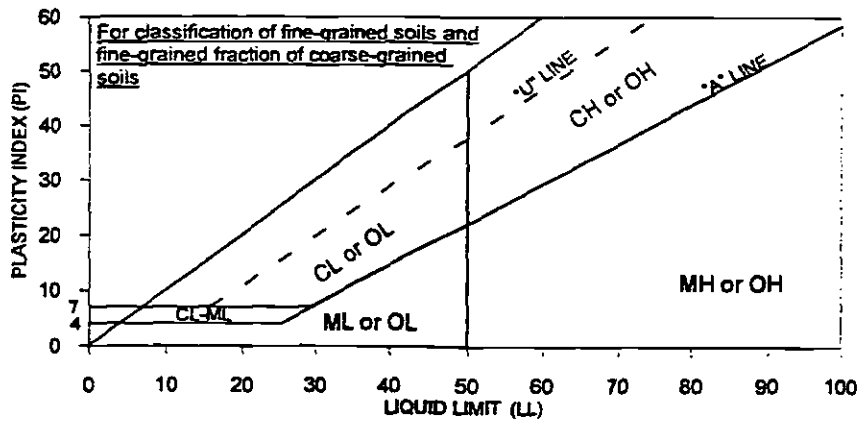


BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-16	B-3	10.0	SP	32:65:3	N/A

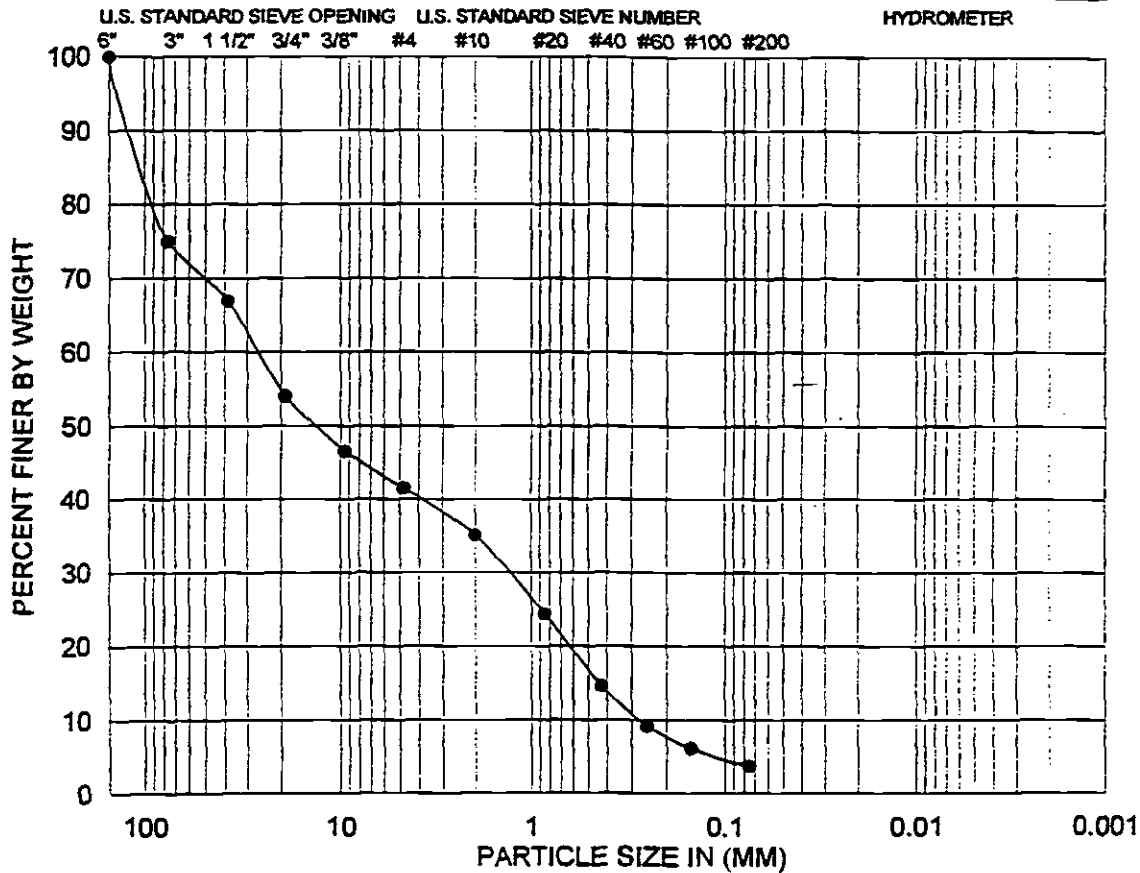


Project No. 95-8347-23
 Eastside Extension
 Metro Redline III

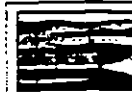
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318,D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



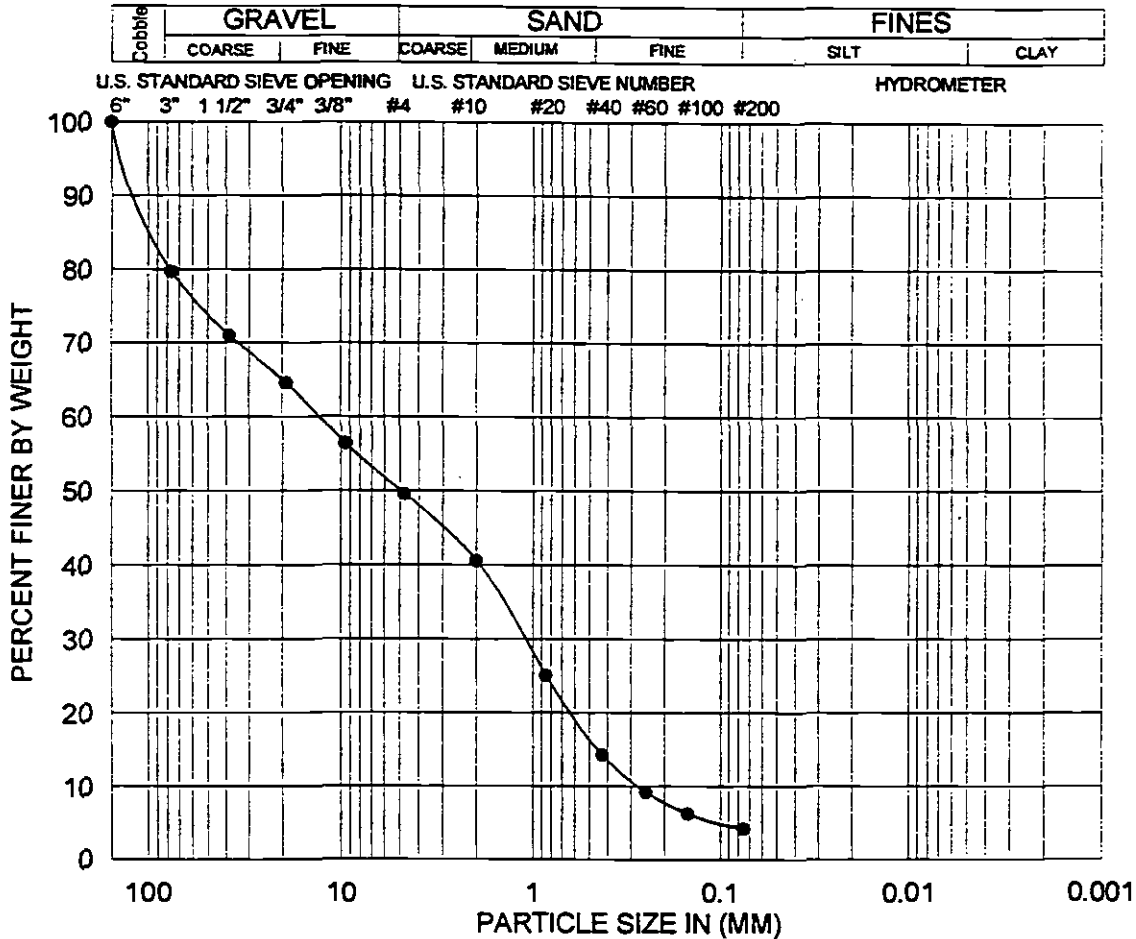
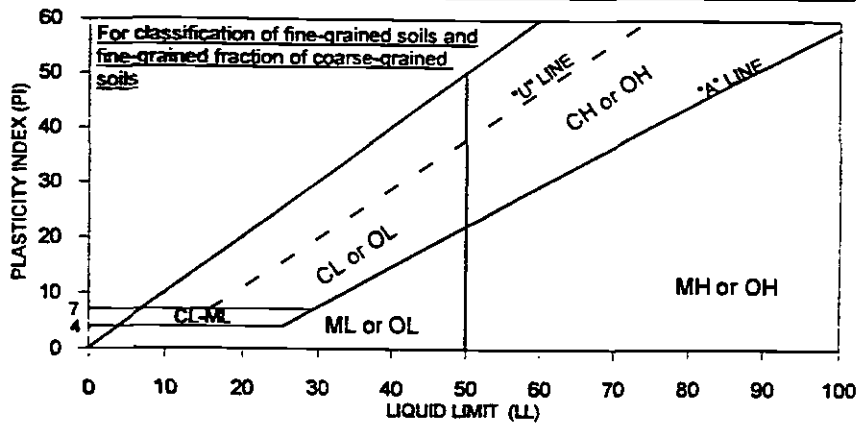
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-16	B-4	15.0-17.5	GP	58:38:4	N/A



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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

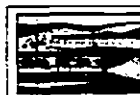
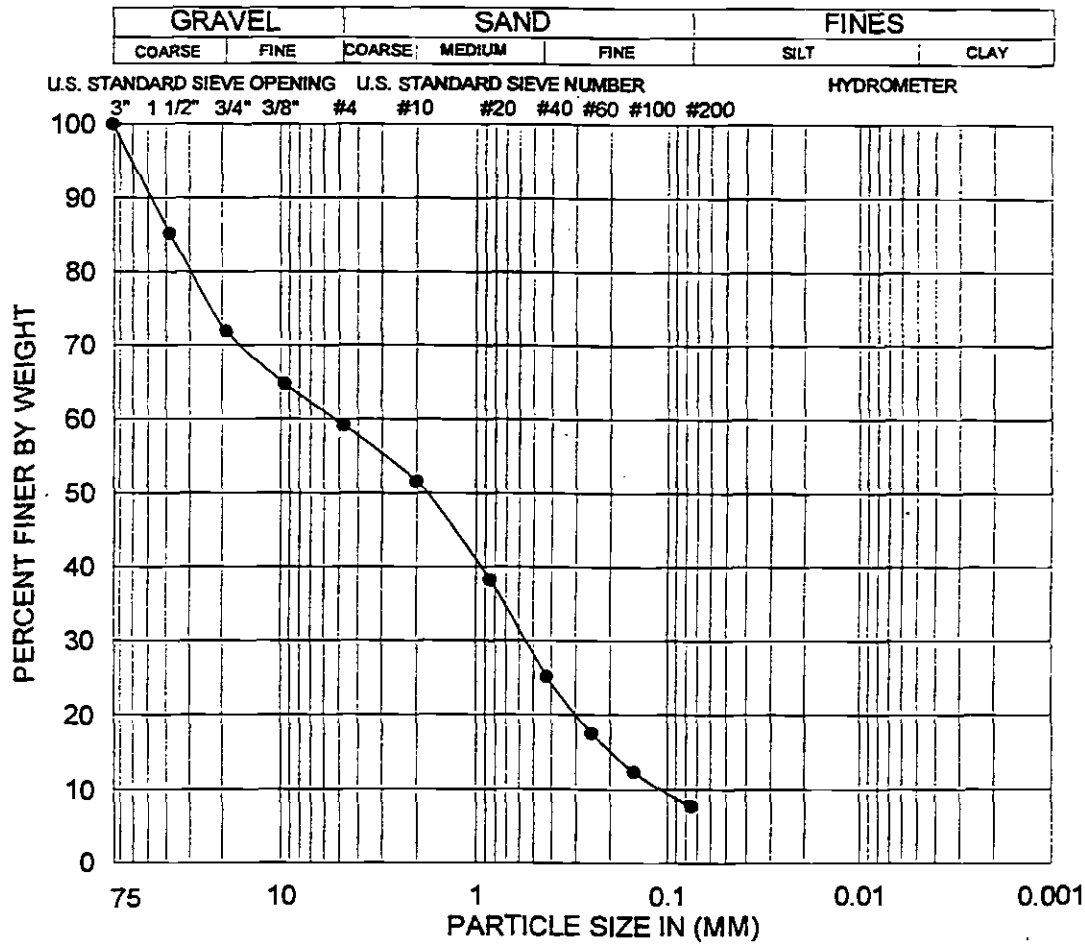
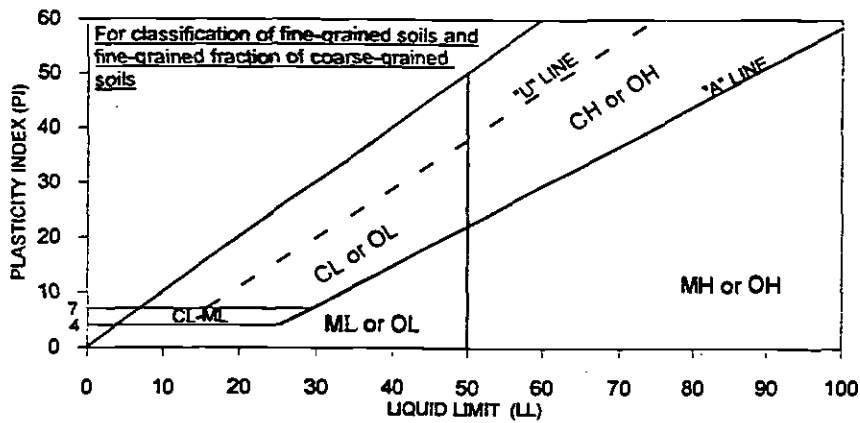


BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-16	B-5	20.0	GP	50:46:4	N/A



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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



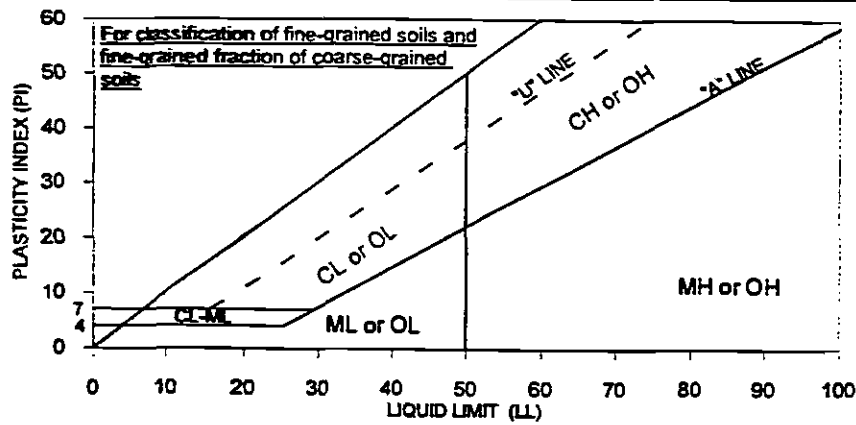
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Metro Redline III

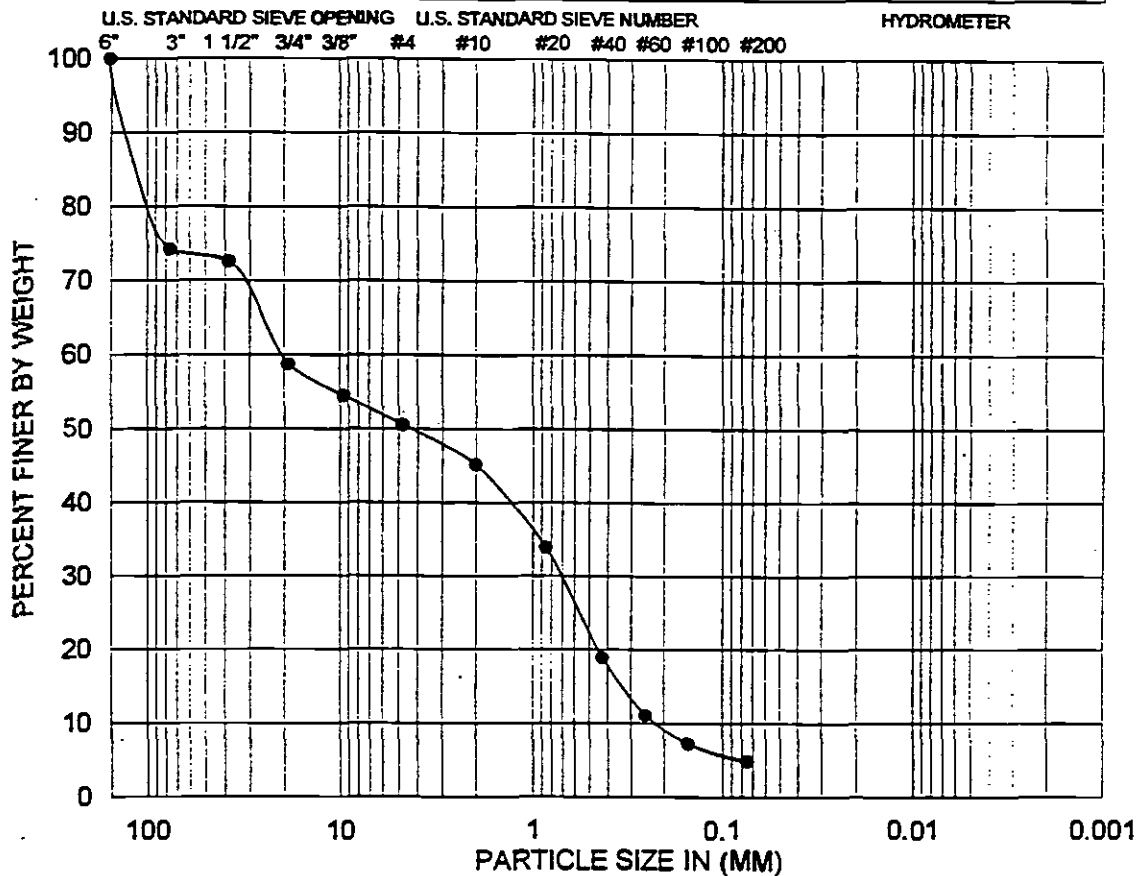
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

12-95

Figure B-30



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



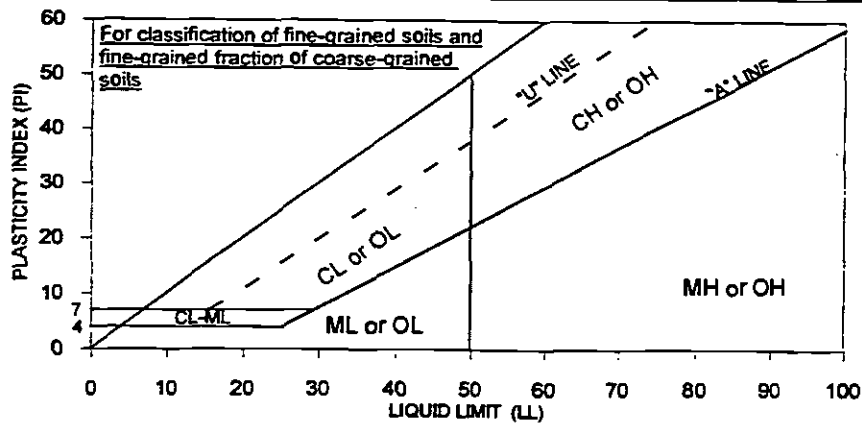
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-16	B-9	35.0-37.0	GP-GM	49:46:5	N/A



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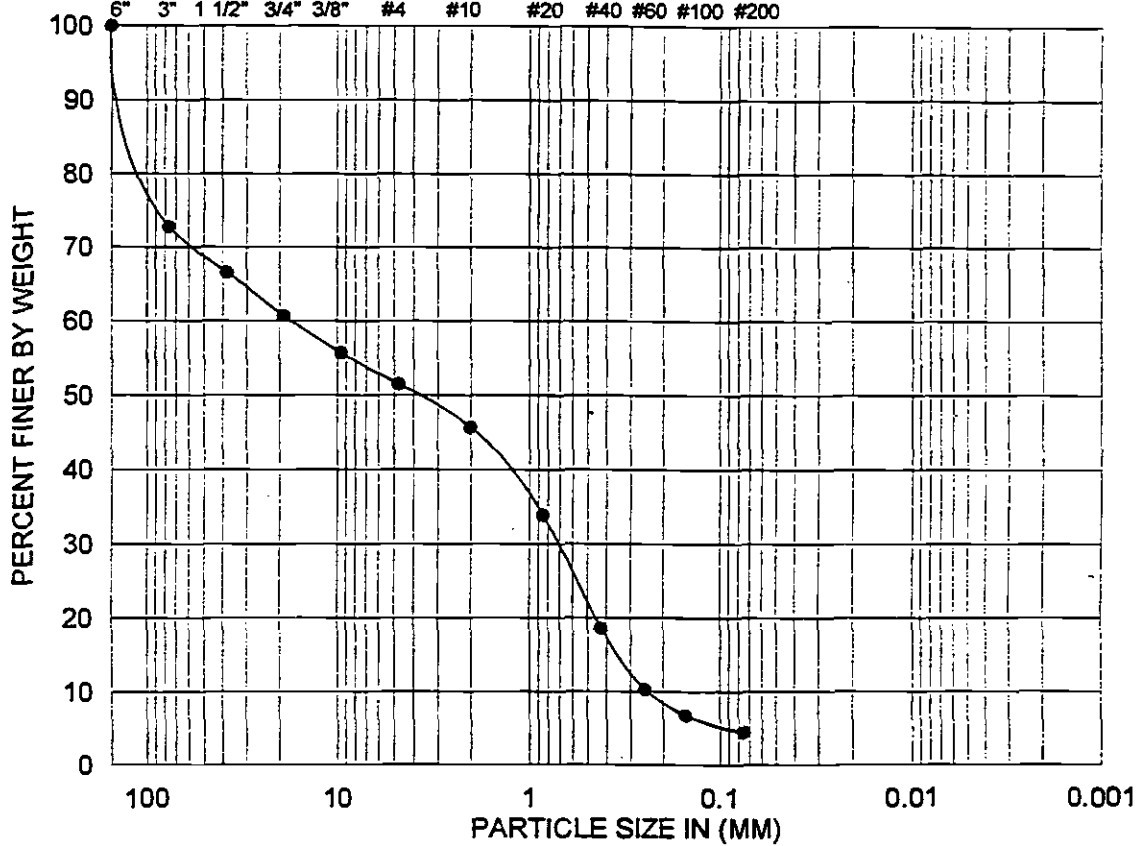
Project No. 95-8347-23
Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318.D422)



Cobble	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER HYDROMETER



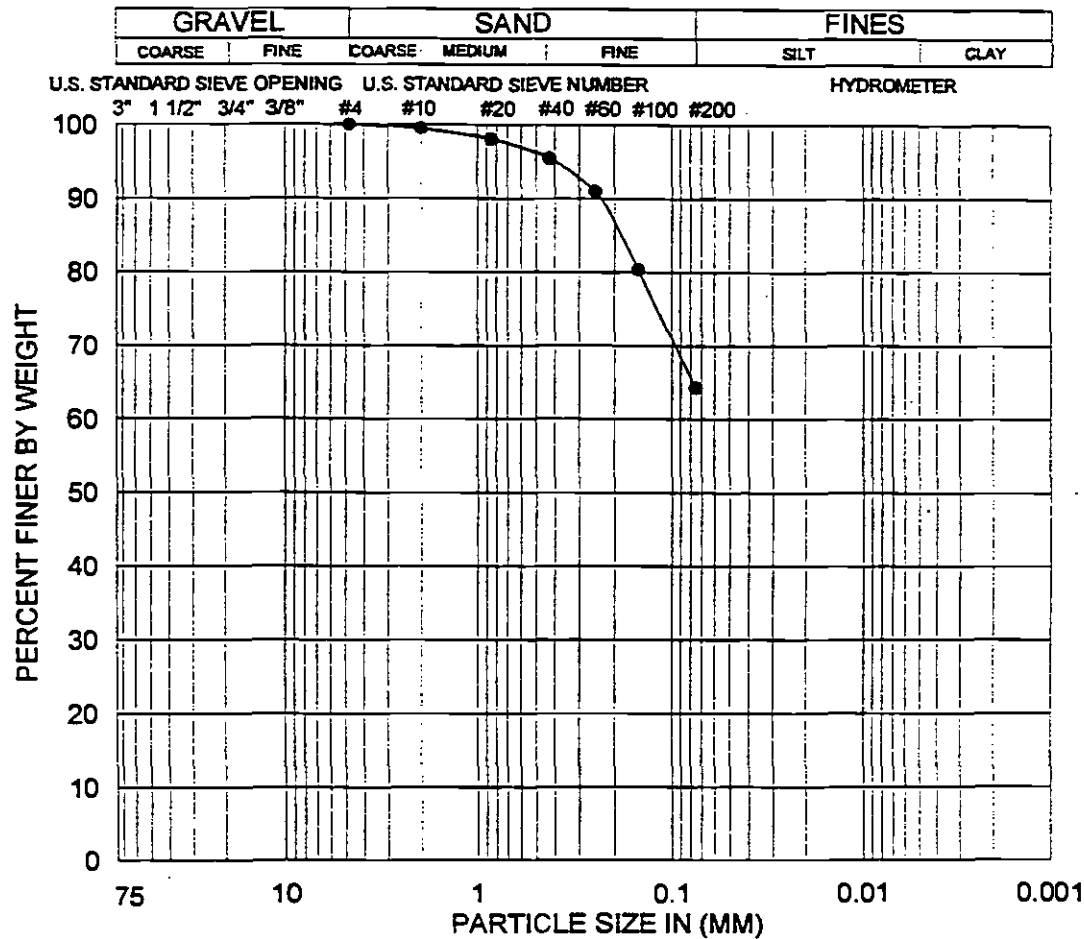
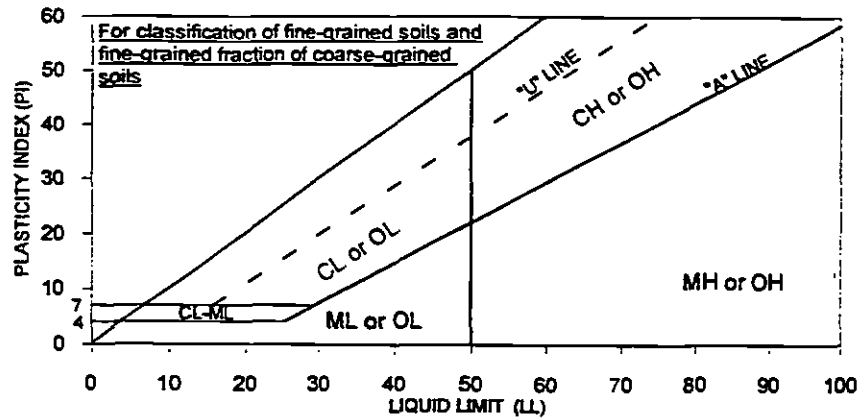
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-16	B-10	39.0	SP	48:48:4	N/A



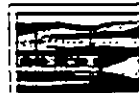
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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



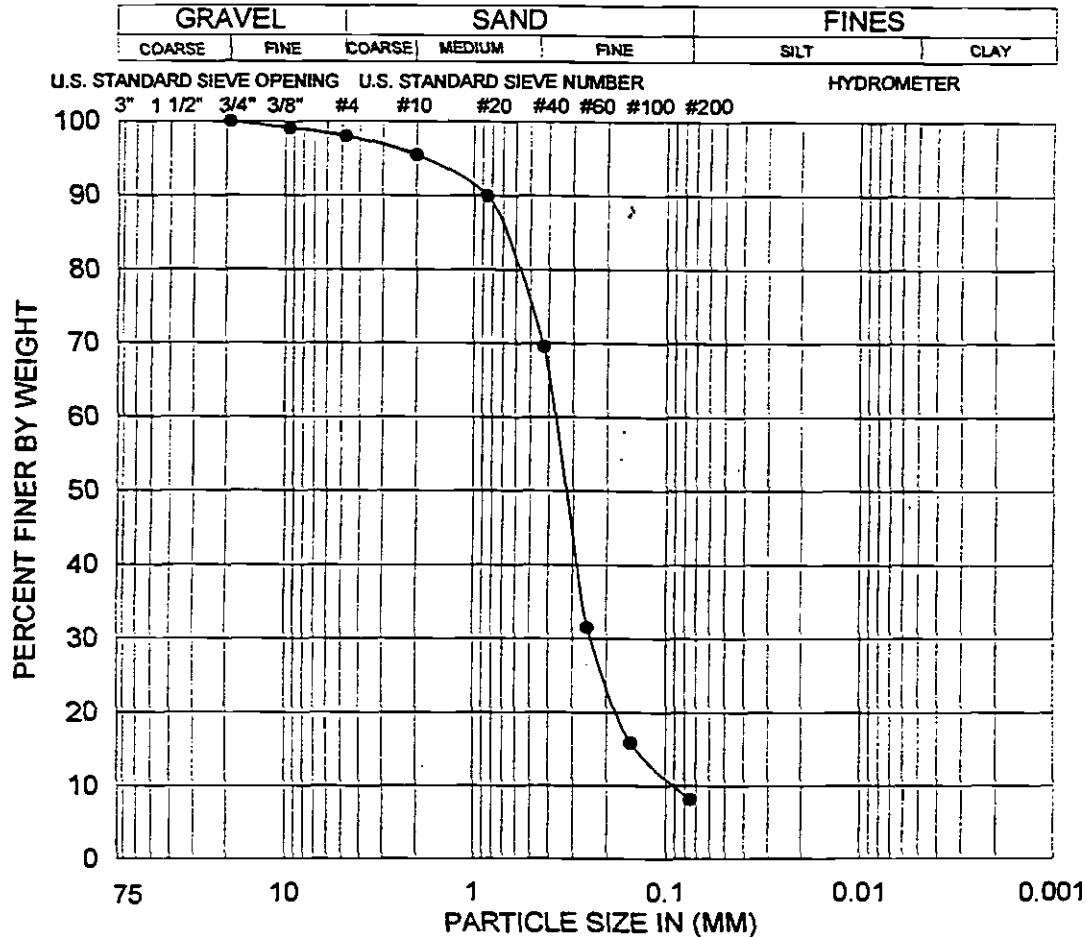
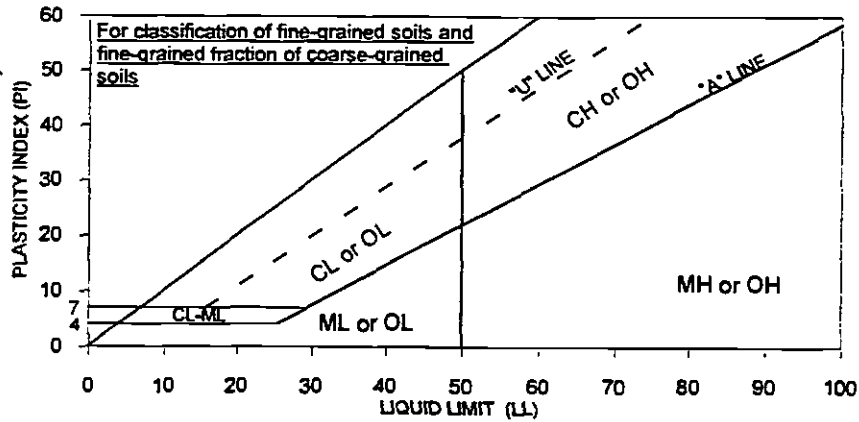
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-16	B-13	47.0-48.0	ML	0:36:64	N/A



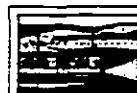
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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



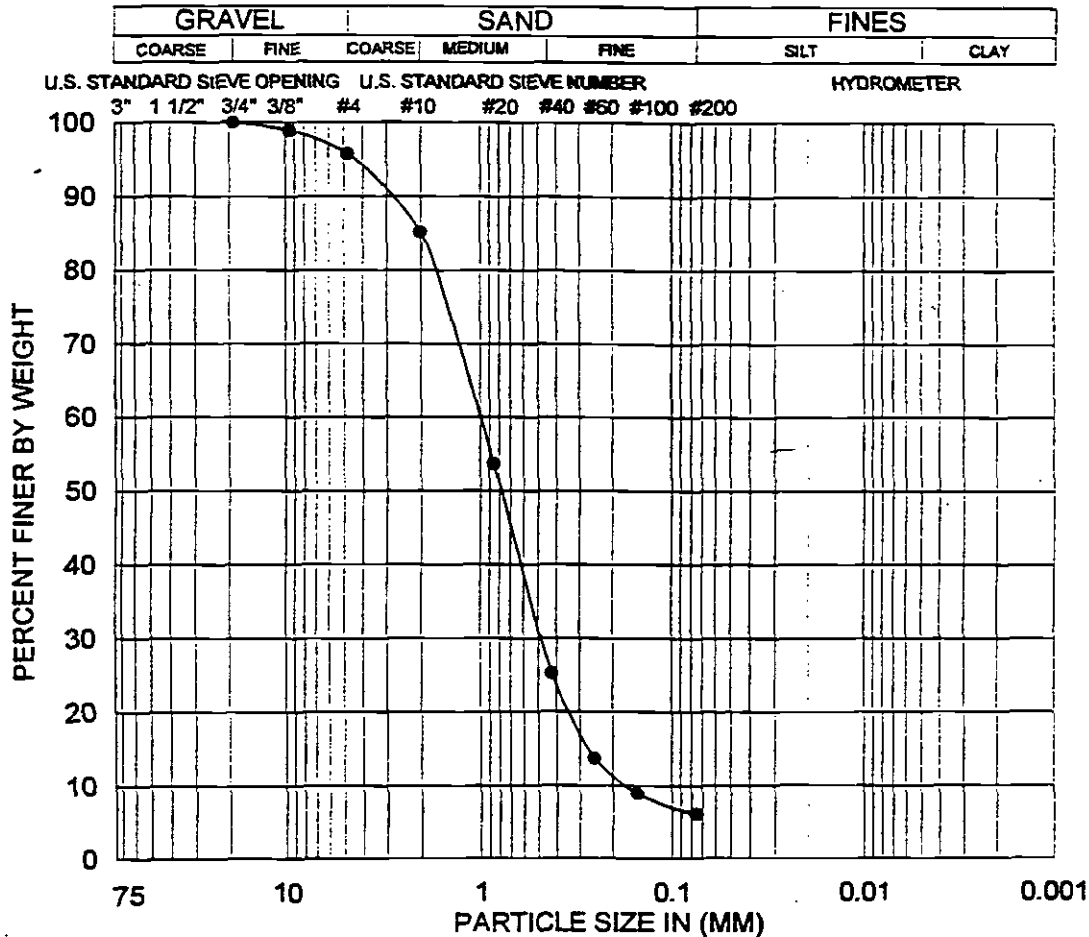
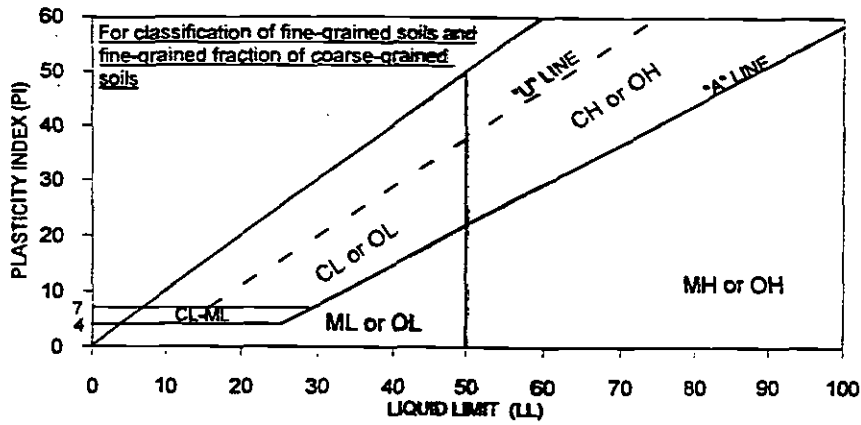
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-16	B-14	49.0-50.0	SP-SM	2:90:8	N/A



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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



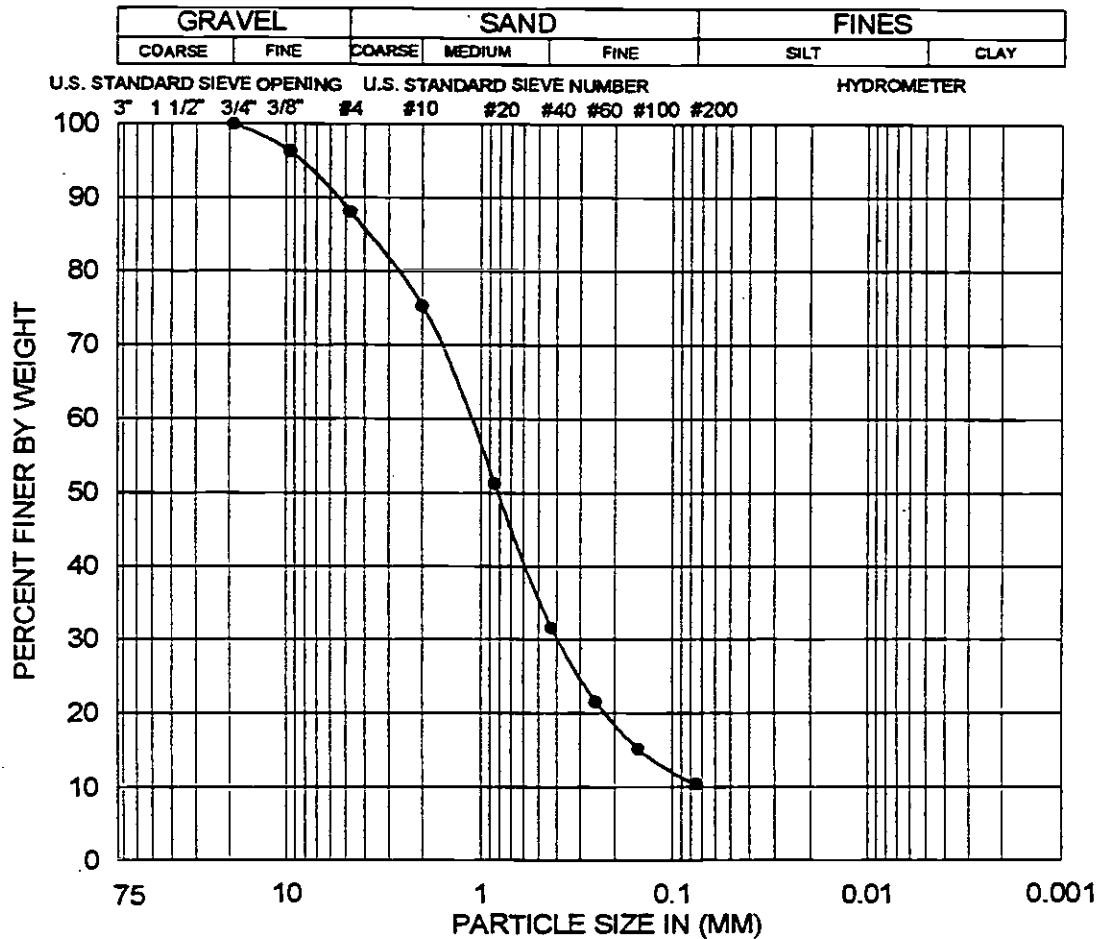
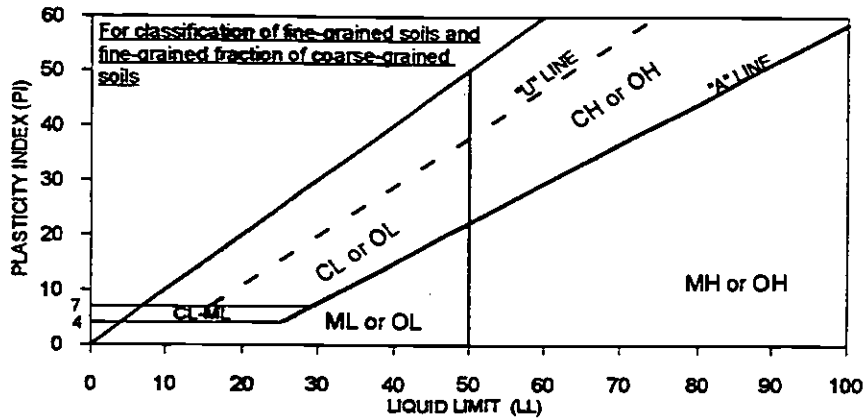
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-16	B-15	53.5-55.0	SP-SM	4:90:6	N/A



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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-17	S-3	15.0	SW-SM	12:78:10	N/A

Not enough sample to meet ASTM specification



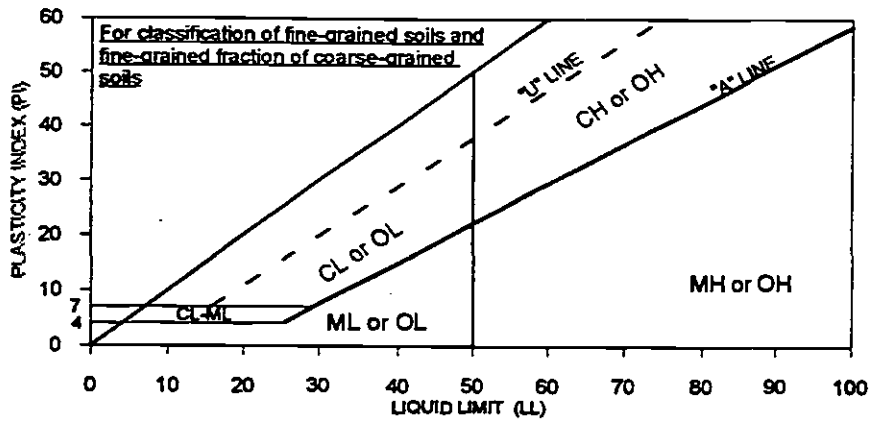
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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

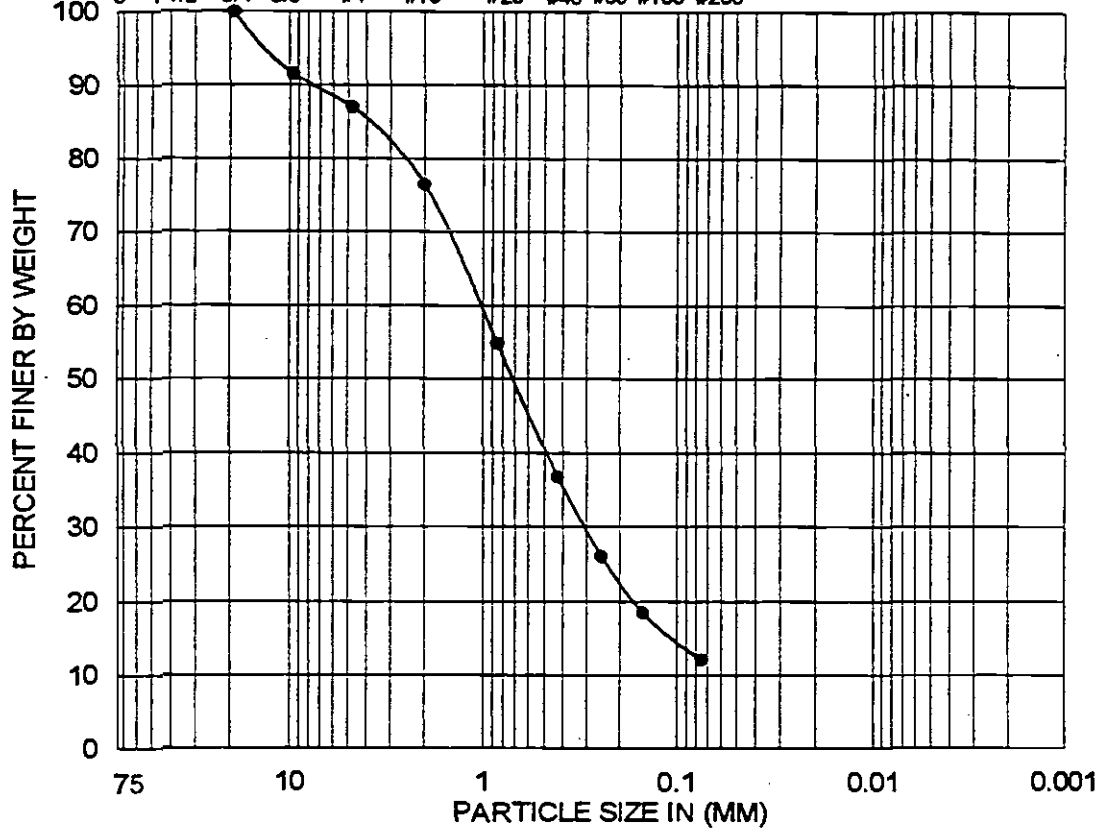
01-96

Figure B-35



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-17	S-5	21.0	SW-SM	13:75:12	N/A

Not enough sample to meet ASTM specification



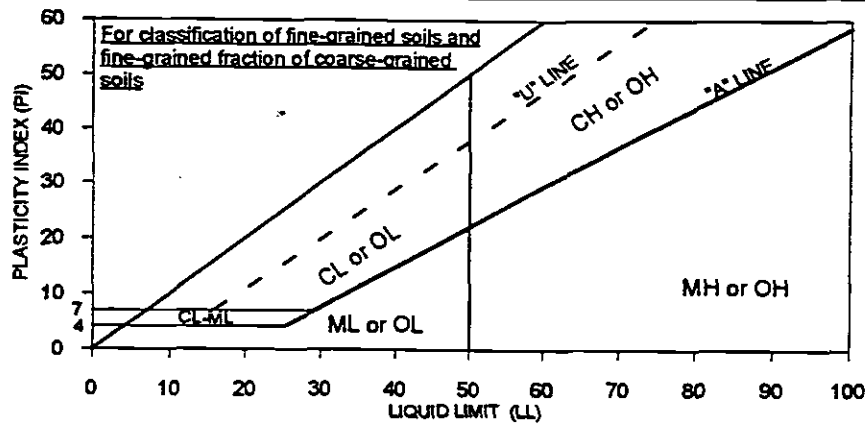
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Project No. 95-8347-23
Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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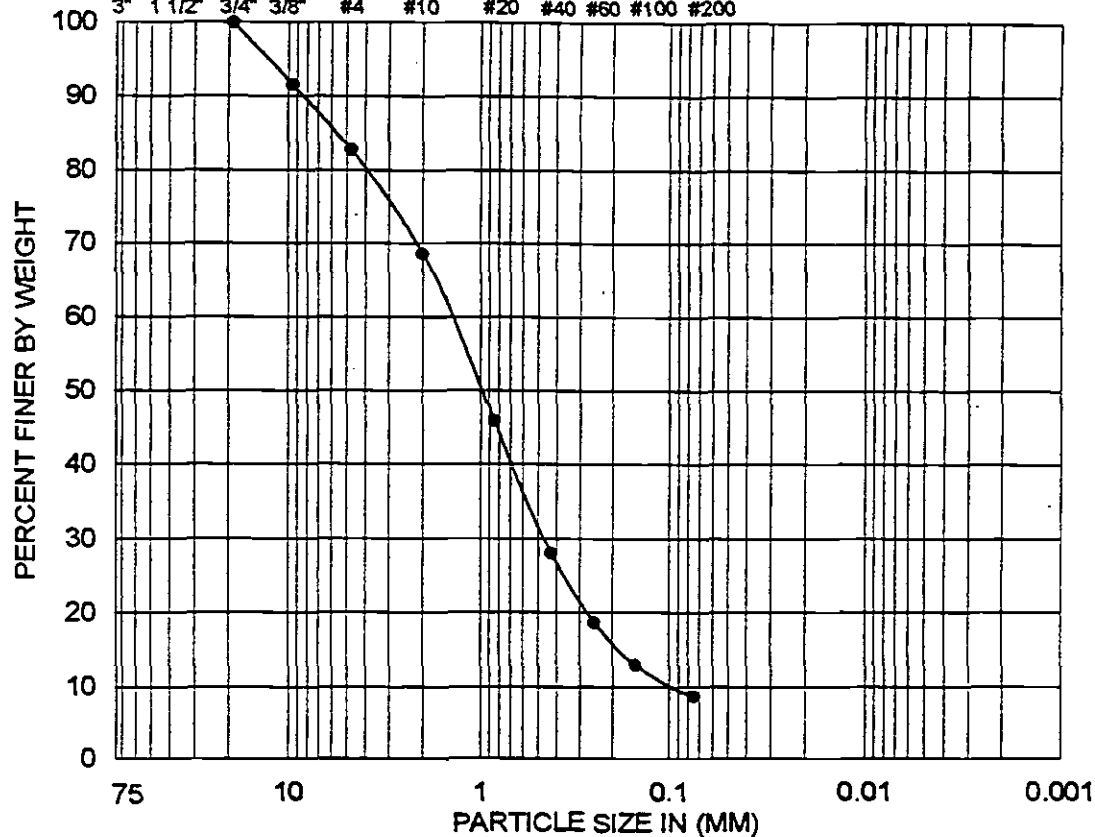
Figure B-36



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER

3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-17	S-7	27.0	SW-SM	17:74:9	N/A

Not enough sample to meet ASTM specification



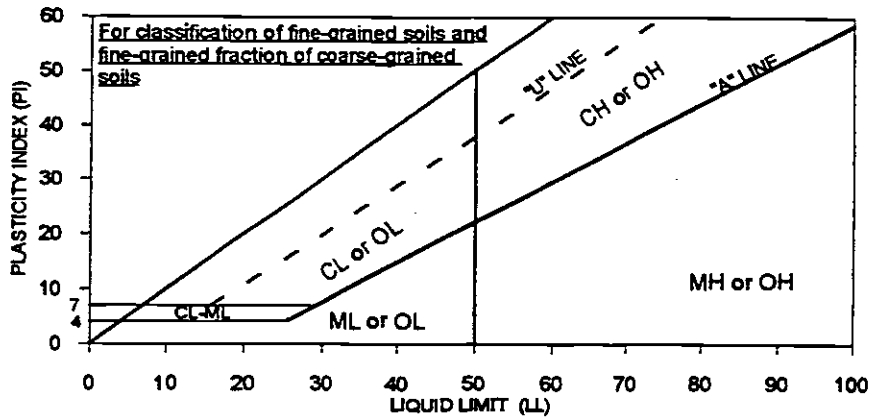
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

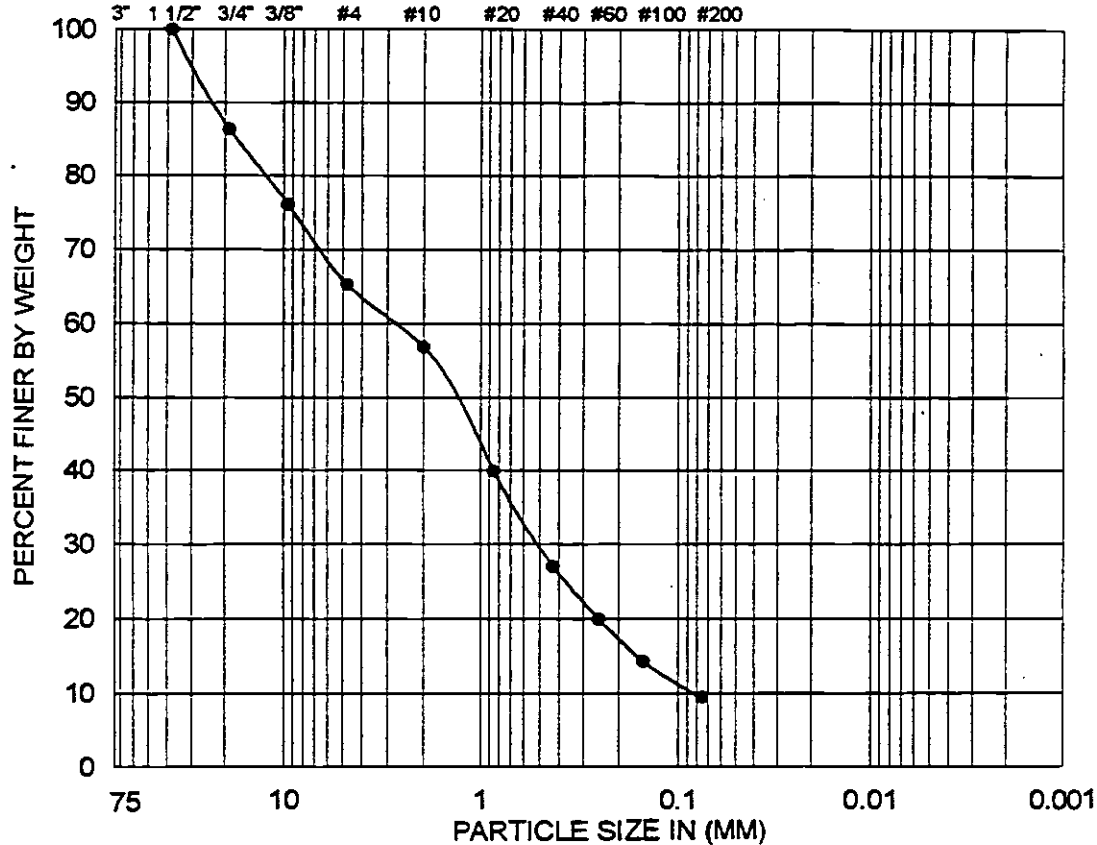
01-96

Figure B-37



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER HYDROMETER



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-17	S-9	33.0	SW-SM	35:55:10	N/A

Not enough material to meet ASTM specification



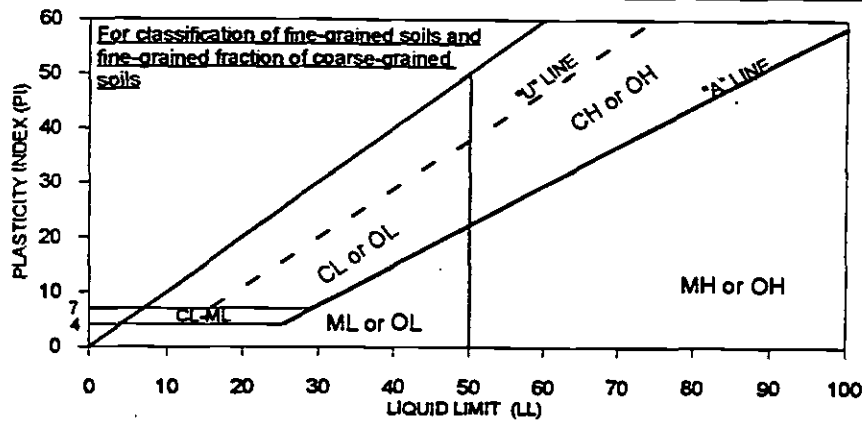
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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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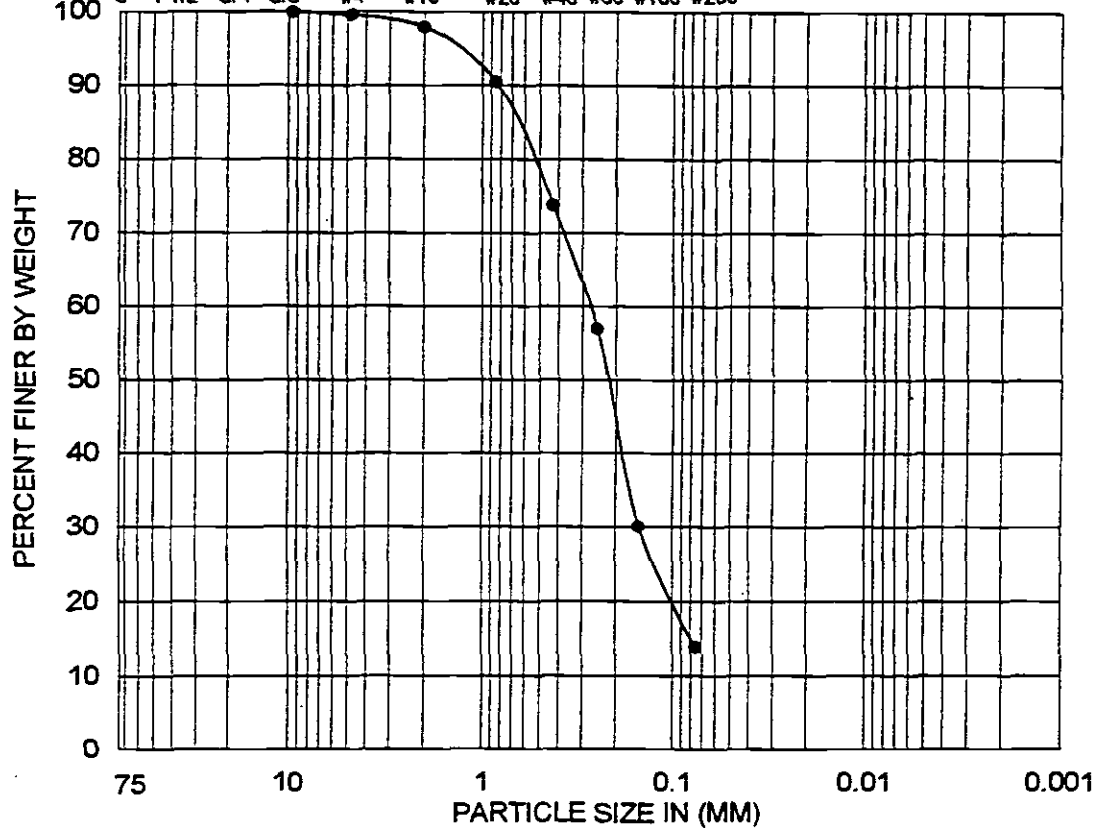
Figure B-38



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER

3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-17	S-17	57.0	SM	0:86:14	N/A



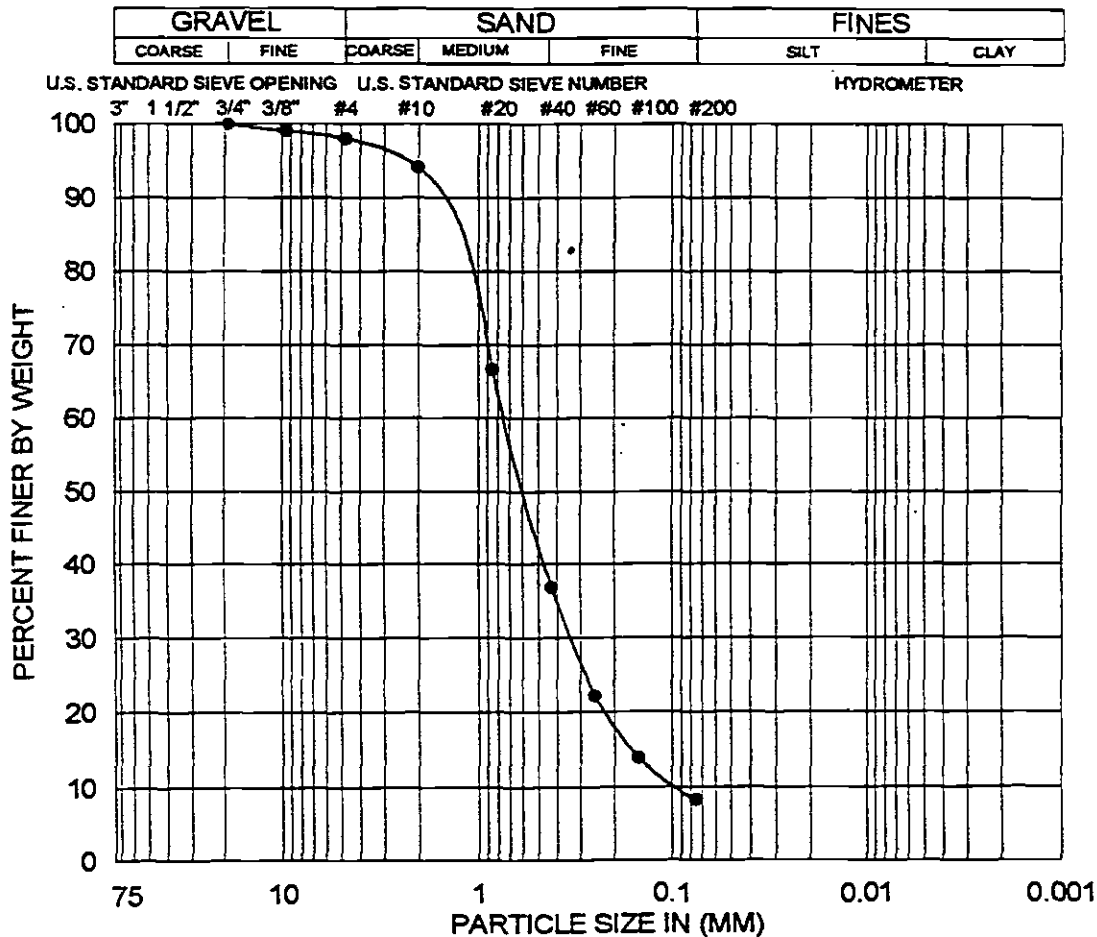
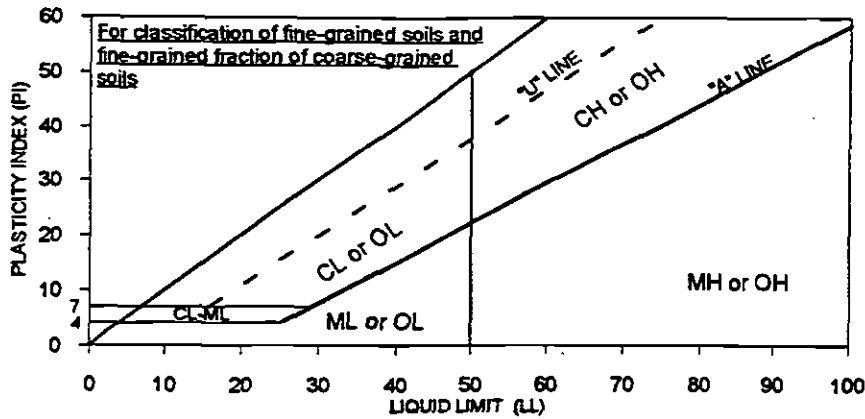
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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-39



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-17	S-19	63.0	SW-SM	2:90:8	N/A



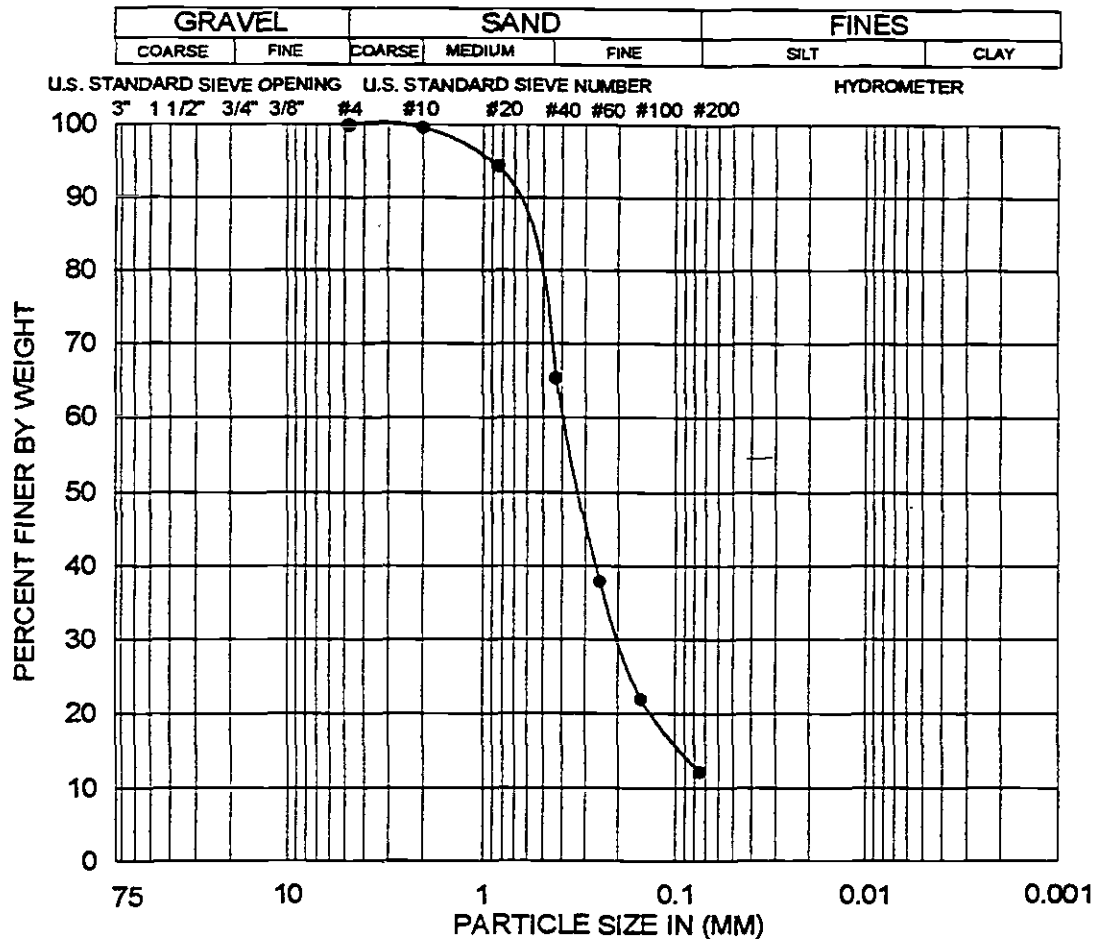
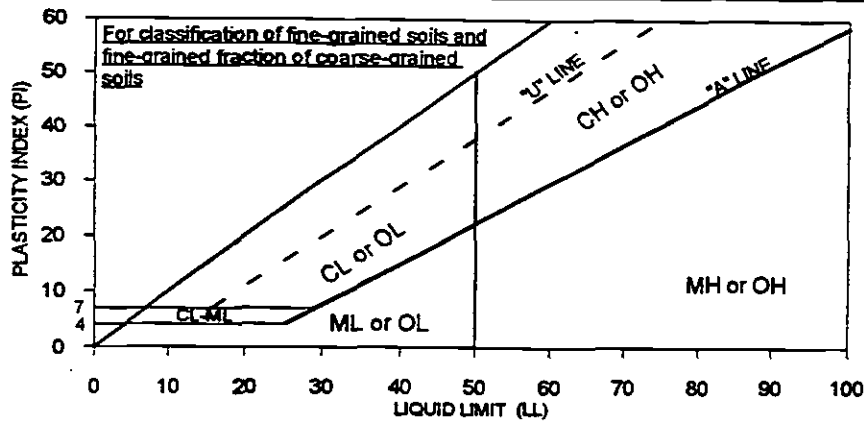
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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-40



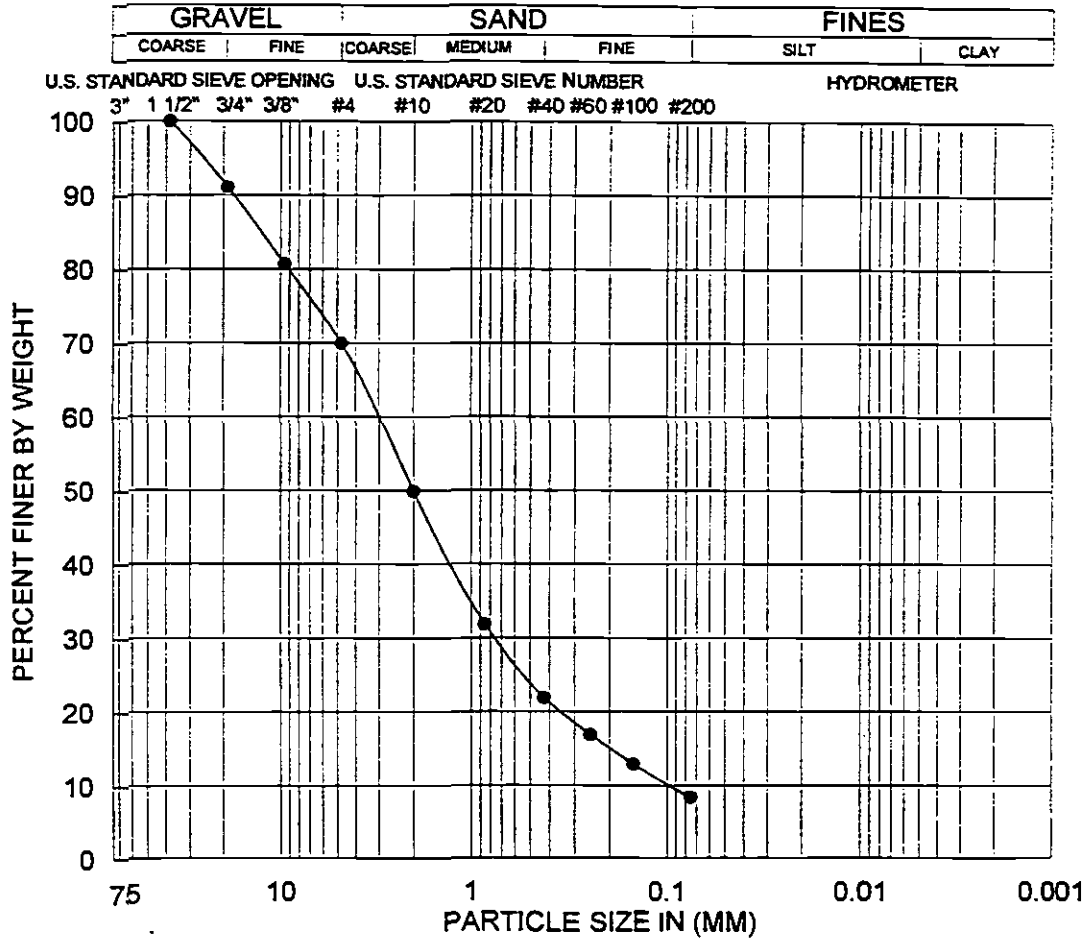
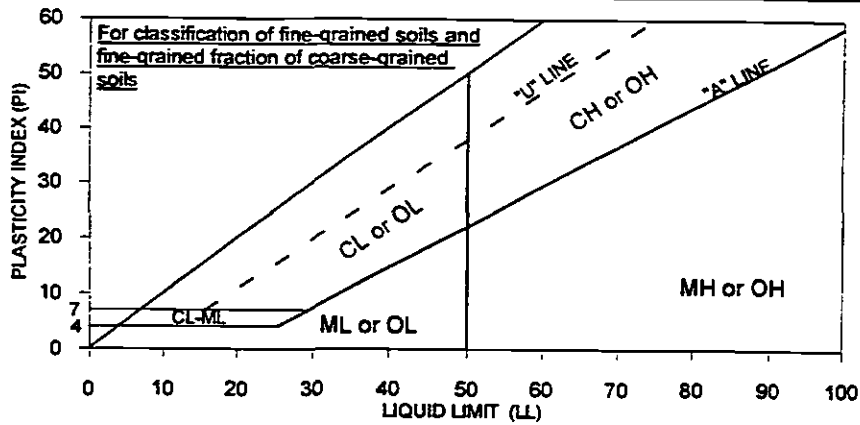
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-17	S-21	70.0	SW-SM	0:88:12	N/A



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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-51	S-6	30.0	Bag	SW-SM	30:62:8	N/A

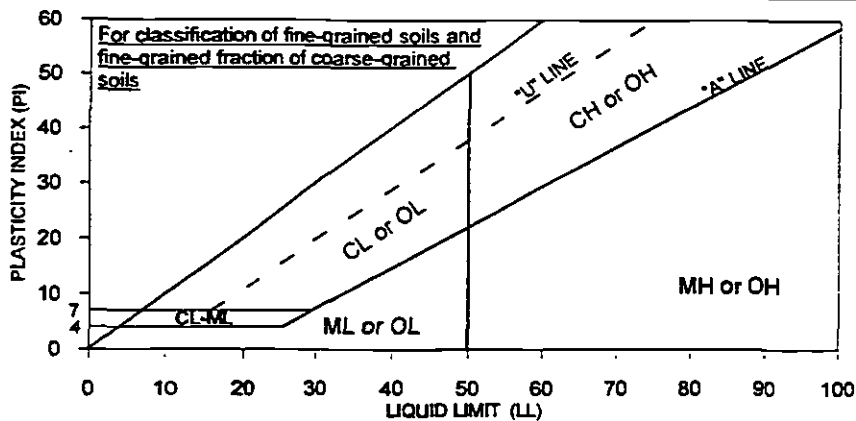
Not enough sample to meet ASTM specification



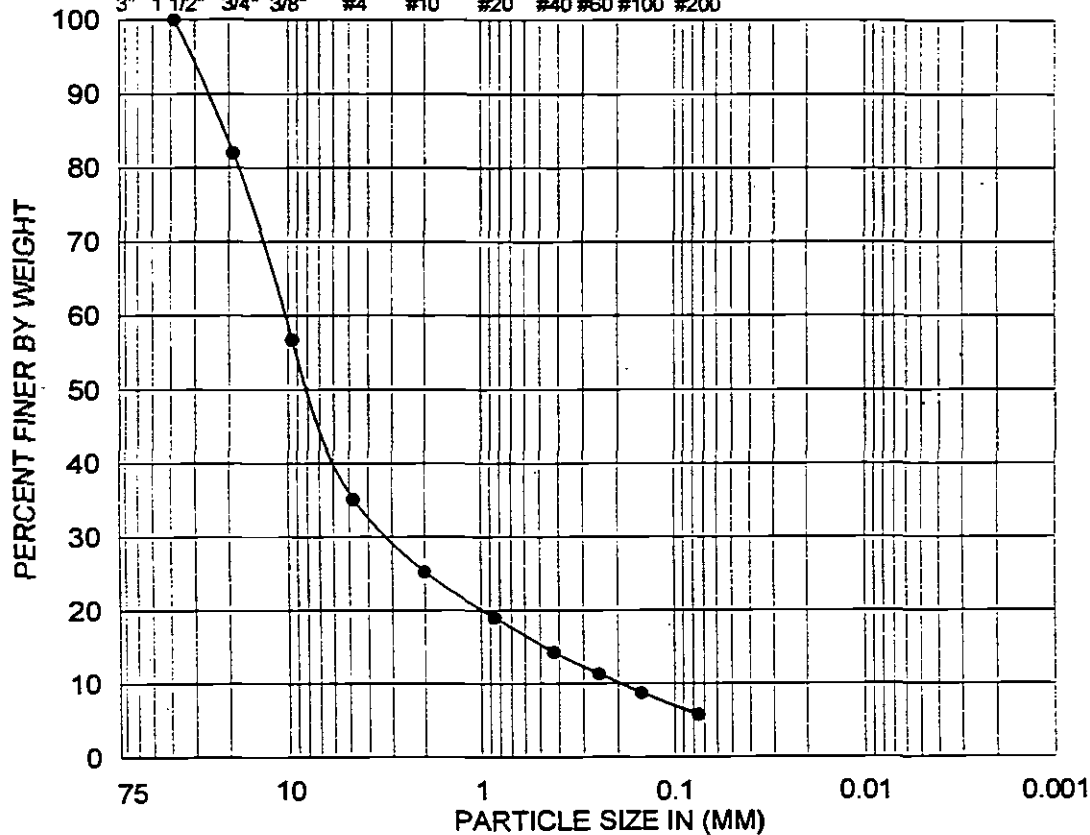
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



GRAVEL		SAND				FINES	
COARSE	FINE	COARSE	MEDIUM	FINE		SILT	CLAY
U.S. STANDARD SIEVE OPENING		U.S. STANDARD SIEVE NUMBER				HYDROMETER	
3"	1 1/2"	3/4"	3/8"	#4	#10	#20	#40 #60 #100 #200



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-51	S-8	38.0	Bag	GP-GM	65:29:6	N/A

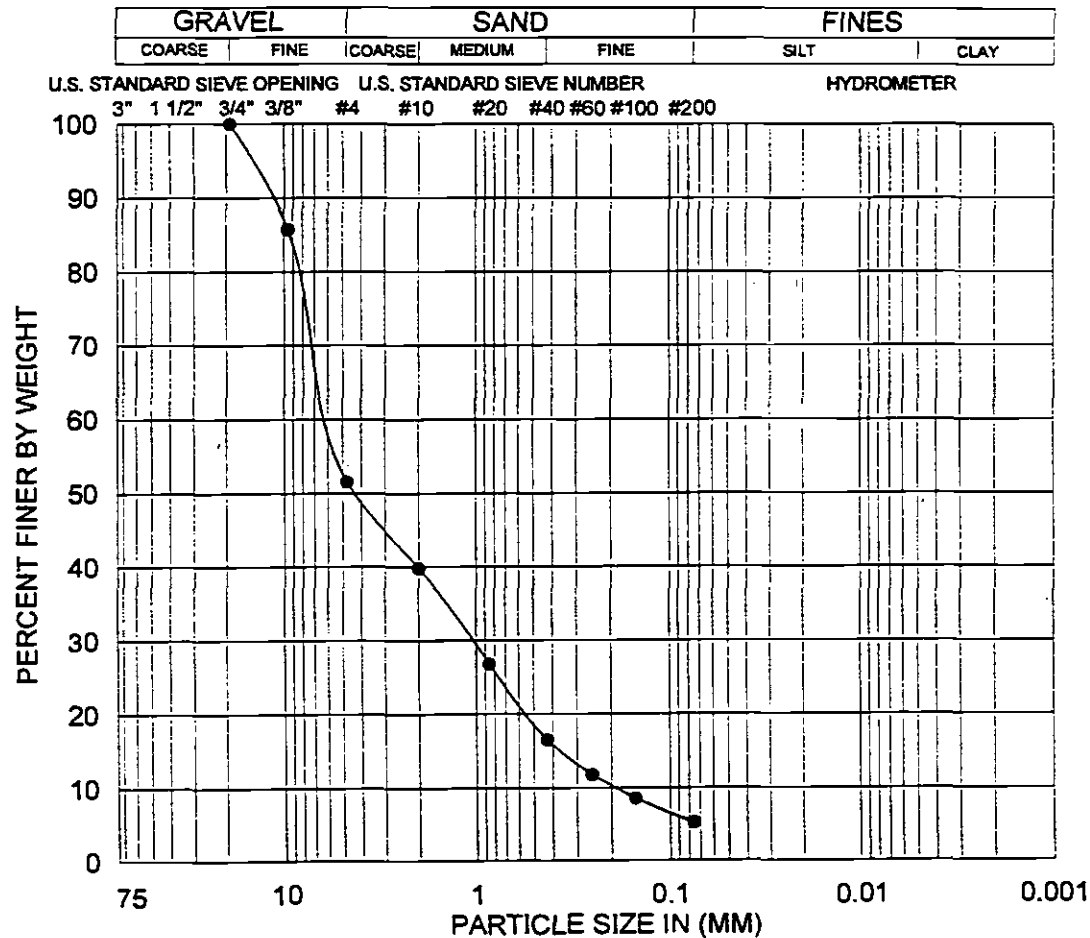
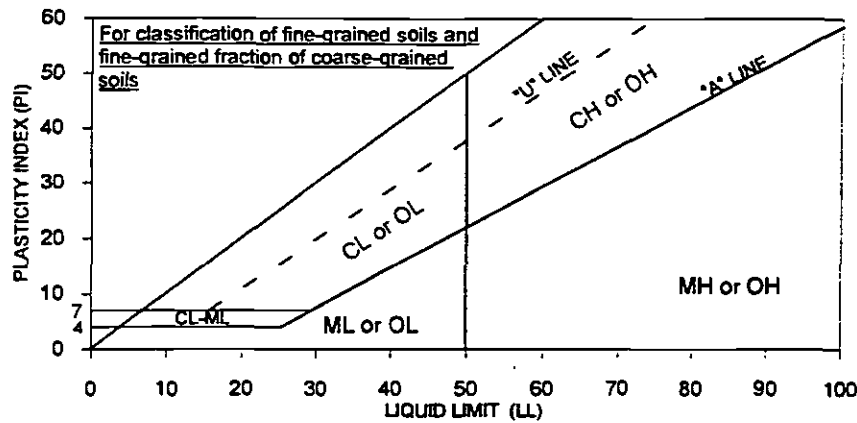
Not enough sample to meet ASTM specification



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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318.D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-51	S-10	44.0	Bag	GW-GM	48:47:5	N/A

Not enough sample to meet ASTM specification

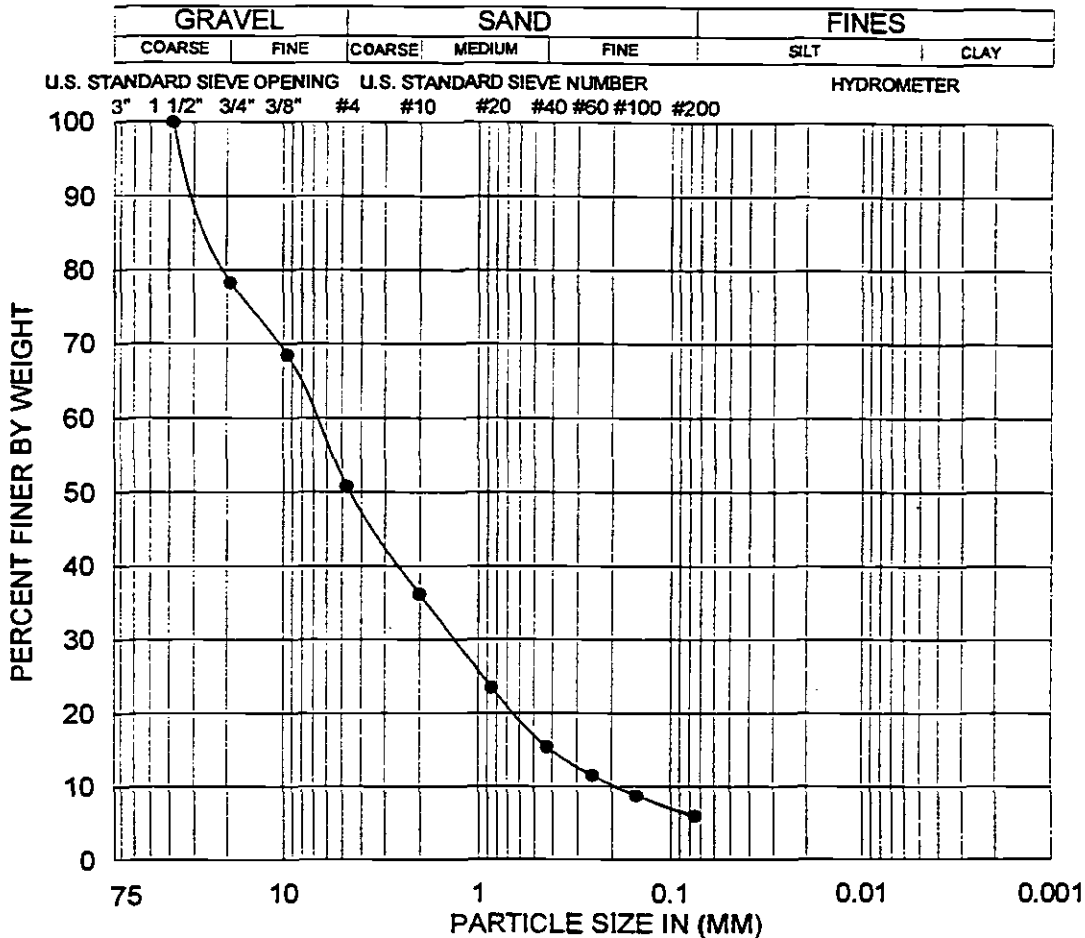
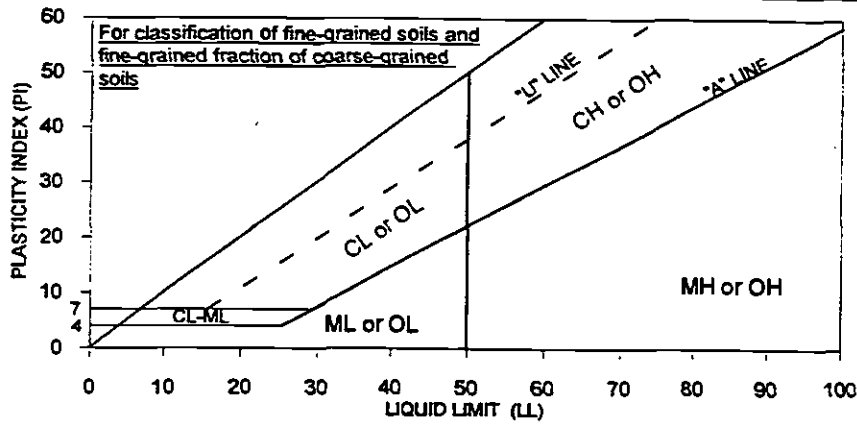


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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-44



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-51	S-12	50.0	Bag	GW-GM	49:45:6	N/A

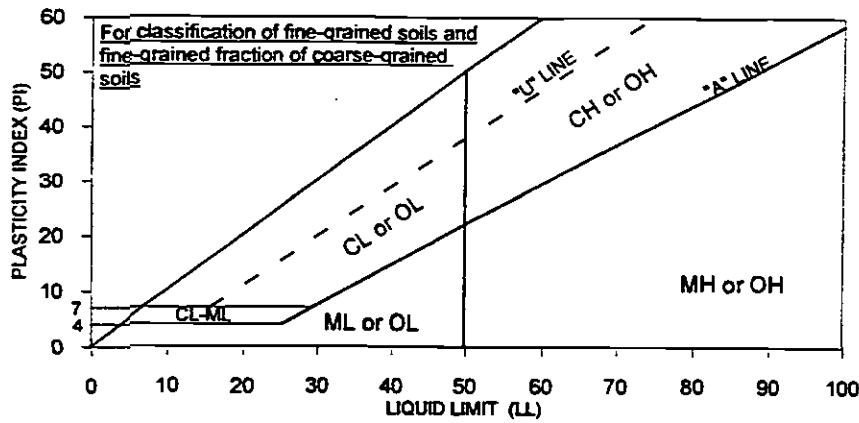
Not enough sample to meet ASTM specification



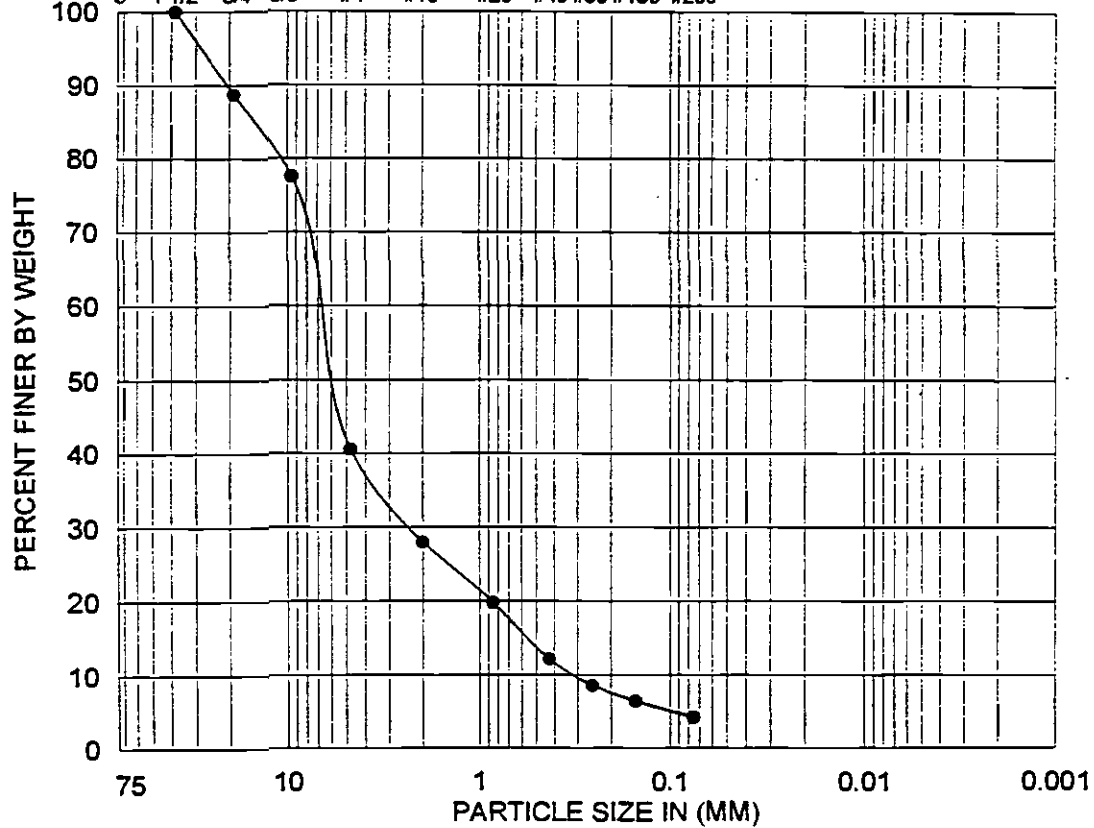
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

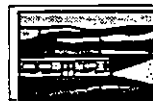


GRAVEL				SAND					FINES			
COARSE		FINE		COARSE	MEDIUM	FINE			SILT		CLAY	
U.S. STANDARD SIEVE OPENING				U.S. STANDARD SIEVE NUMBER							HYDROMETER	
100	3"	1 1/2"	3/4"	3/8"	#4	#10	#20	#40	#60	#100	#200	



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-51	S-14	56.0	Bag	GP	59:37:4	N/A

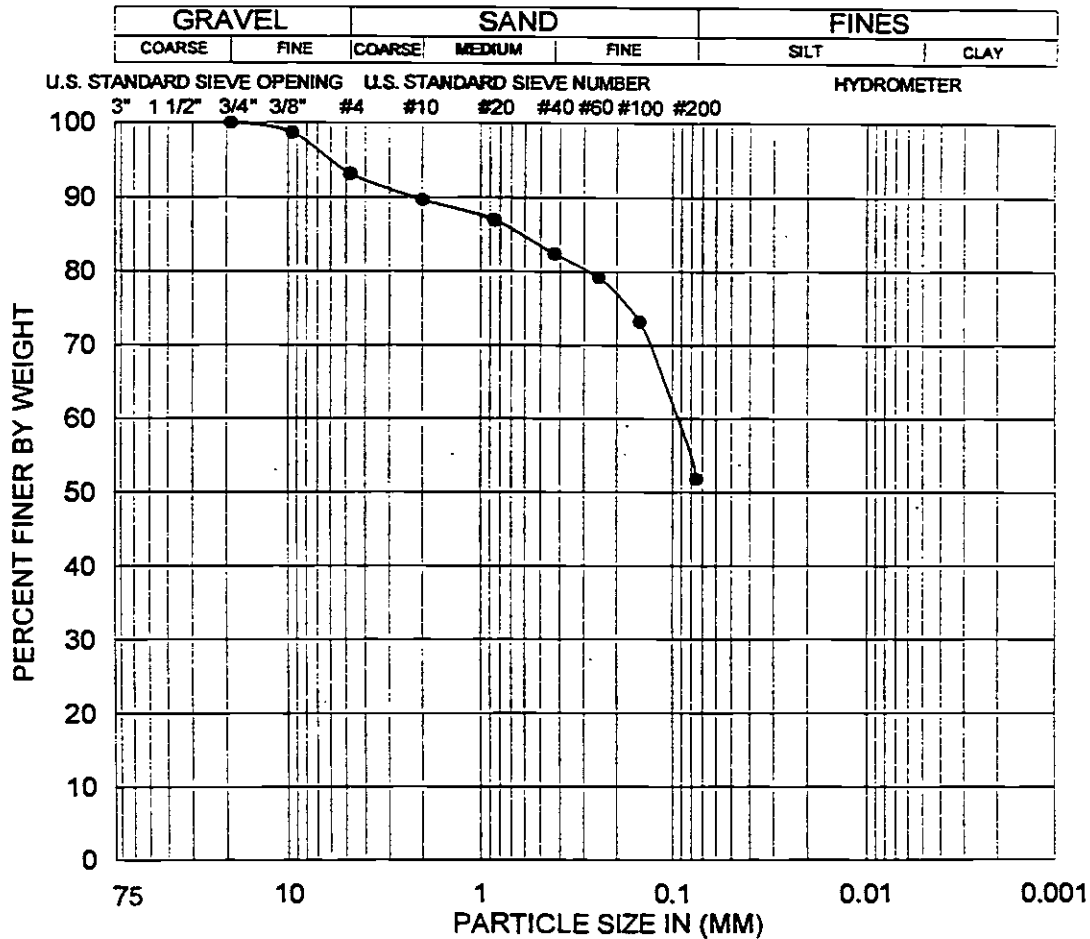
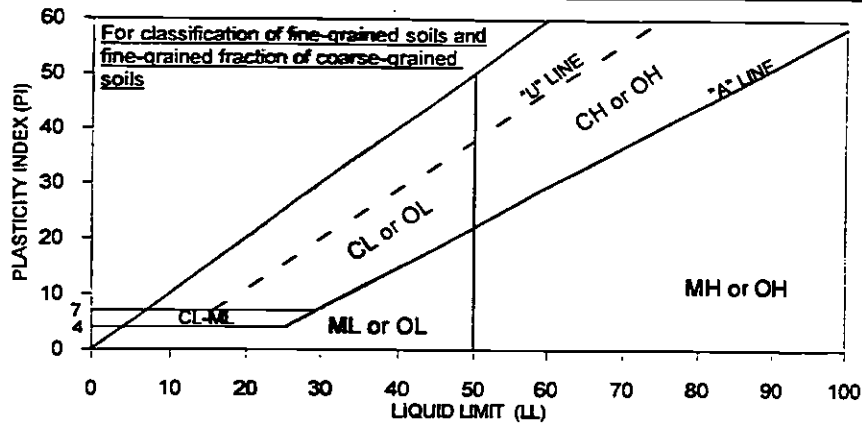
Not enough sample to meet ASTM specification



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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-51	S-16	62.0	Bag	ML	7:41:52	N/A



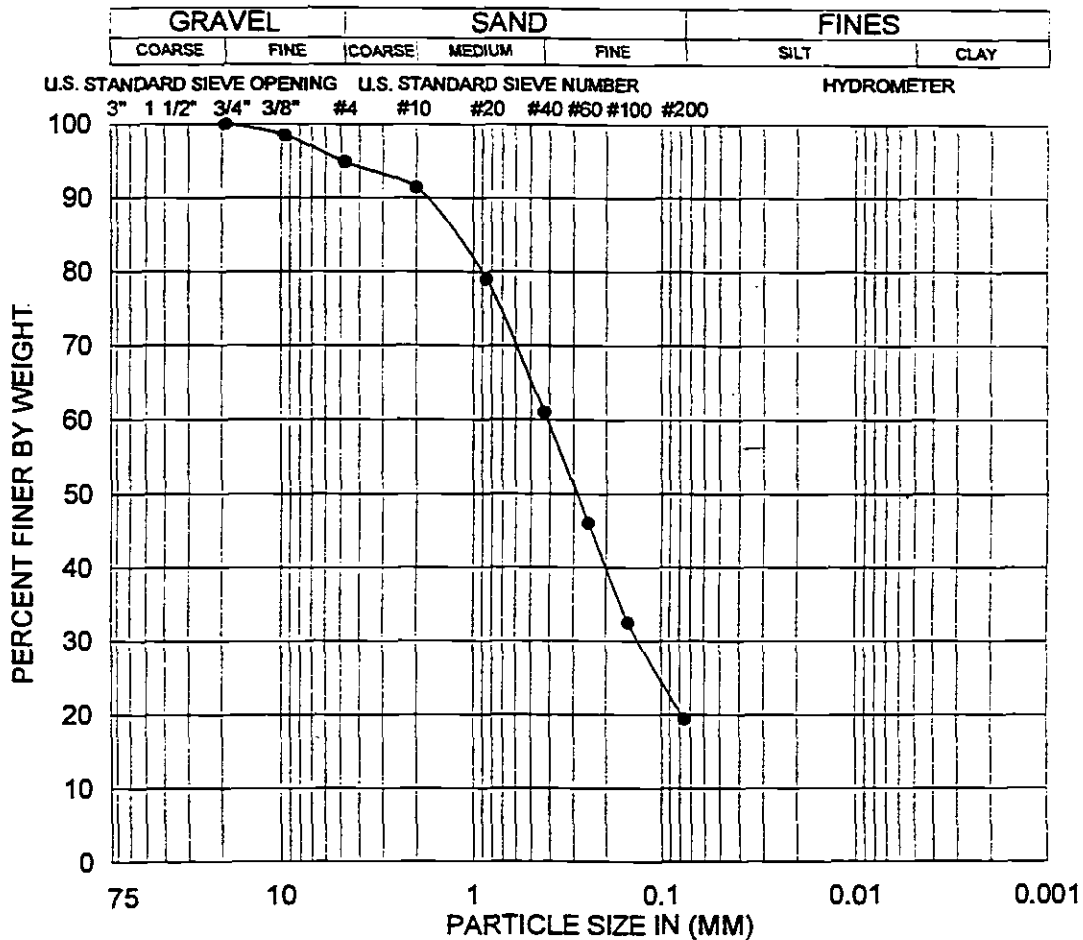
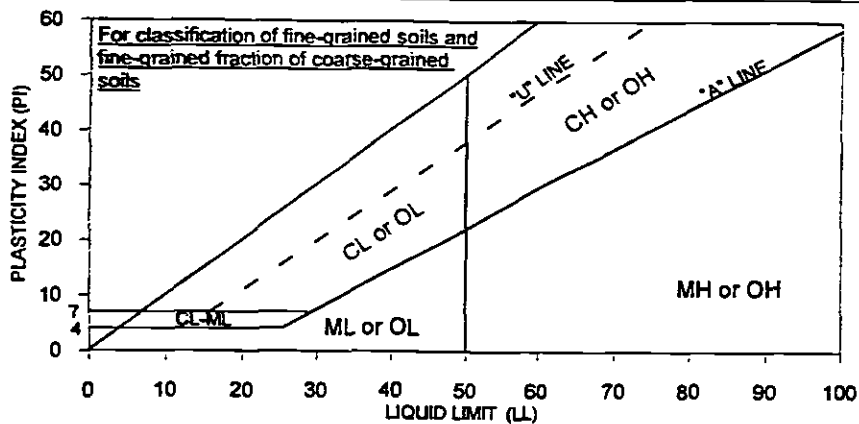
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-47



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-51	S-18	68.0	Bag	SM	5:75:20	N/A

Not enough sample to meet ASTM specification



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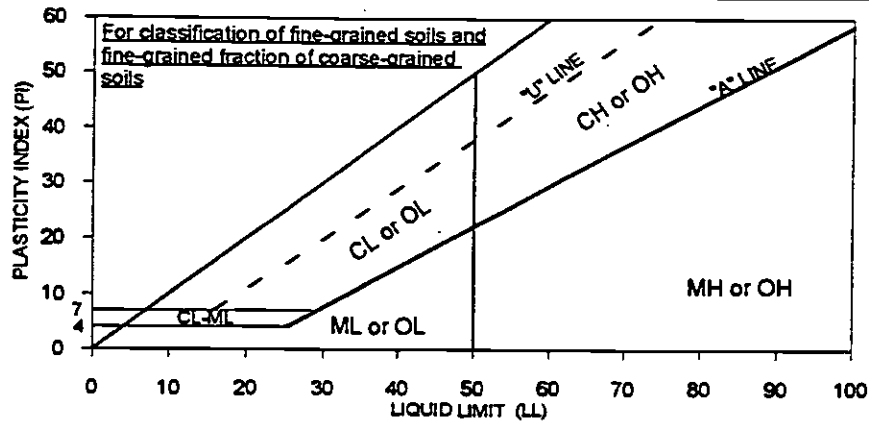
Project No. 95-8347-23

Eastside Extension
Metro Redline III

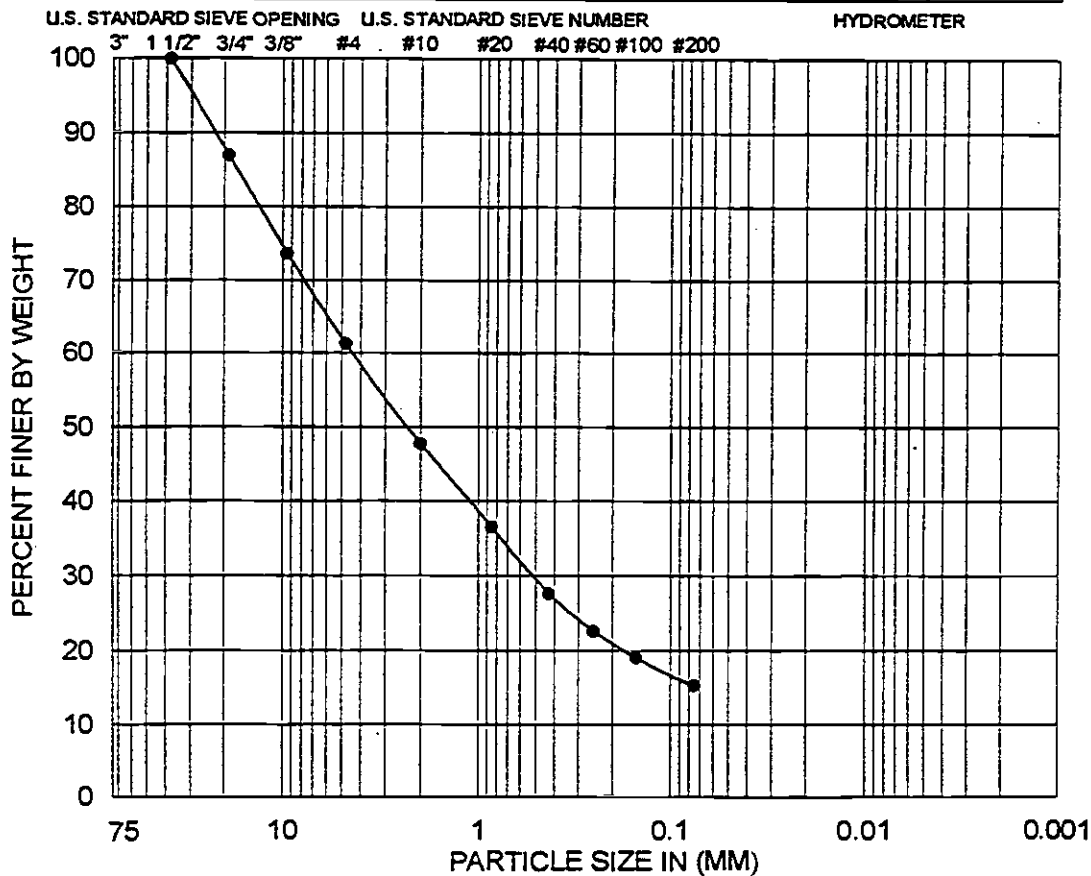
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-48

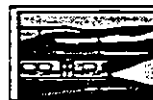


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-52	S-5	20.0	Bag	SM	39:46:15	N/A

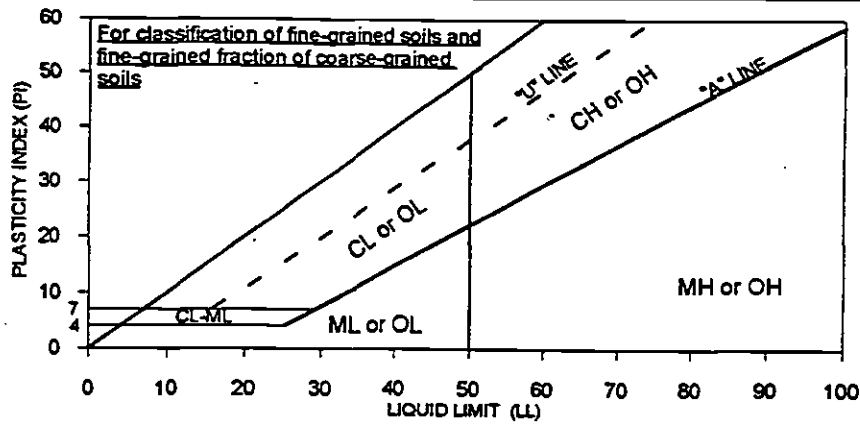
Not enough sample to meet ASTM specification



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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

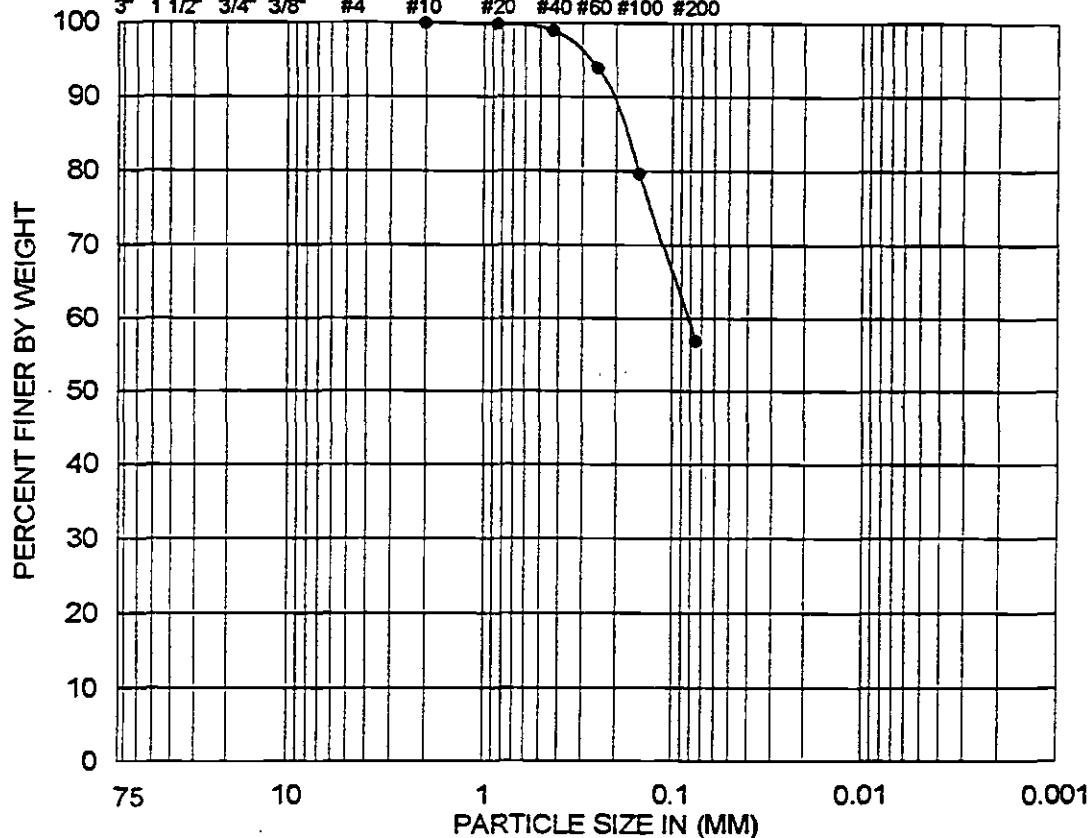


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200

U.S. STANDARD SIEVE NUMBER

HYDROMETER



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-52	S-7	26.0	Bag	ML	0:43:57	N/A



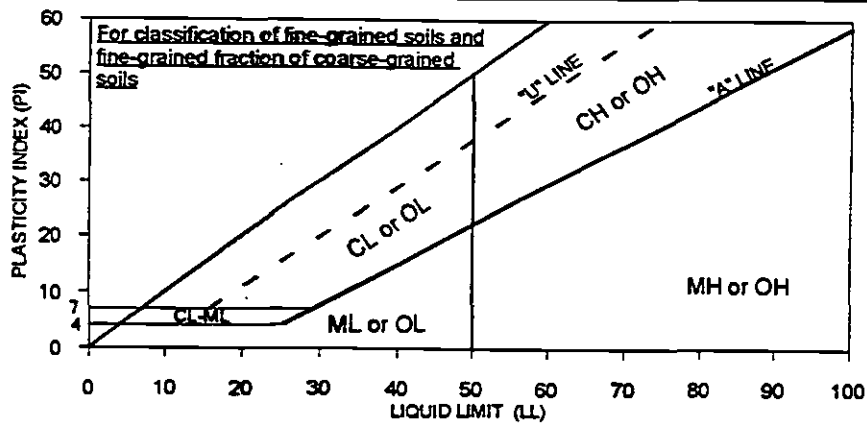
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Metro Redline III

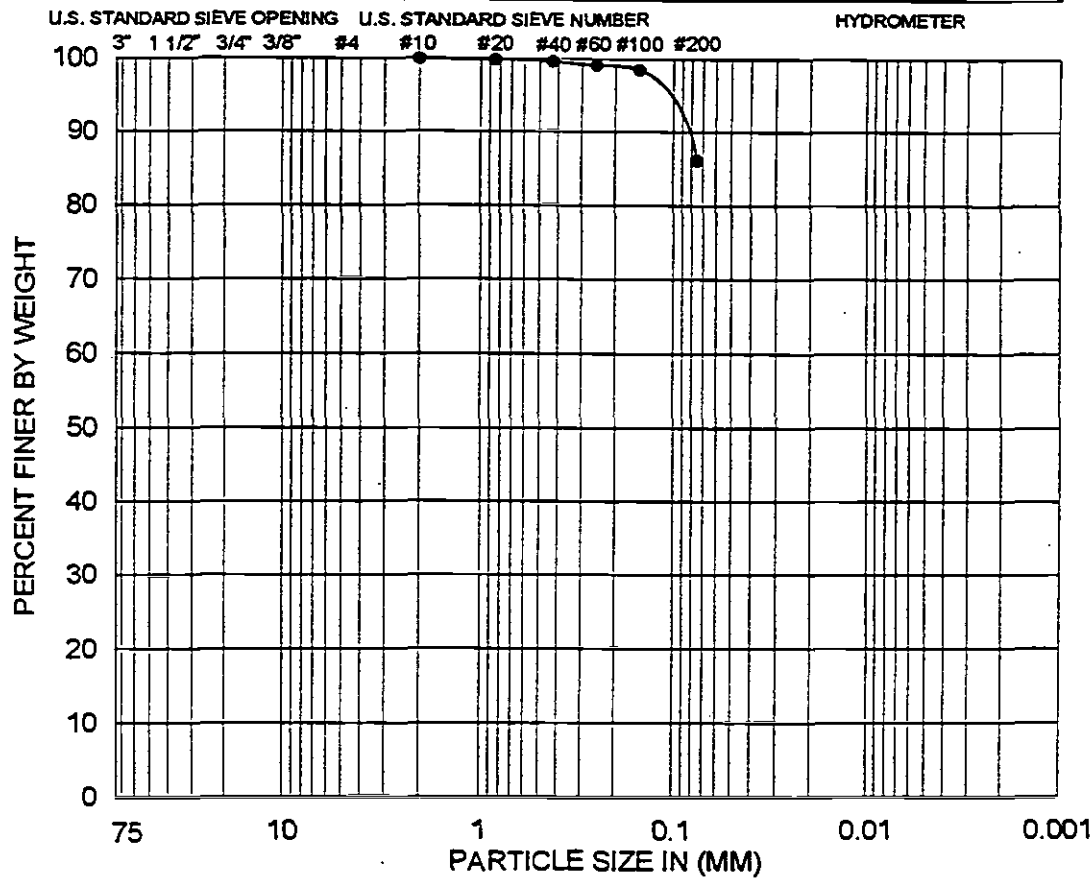
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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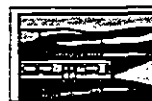
Figure B-50



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



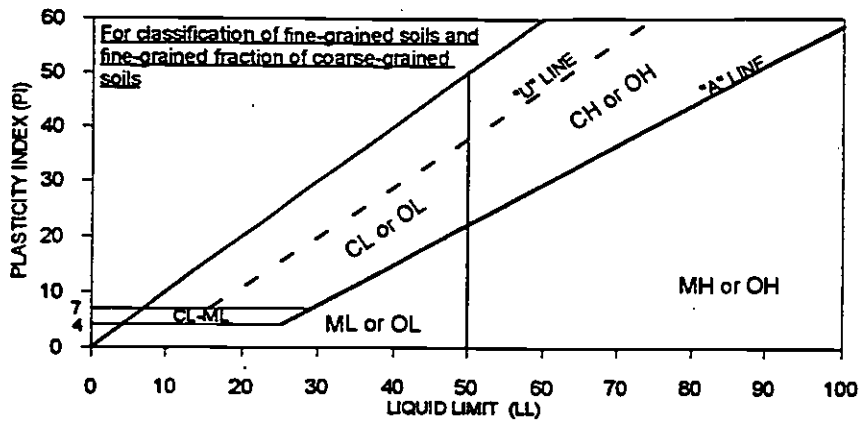
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-52	S-9	32.0	Bag	ML	0:14:86	N/A



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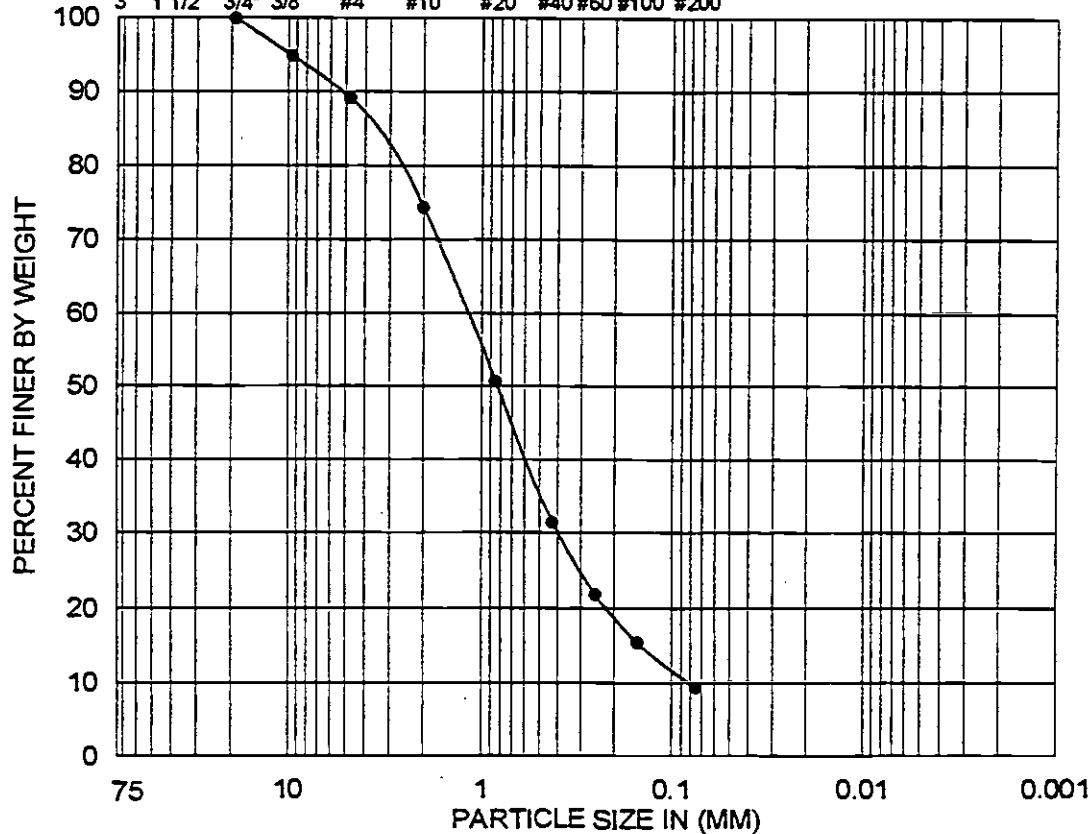
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER HYDROMETER

3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-52	S-11	38.0	Bag	SW-SM	11:80:9	N/A



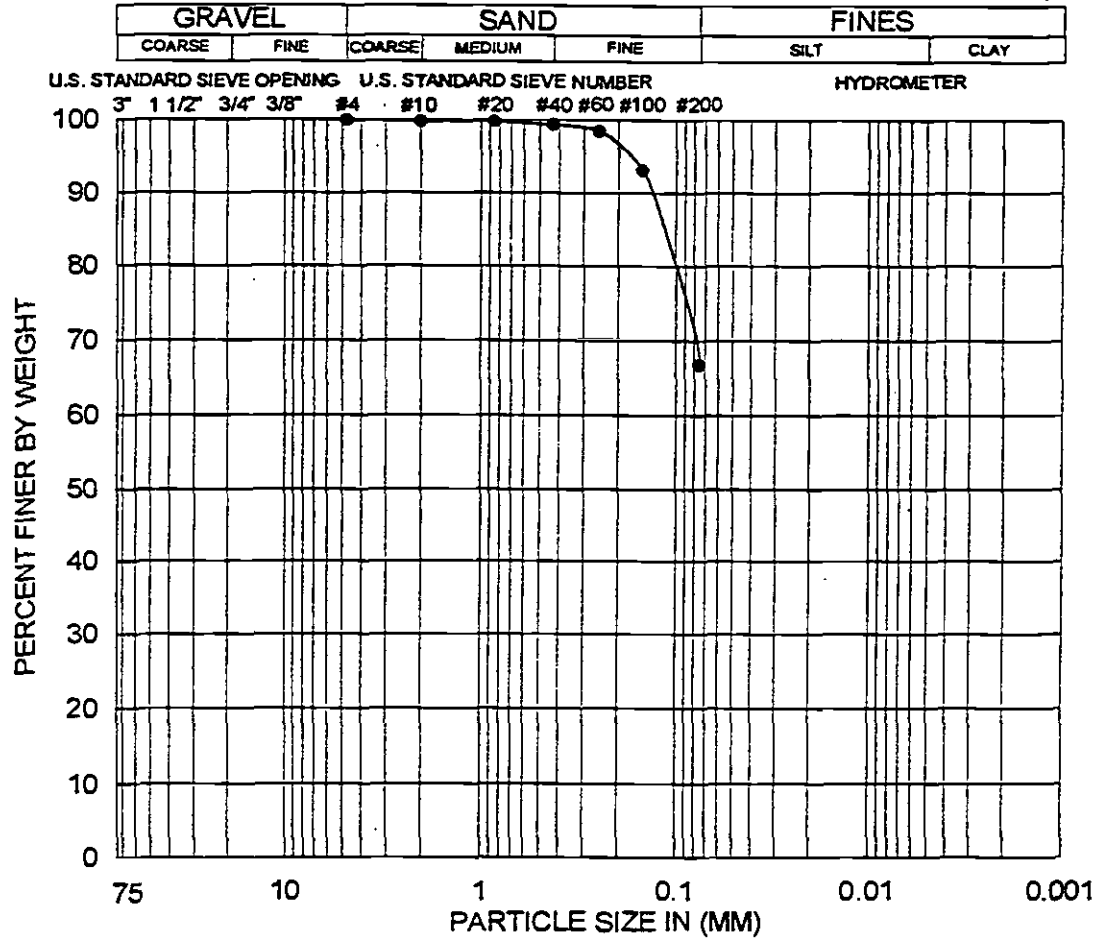
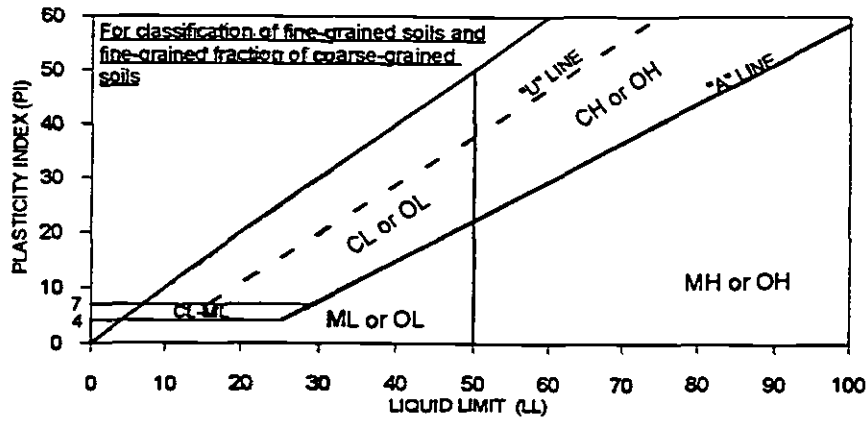
GeoTransit
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Eastside Extension
Metro Redline III

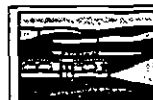
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

11-95

Figure B-52



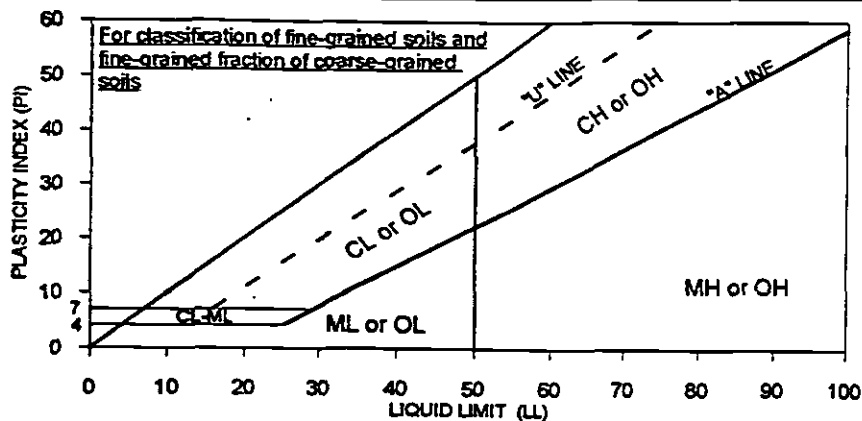
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-52	S-13	44.0	Bag	ML	0.33:67	N/A



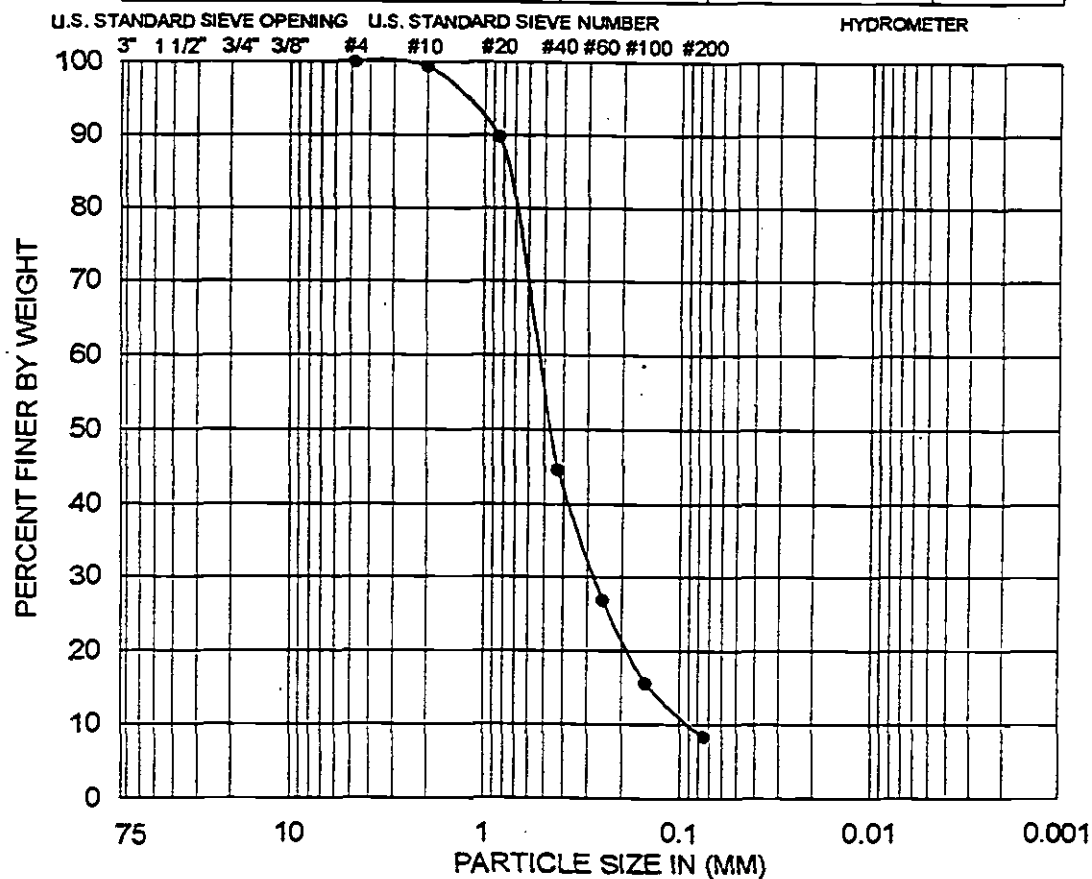
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-52	S-17	56.0	Bag	SP-SM	0:92:8	N/A



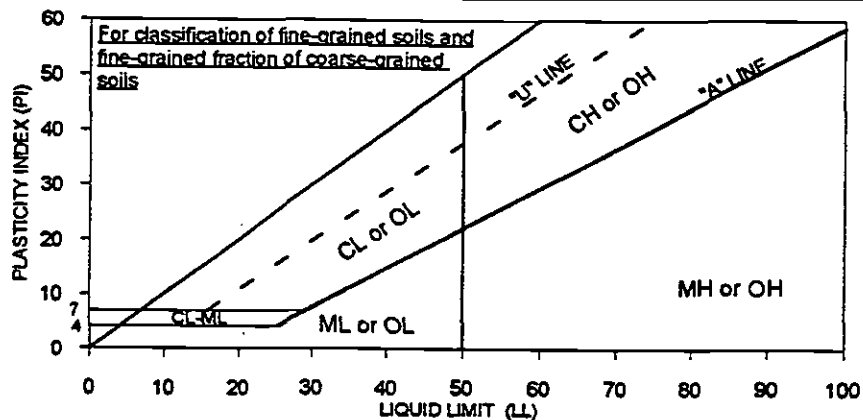
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Metro Redline III

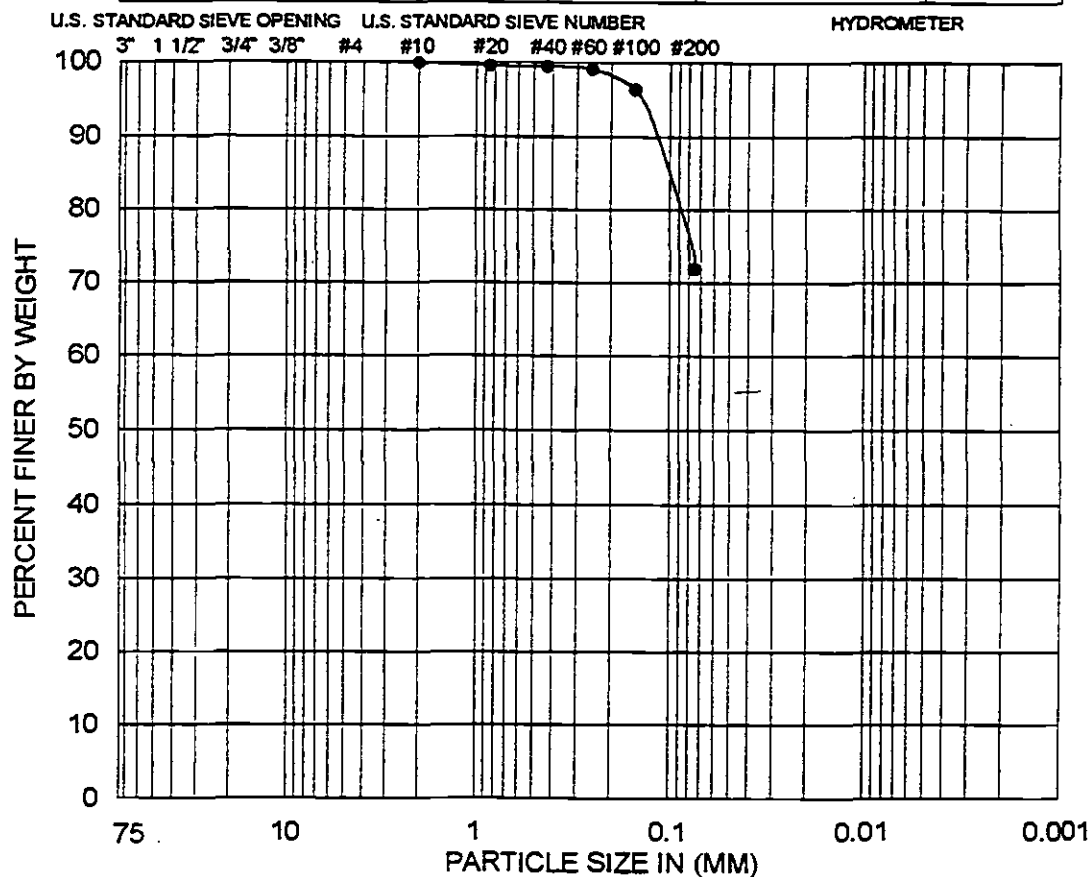
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

11-95

Figure B-54



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



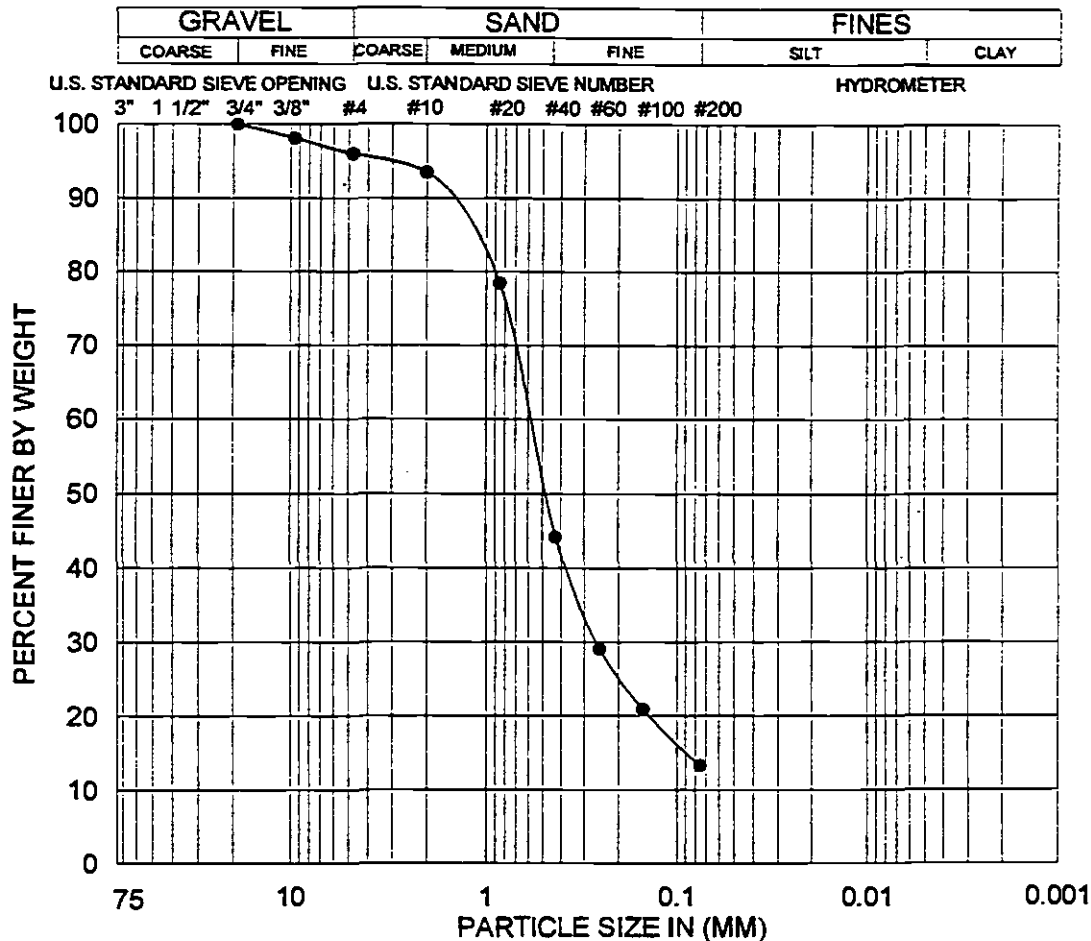
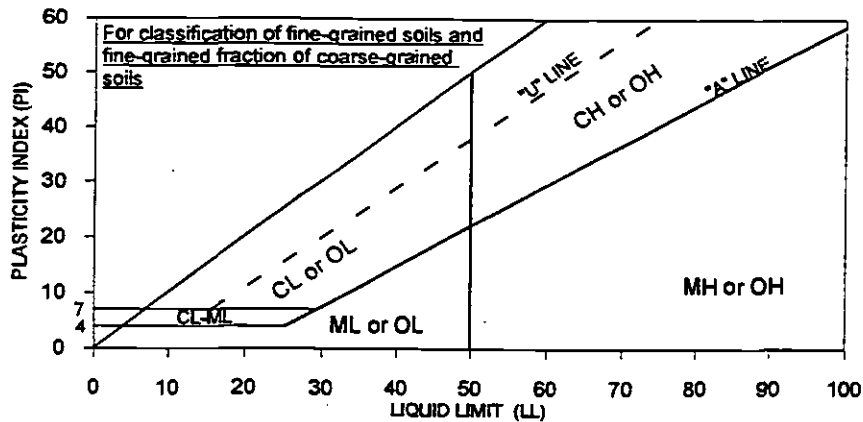
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-52	S-20	63.0	Bag	ML	0:28:72	N/A



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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

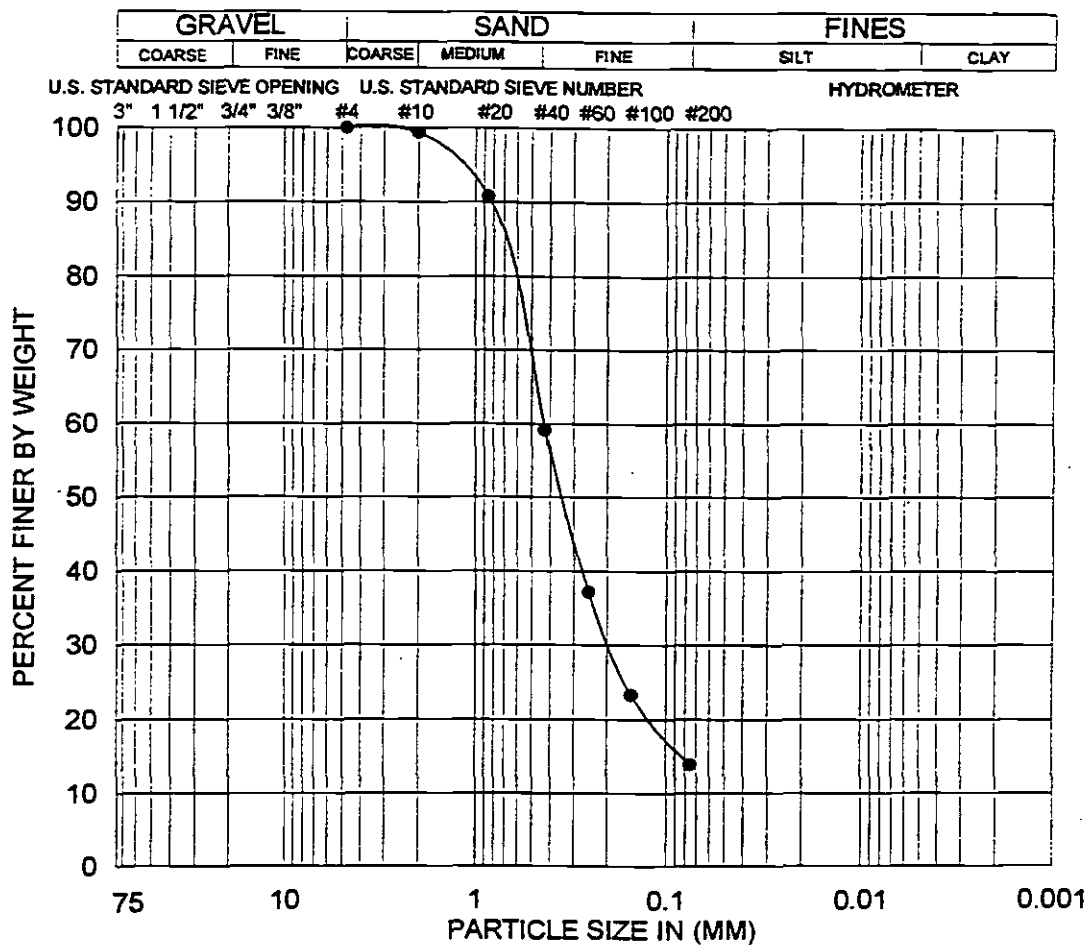
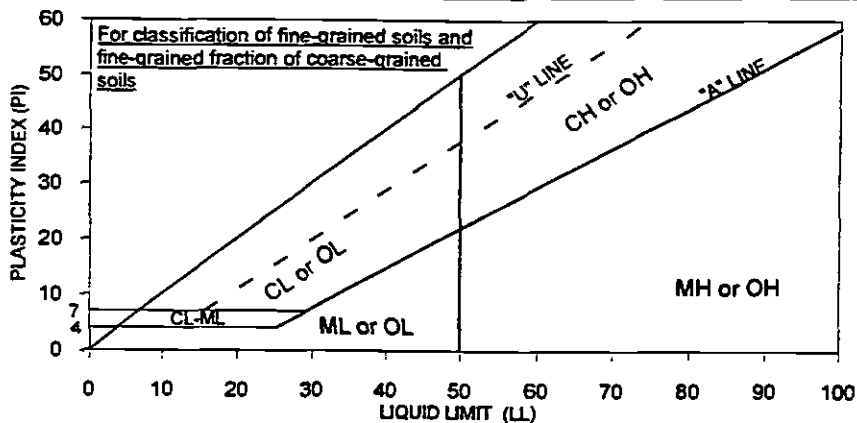


BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD54A	S-8	49.0	SM	4:83:13	N/A



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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
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BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD54A	S-10	55.0	SM	0:86:14	N/A



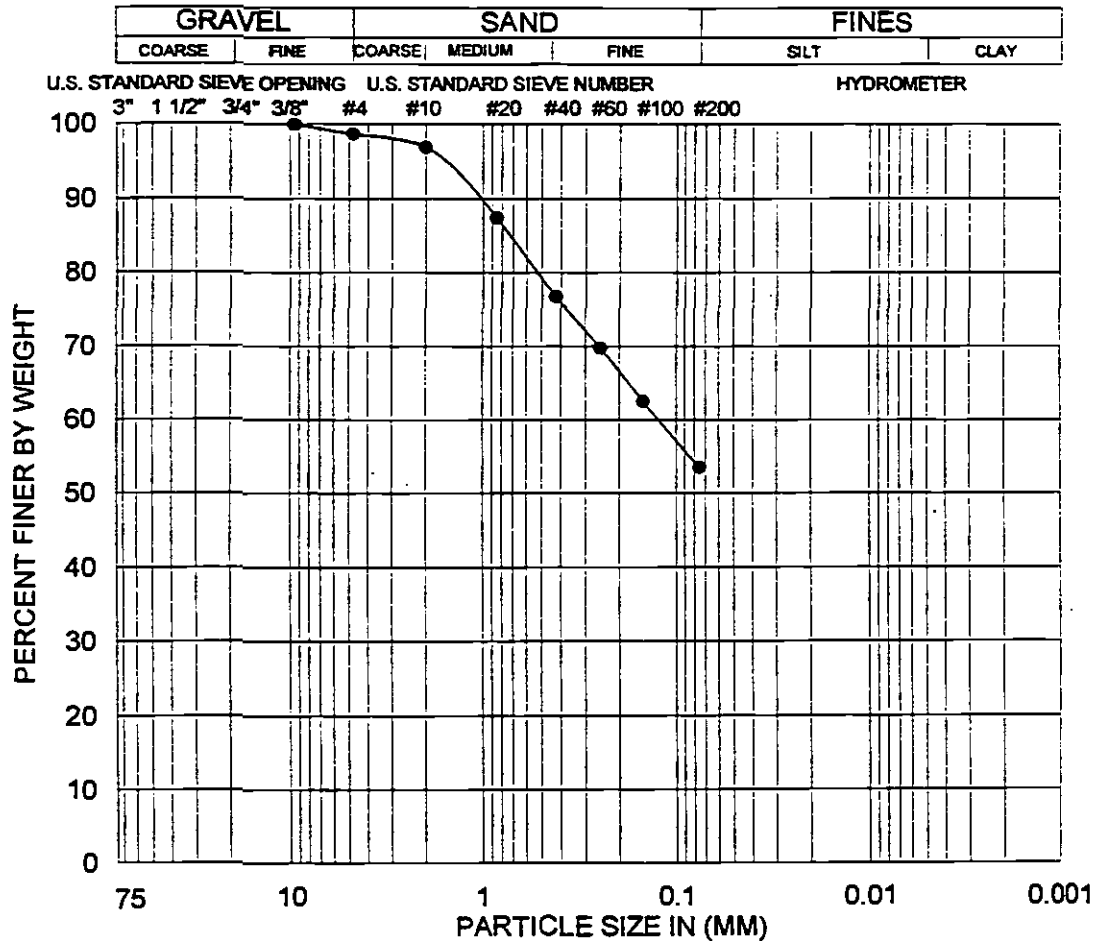
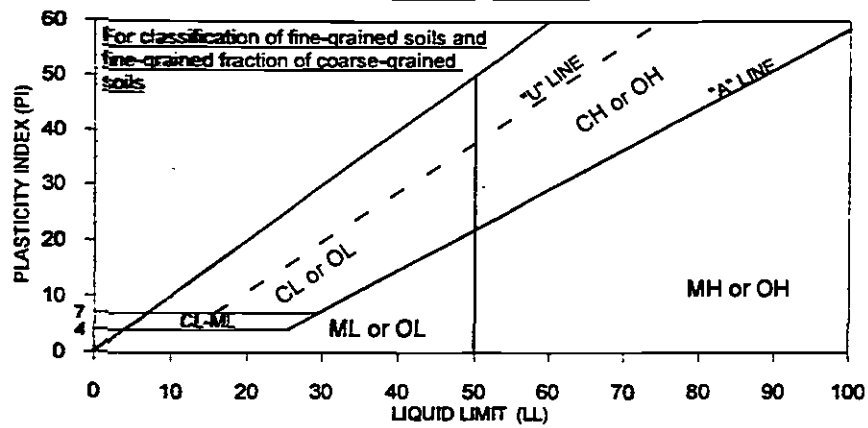
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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-57



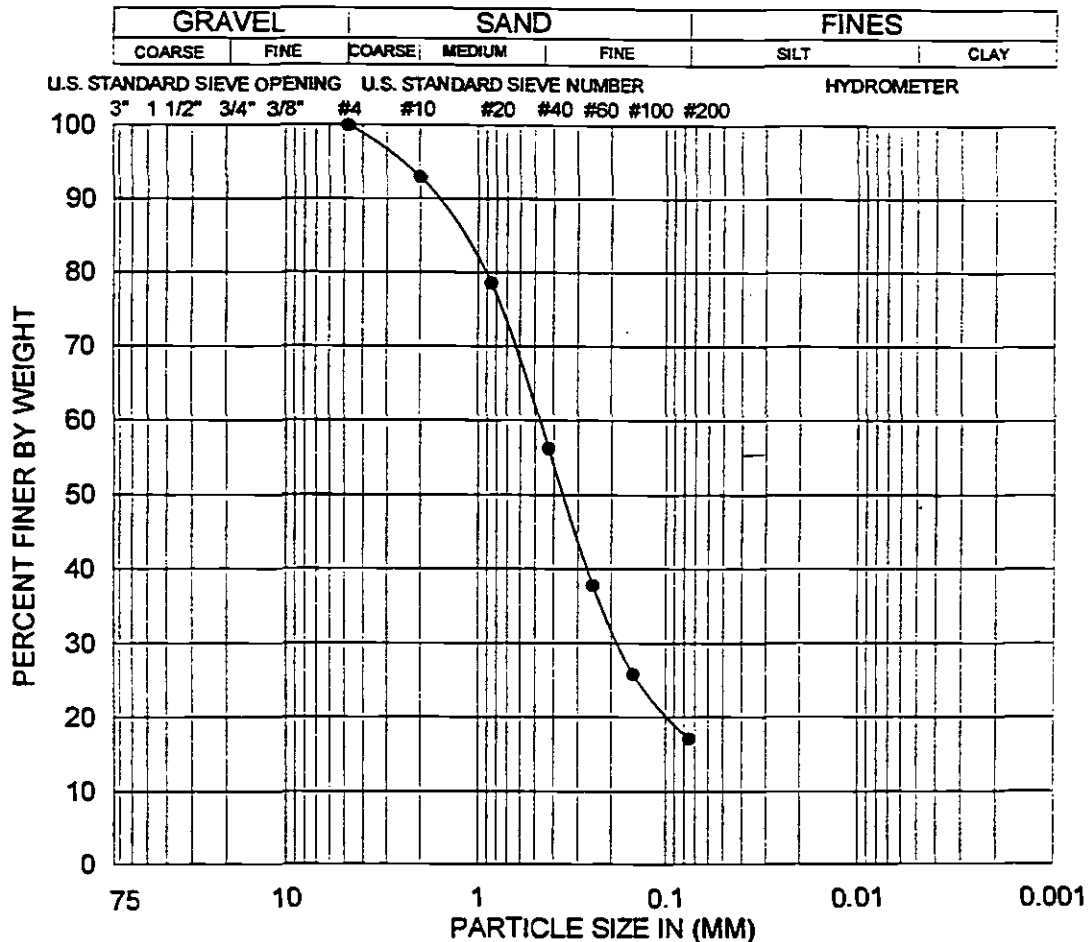
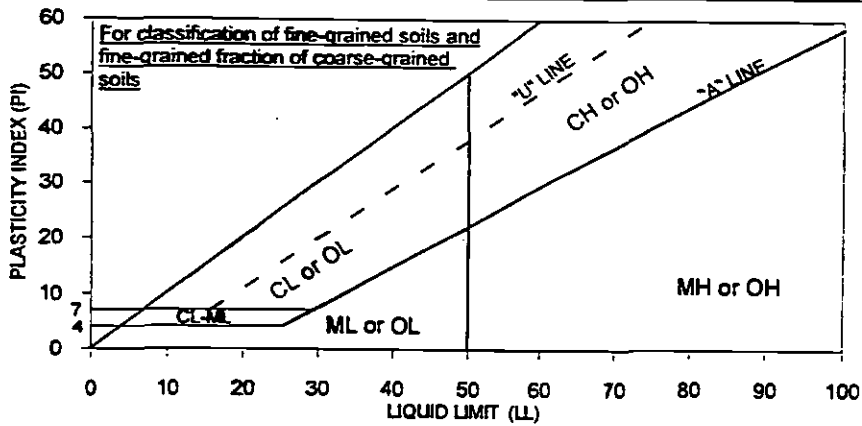
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD54A	S-12	61.0	ML	1:45:54	N/A



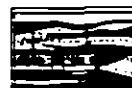
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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



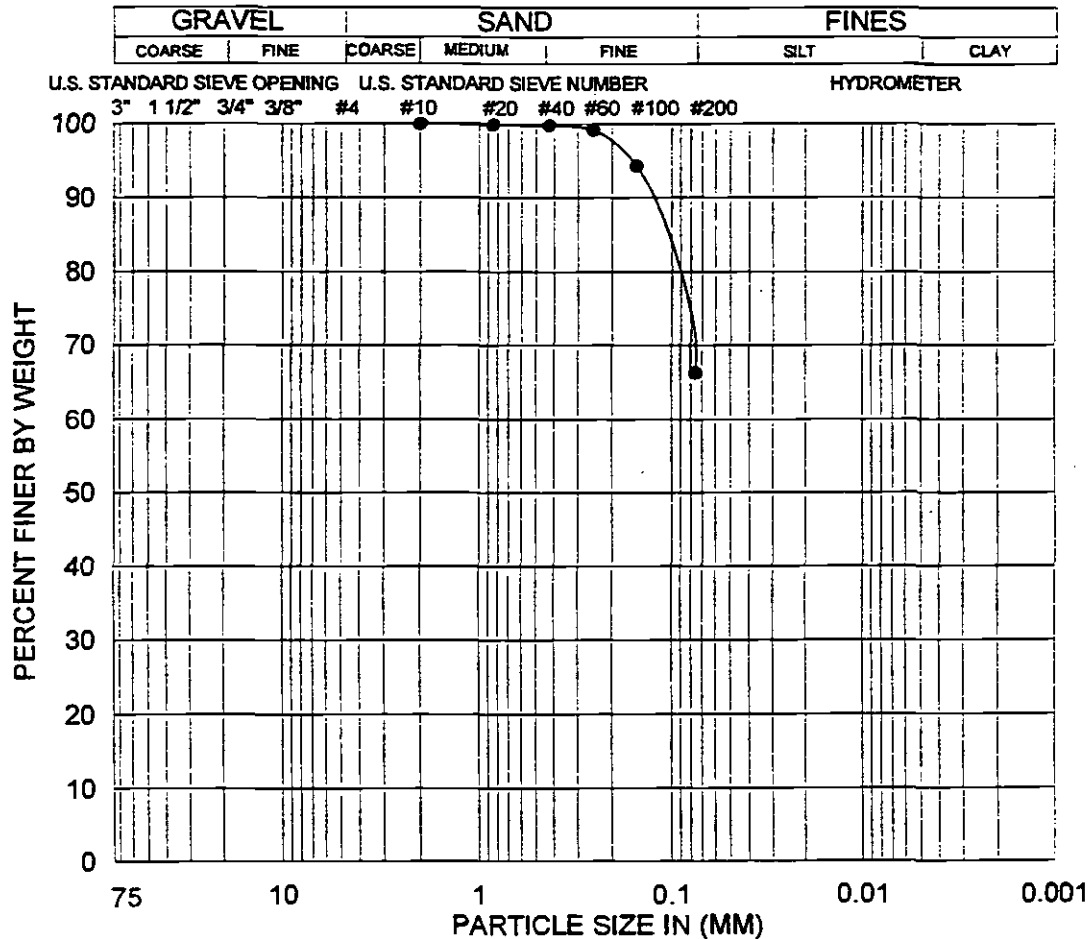
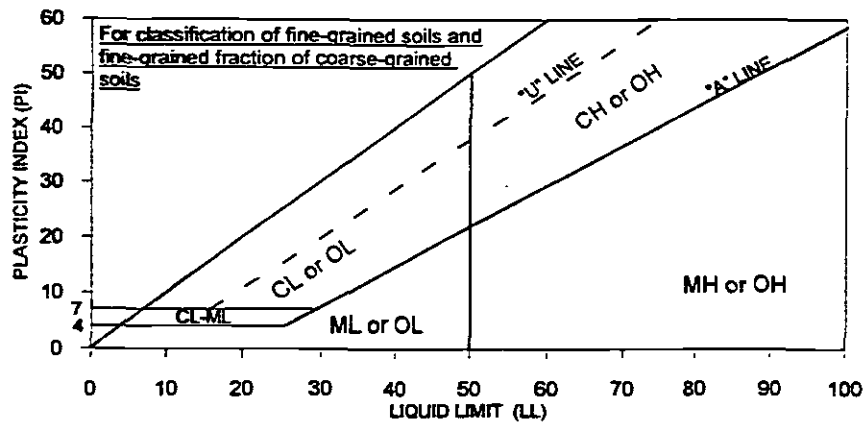
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD54A	S-14	67.0	SM	0:83:17	N/A



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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



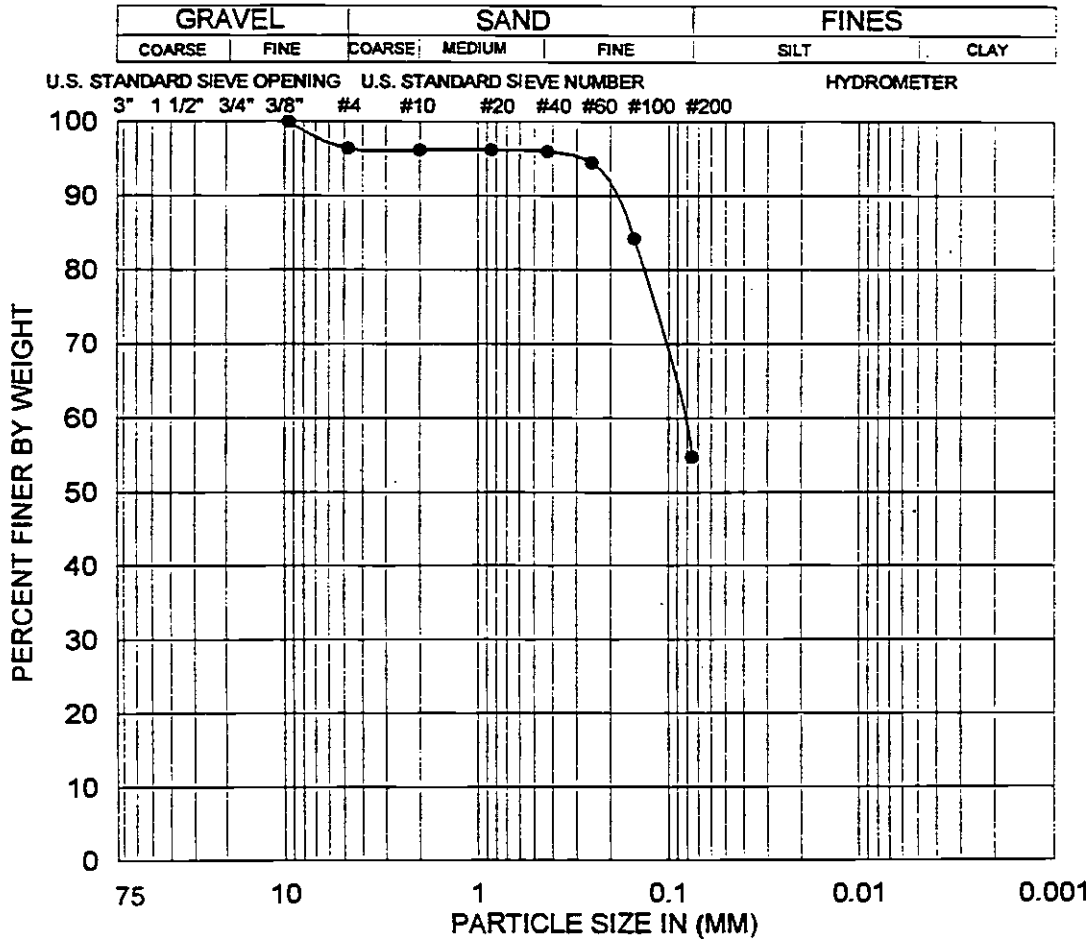
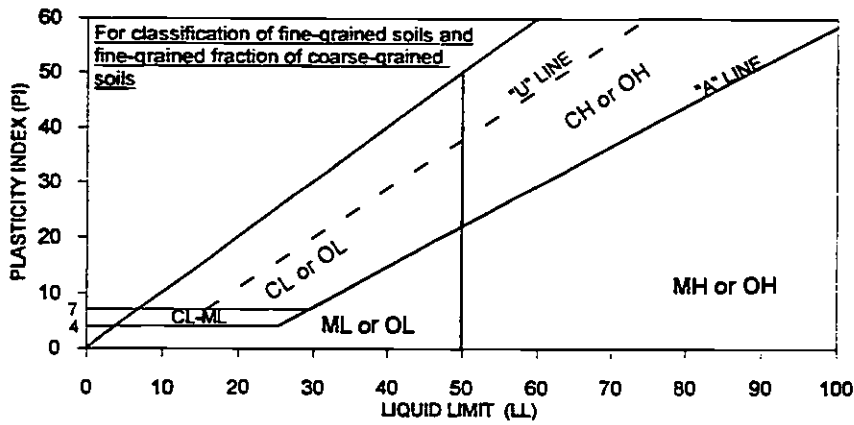
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD54A	S-16	73.0	ML	0:34:66	N/A



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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



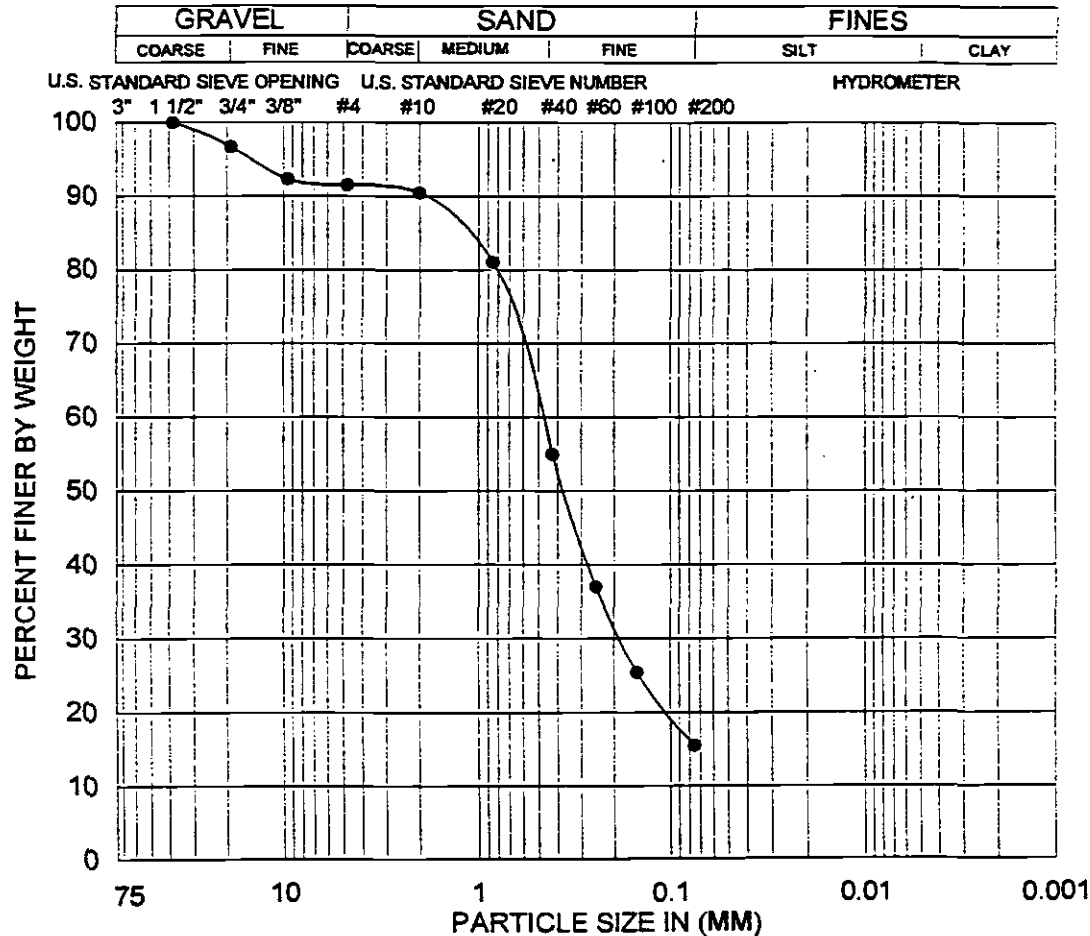
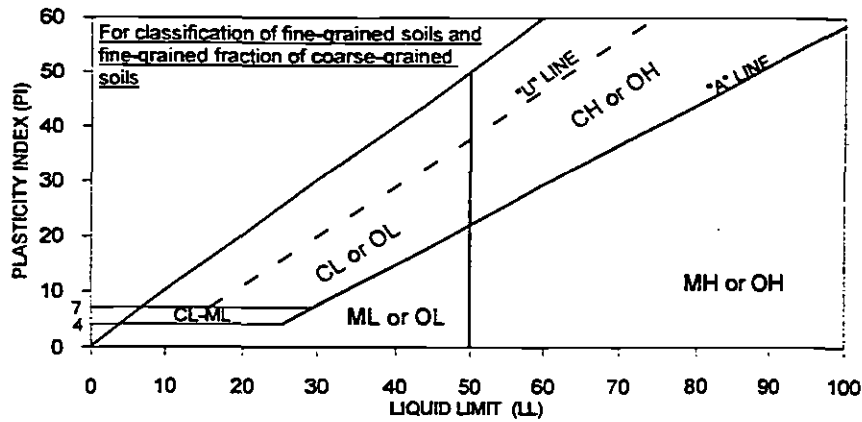
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD54A	S-18	79.0	ML	4:41:55	N/A



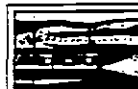
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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-54B	S-2	55.0	SM	9:75:16	N/A



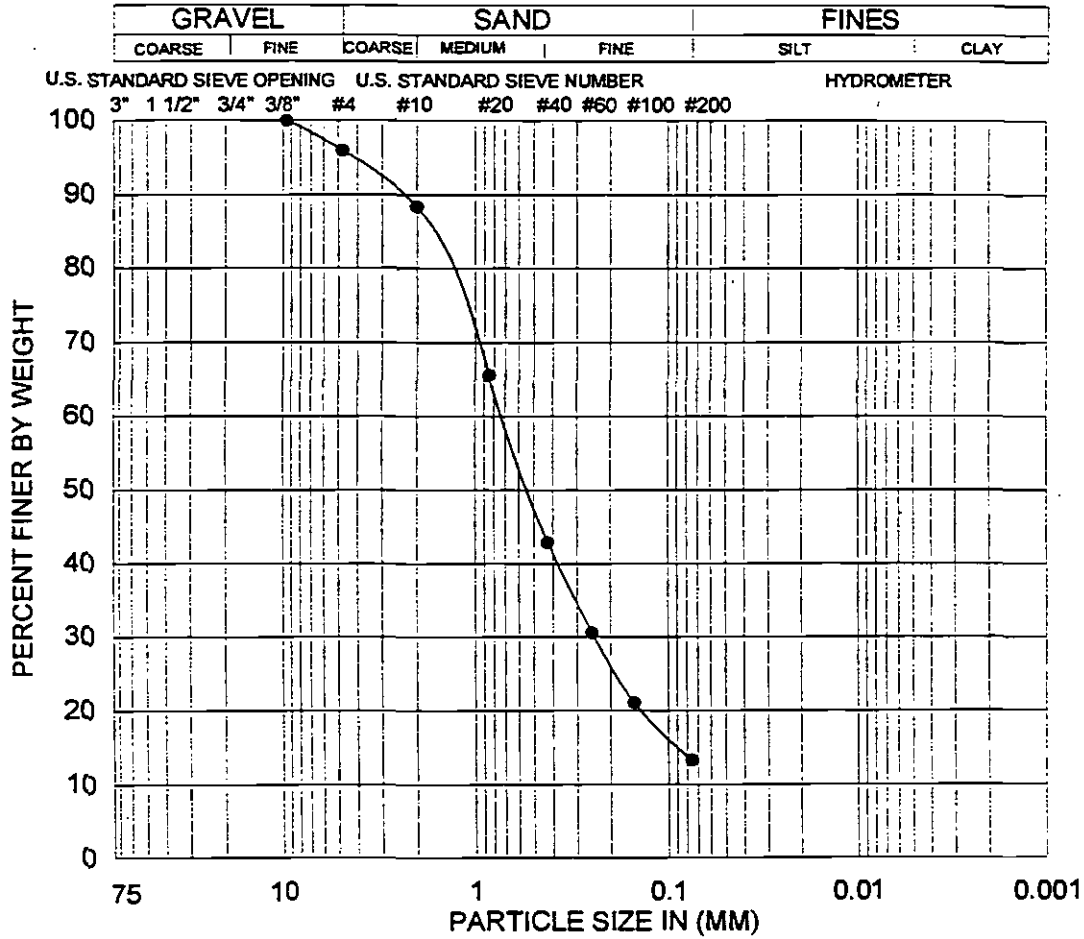
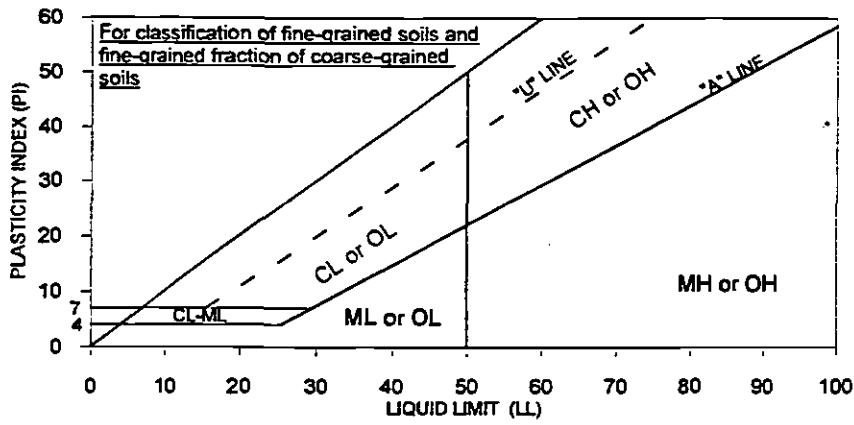
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EASTSIDE EXTENSION

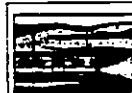
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-61-1



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-54B	S-4	65.0	SM	4:83:13	N/A



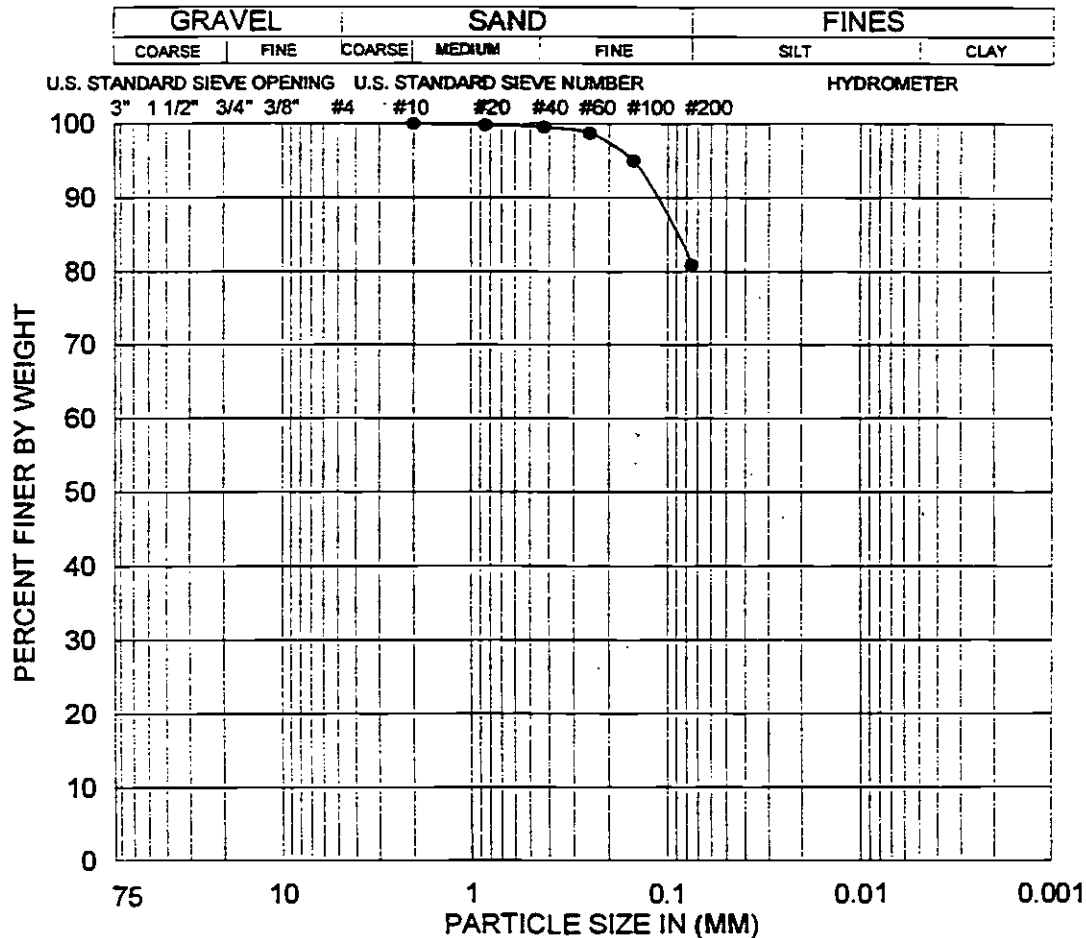
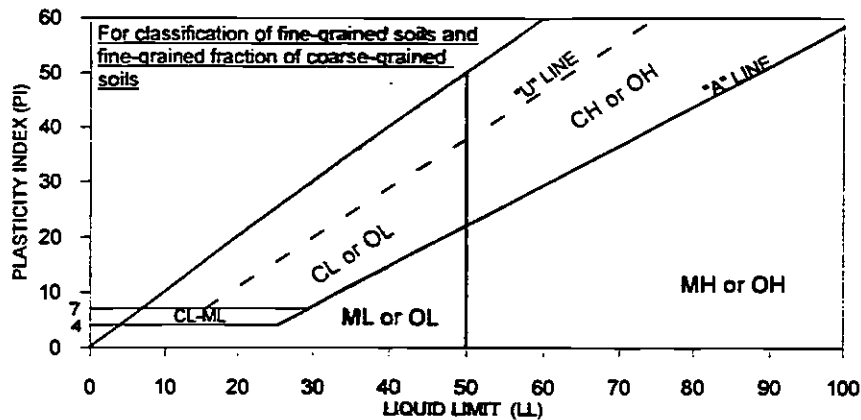
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METRORAIL
EASTSIDE EXTENSION

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-61-2



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-54B	S-5	70.0	ML	0:19:81	N/A



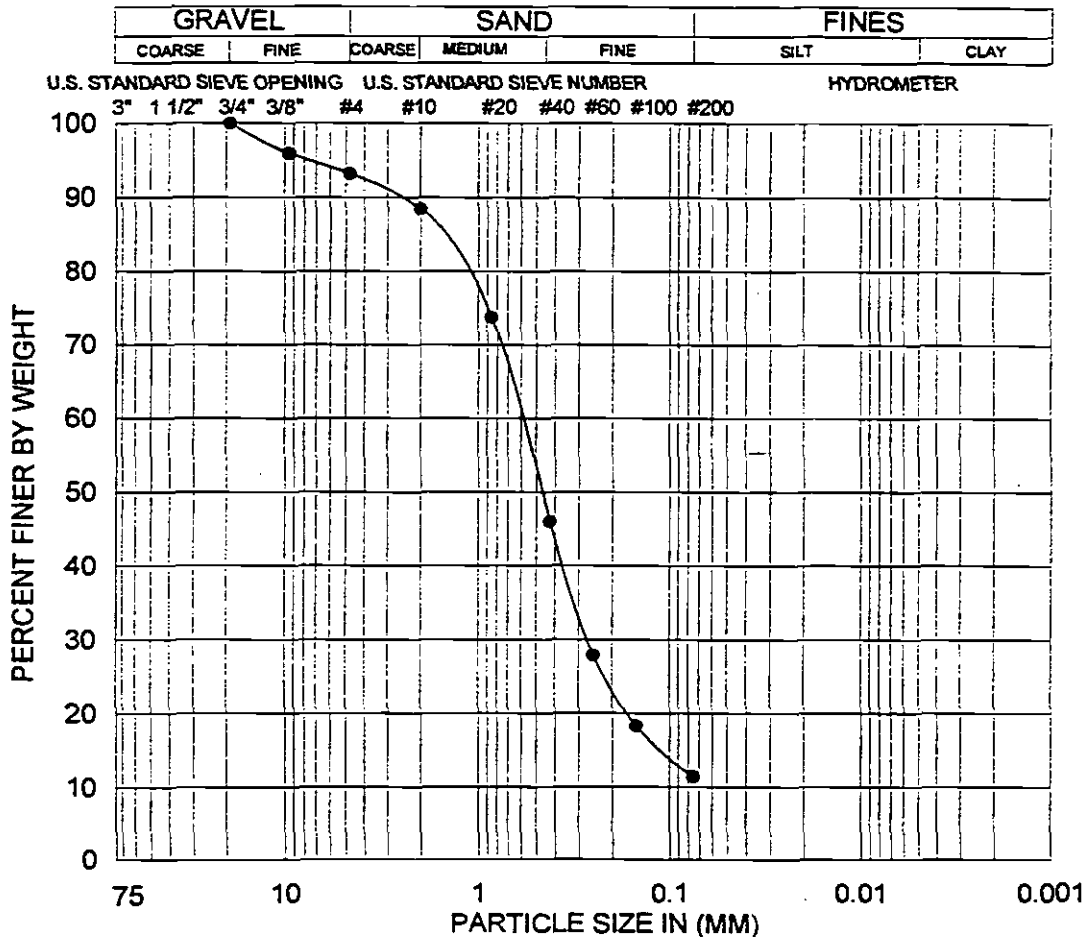
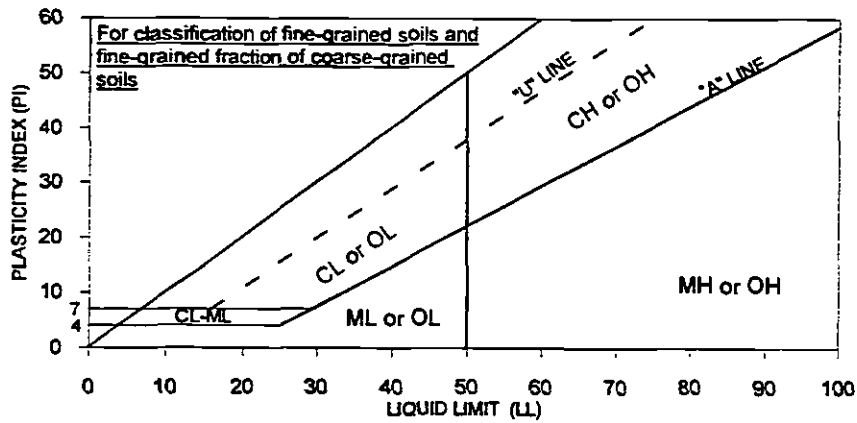
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METRORAIL
EASTSIDE EXTENSION

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-61-3



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-54B	S-7	80.0	SW-SM	7:82:11	N/A



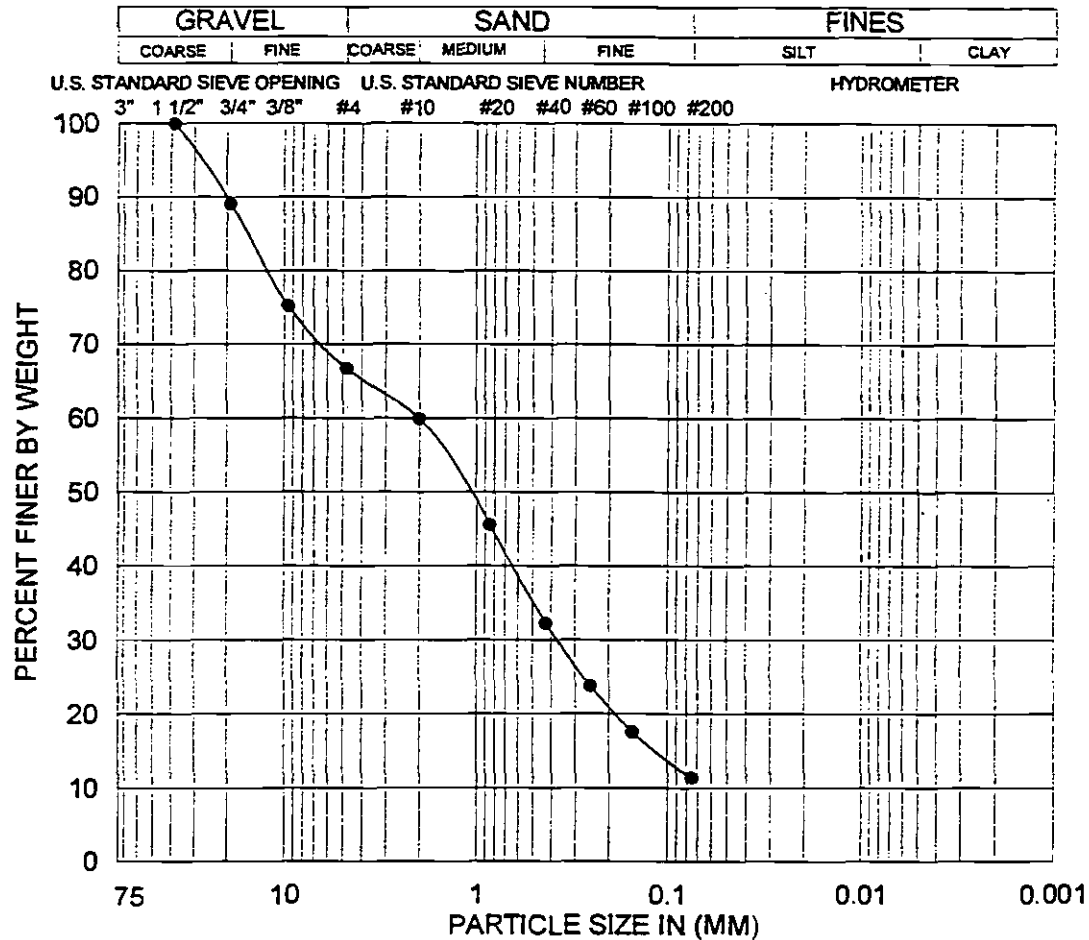
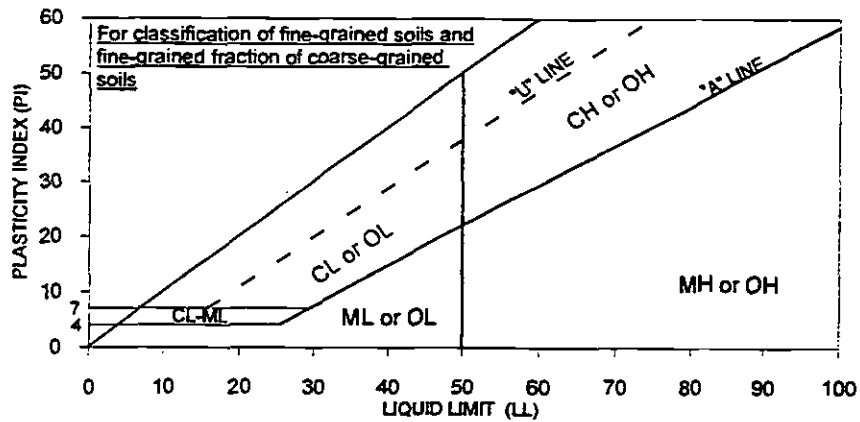
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METRORAIL
EASTSIDE EXTENSION

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-61-4



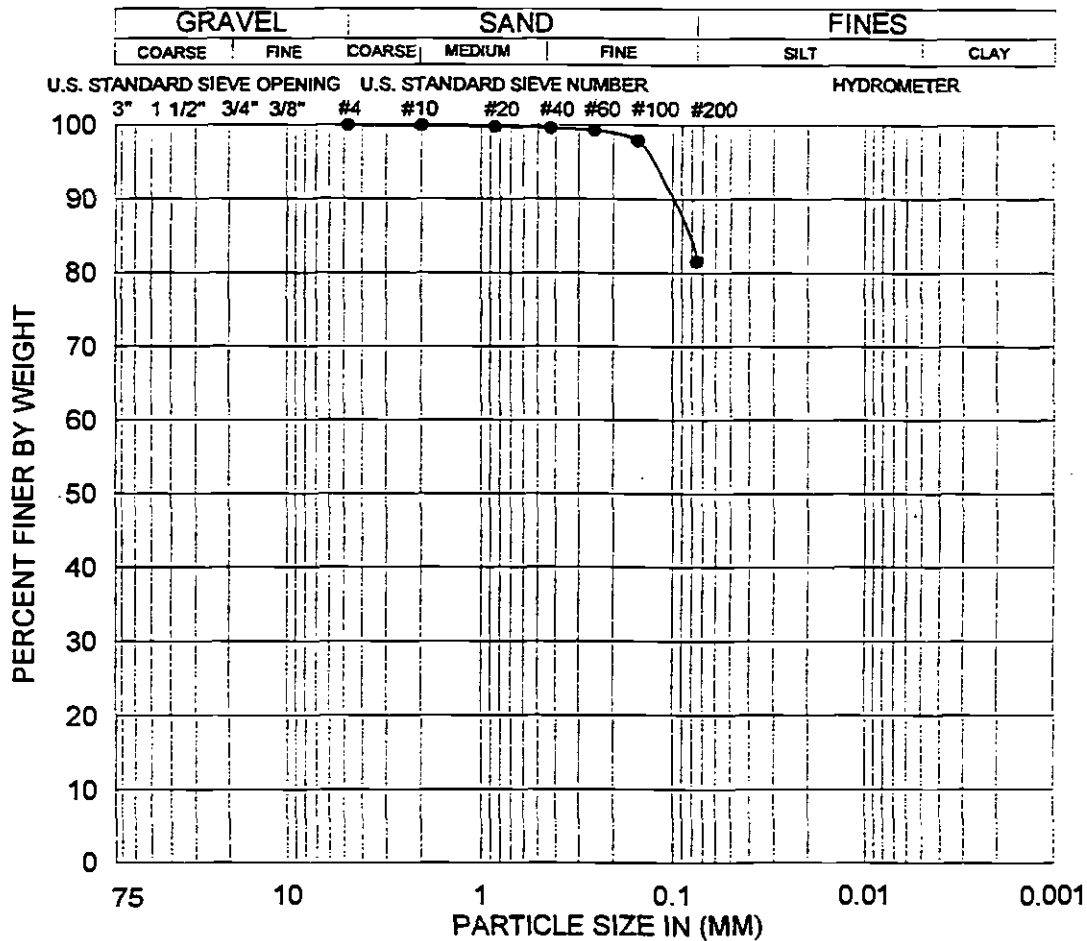
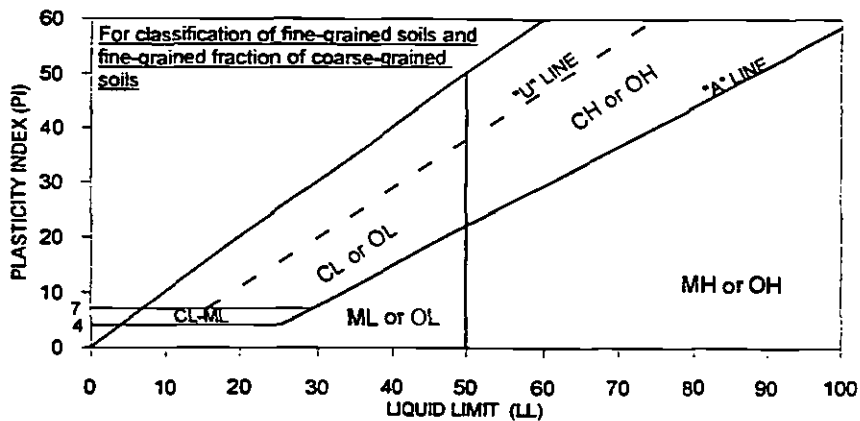
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METRORAIL
EASTSIDE EXTENSION

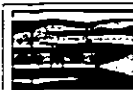
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-61-5



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-54B	S-9	90.0	ML	0:18:82	N/A



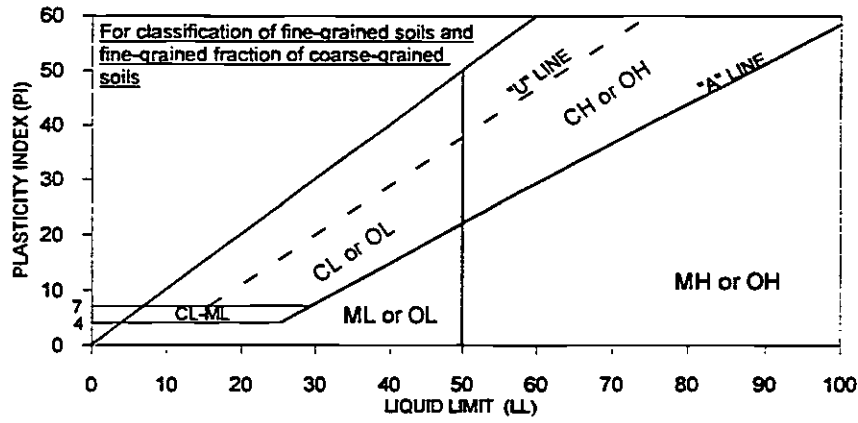
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EASTSIDE EXTENSION

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

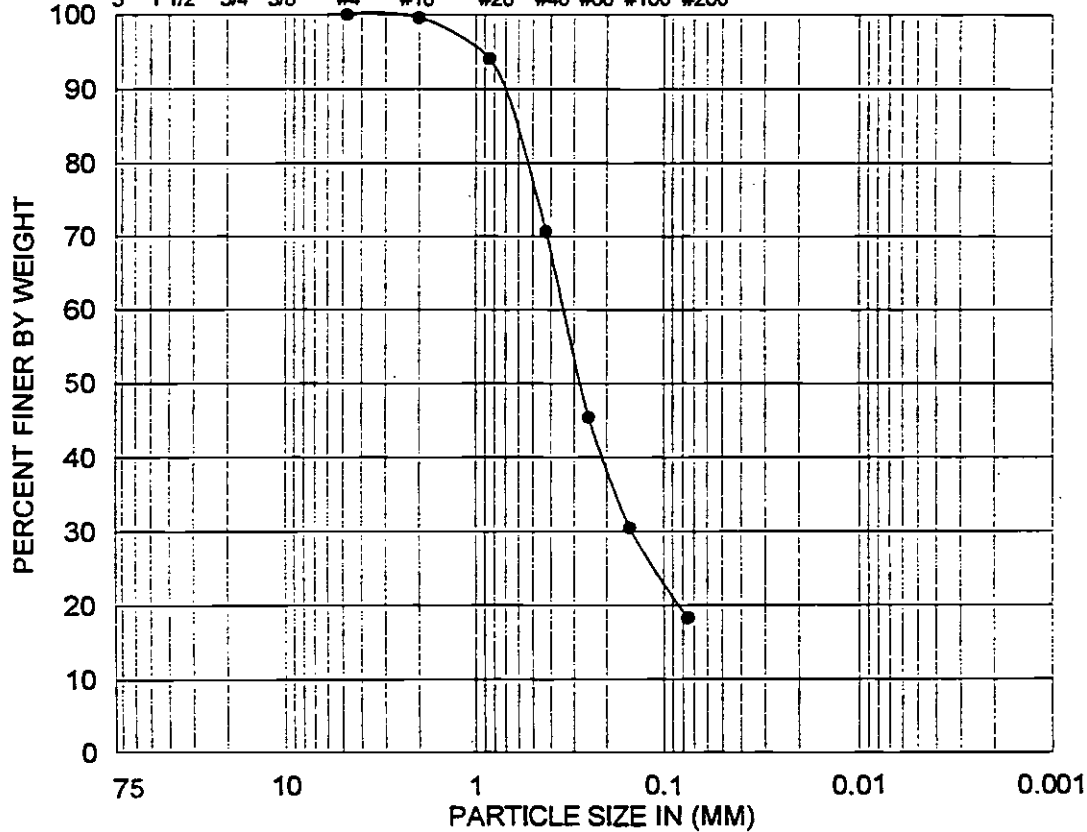
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Figure B-61-6

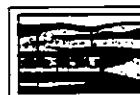


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER HYDROMETER



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-54B	S-10	95.0	SM	0:28:18	N/A



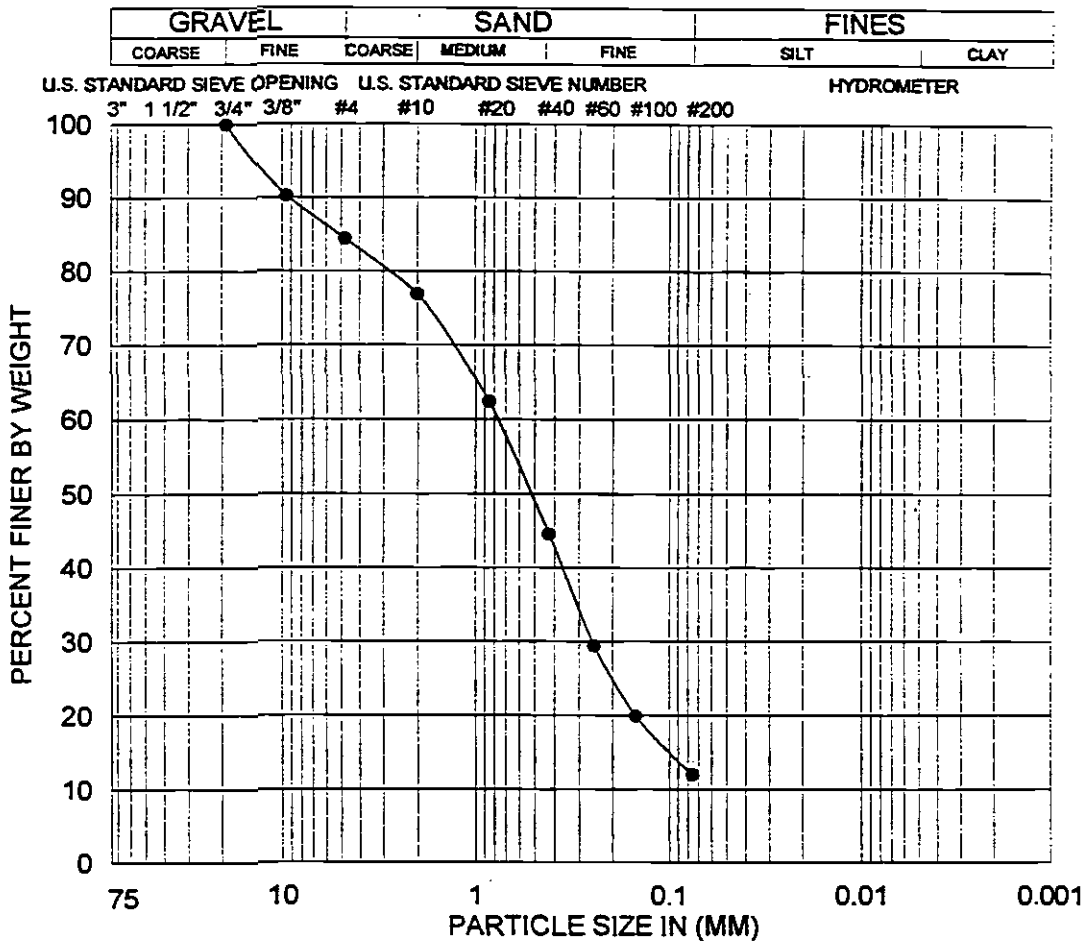
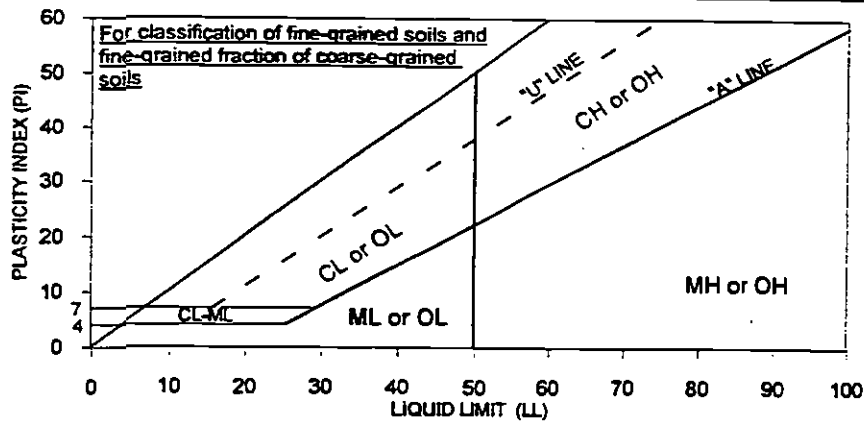
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METRORAIL
EASTSIDE EXTENSION

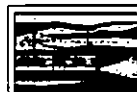
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-61-7



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-54C	S-4	55.0	SW-SM	16:72:12	N/A



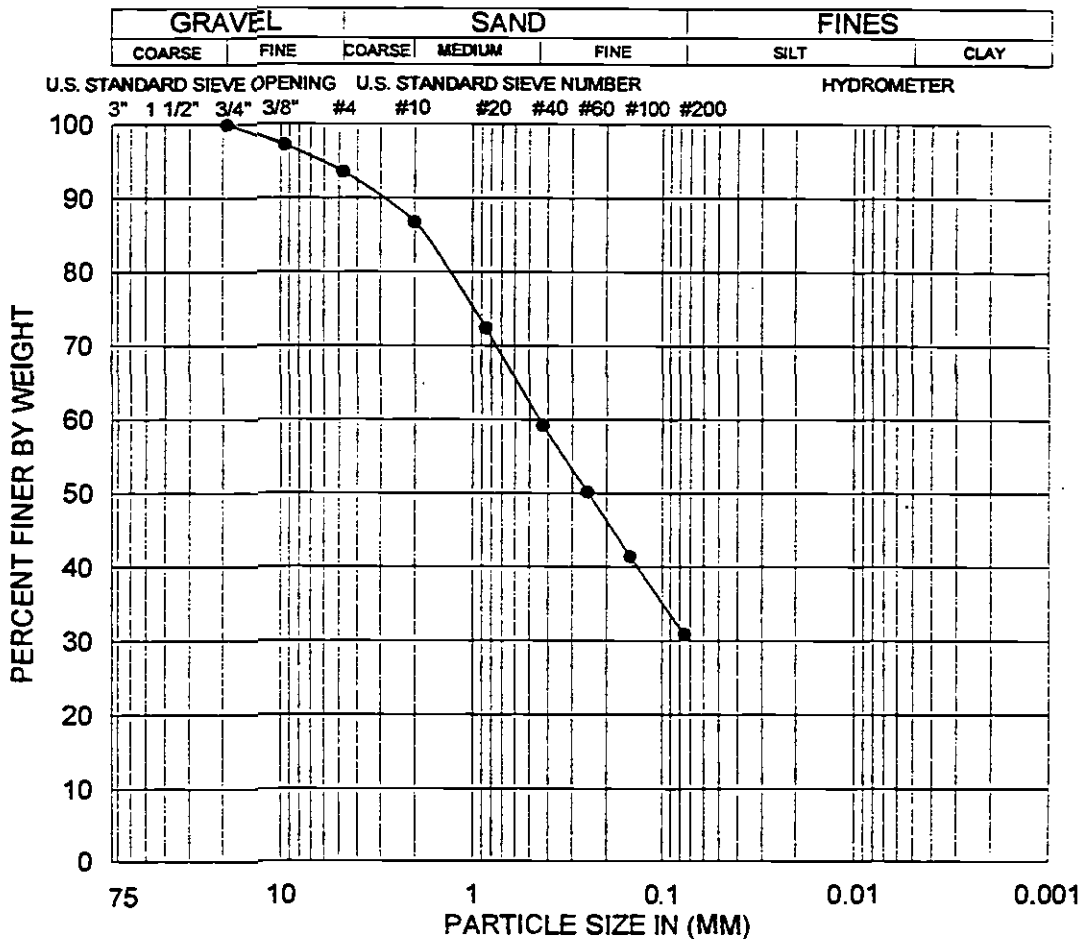
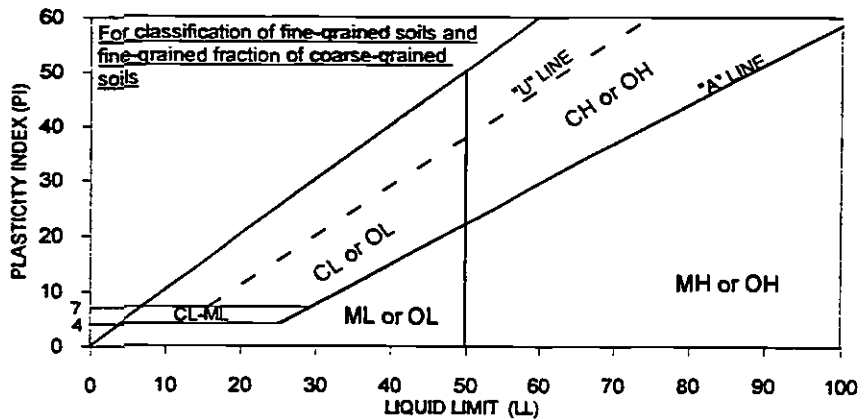
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METRORAIL
EASTSIDE EXTENSION

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-61-8

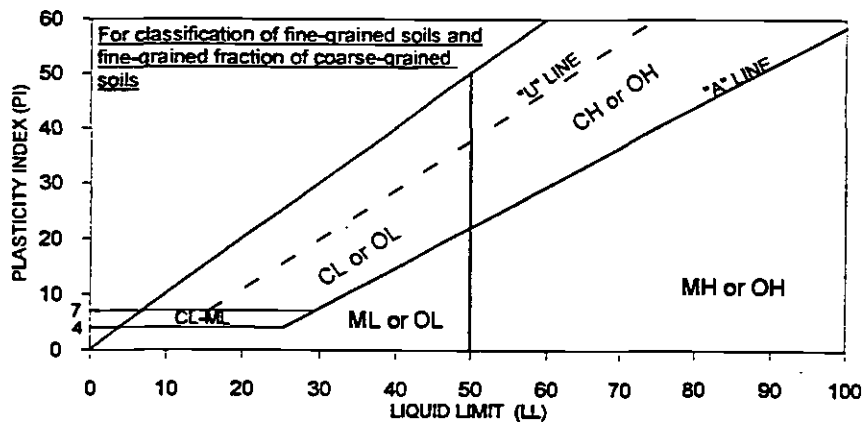


BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-54C	S-10	63.5	SM	6:63:31	N/A



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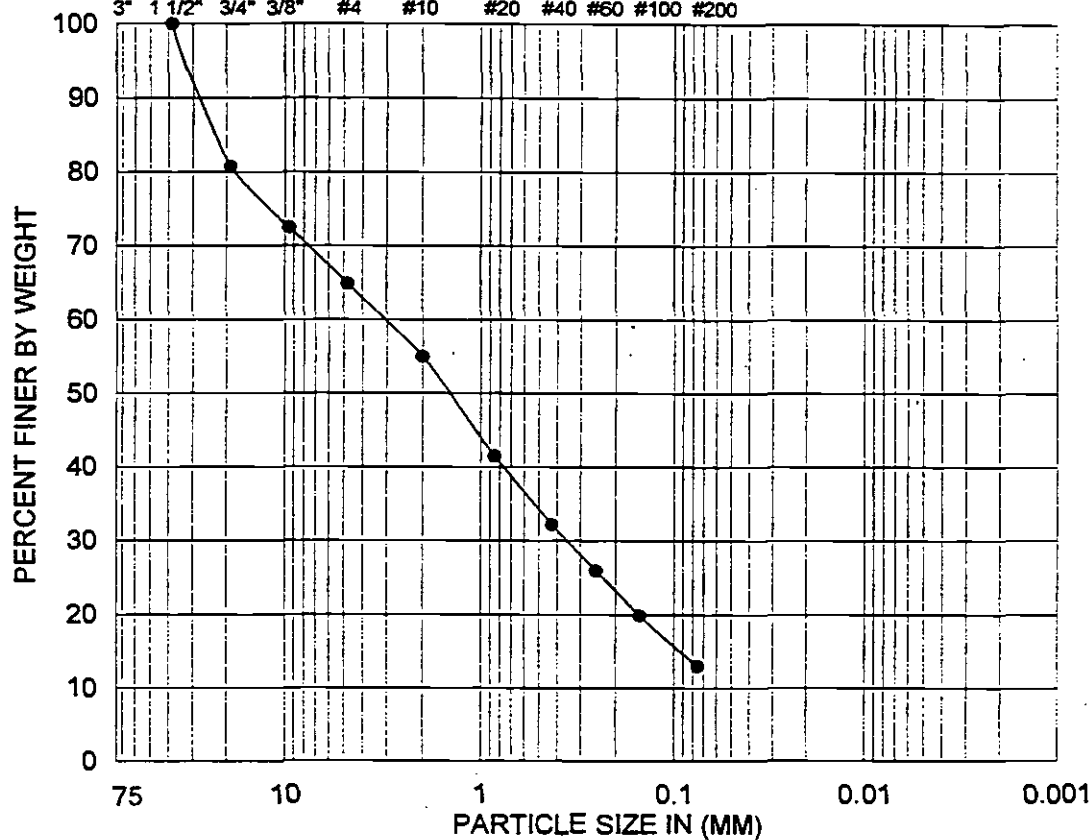
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER HYDROMETER

3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-54C	S-13	68.0	SM	35:52:13	N/A

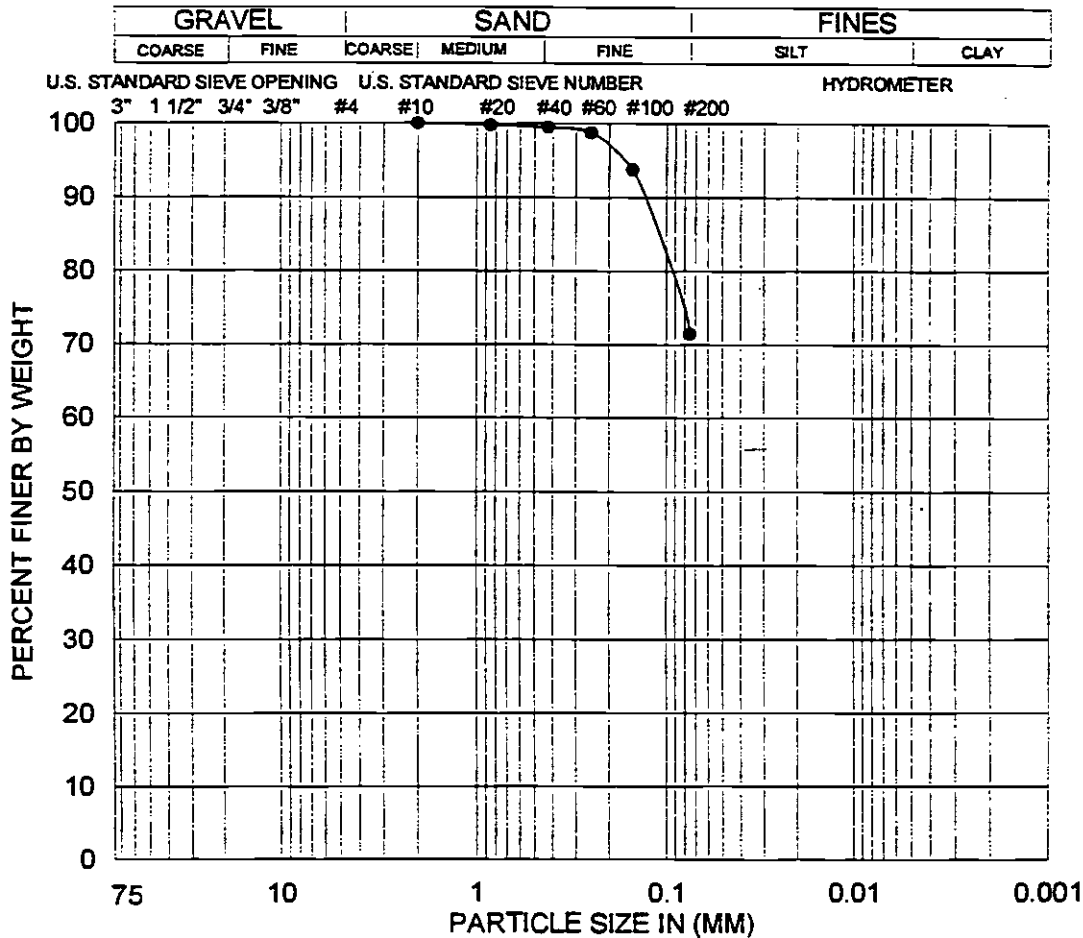
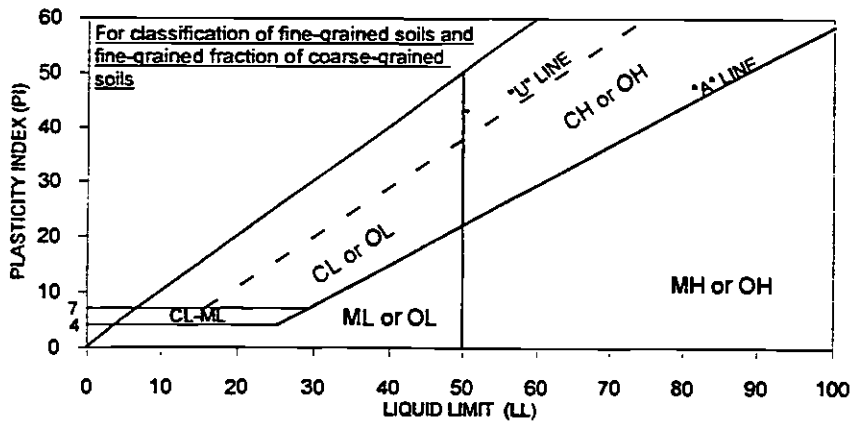


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METRORAIL
EASTSIDE EXTENSION

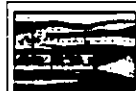
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318,D422)

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Figure B-61-10



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-54C	S-18	75.5	ML	0:29:71	N/A



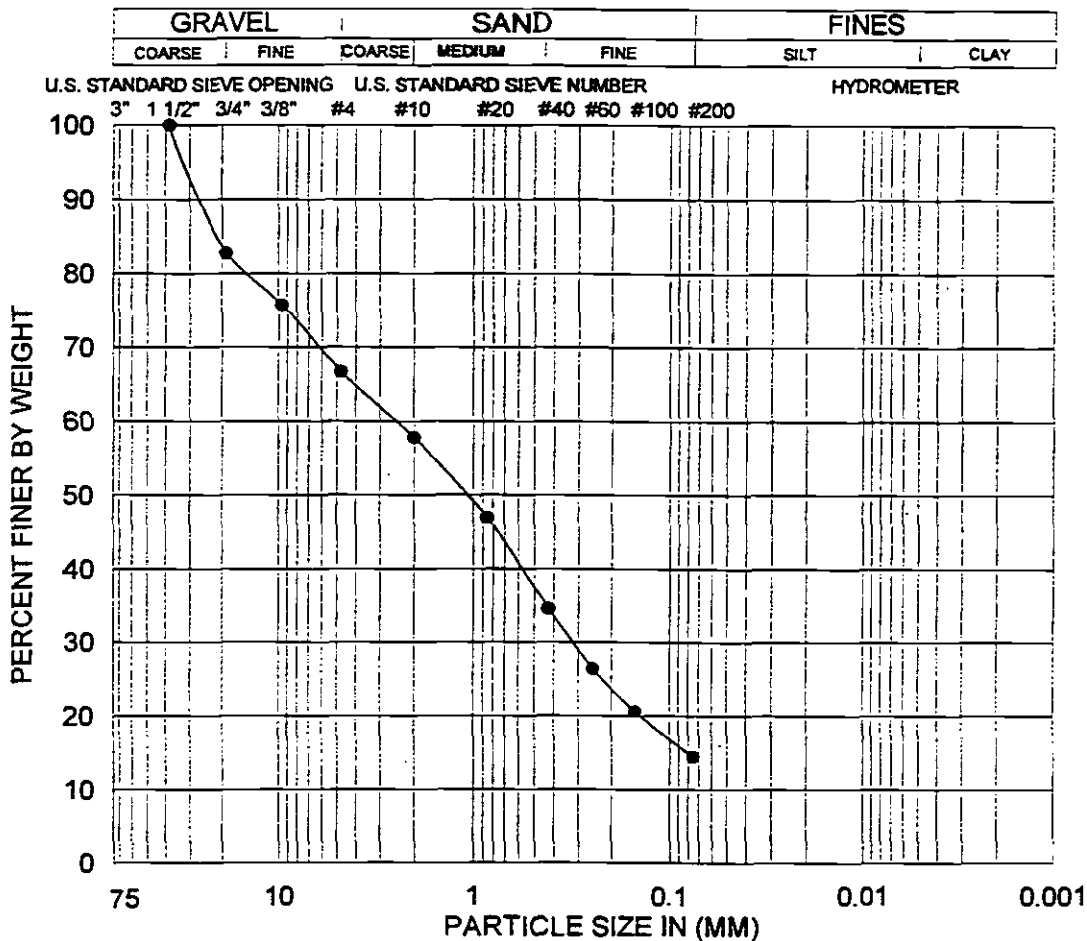
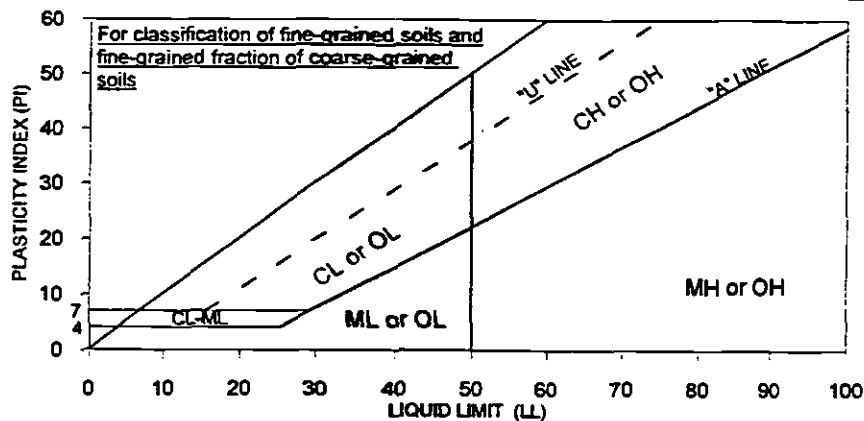
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METRORAIL
EASTSIDE EXTENSION

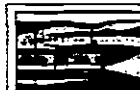
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-61-11



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-54C	S-25	87.0	SM	33:52:15	N/A



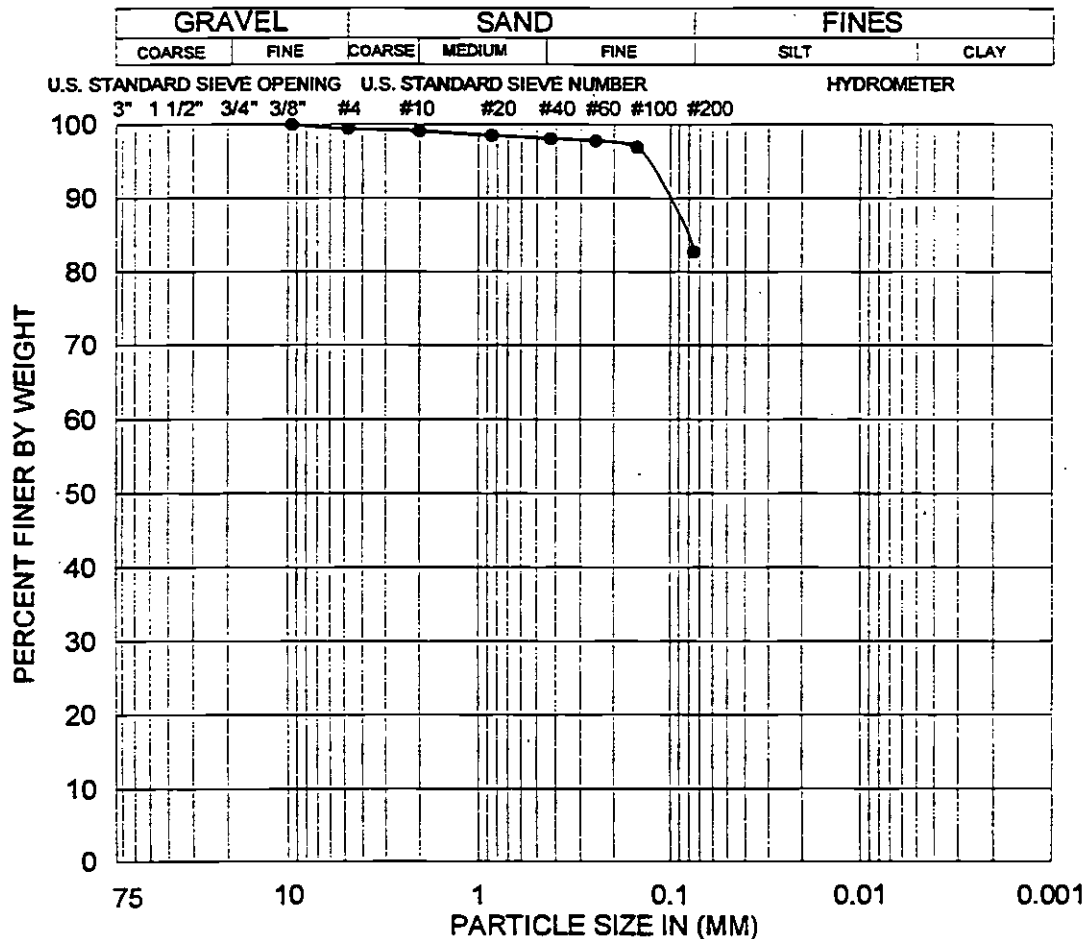
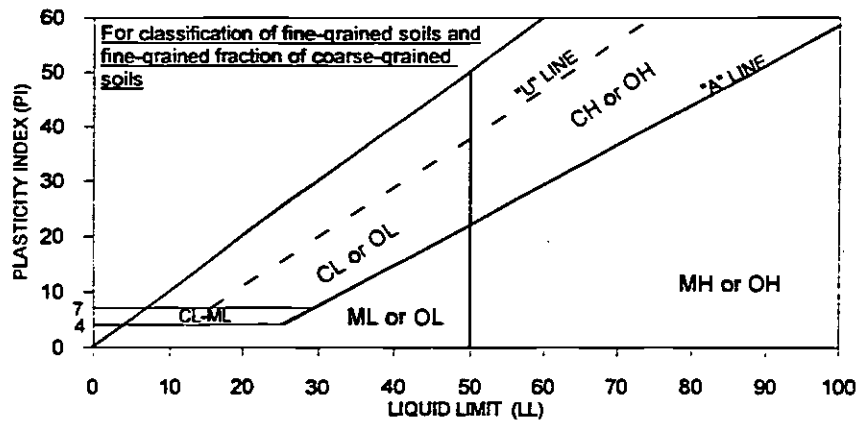
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Project No. 95-8347-24
METRORAIL
EASTSIDE EXTENSION

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-61-12



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-54C	S-29	93.0	ML	1:16:83	N/A



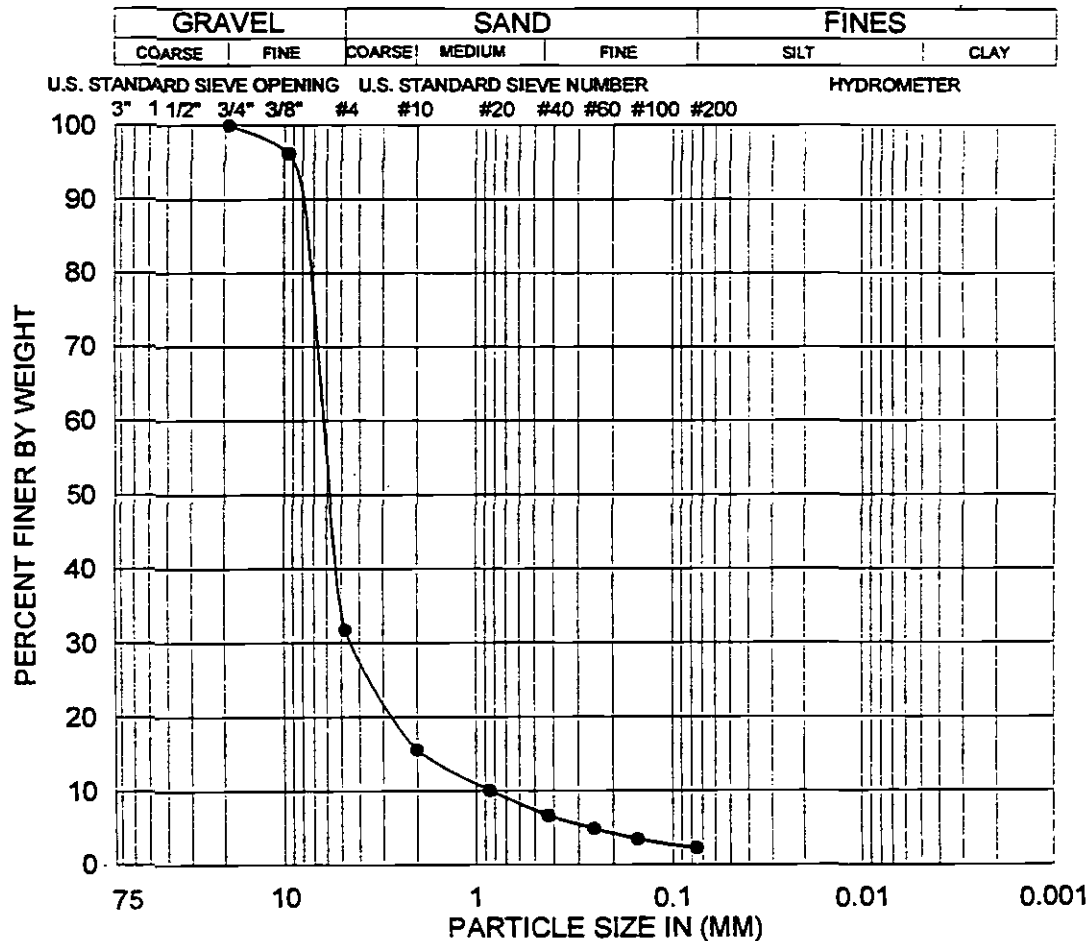
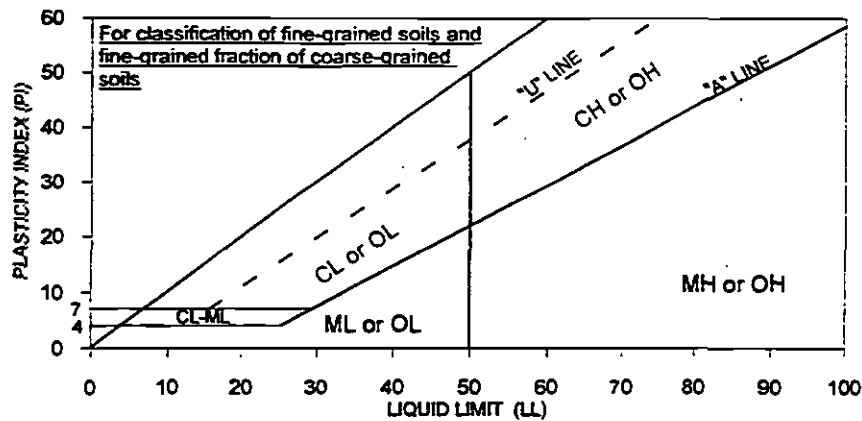
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Project No. 95-8347-24
METRORAIL
EASTSIDE EXTENSION

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-61-13



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD55A	D-6	28.0	GP	68:30:2	N/A



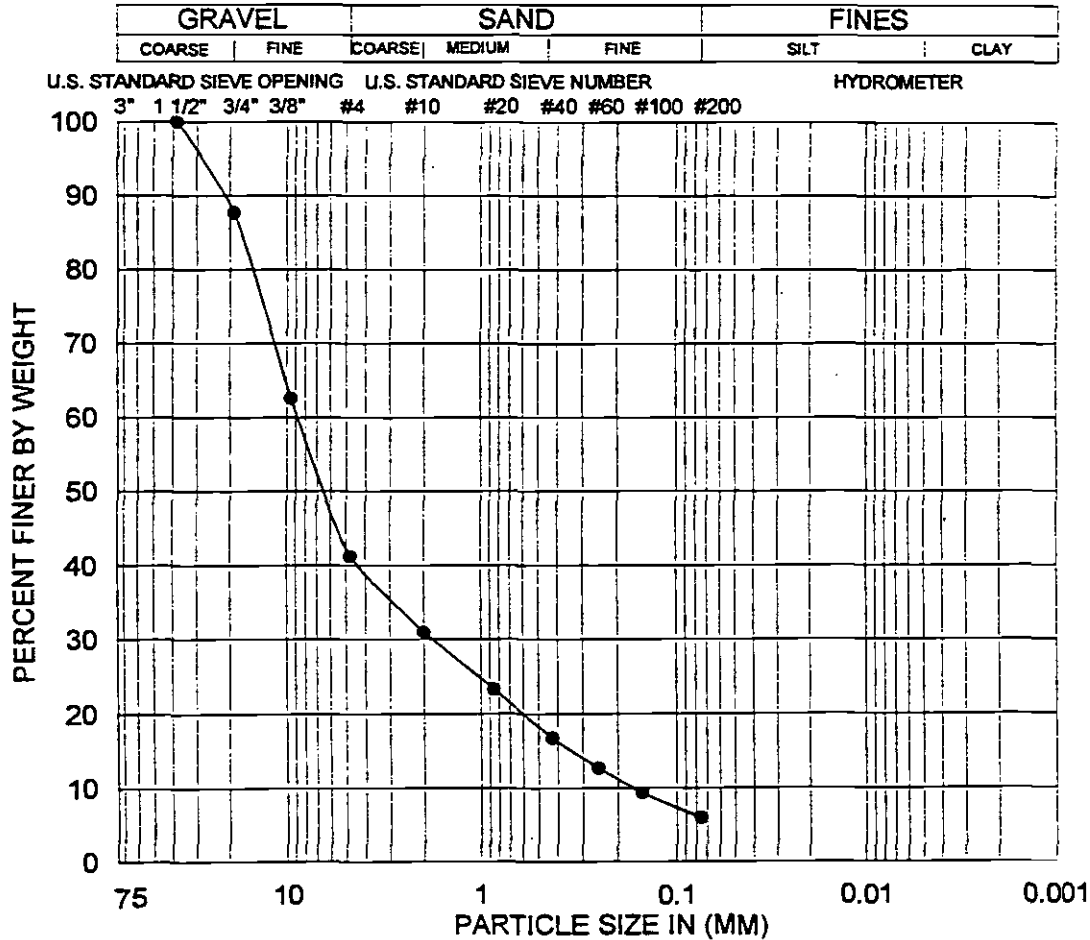
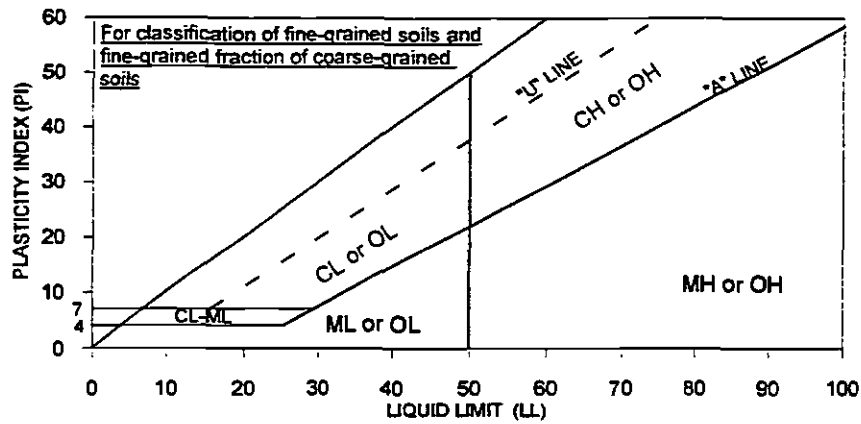
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Consultants

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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-62



Not enough sample to meet ASTM specification



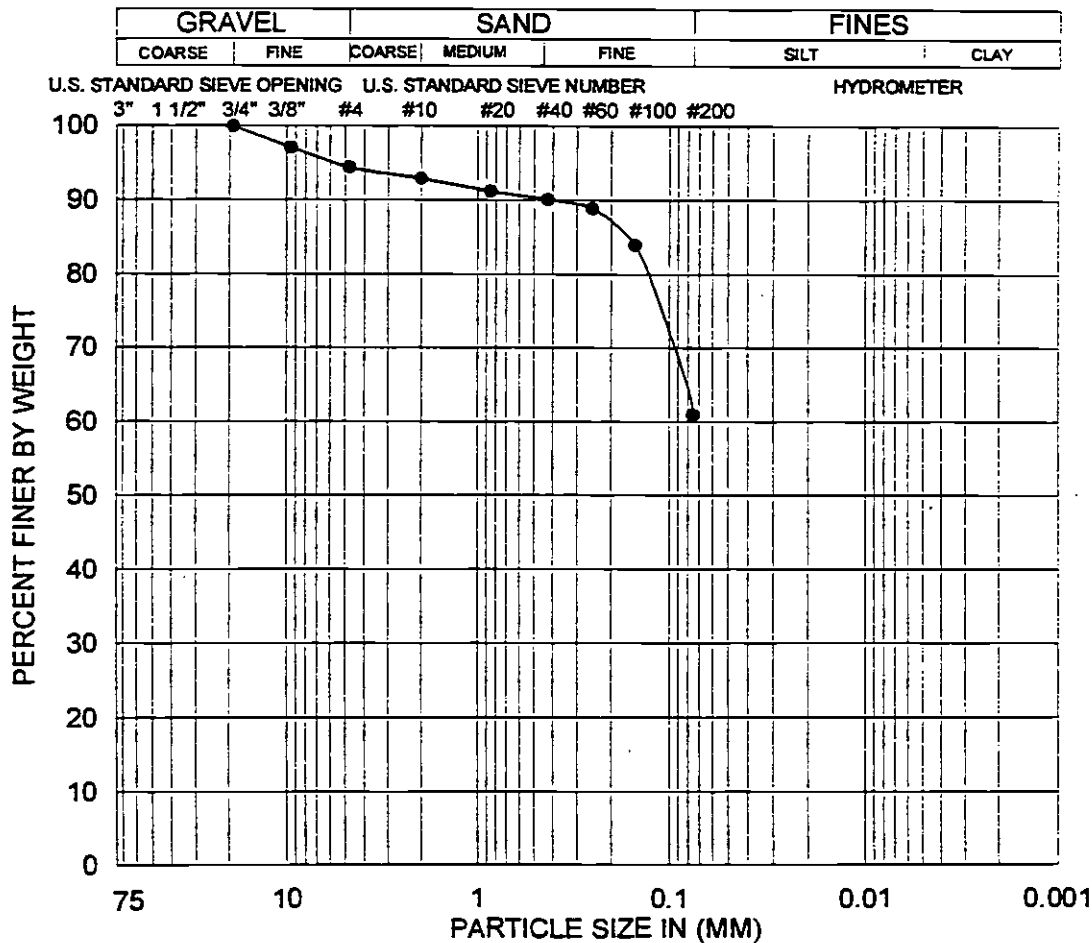
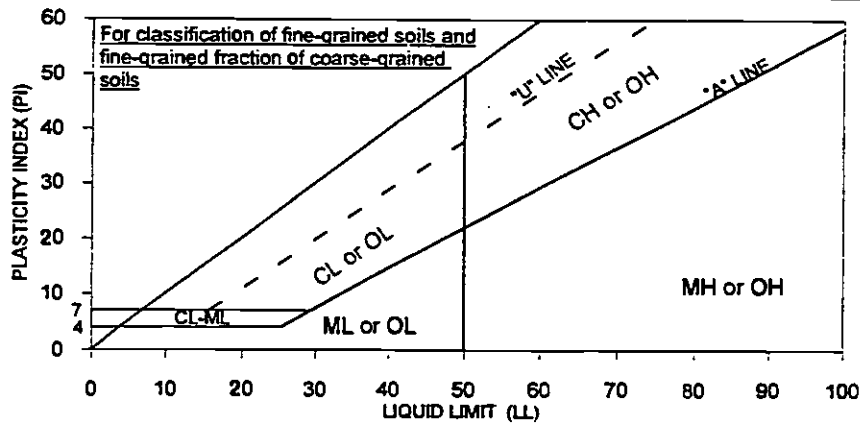
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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-63



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD55A	S-11	43.0	ML	6:33:61	N/A

Not enough sample to meet ASTM specification

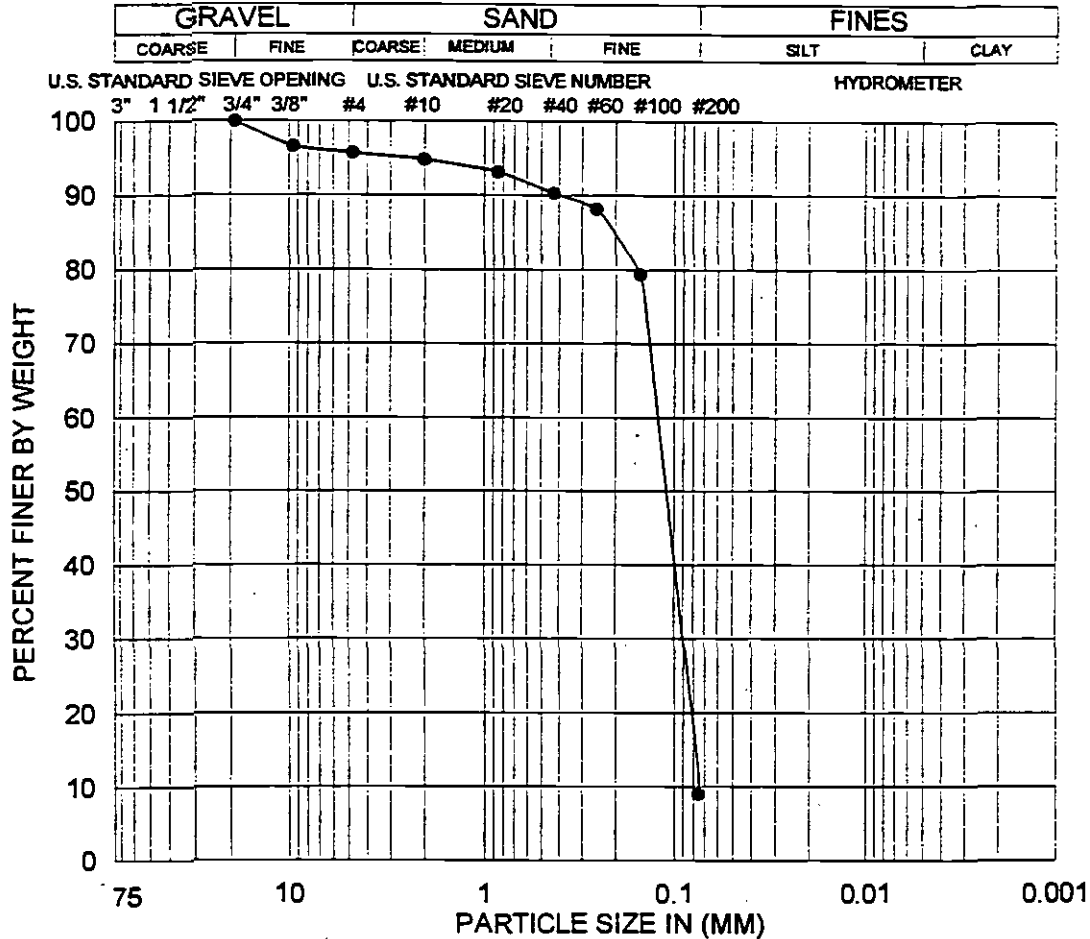
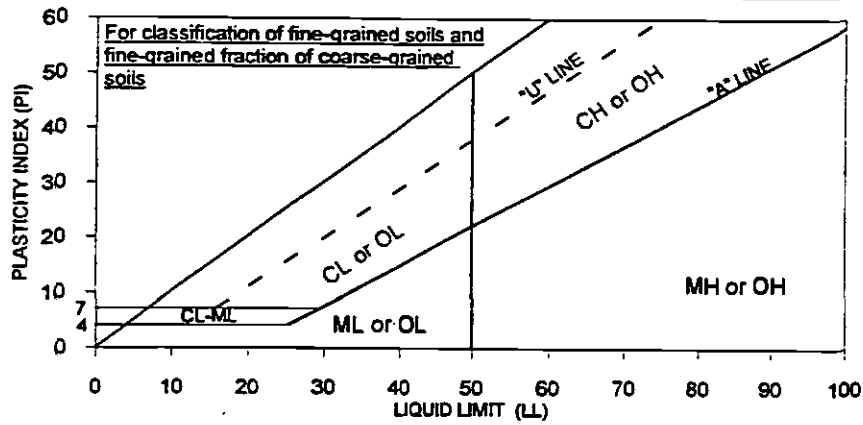


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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-64



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD55A	S-13	49.0	SP-SM	4:87:9	N/A

Not enough sample to meet ASTM specification



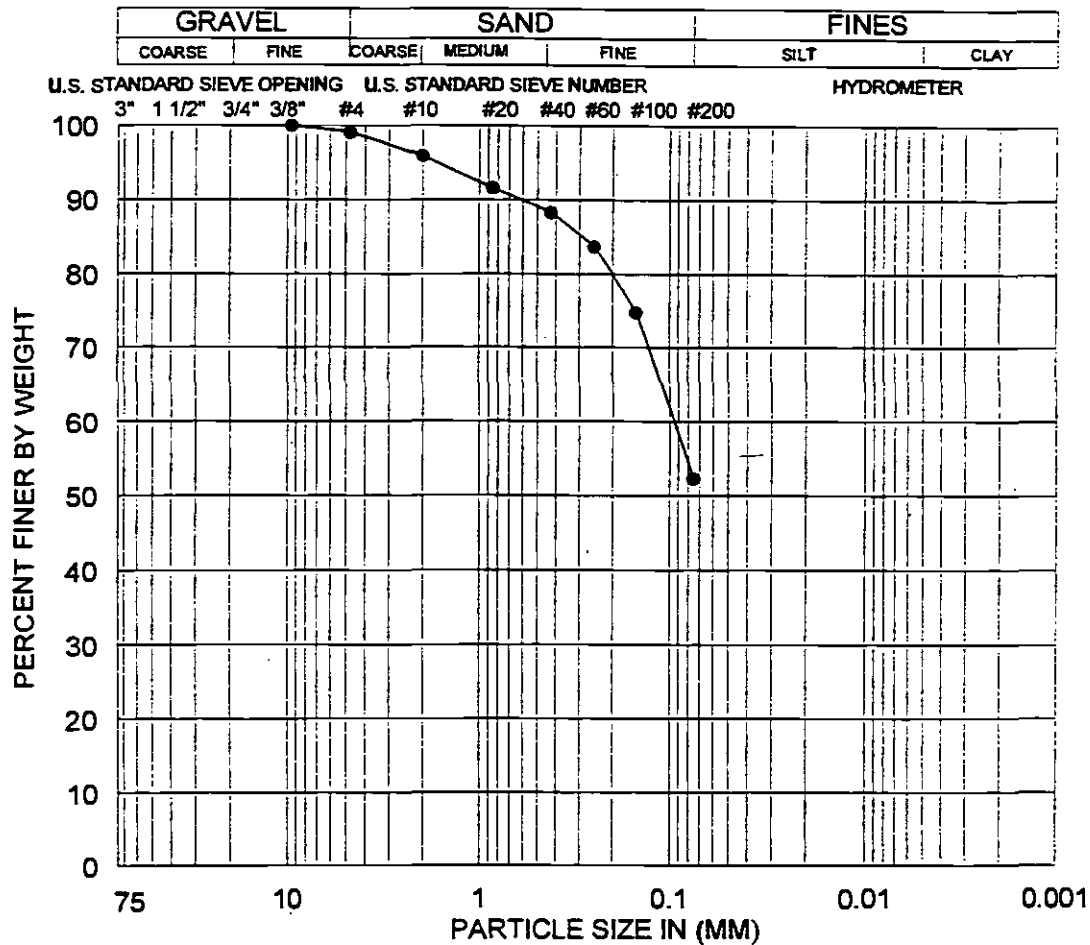
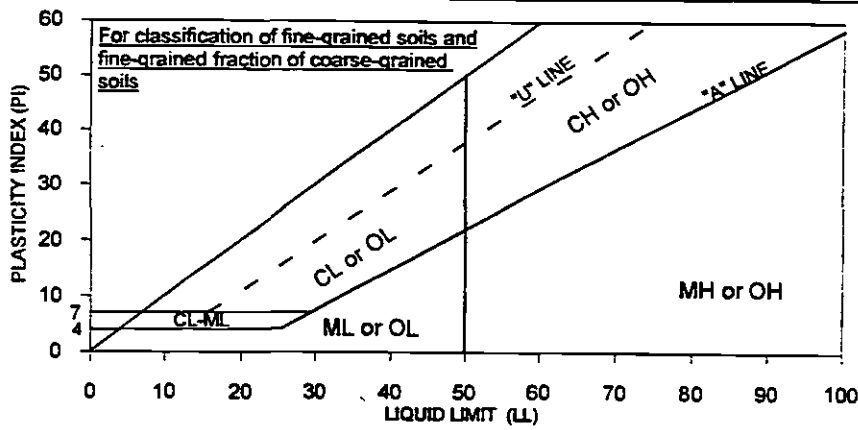
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-65



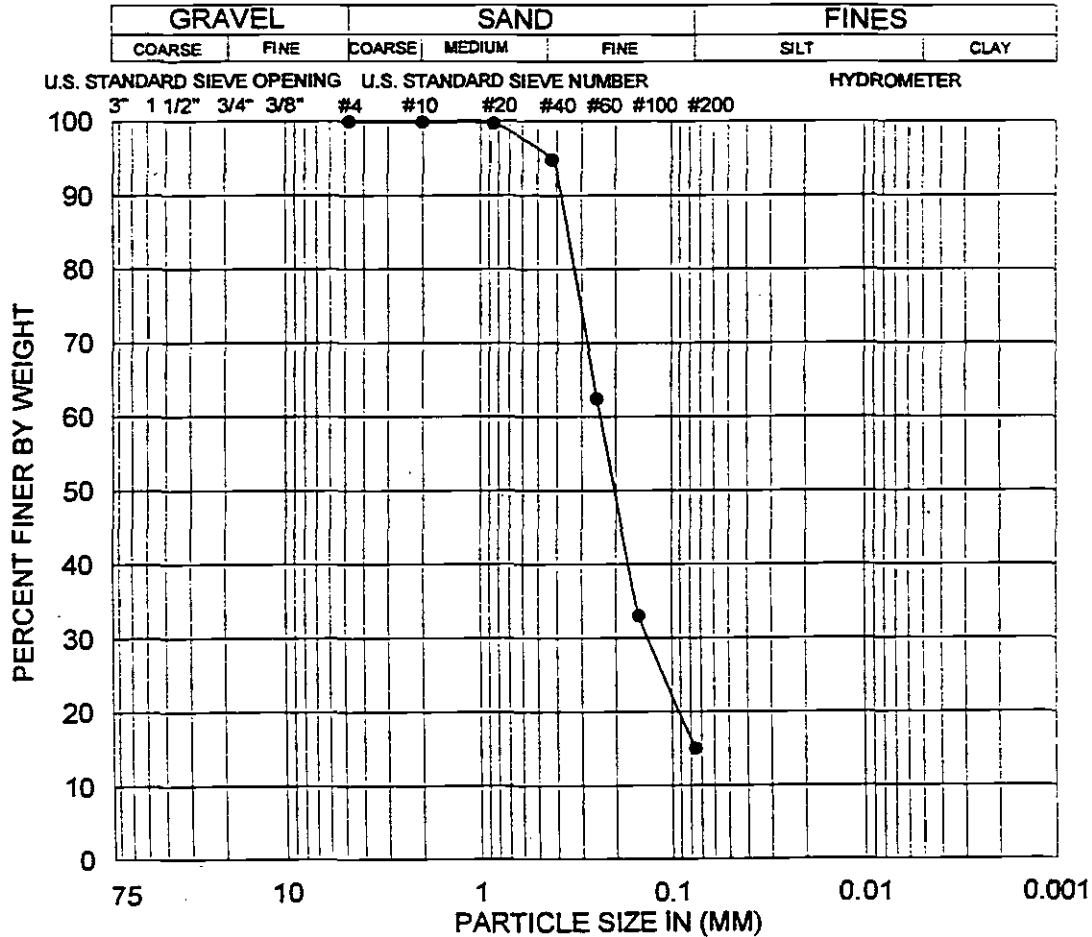
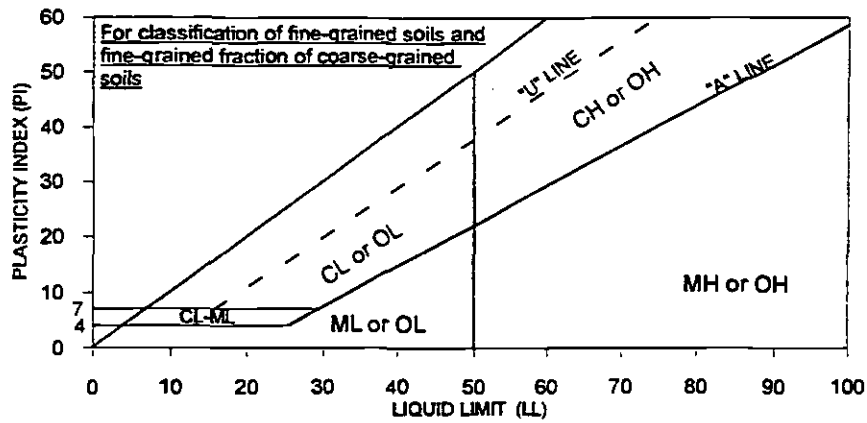
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD55A	S-16	56.0	ML	1:47:52	N/A



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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



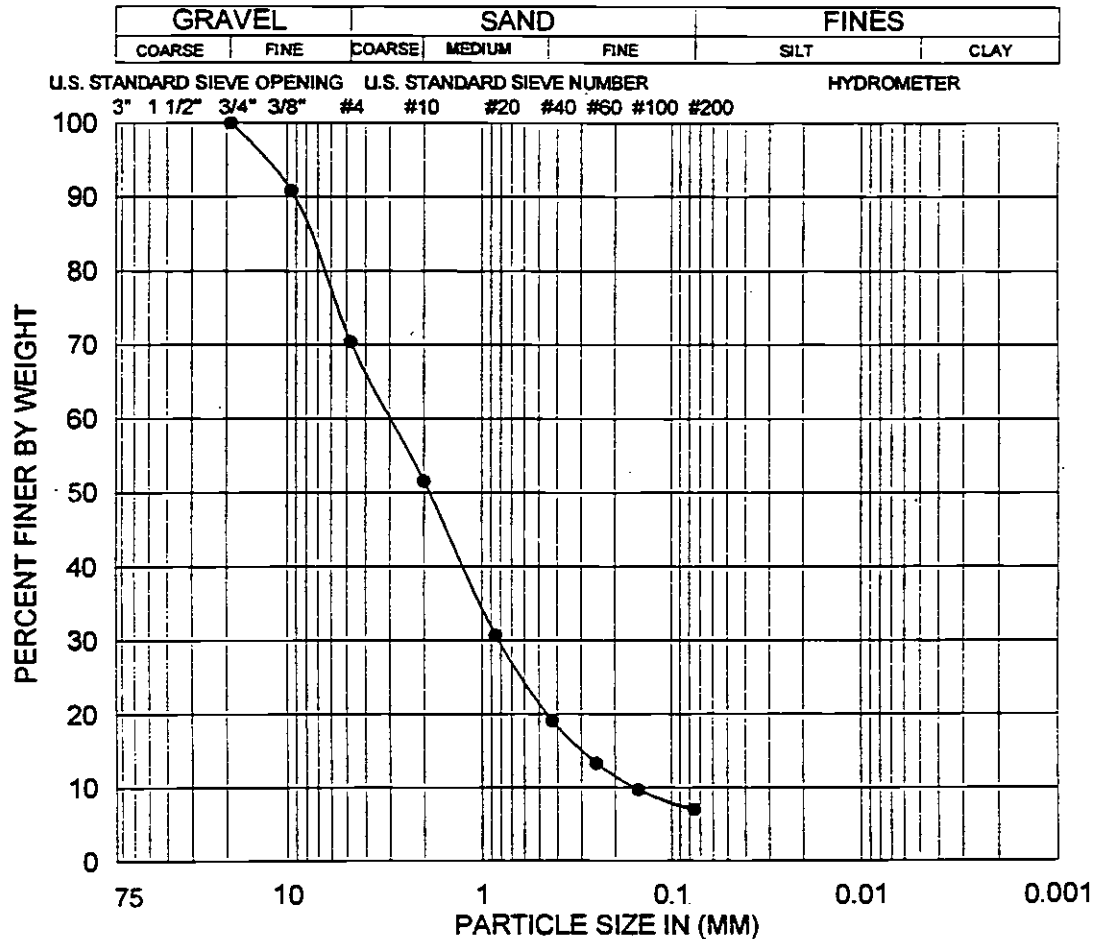
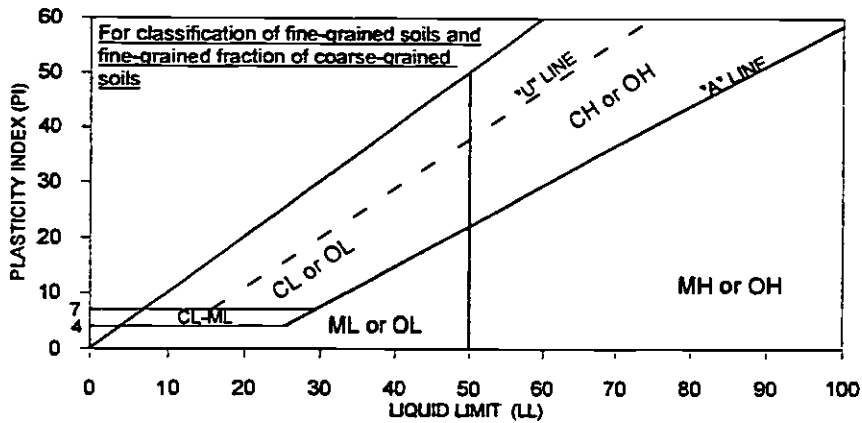
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD55A	S-18	61.0	SM	0:85:15	N/A



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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



Not enough sample to meet ASTM specification



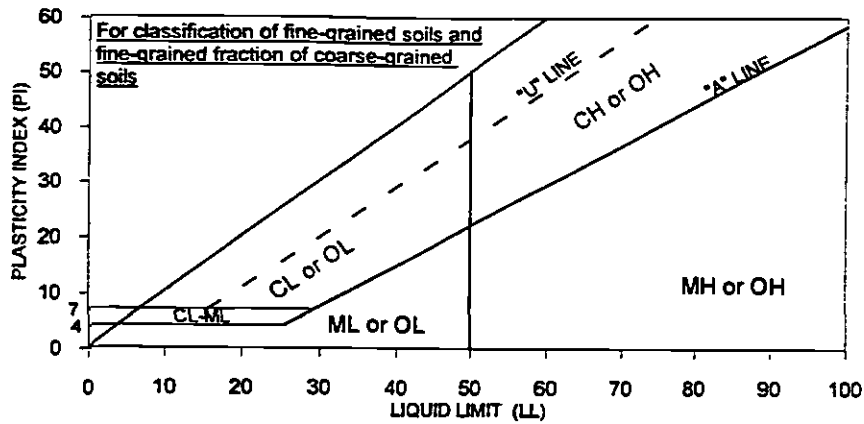
Project No. 95-8347-23

**Eastside Extension
Metro Redline III**

**ATTERBERG LIMITS, PARTICLE-SIZE CURVE
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Figure B-68

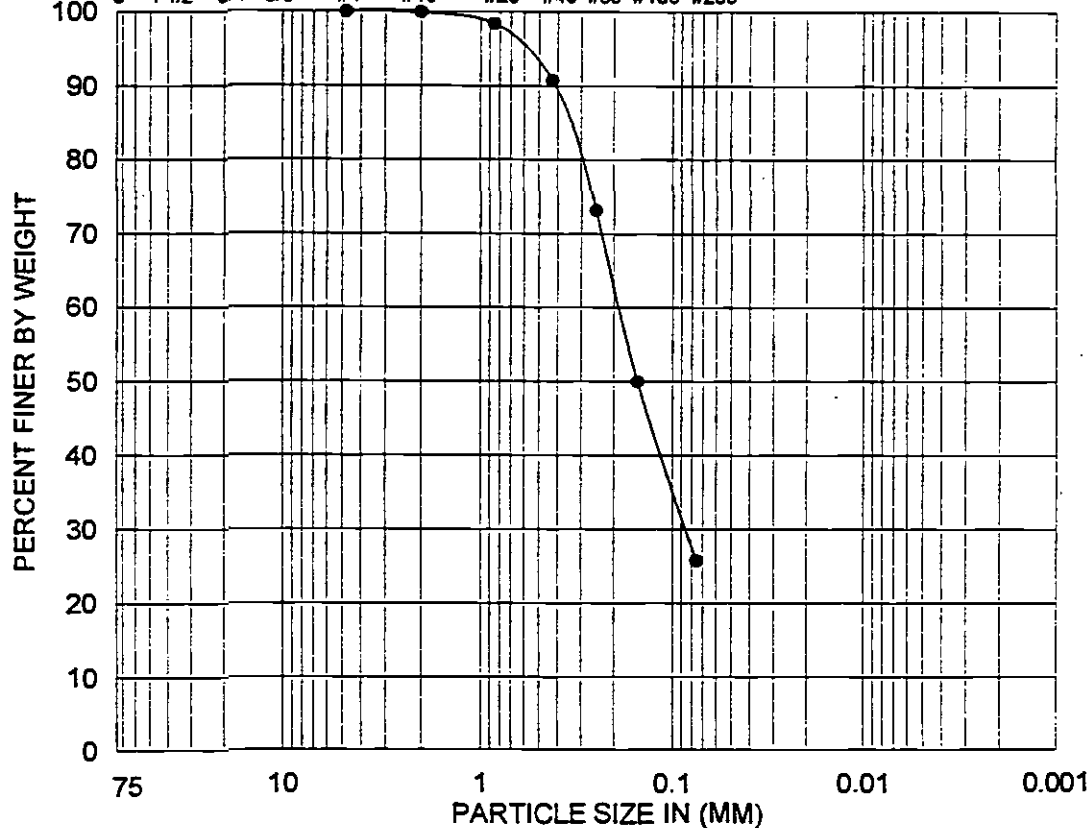


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200

U.S. STANDARD SIEVE NUMBER

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BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD56-1	S-13	47.0	SM	0:74:26	N/A



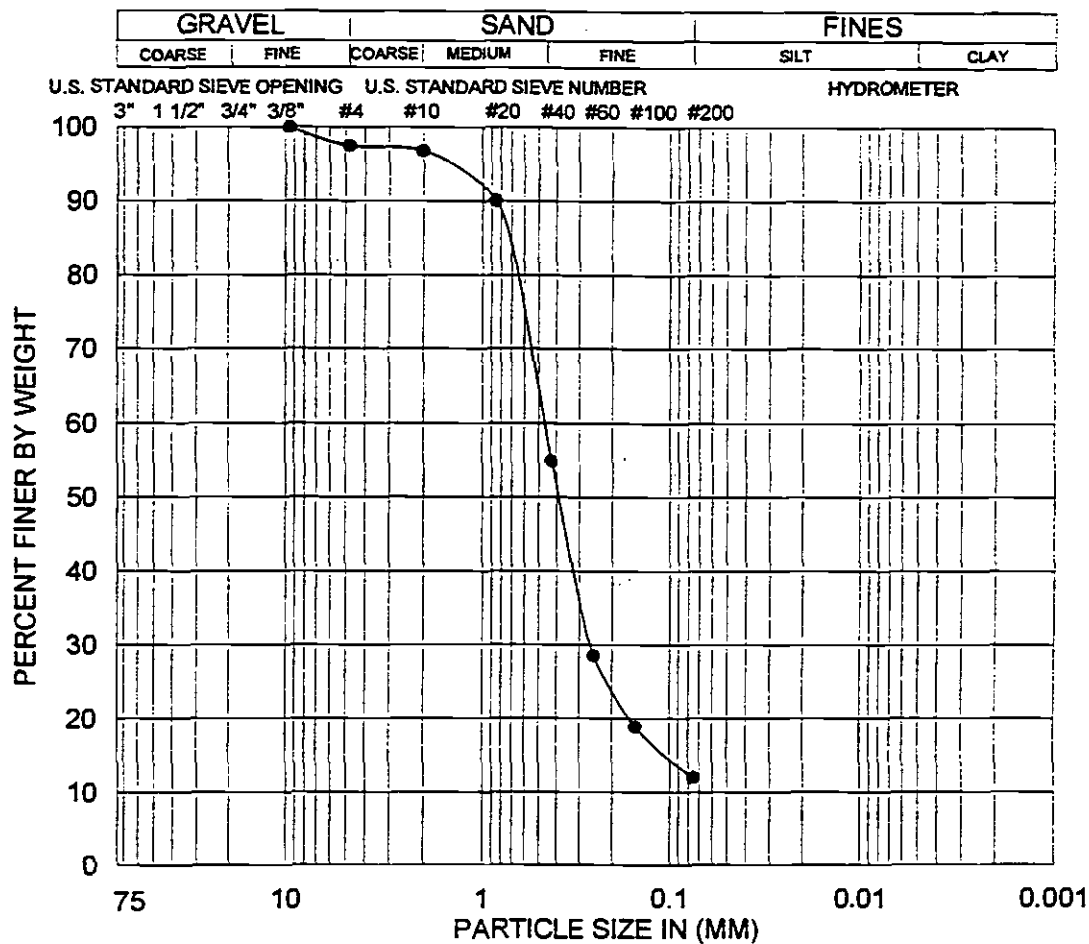
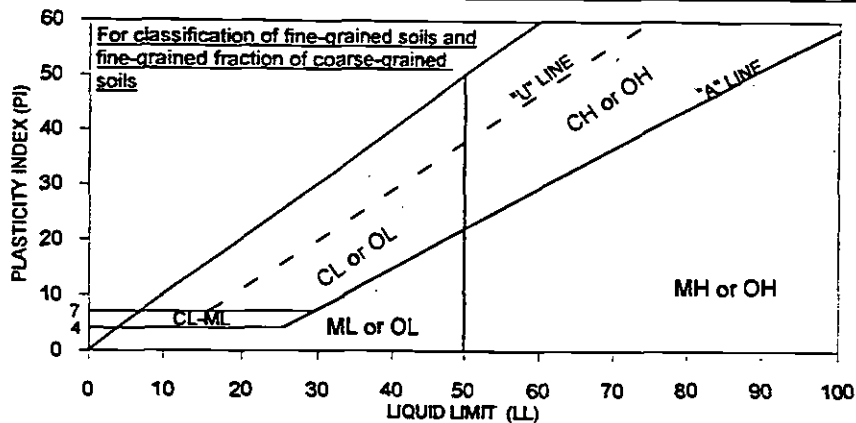
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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
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Figure B-69



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD56-1	S-15	53.0	SP-SM	3:85:12	N/A



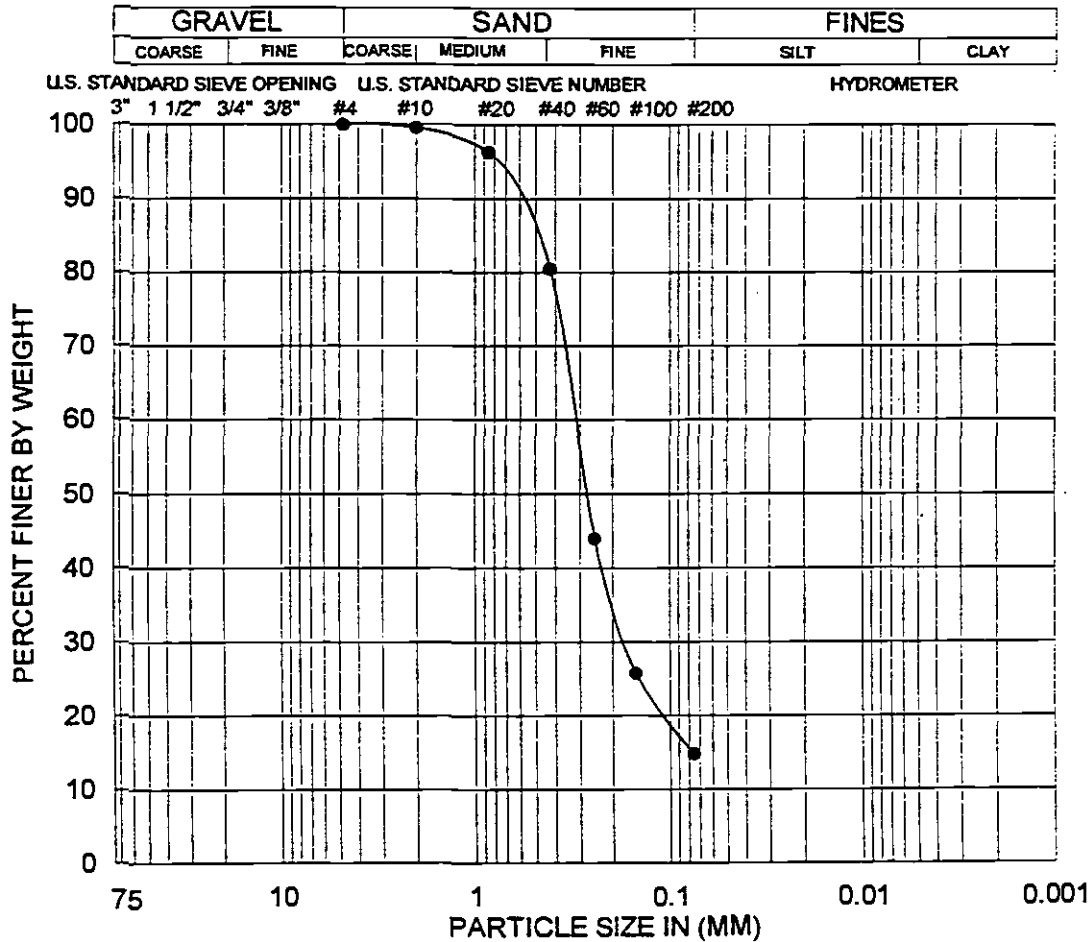
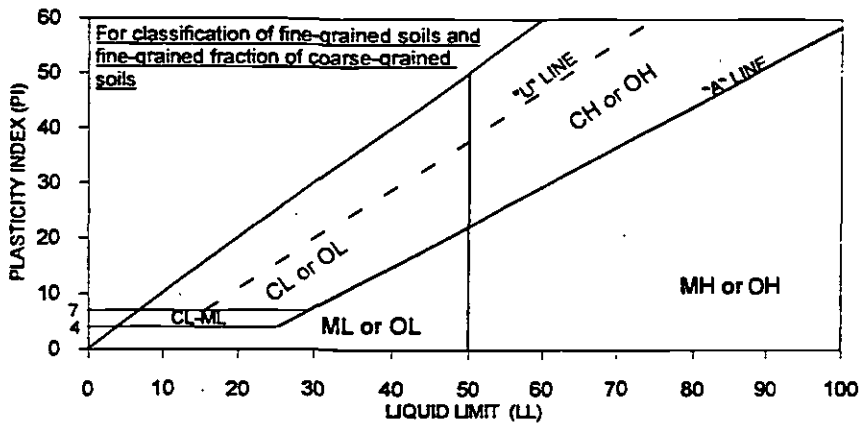
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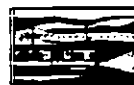
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-70



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD56-1	S-17	59.0	SM	0:85:15	N/A



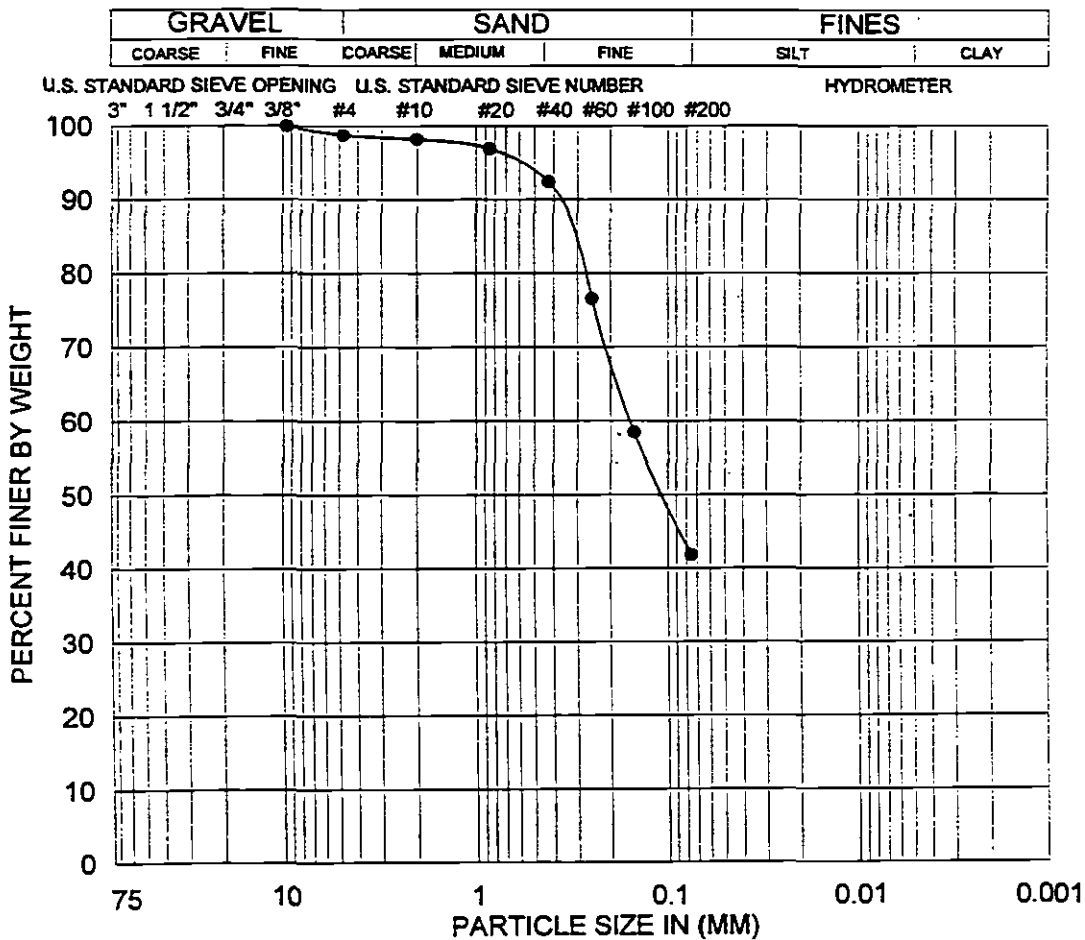
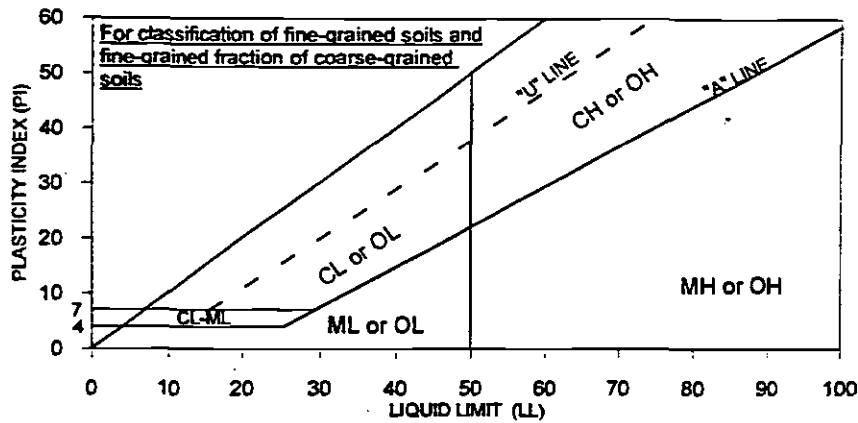
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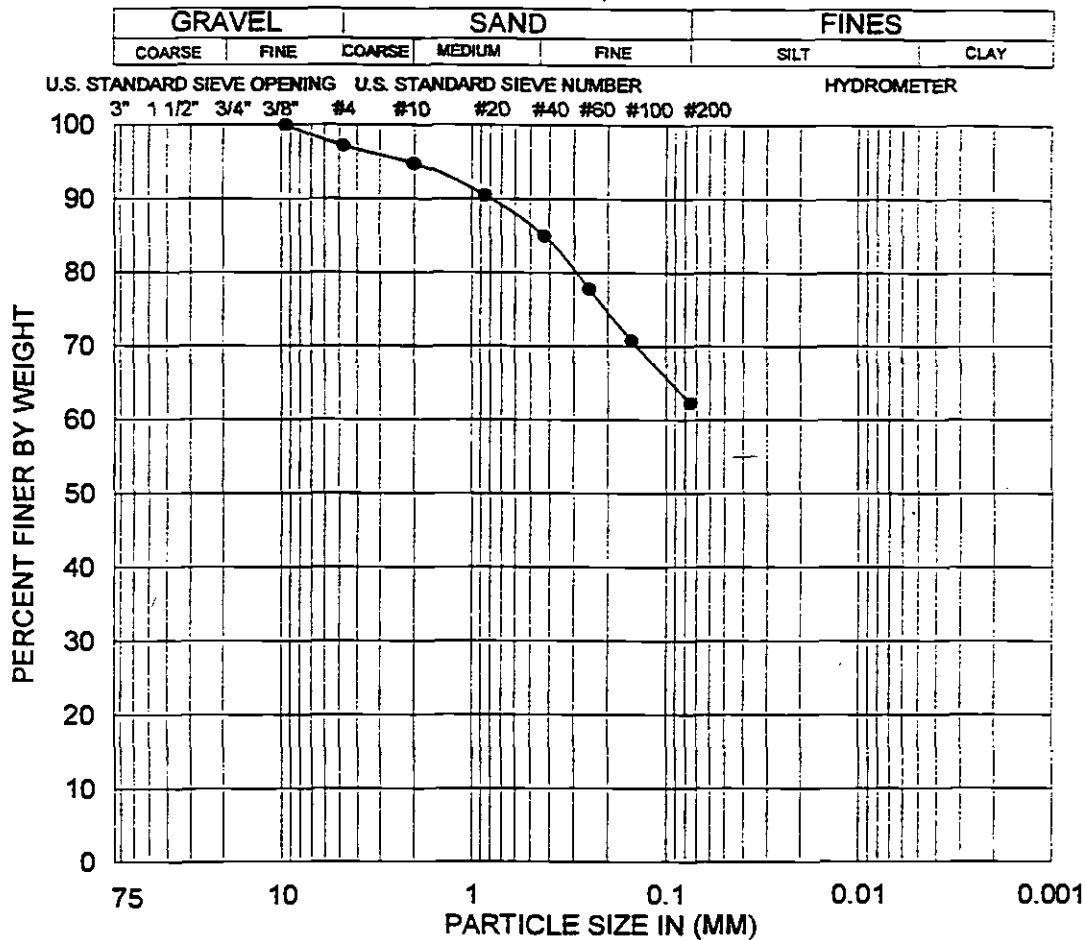
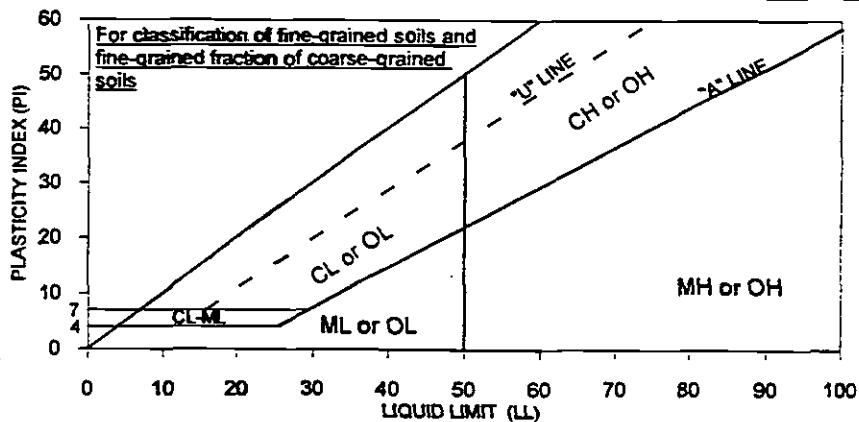
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**Eastside Extension
Metro Redline III**

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-71





BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-57	S-5	17.0	ML	3:35:62	N/A



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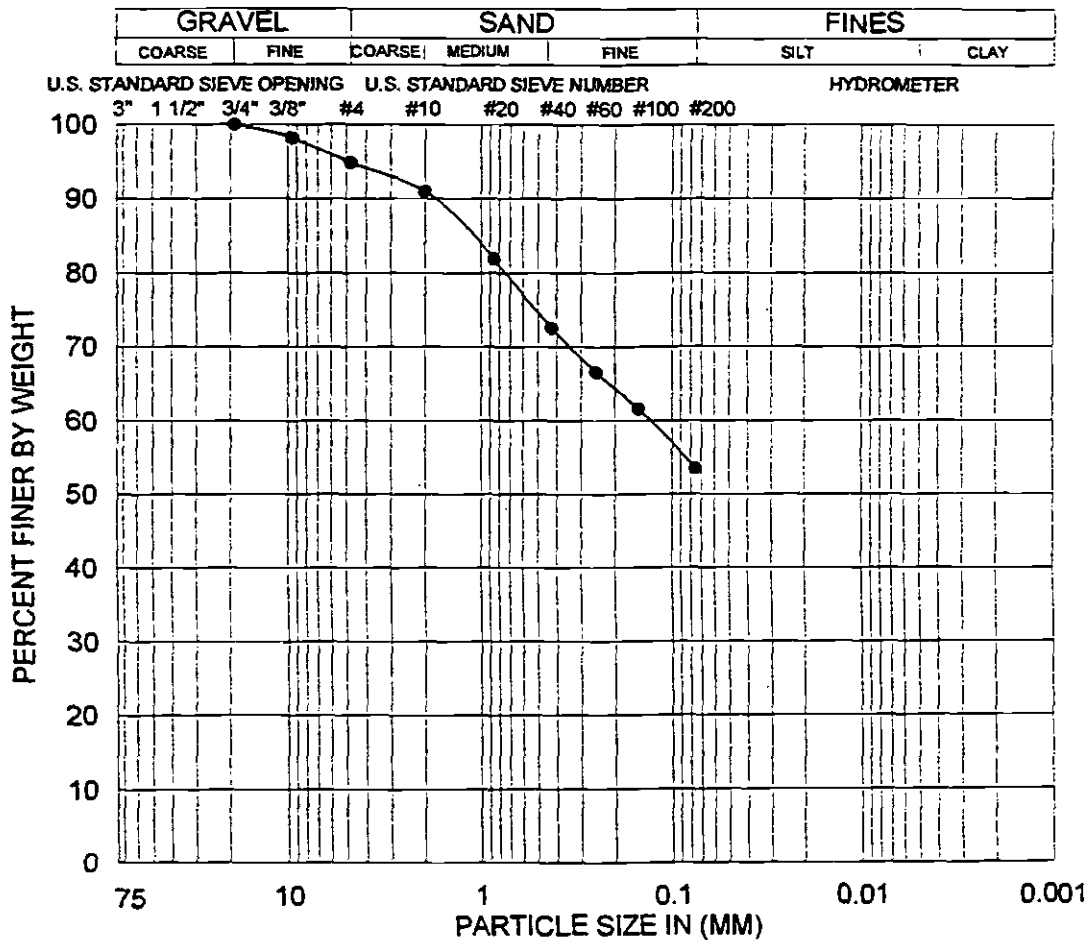
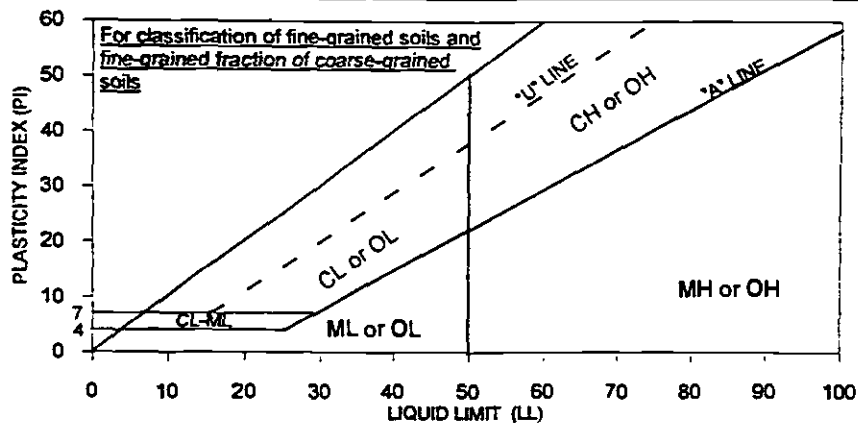
Project No. 95-8347-23

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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-73



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-57	S-7	24.0	SM	5:41:54	N/A



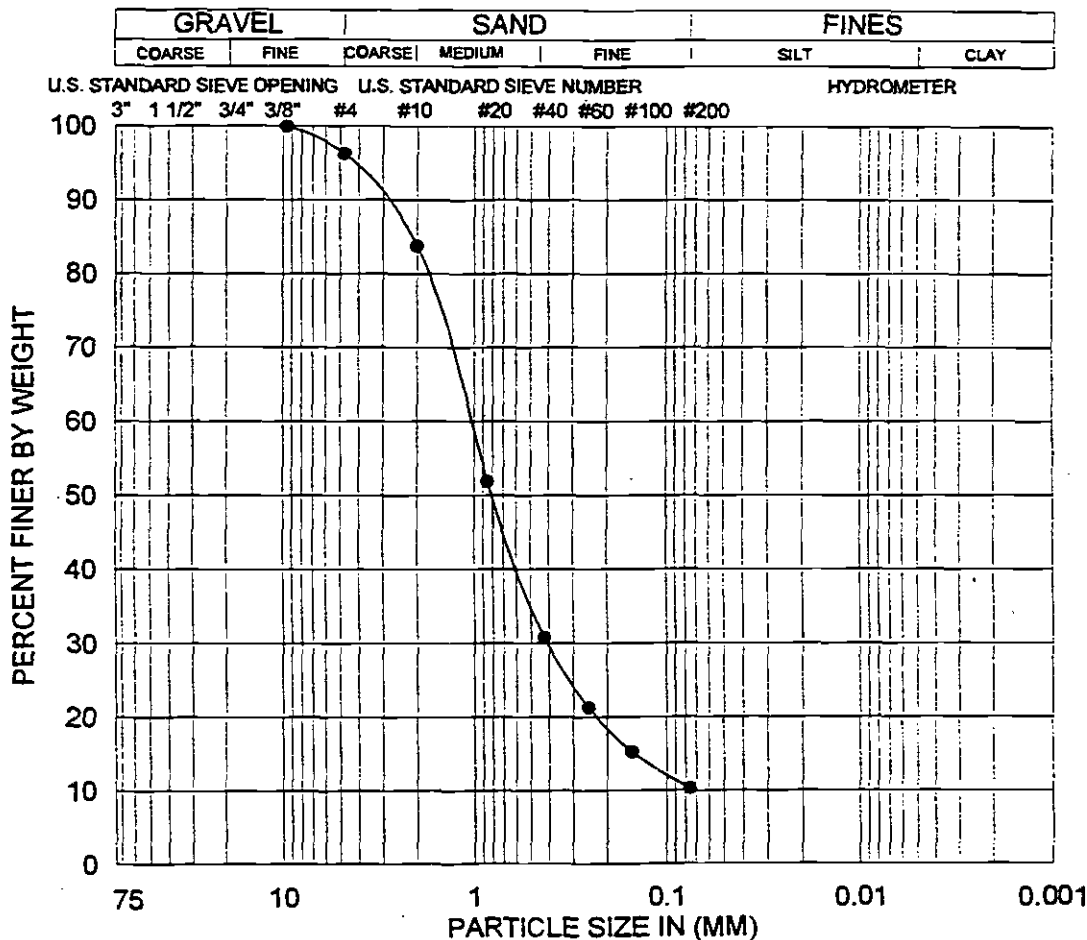
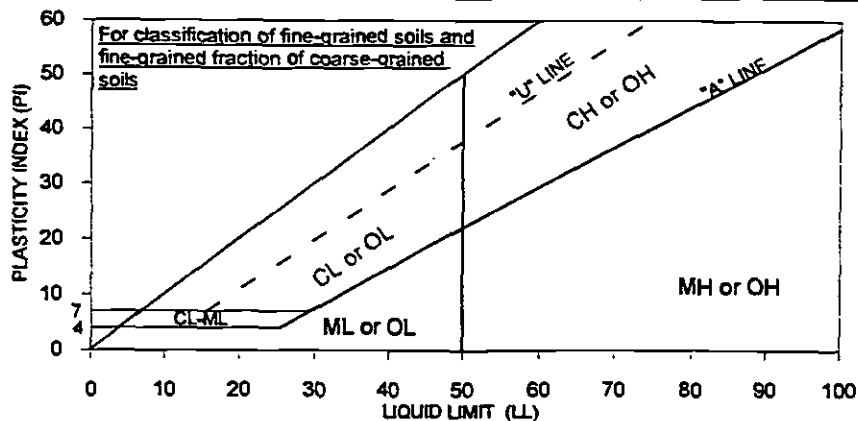
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Eastside Extension
Metro Redline III

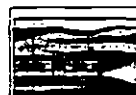
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

01-96

Figure B-74



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
DD-57	S-9	30.0	SW-SM	4:86:10	N/A



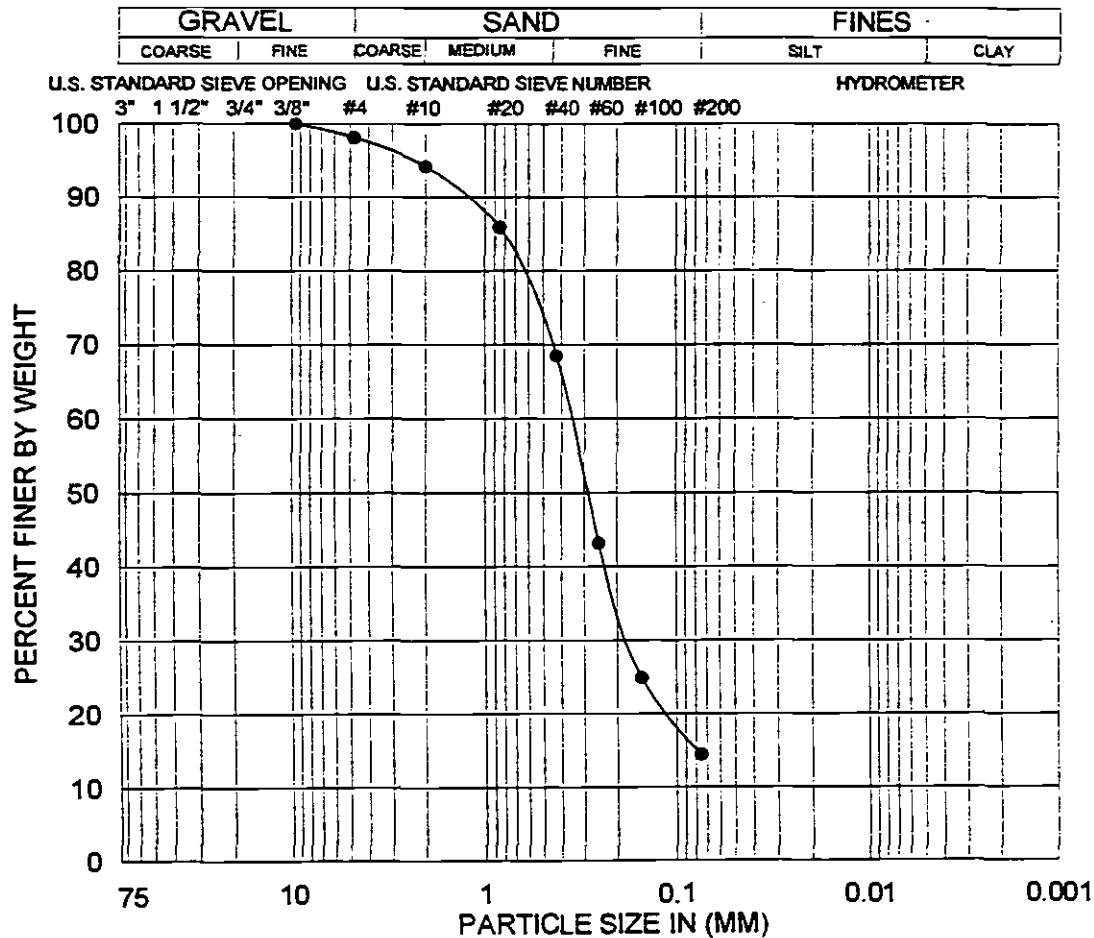
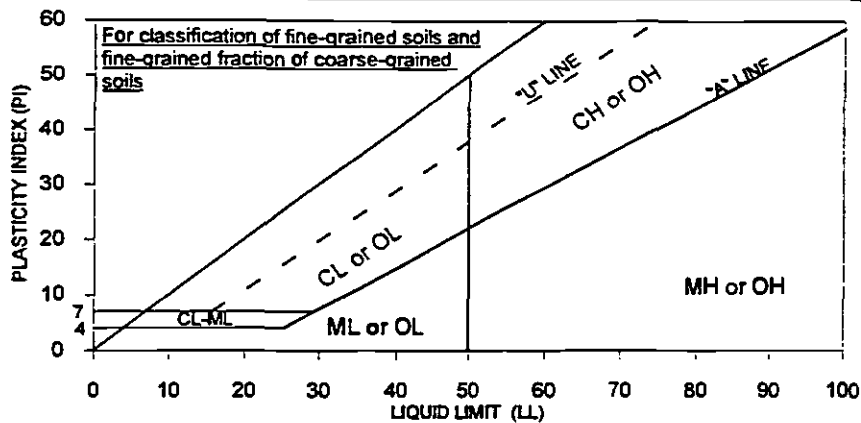
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Eastside Extension
Metro Redline III

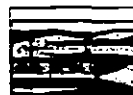
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-75



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-57	S-11	36.0	SM	2:84:14	N/A



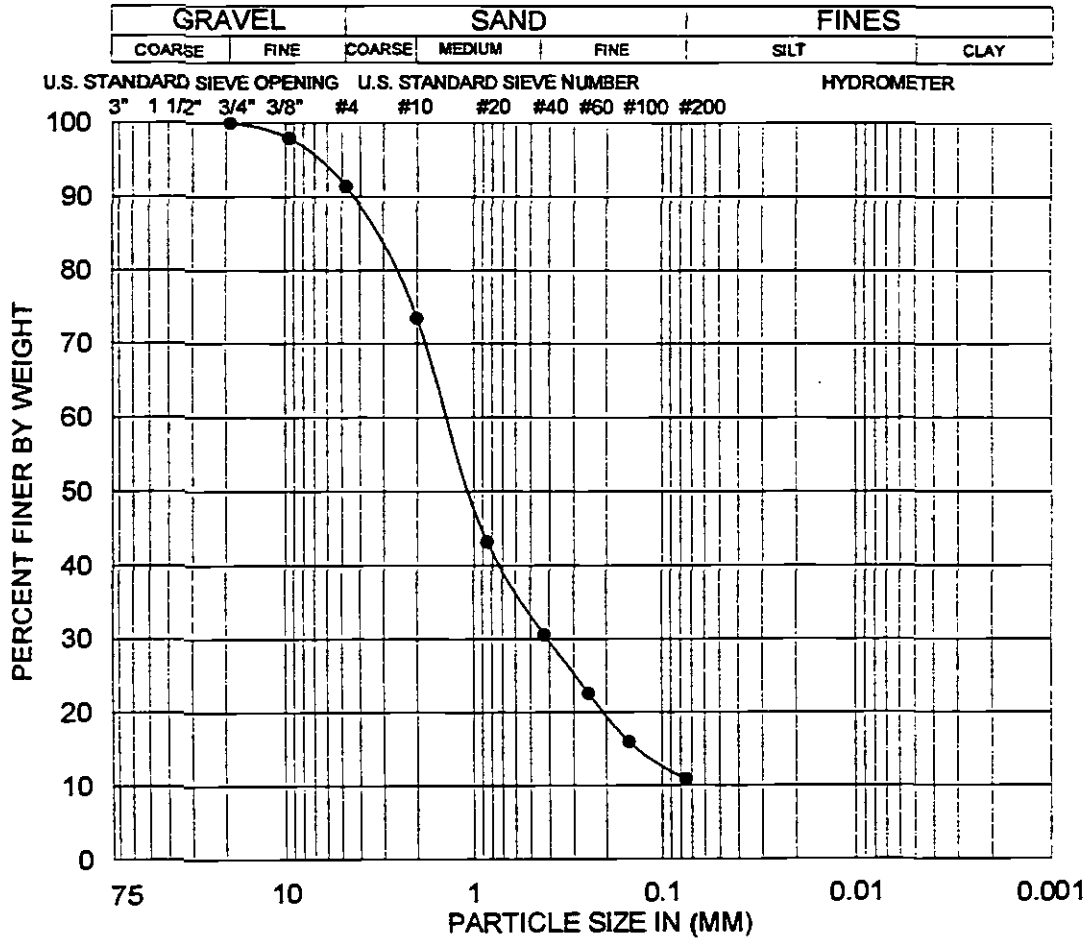
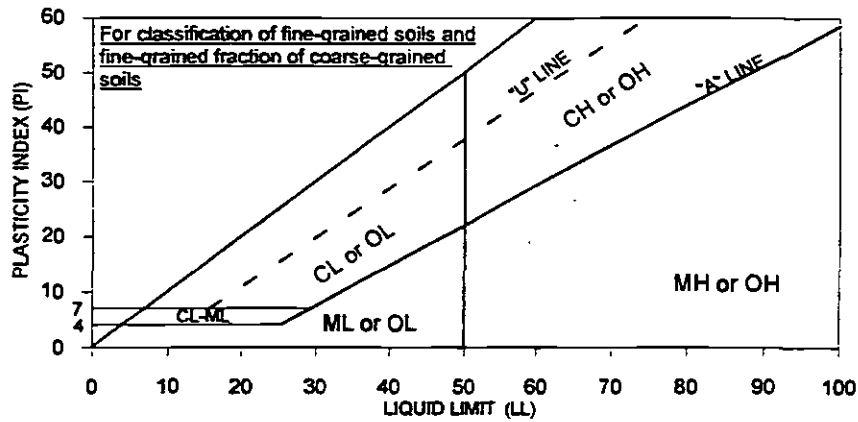
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

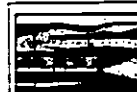
01-96

Figure B-76



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
DD-57	D-14	45.0	SW-SM	9:80:11	N/A

Not enough sample to meet ASTM specification



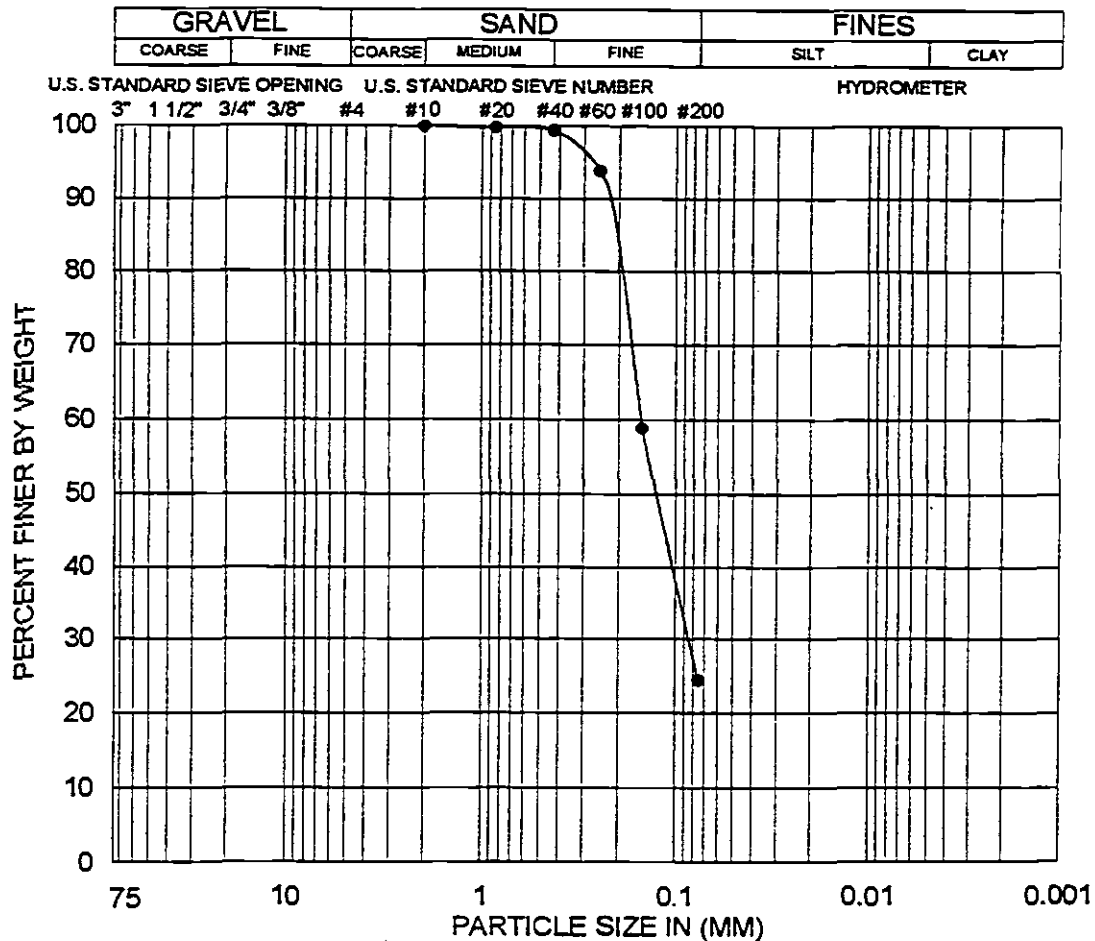
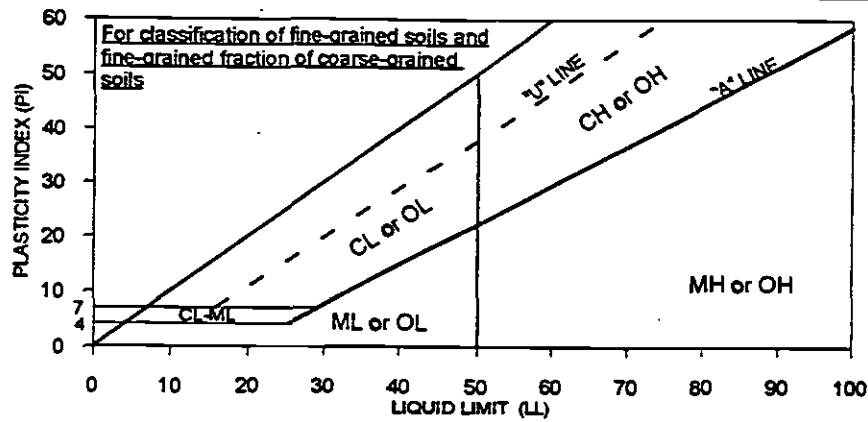
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Consultants

Project No. 95-8347-23
Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure 8-77



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-6	S-3	15.0	Bag	SM	0:76:24	N/A



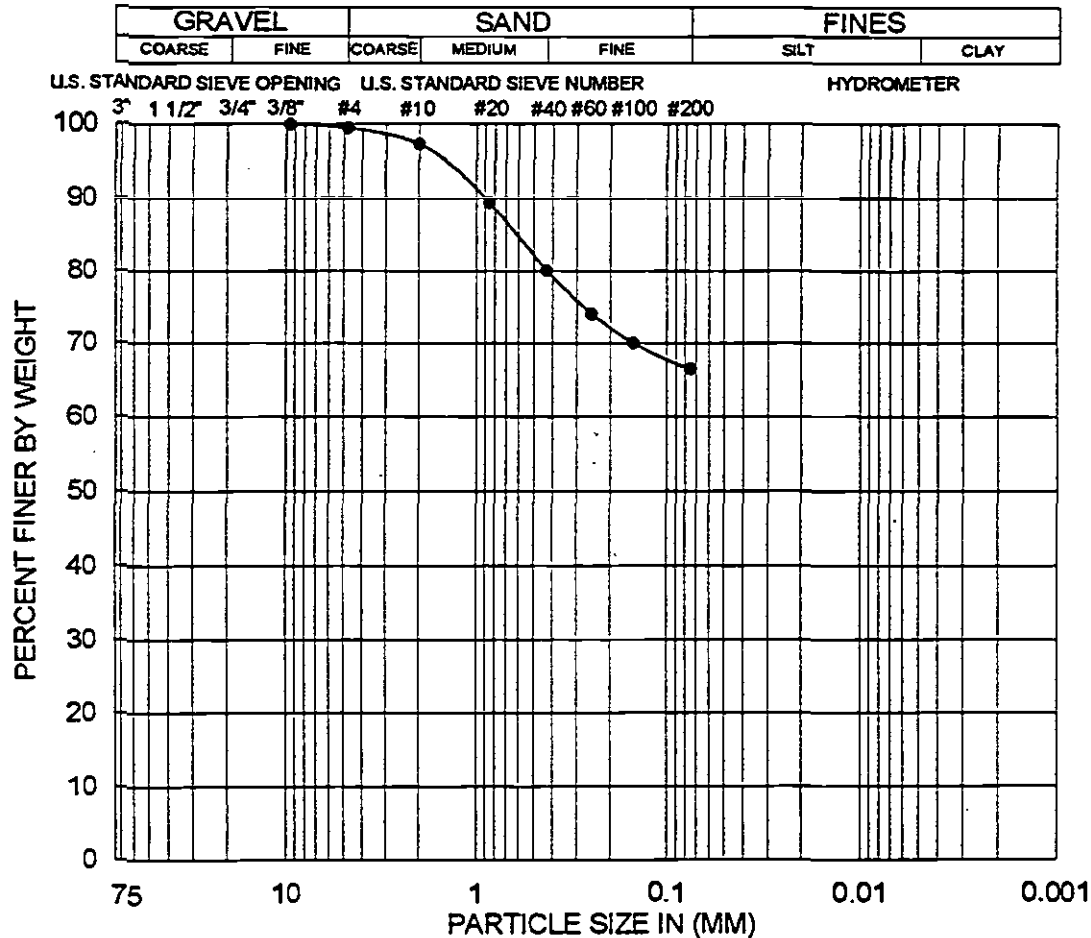
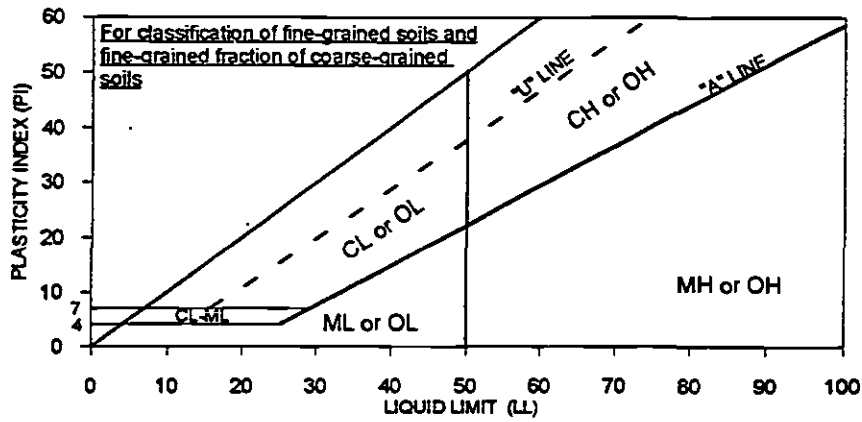
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Eastside Extension
Metro Redline III

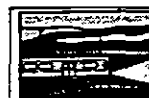
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

11-95

Figure B-78



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-6	S-5	25.0	Bag	CL	0:33:67	N/A



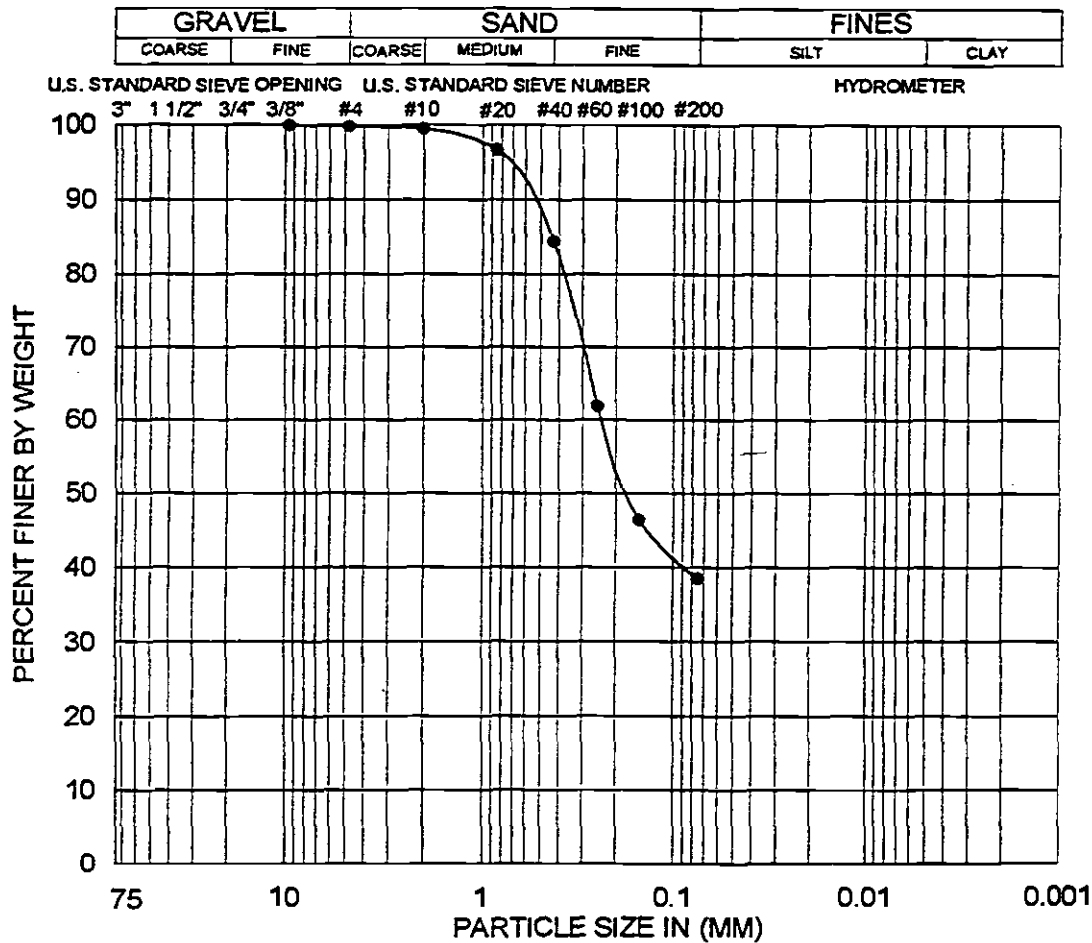
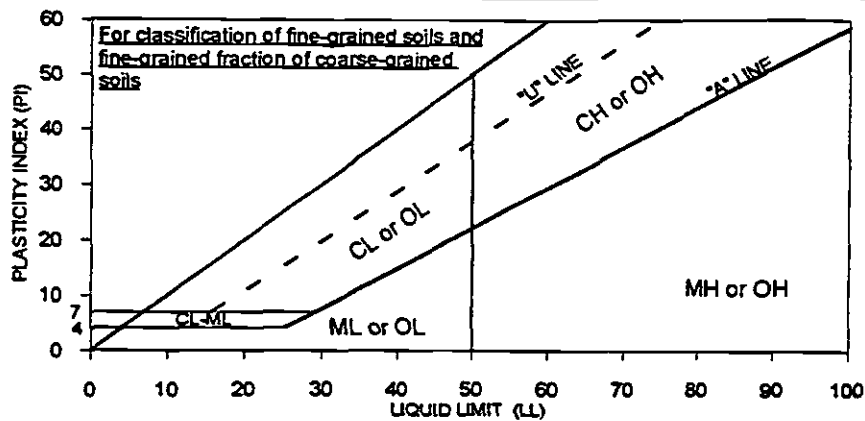
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Project No. 95-8347-23
Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-79

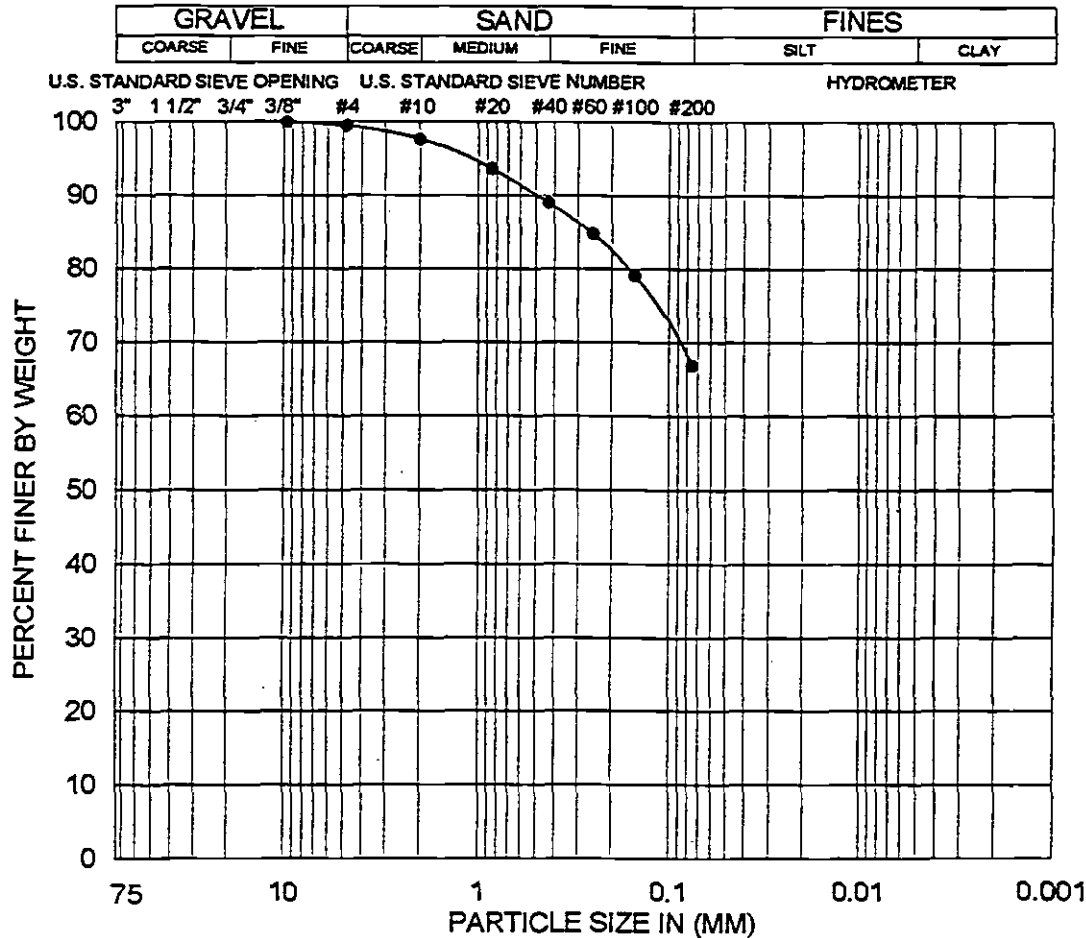
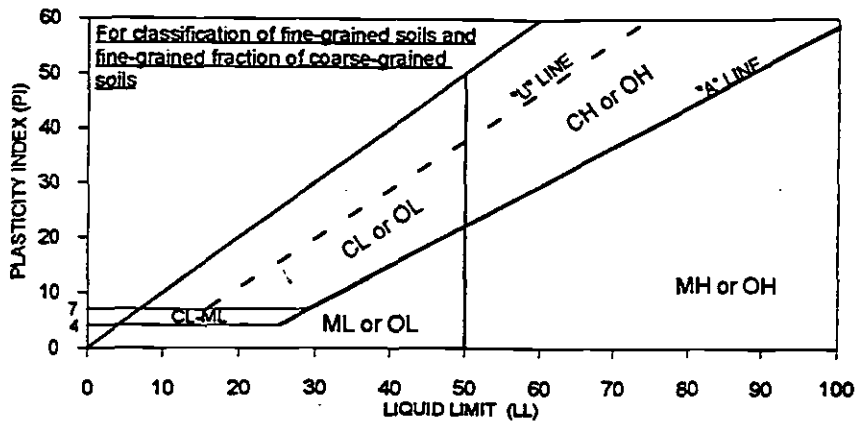


BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-6	S-7	35.0	Bag	SC-SM	0:61:39	N/A



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 Eastside Extension
 Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318, D422)



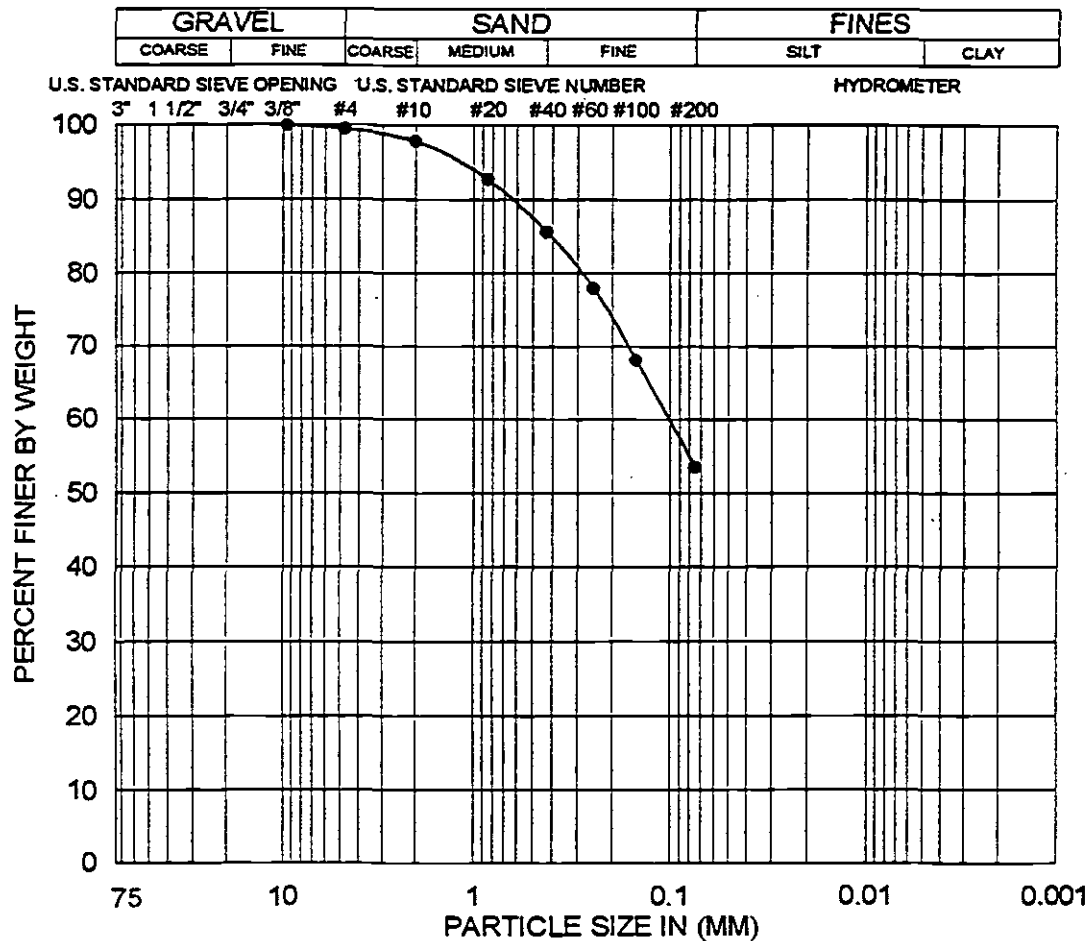
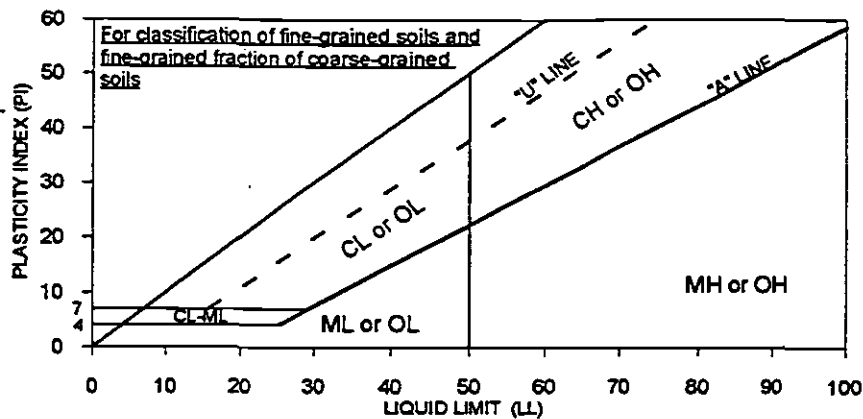
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
SD-6	S-11	53.0	Bag	CL	0:33:67	N/A



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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

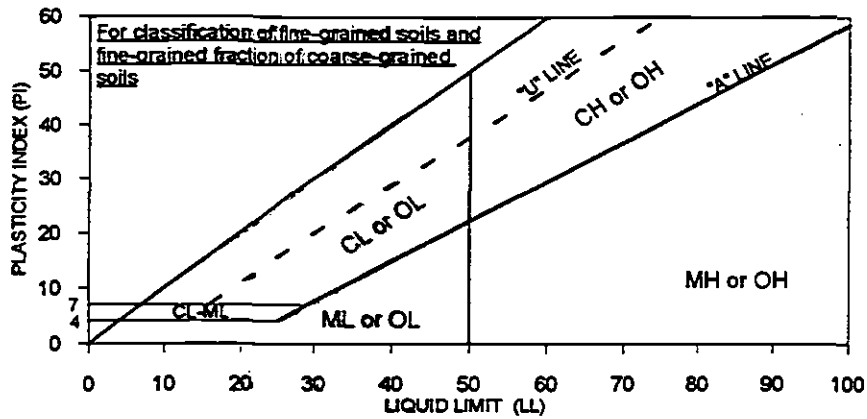


BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-6	S-15	65.0	Bag	CL	0:46:54	N/A



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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318,D422)

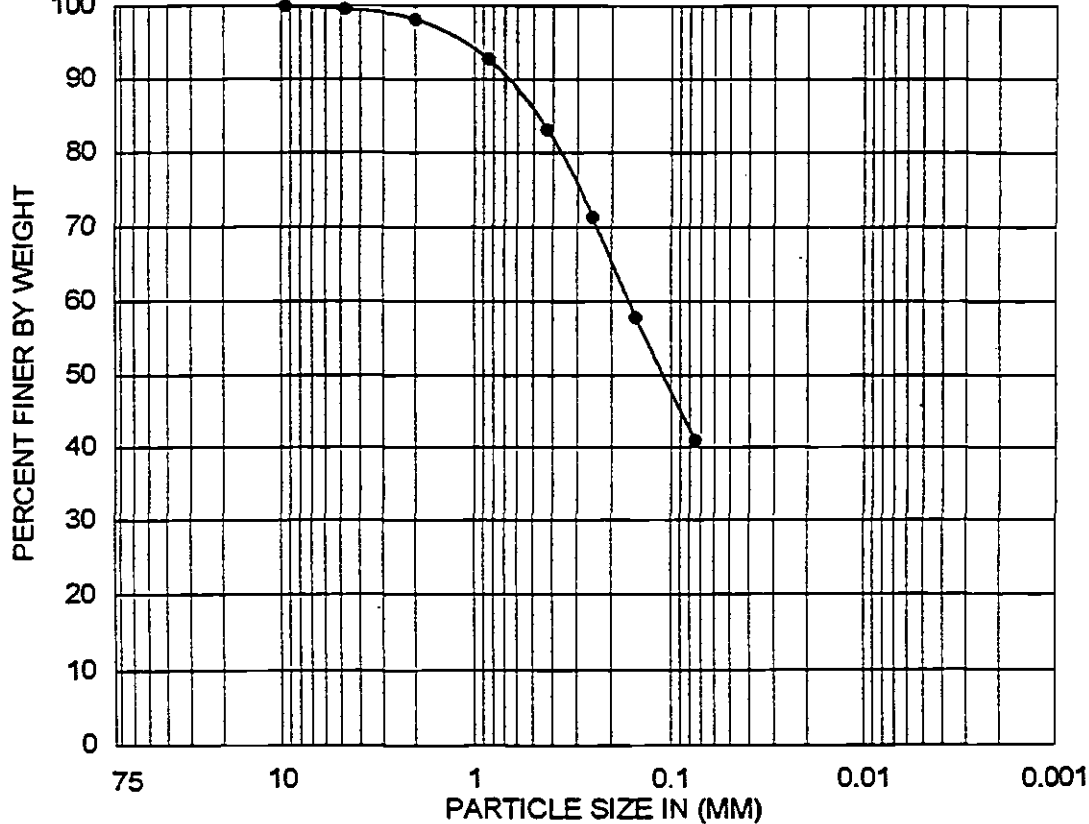


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200

U.S. STANDARD SIEVE NUMBER

HYDROMETER



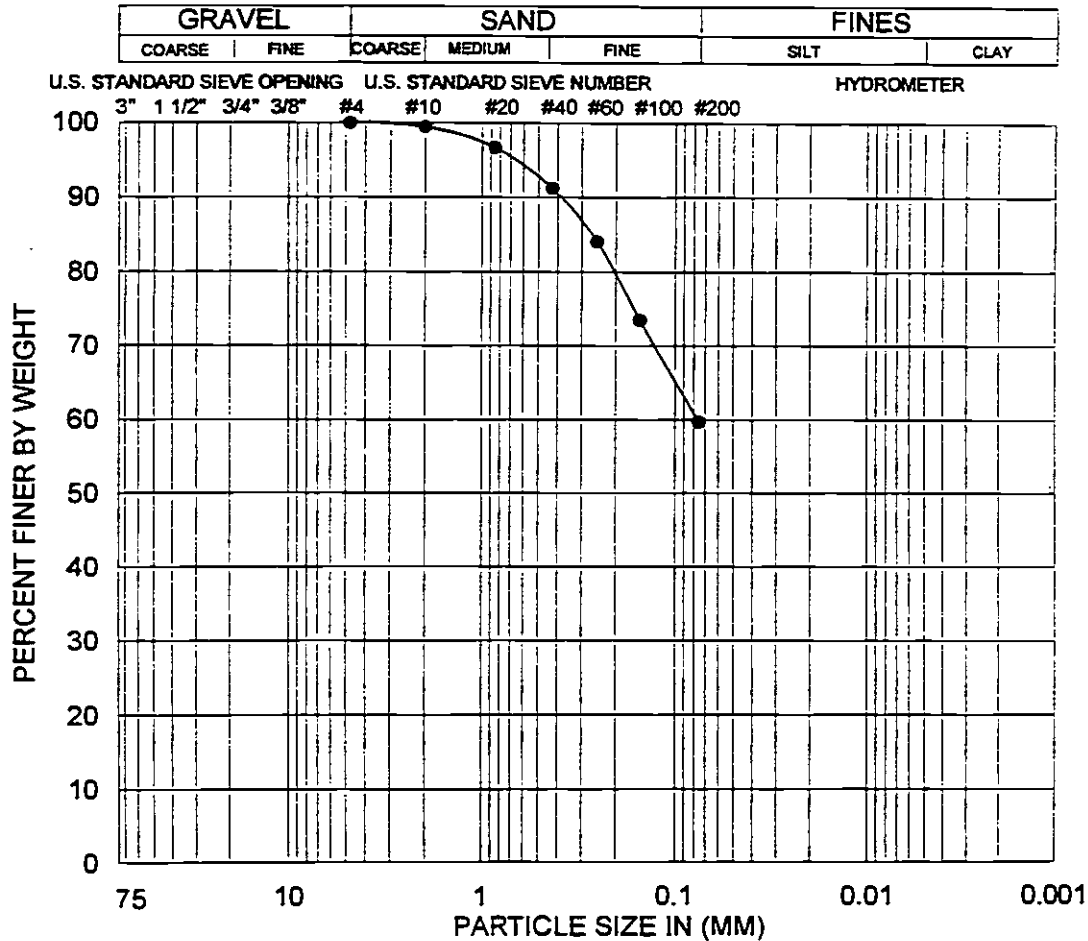
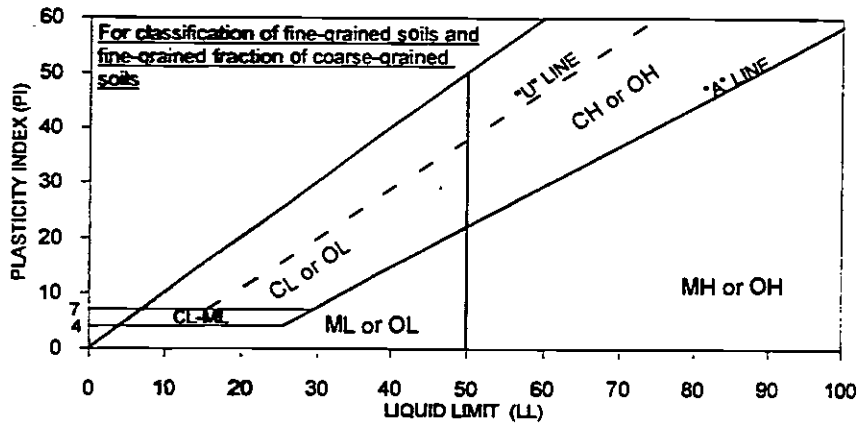
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
SD-6	S-19	77.0	Bag	SC	0:59:41	N/A



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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



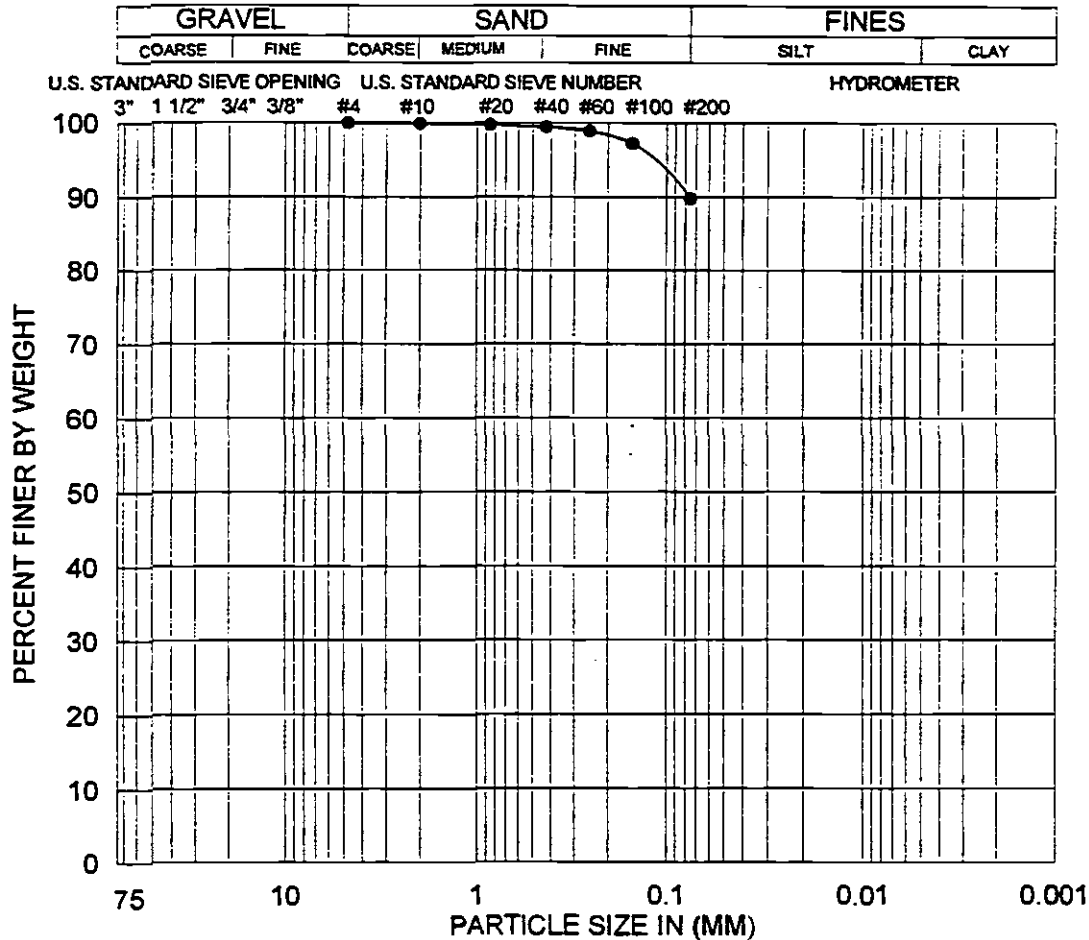
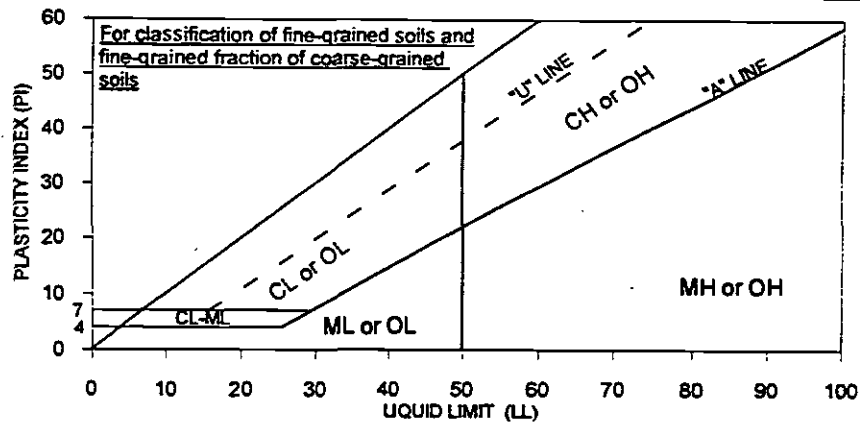
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-7	S-2	15.0	CL	0:40:60	N/A



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Eastside Extension
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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



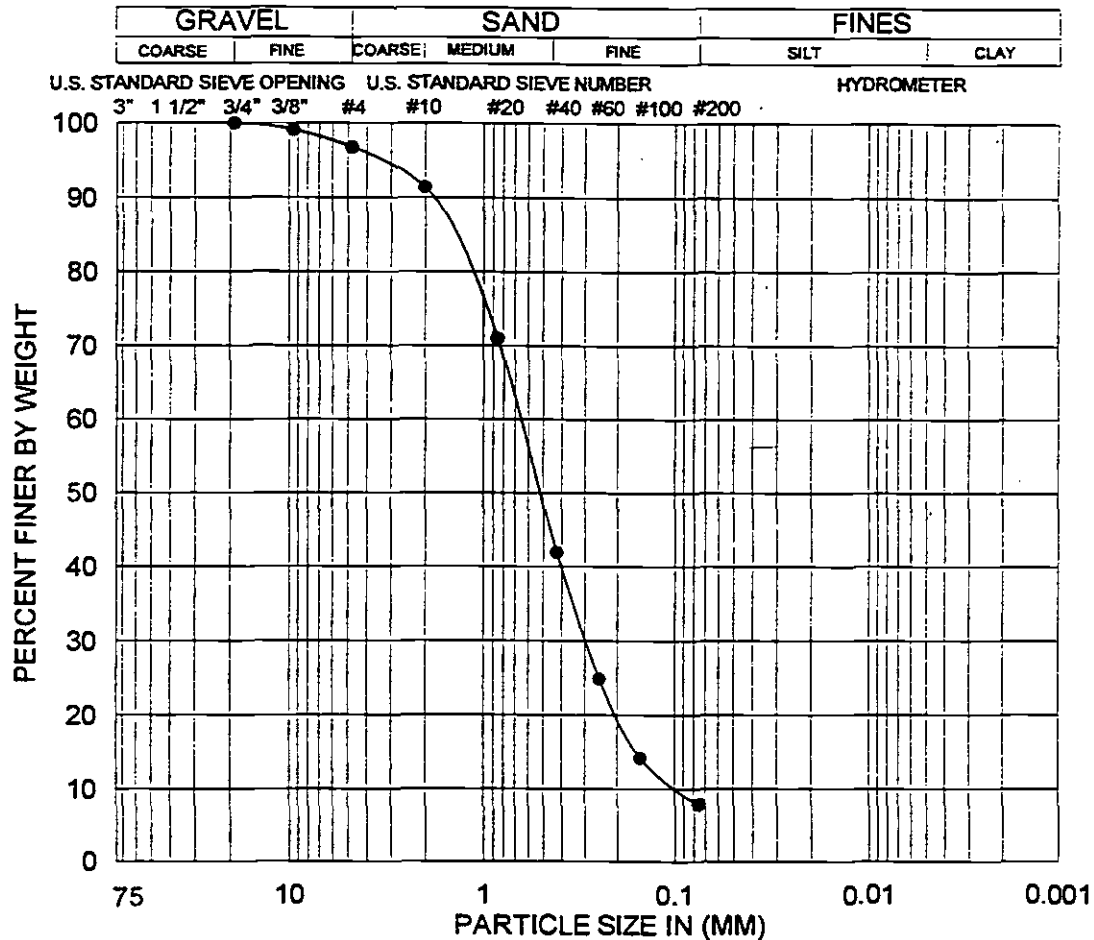
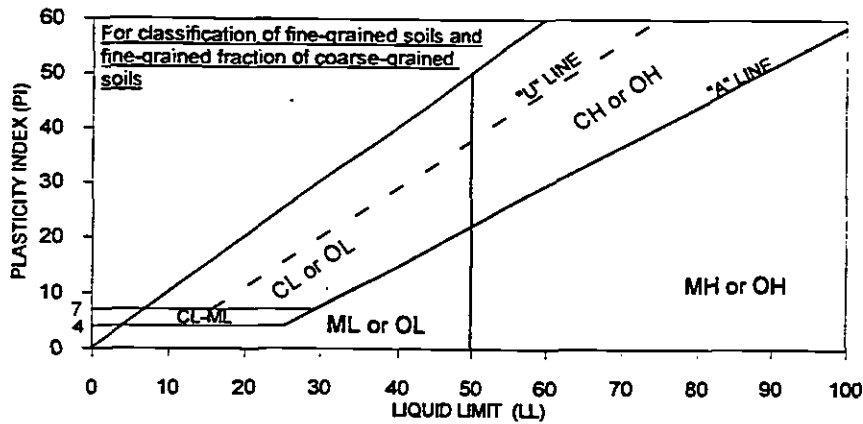
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-7	S-7	35.0	ML	0:10:90	N/A



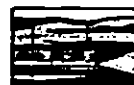
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**Eastside Extension
Metro Redline III**

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-7	S-9	45.0	SW-SM	3:89:8	N/A



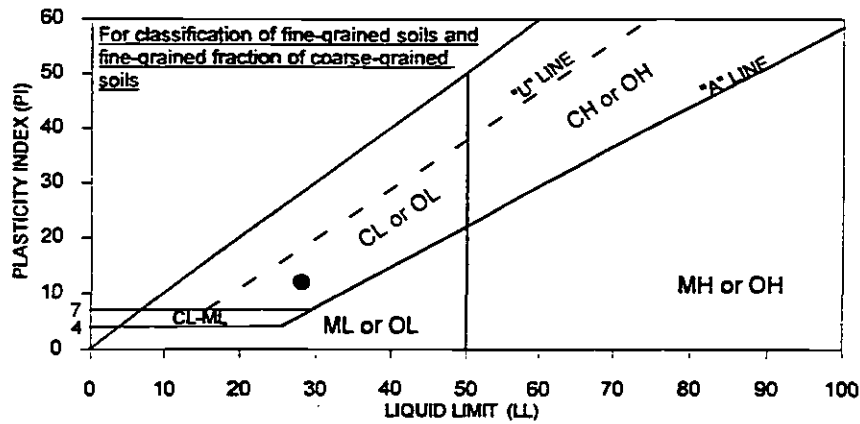
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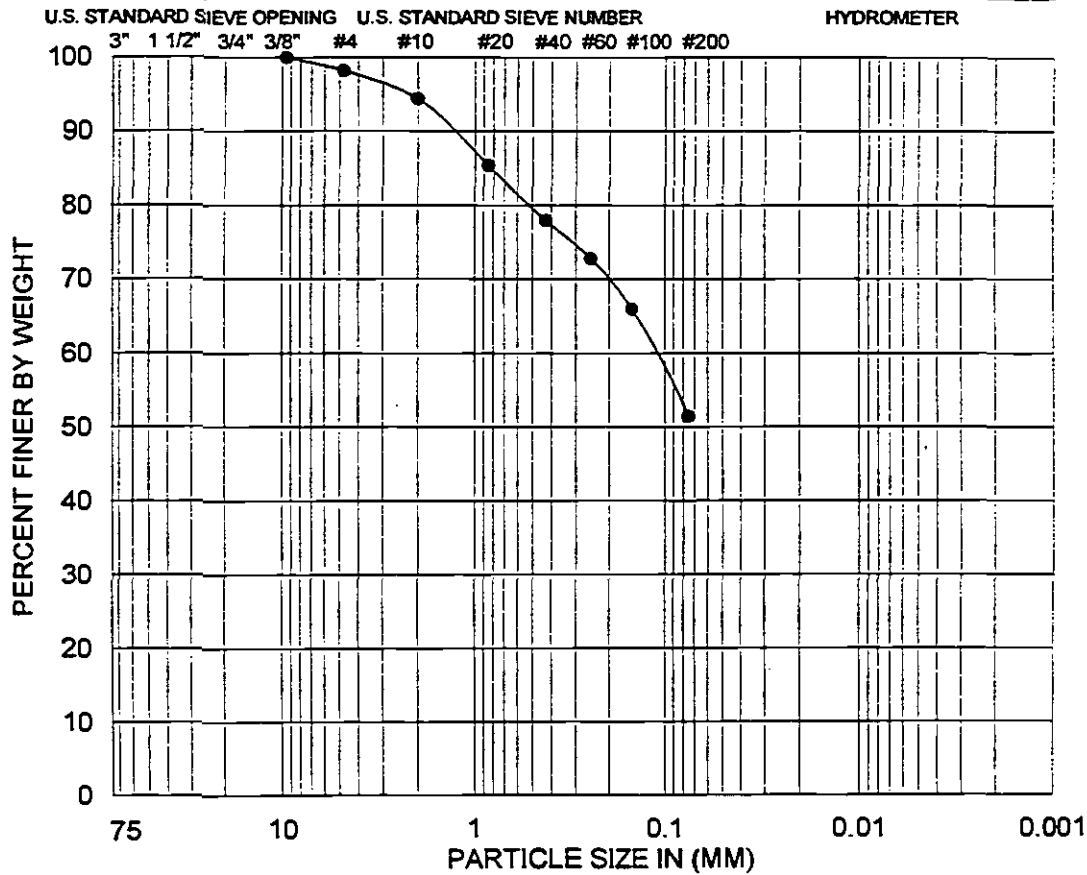
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-87



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-7	S-11	55.0	CL	2:47:51	28,16,12



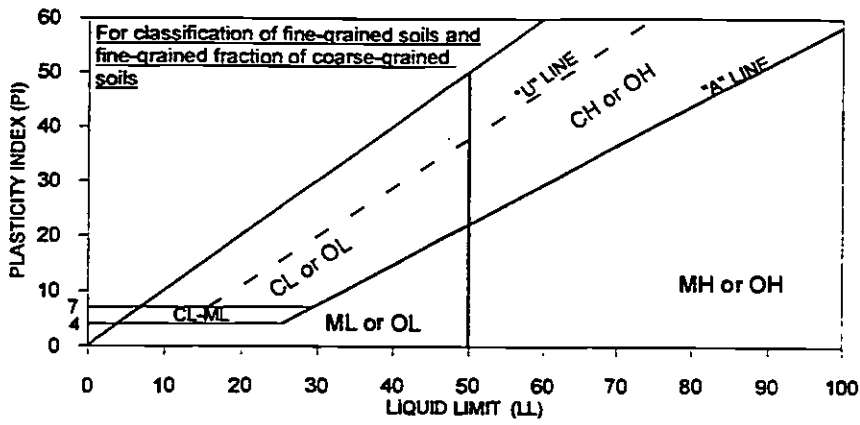
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Project No. 95-8347-23
Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

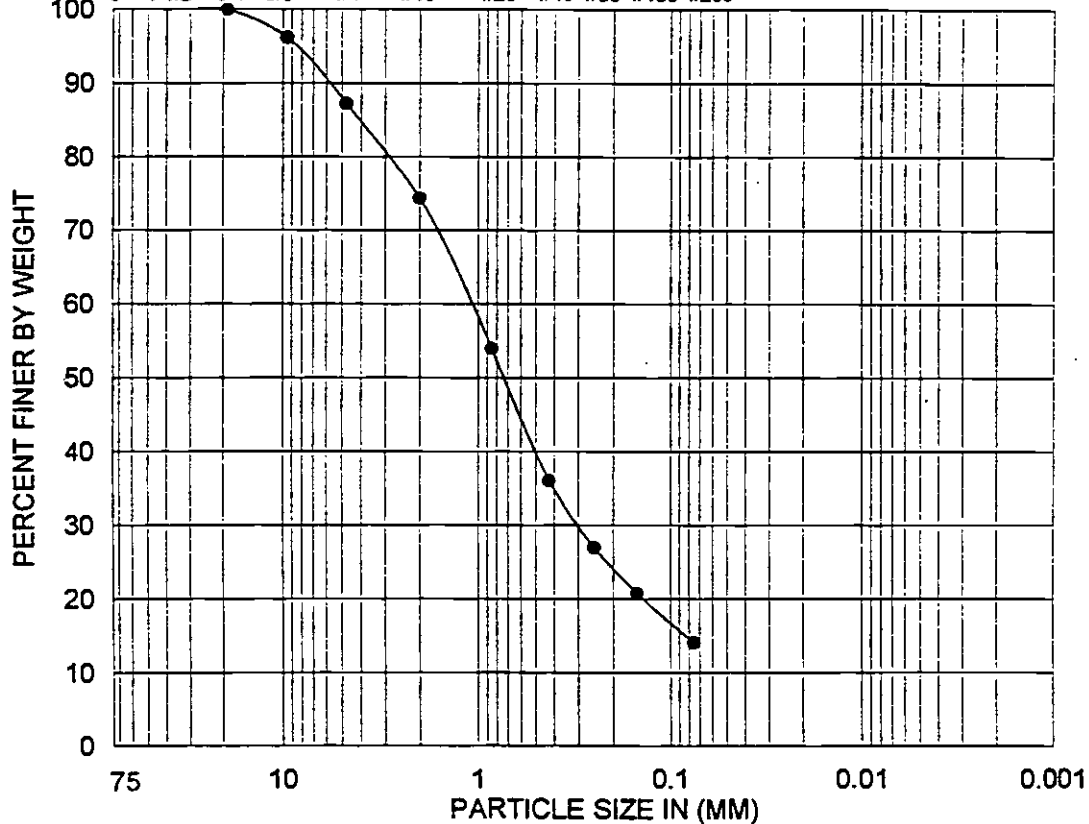
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Figure B-88



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
SD-7	S-15	74.0	SM	13:73:14	N/A

Not enough sample to meet ASTM specification



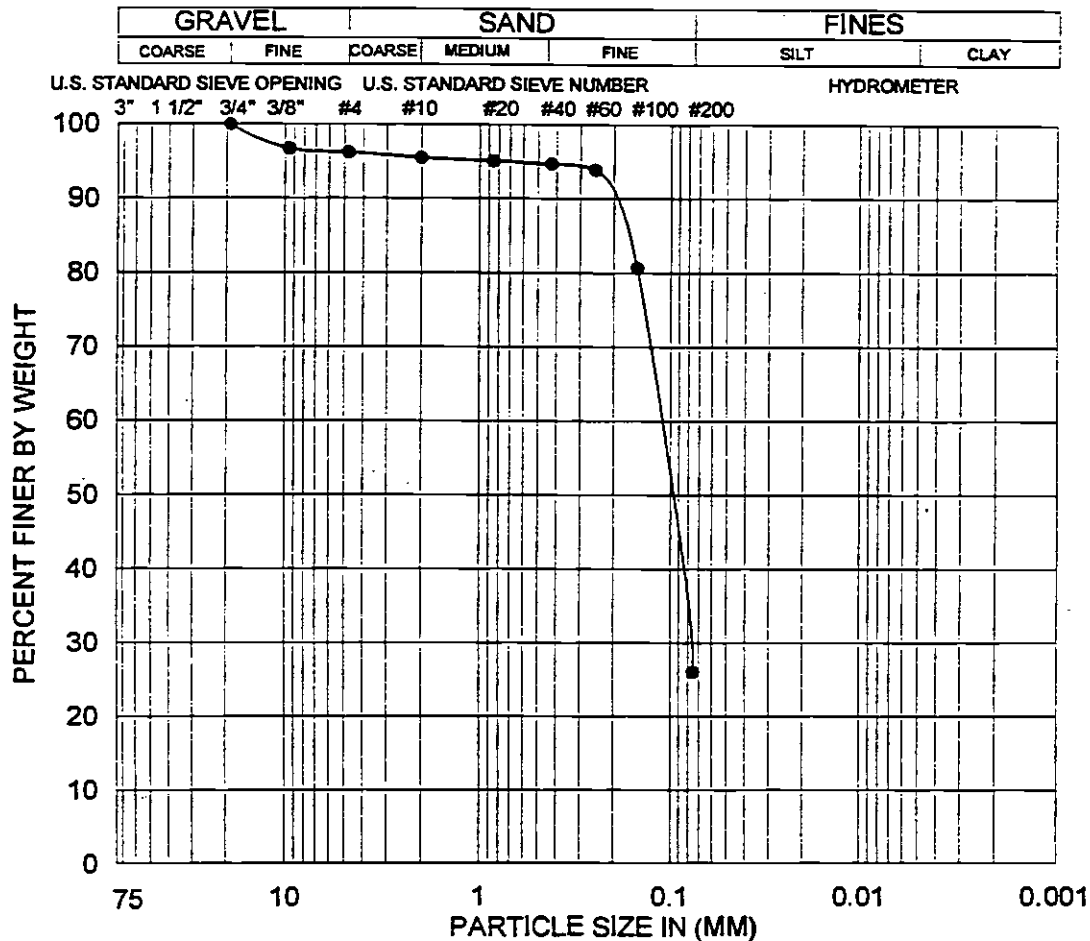
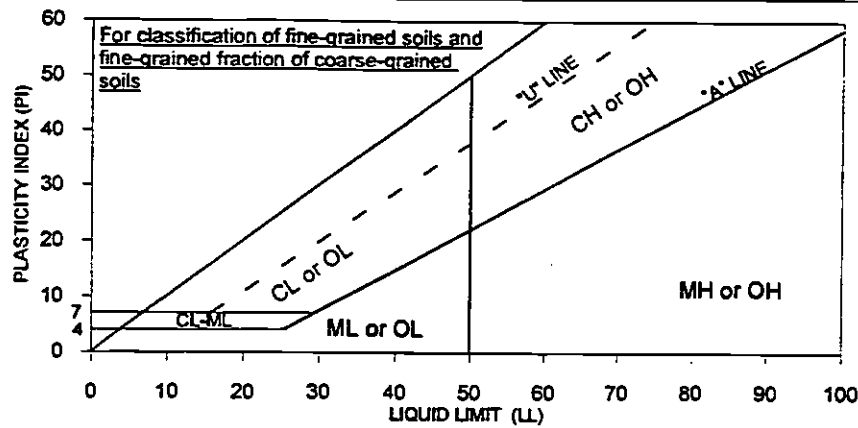
GeoTransit
Consultants

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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-89



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-7	S-17	84.0	SM	4:70:26	N/A

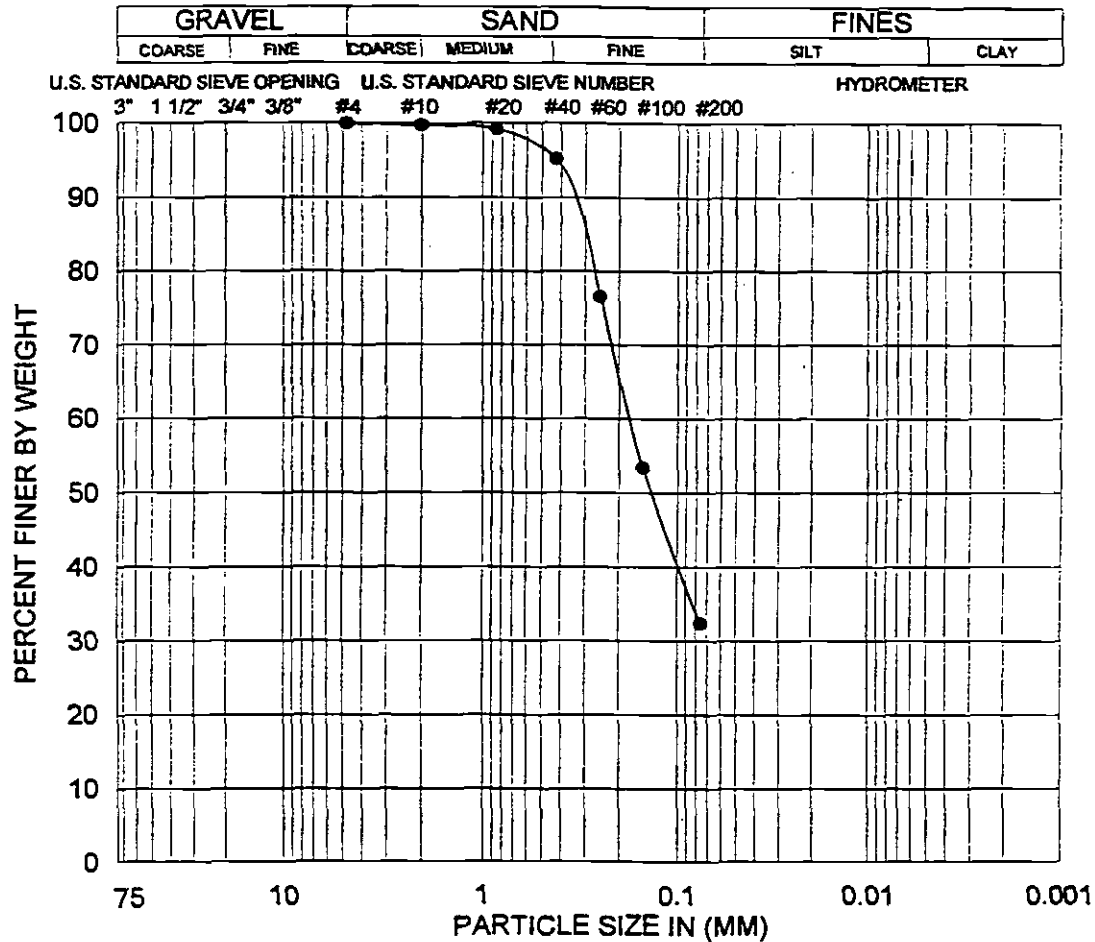
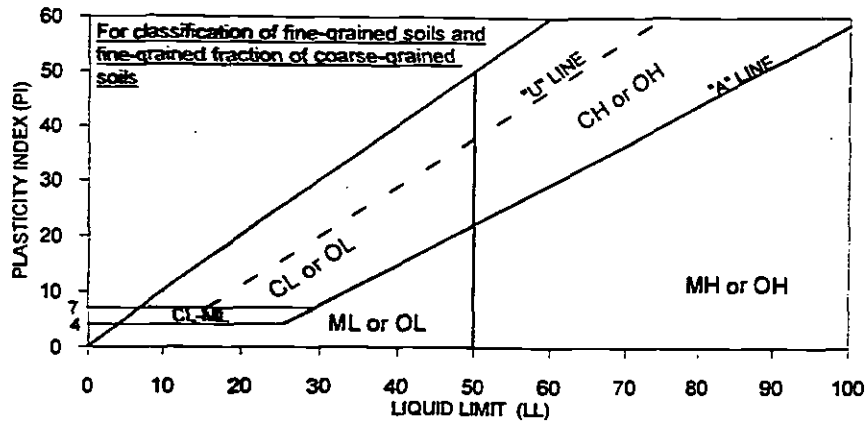
Not enough sample to meet ASTM specification



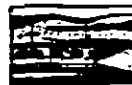
GeoTransit
Consultants

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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



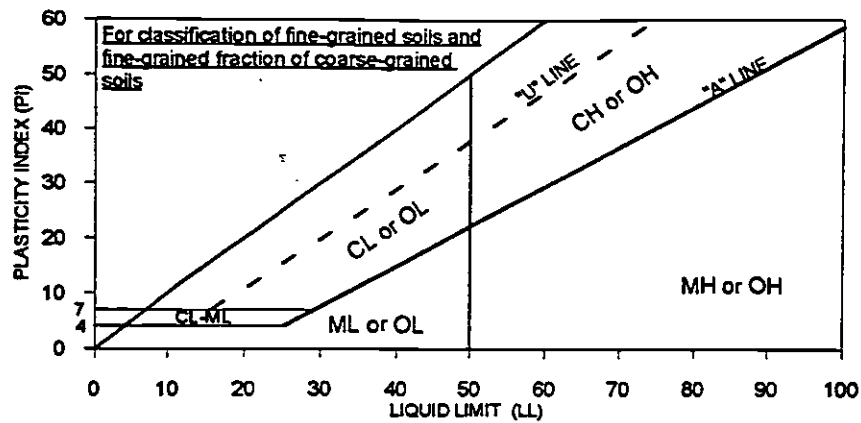
BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-7	S-19	94.0	SM	0:68:32	N/A



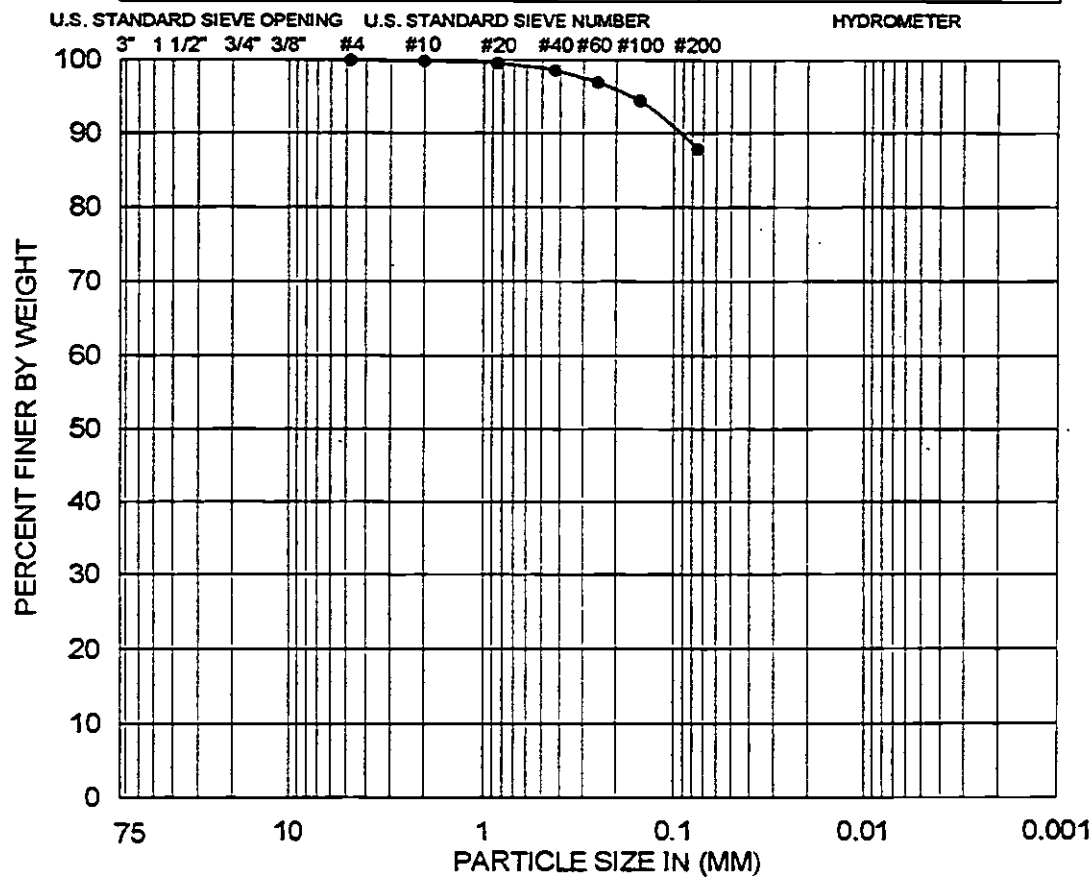
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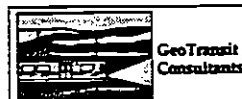
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

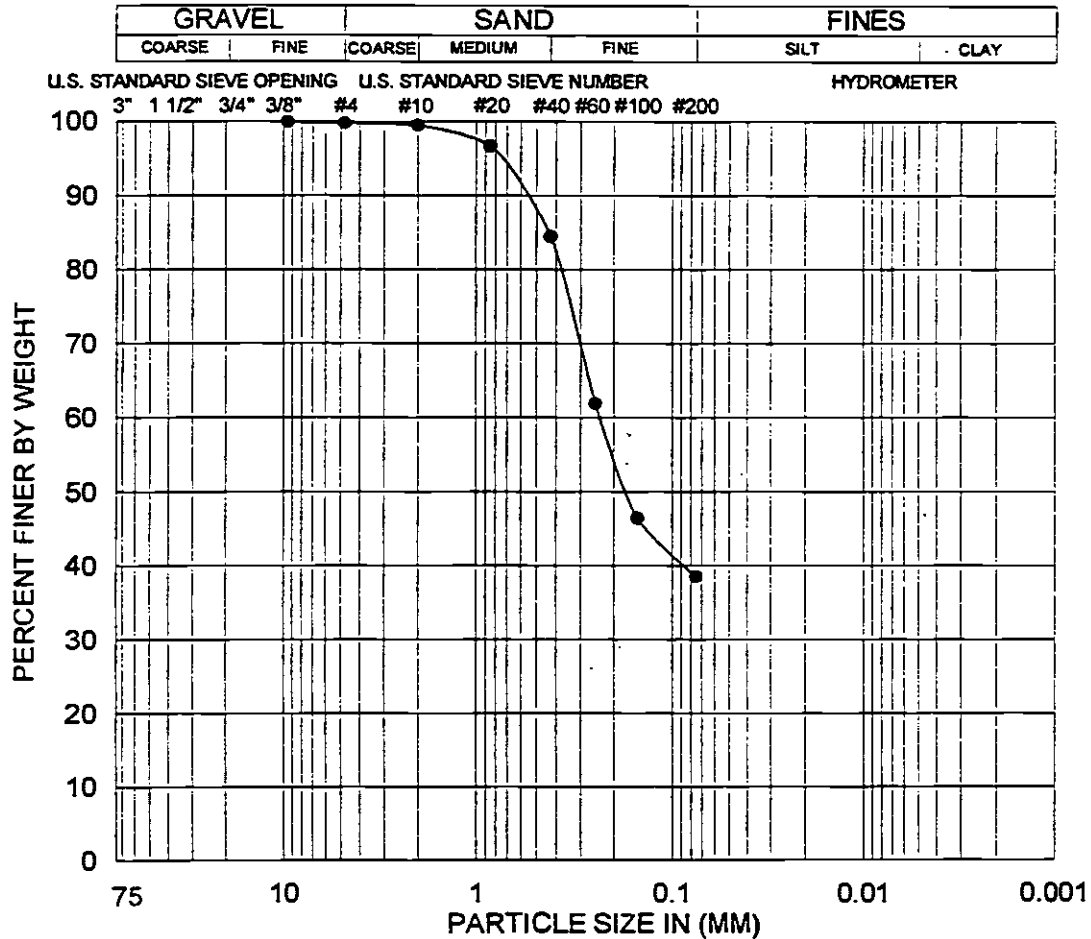
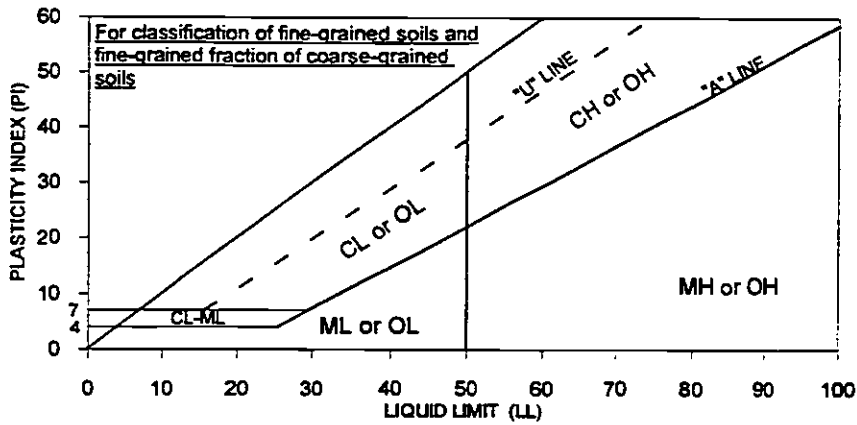


BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-8	S-5	25.0	Bag	CL	0:12:88	N/A



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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
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BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-8	S-7	34.0	Bag	SC	0:51:49	N/A



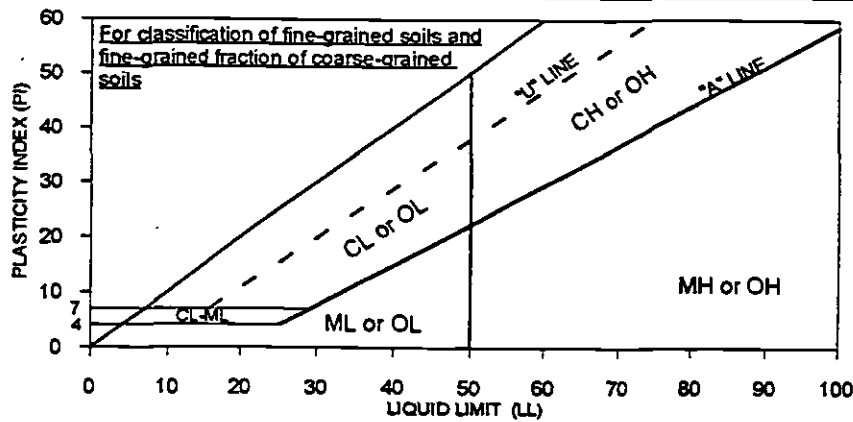
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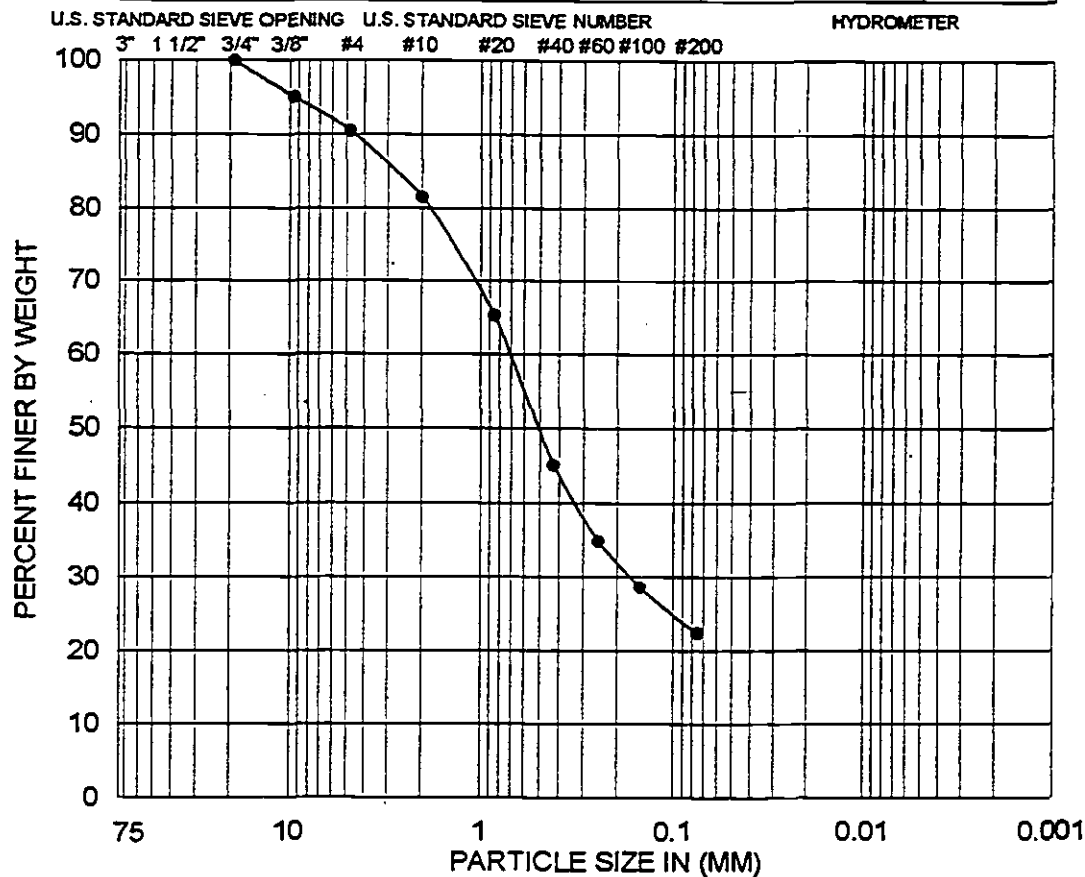
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

11-95

Figure B-93



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



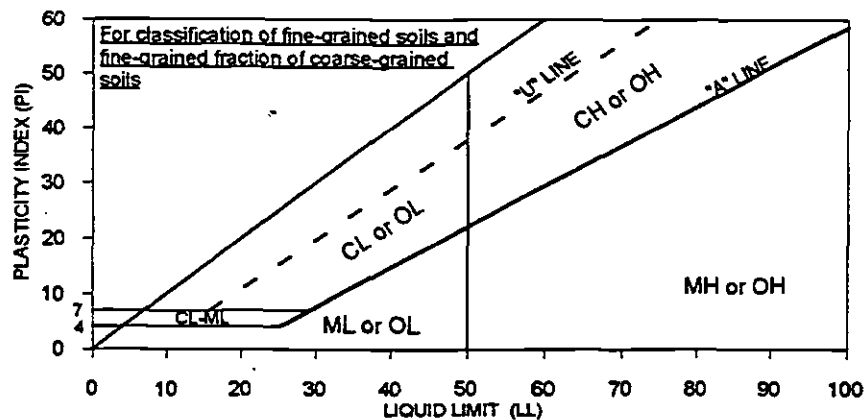
BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-8	S-9	45.0	Bag	SC	10:68:22	N/A



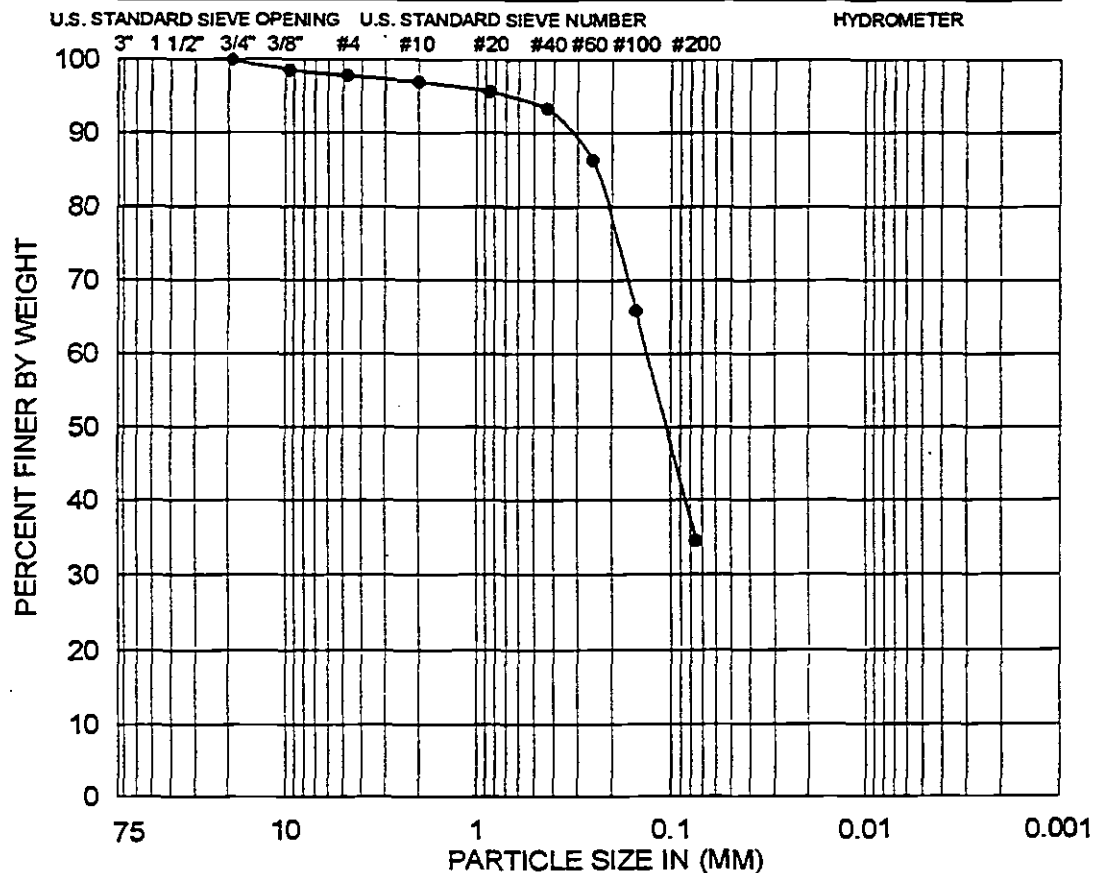
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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

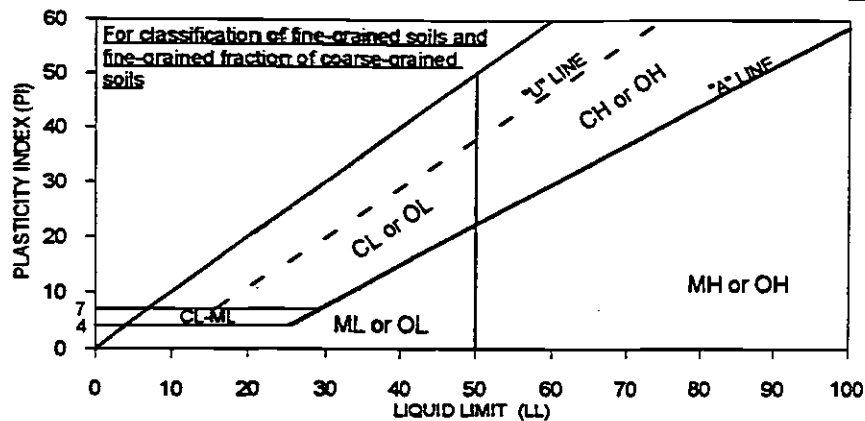


BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-8	S-11	53.0	Bag	SM	2:63:35	N/A

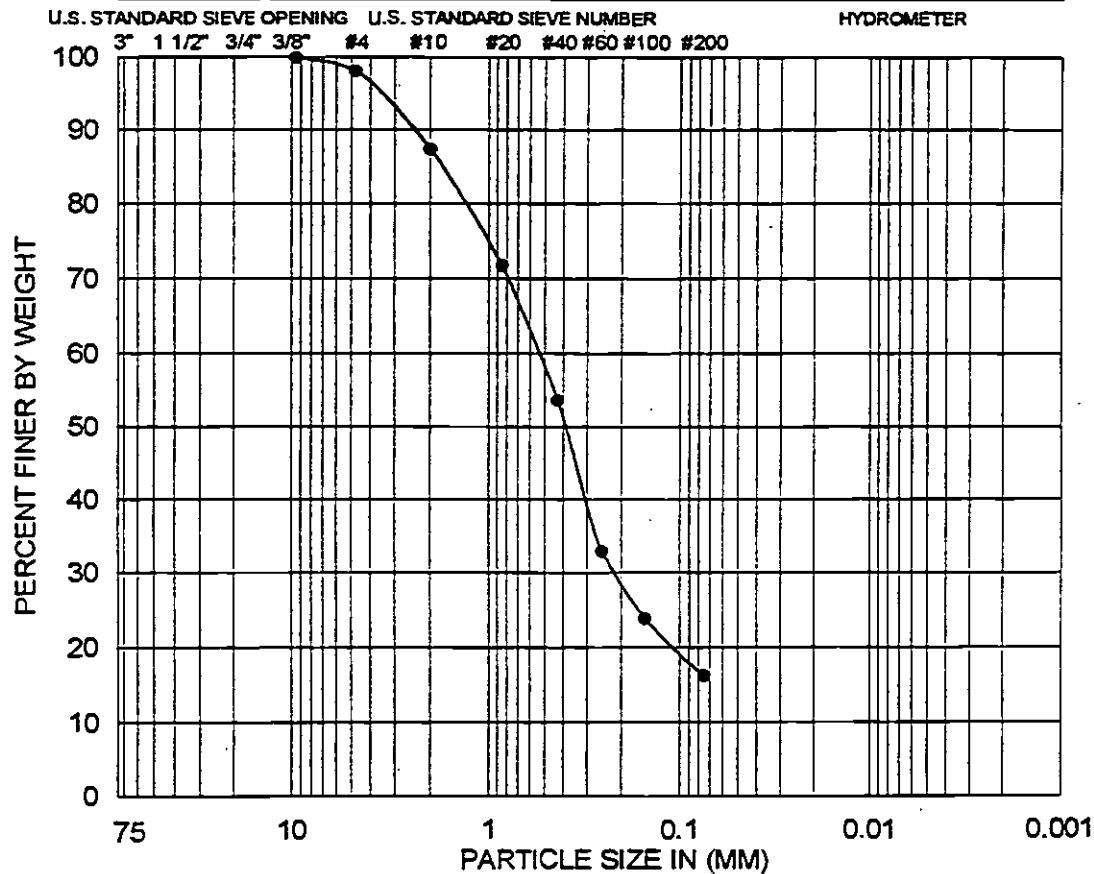


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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318,D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

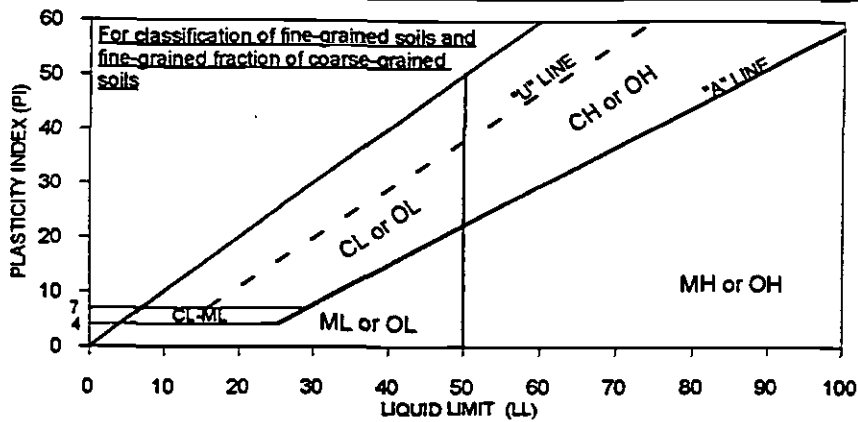


BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
SD-8	S-13	60.0	Bag	SM	2:82:16	N/A

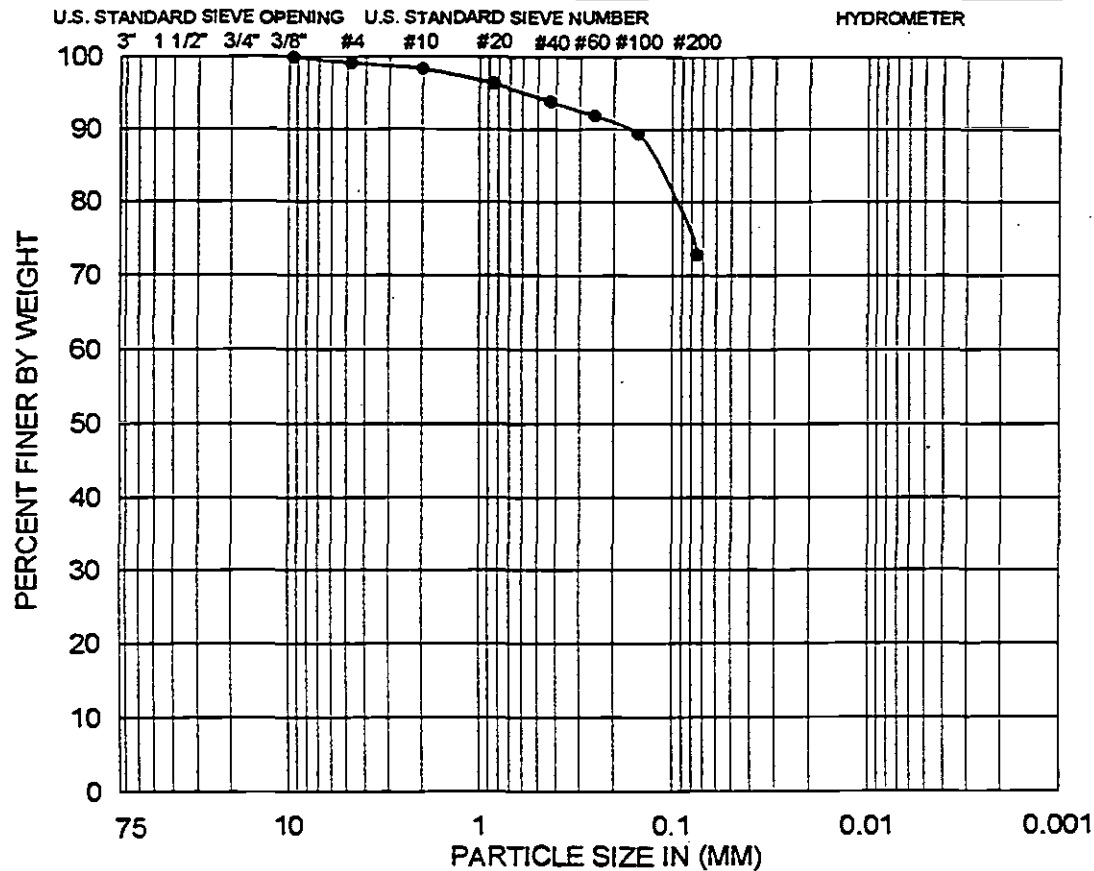


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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318, D422)



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
SD-8	S-15	69.0	Bag	ML	1:26:73	N/A



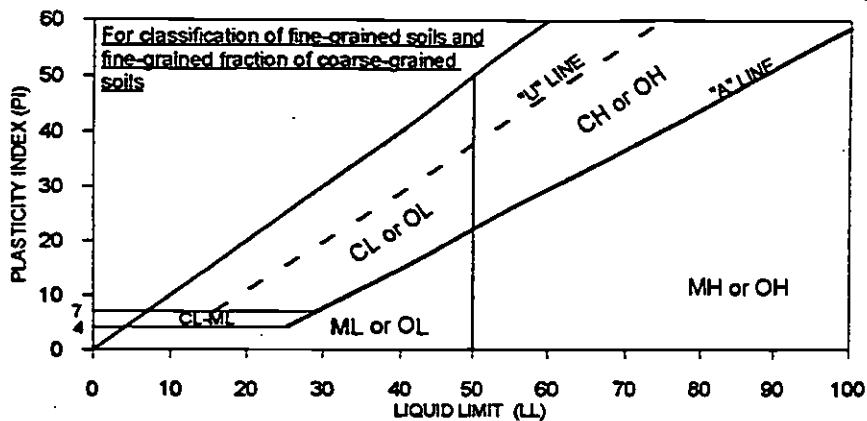
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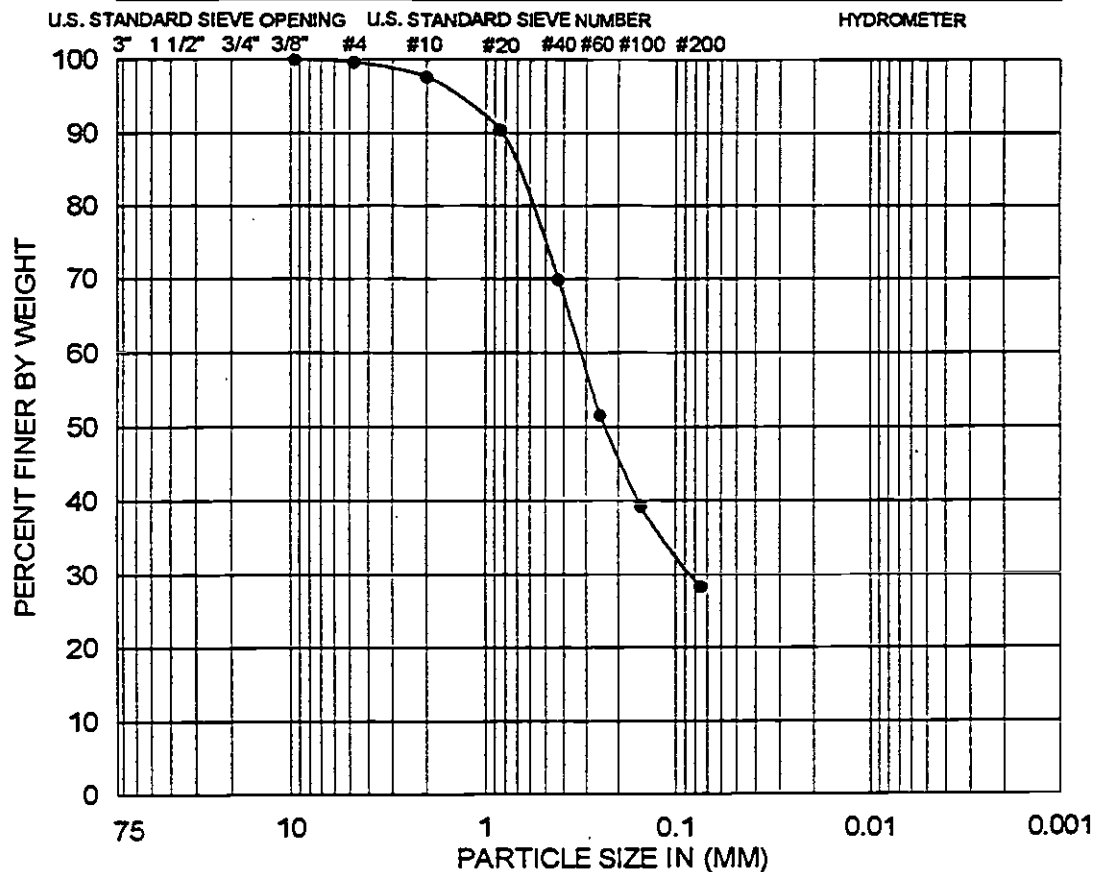
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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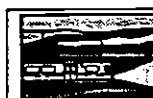
Figure B-97



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
SD-8	S-19	87.0	Bag	SM	0:72:28	N/A

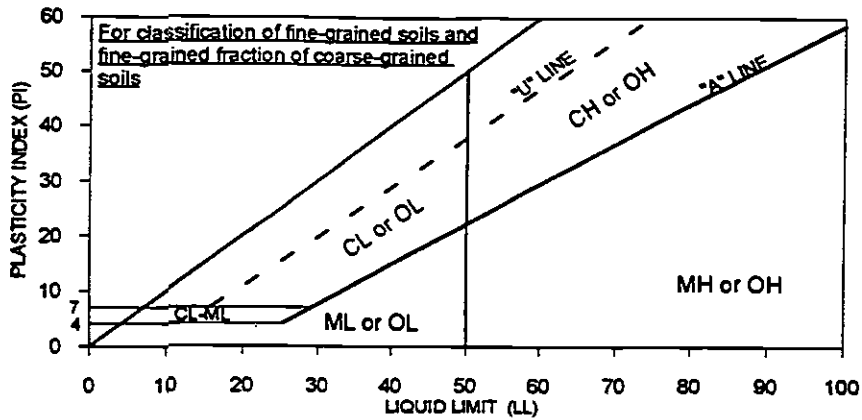


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Project No. 95-8347-23

Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

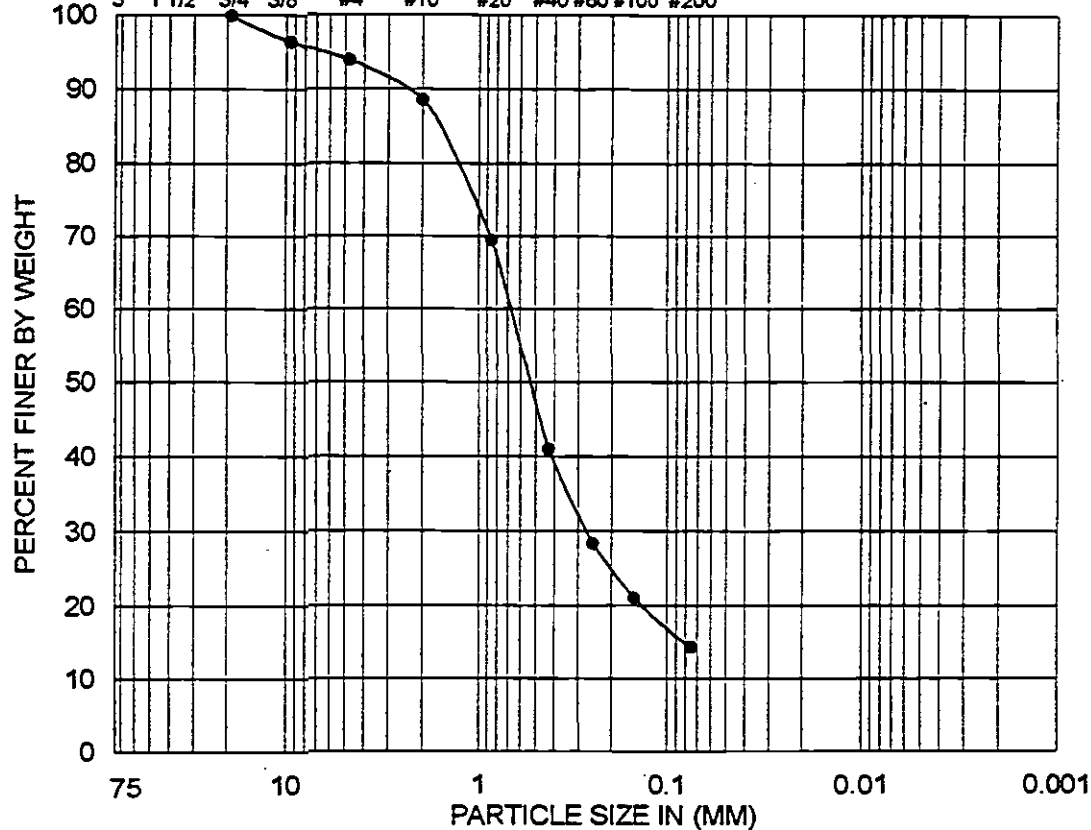


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200

U.S. STANDARD SIEVE NUMBER

HYDROMETER



BORING NO.	SAMPLE NO.	DEPTH (ft)	SAMPLE TYPE	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-8	S-21	93.0	Bag	SM	6:80:14	N/A

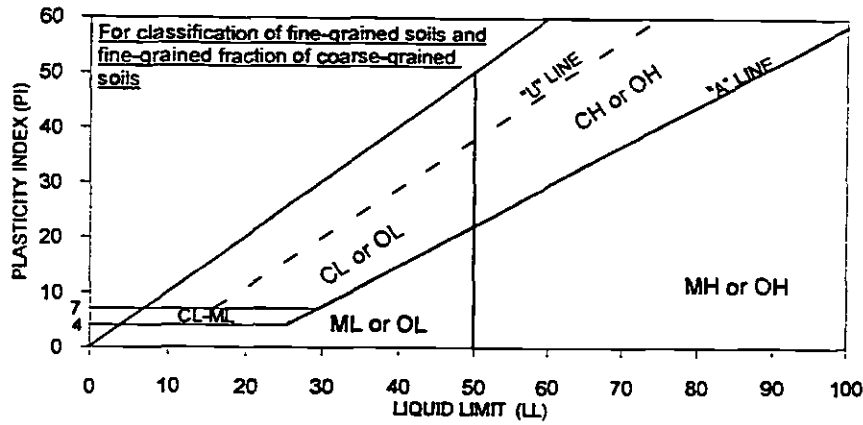


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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318,D422)

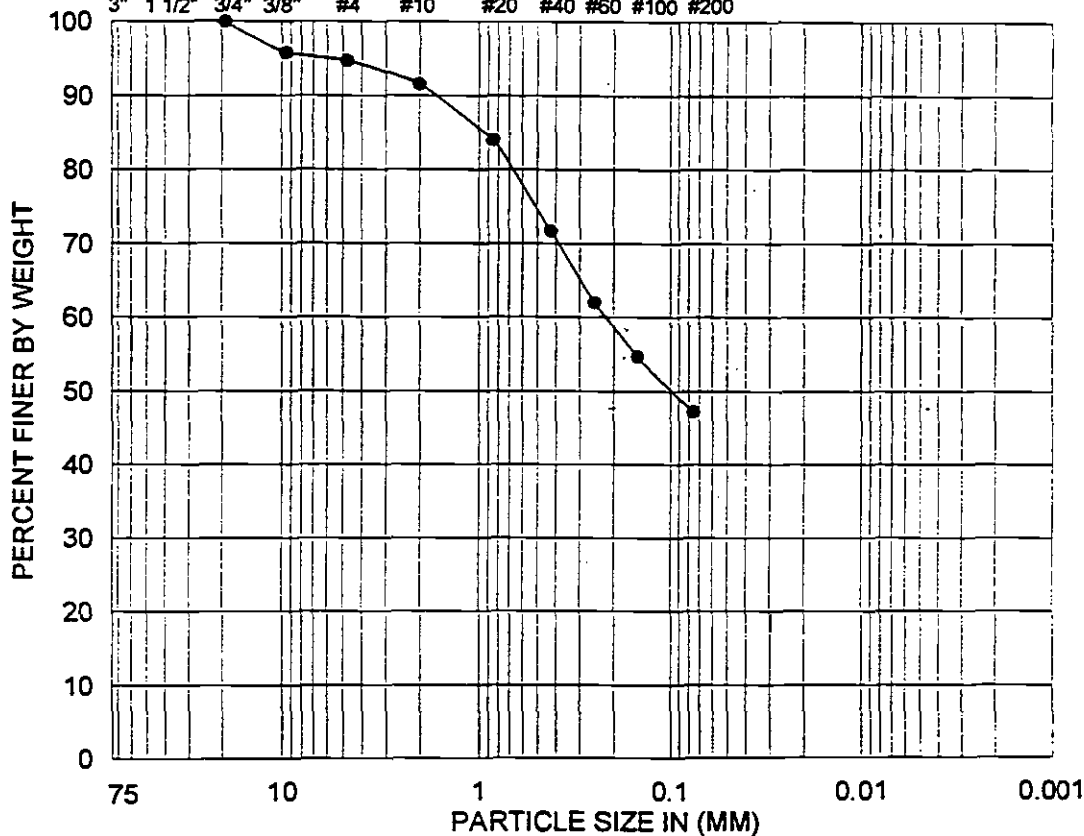
11-95

Figure B-99



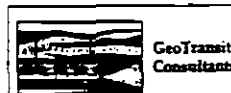
GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-9	S-7	33.0	SC	5:48:47	N/A

Not enough sample to meet ASTM specification

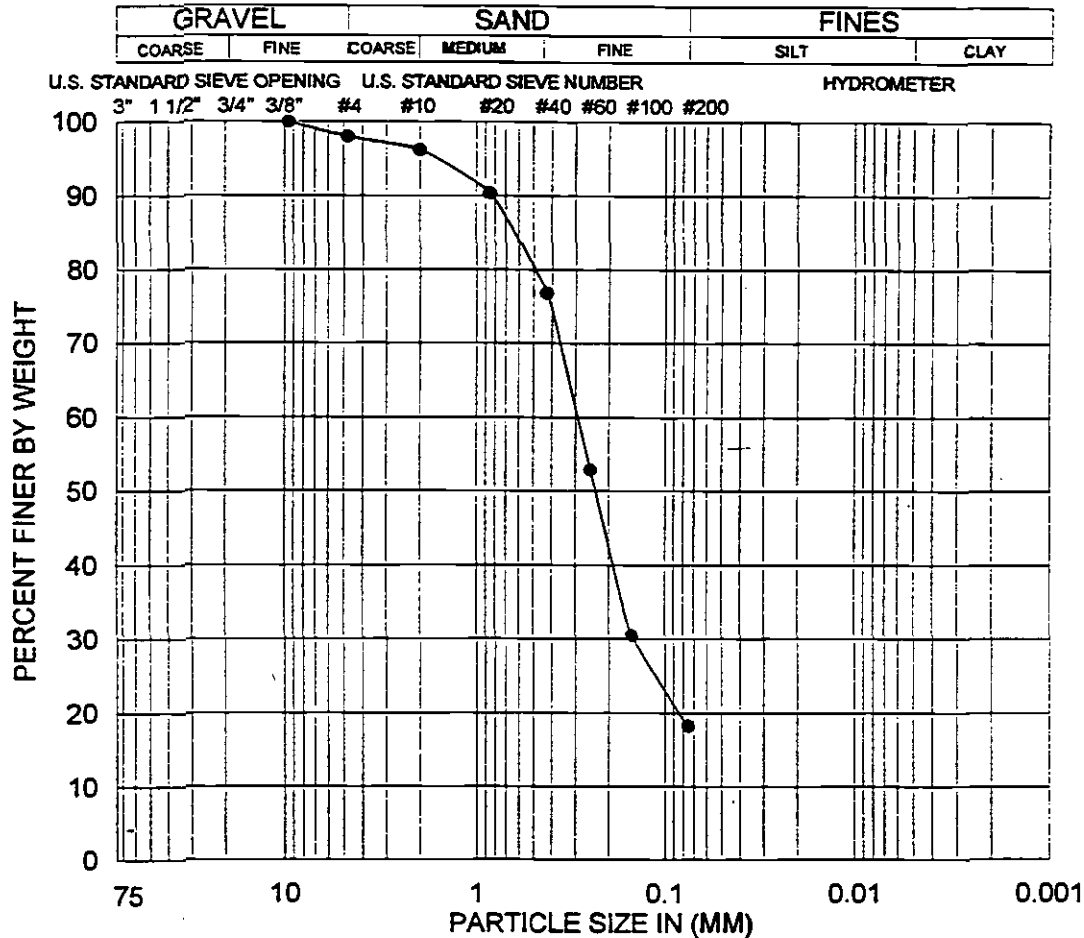
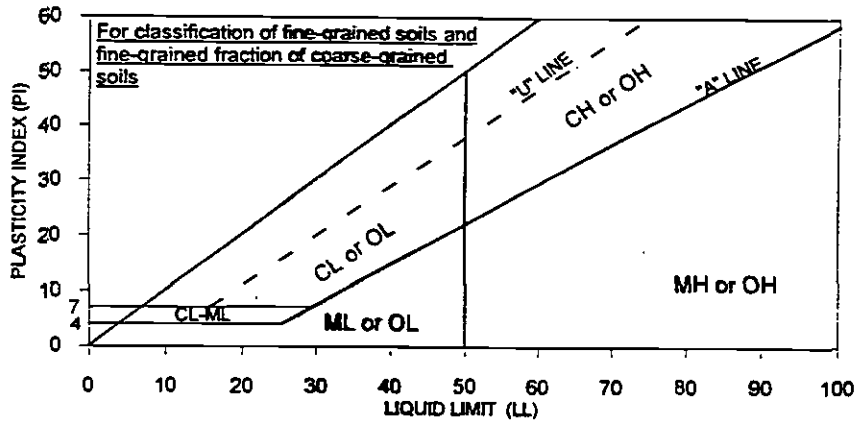


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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-100

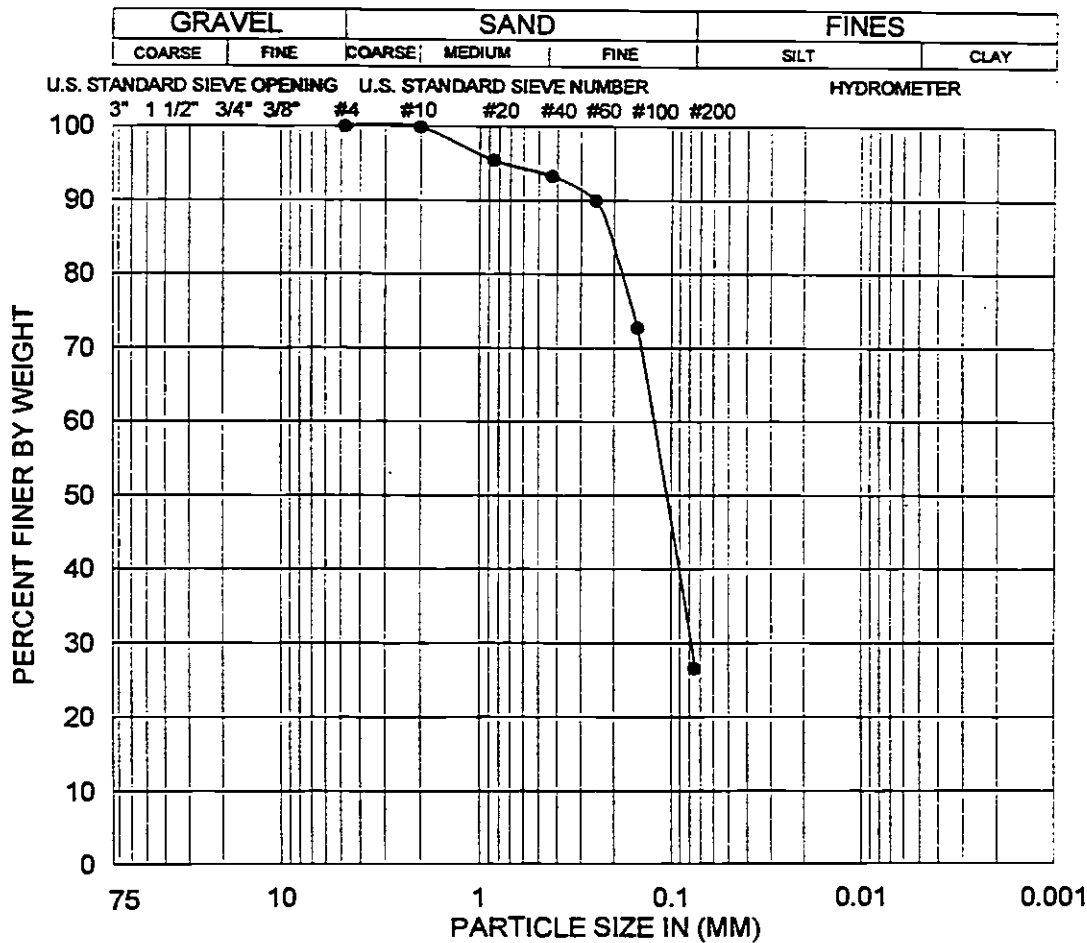
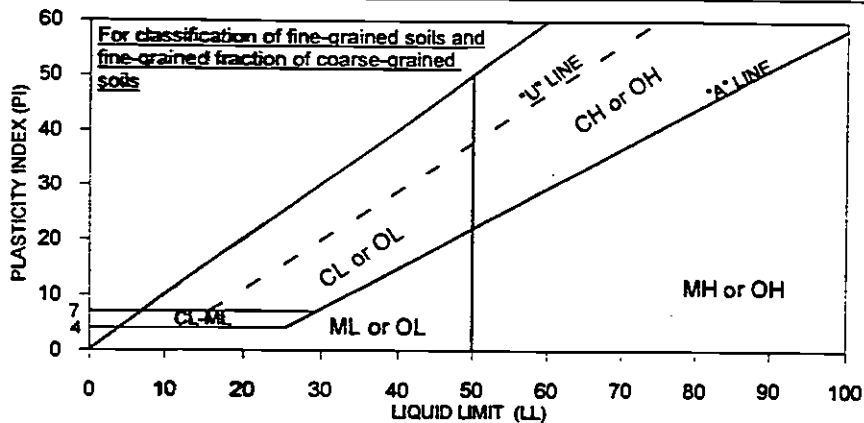


BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-9	S-9	42.0	SM	2:80:18	N/A

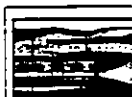


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Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318,D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-9	S-11	50.0	SM	0:73:27	N/A



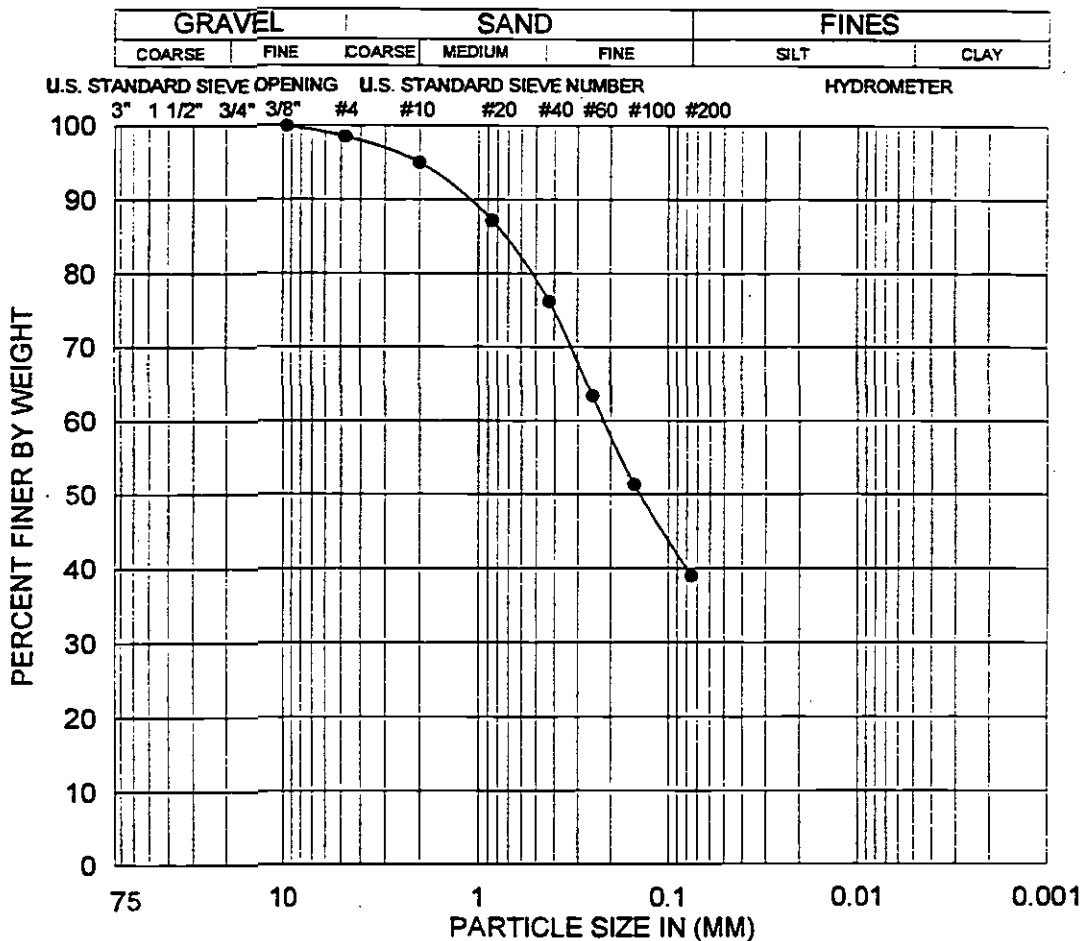
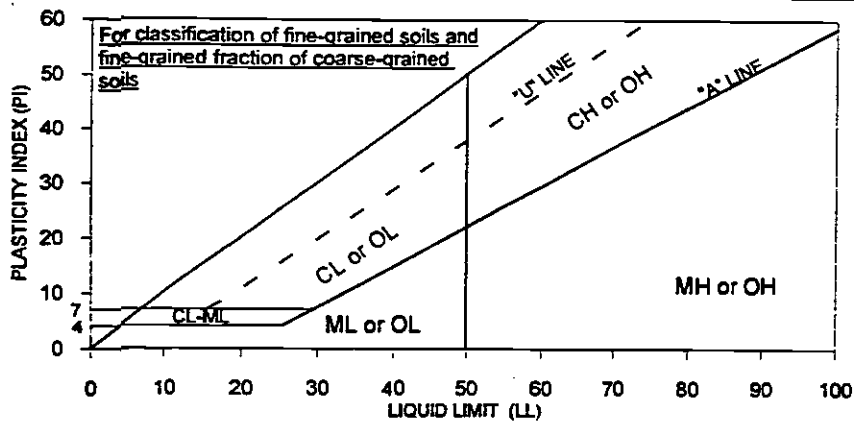
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Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

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Figure B-102



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-10	S-9	45.0	SM	2:59:39	N/A



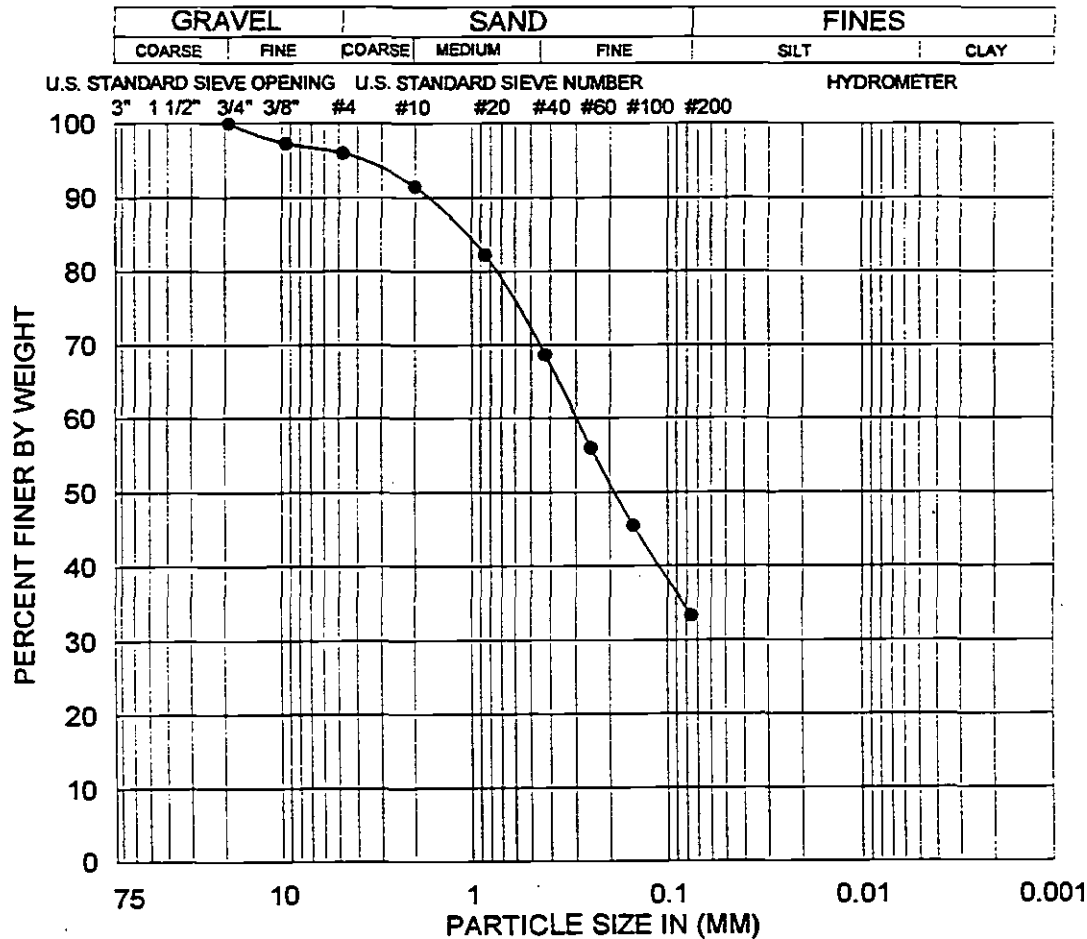
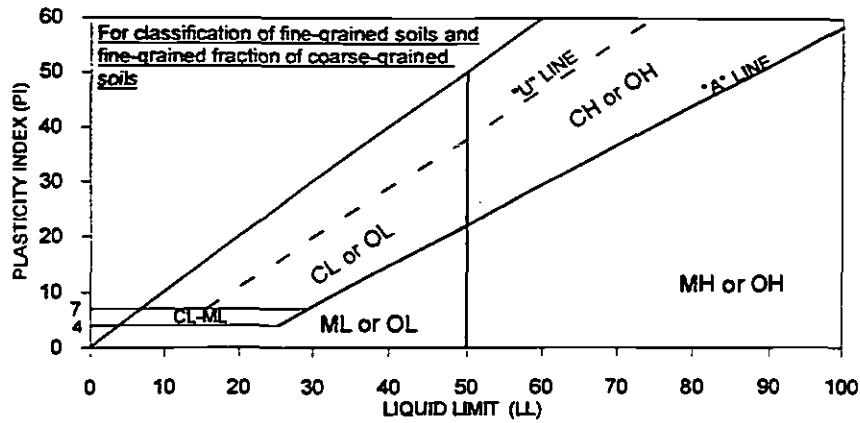
GeoTransit
Consultants

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ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318, D422)

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Figure B-103



BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL,PL,PI
SD-10	S-13	57.0	SM	4:63:33	N/A

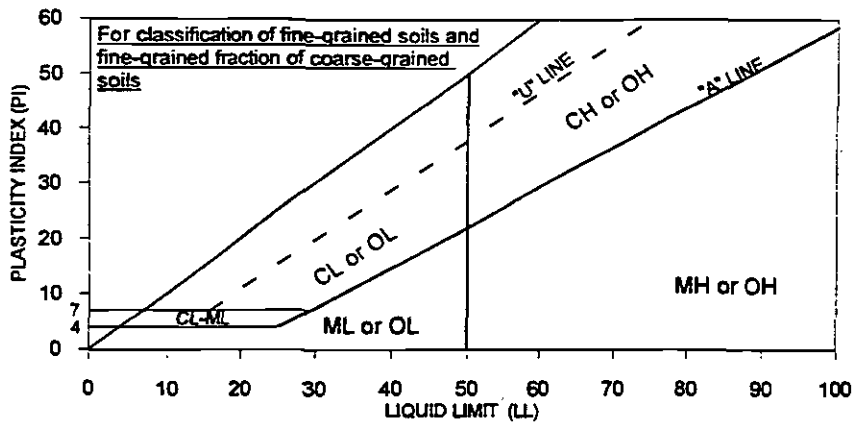
Not enough sample to meet ASTM specification



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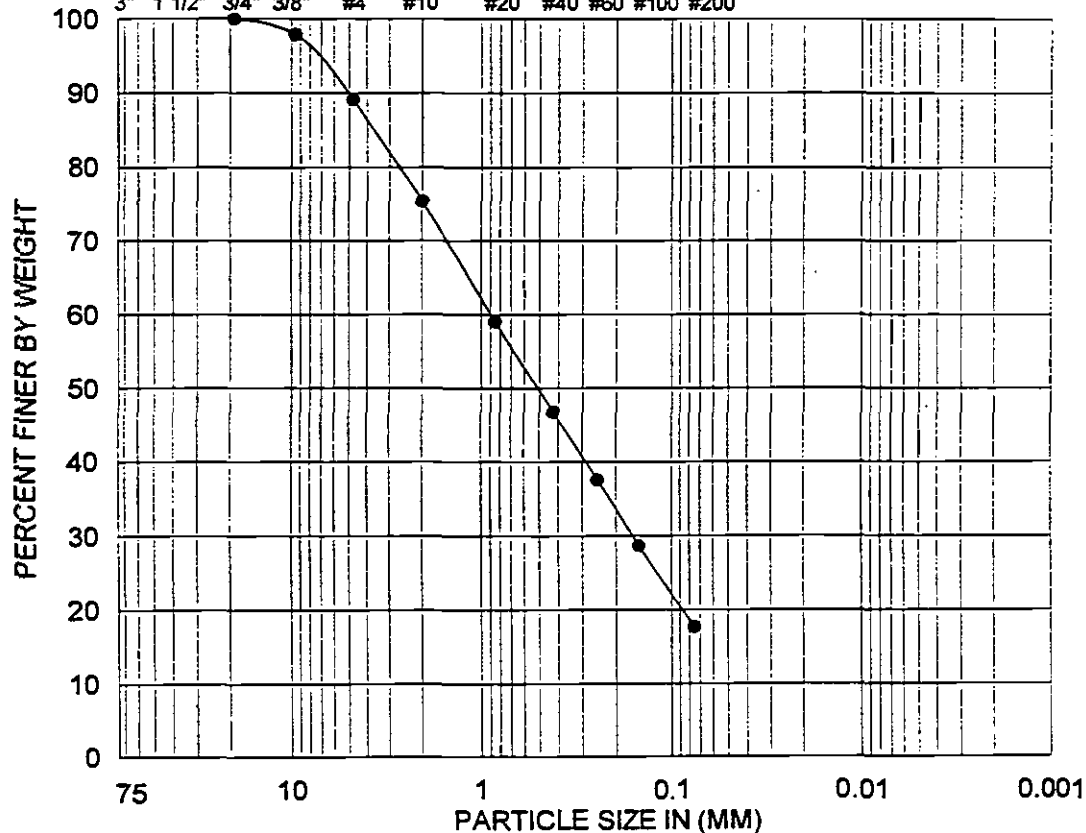
Project No. 95-8347-23
Eastside Extension
Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
(ASTM D4318,D422)

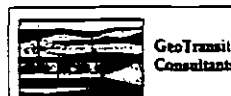


GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING U.S. STANDARD SIEVE NUMBER HYDROMETER
 3" 1 1/2" 3/4" 3/8" #4 #10 #20 #40 #60 #100 #200

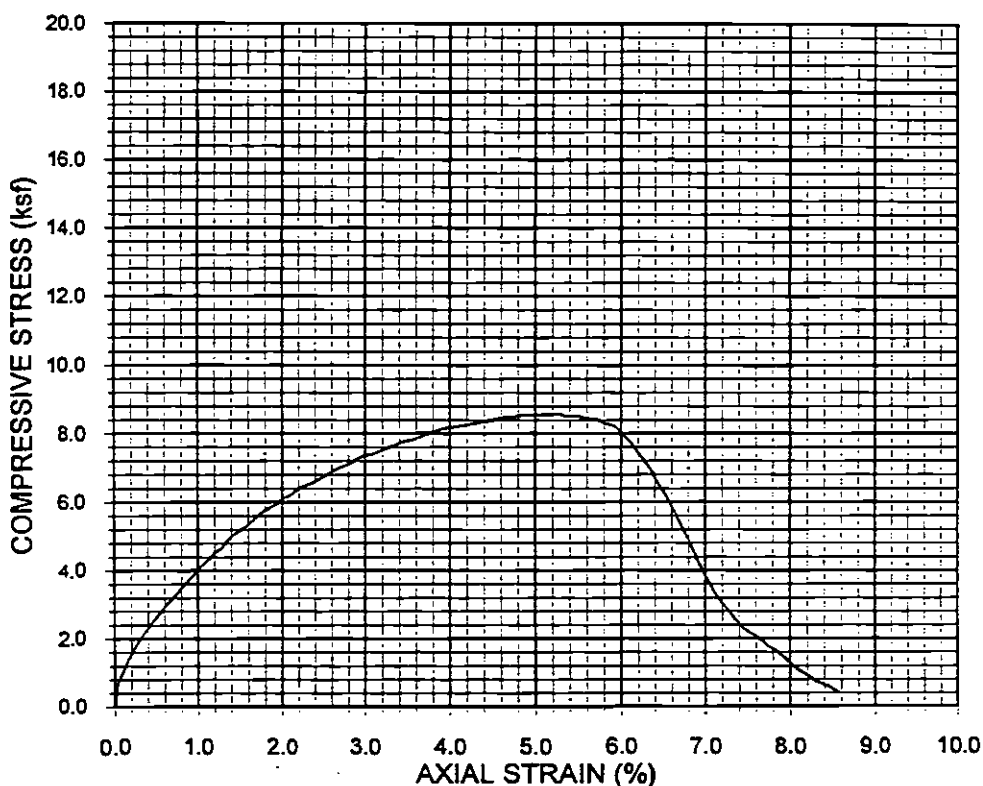
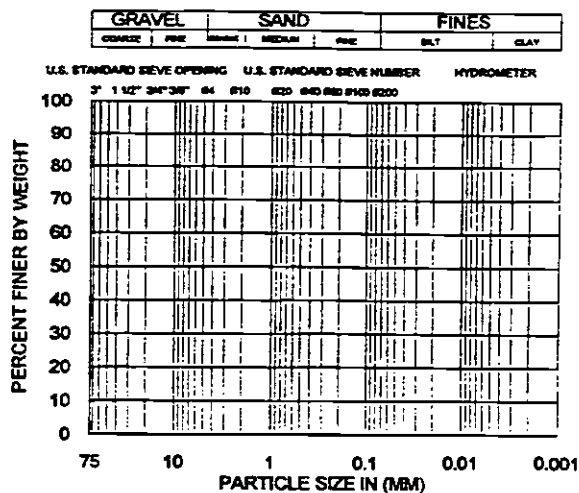
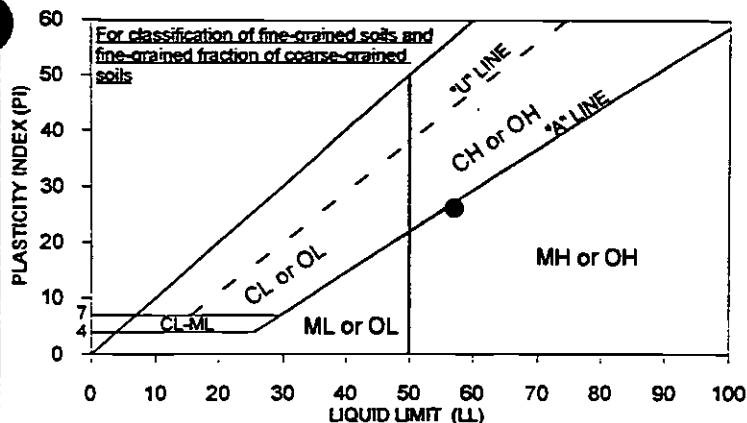


BORING NO.	SAMPLE NO.	DEPTH (ft)	SOIL TYPE	GR:SA:FI (%)	LL, PL, PI
SD-10	S-15	63.0	SM	11:71:18	N/A



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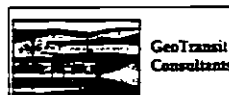
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 (ASTM D4318, D422)



BORING NO.	SAMPLE NO.	DEPTH (ft)	Unconfined Compressive Strength (ksf)	Strain at Failure (%)	GR:SA:FI (%)	LL,PL,PI
DD-57	P-18	55.5	8.583	5.28	N/A	57,31,26

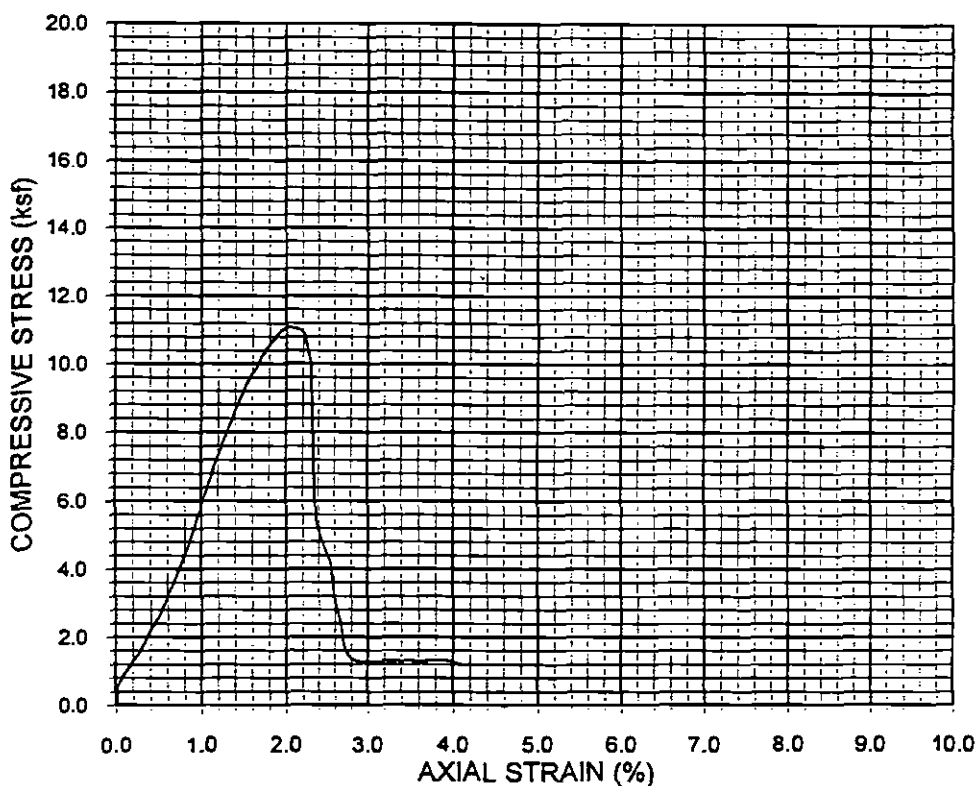
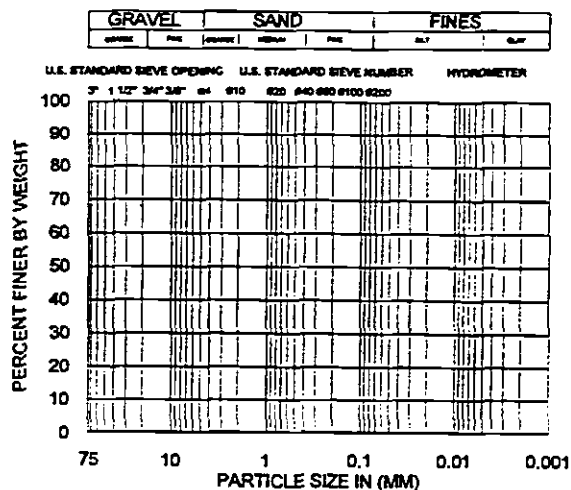
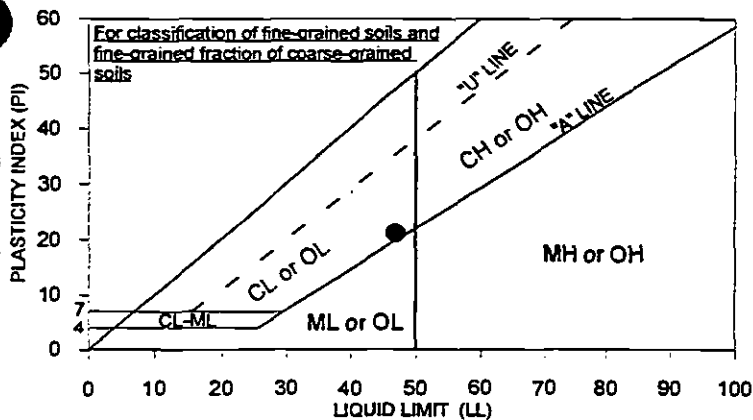
Sample Description: Olive Elastic Silt (MH)

Sample Type : Undisturbed Shelby Tube
 Initial Moisture Content (%) : 27.2
 Dry Density (pcf) : 96.7
 Avg. Sample Diameter (in.) : 2.876
 Avg. Sample Height (in.) : 5.917
 Degree of Saturation (%) : 99
 Strain Rate (inch/min) : 0.04



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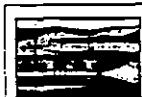
ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 UNCONFINED COMPRESSIVE STRENGTH
 (ASTM D4318, D422, D2166)



BORING NO.	SAMPLE NO.	DEPTH (ft)	Unconfined Compressive Strength (ksf)	Strain at Failure (%)	GR:SA:FI (%)	LL,PL,PI
SD-9	P-14	62.5-63.1	11.101	2.02	N/A	47,26,21

Sample Description: Olive Brown Lean Clay (CL)

Sample Type : Undisturbed Shelby Tube
 Initial Moisture Content (%) : 27.2
 Dry Density (pcf) : 96.8
 Avg. Sample Diameter (in.) : 2.861
 Avg. Sample Height (in.) : 6.000
 Degree of Saturation (%) : 99
 Strain Rate (inch/min) : 0.04



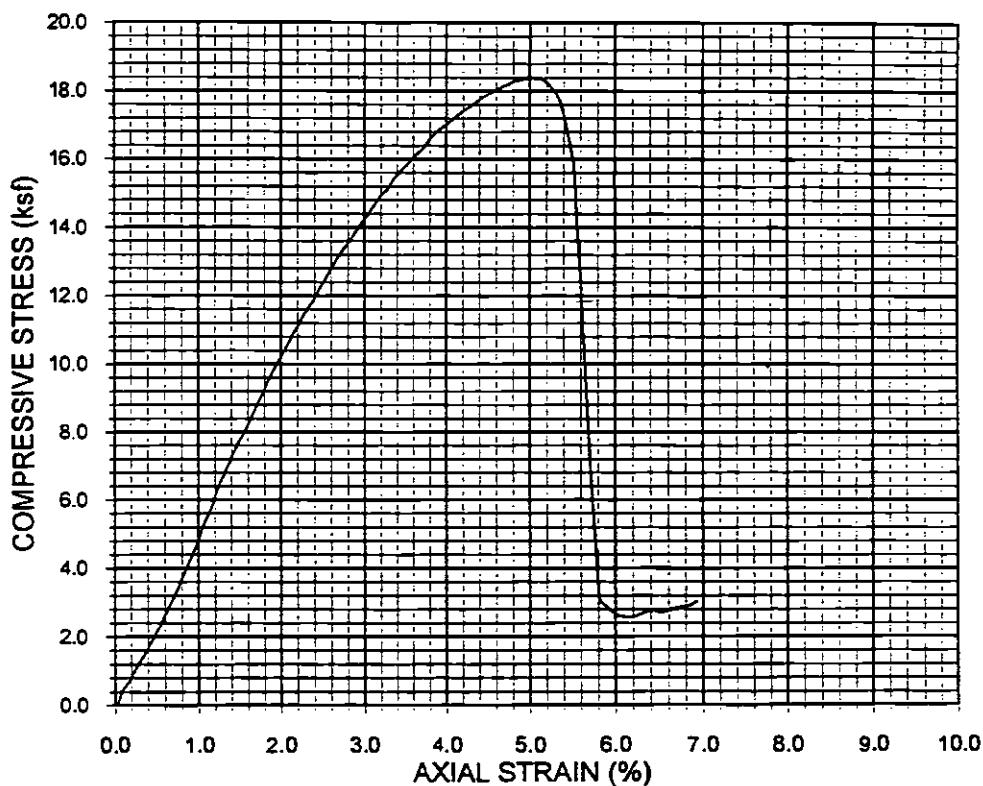
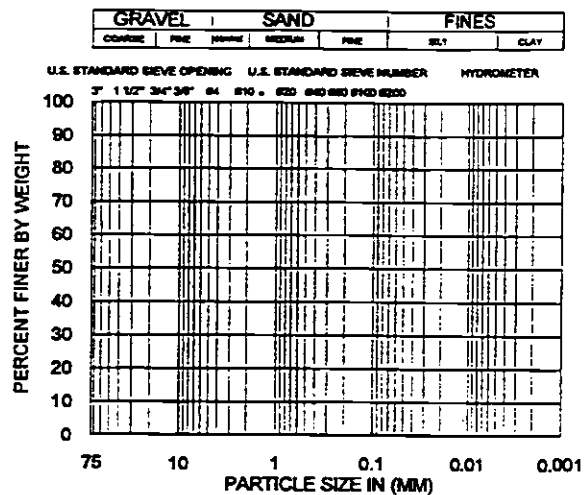
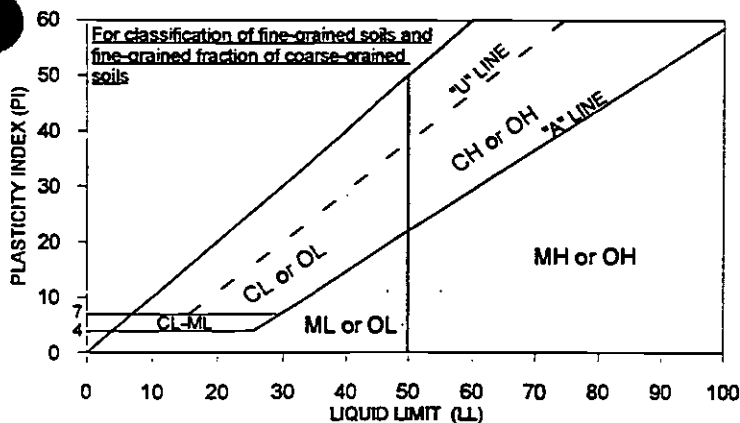
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 Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 UNCONFINED COMPRESSIVE STRENGTH
 (ASTM D4318, D422, D2166)

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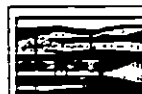
Figure B-107



BORING NO.	SAMPLE NO.	DEPTH (ft)	Unconfined Compressive Strength (ksf)	Strain at Failure (%)	GR:SA:FI (%)	LL,PL,PI
SD-9	P-26	91.8-92.4	18.404	4.99	N/A	N/A

Sample Description: Olive Silt (ML)

Sample Type : Undisturbed Shelby Tube
 Initial Moisture Content (%) : 28.2
 Dry Density (pcf) : 96.3
 Avg. Sample Diameter (in.) : 2.871
 Avg. Sample Height (in.) : 5.980
 Degree of Saturation (%) : 100
 Strain Rate (inch/min) : 0.04



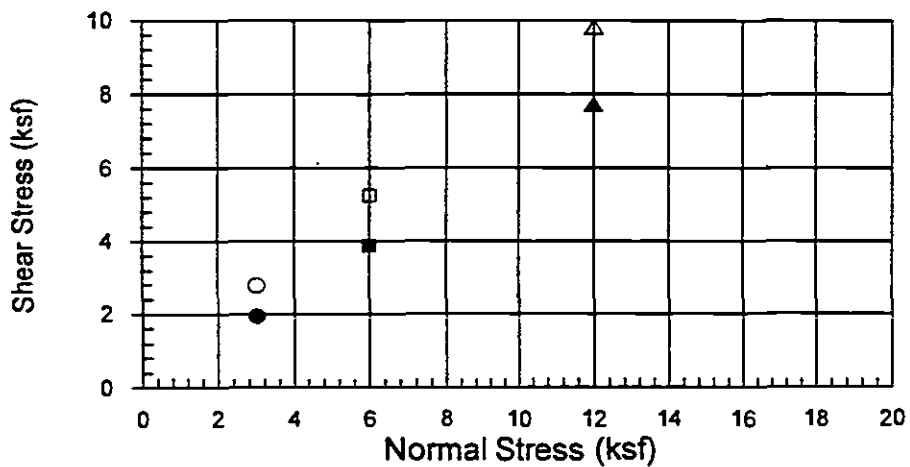
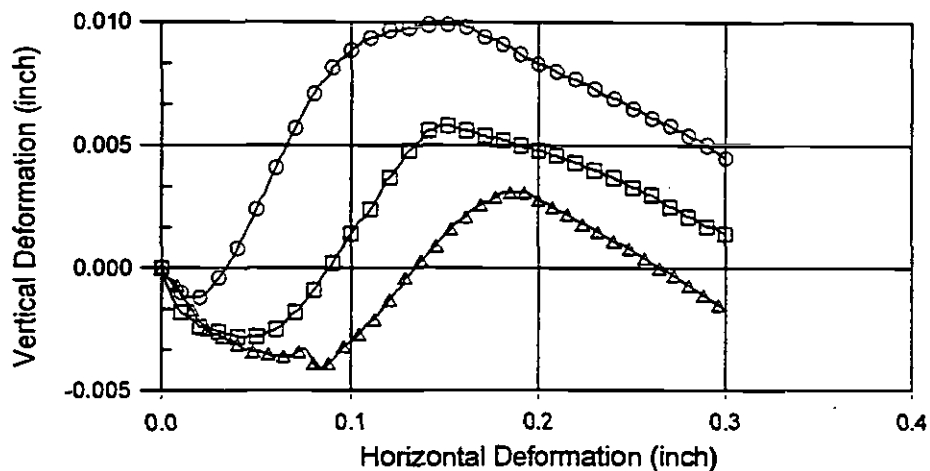
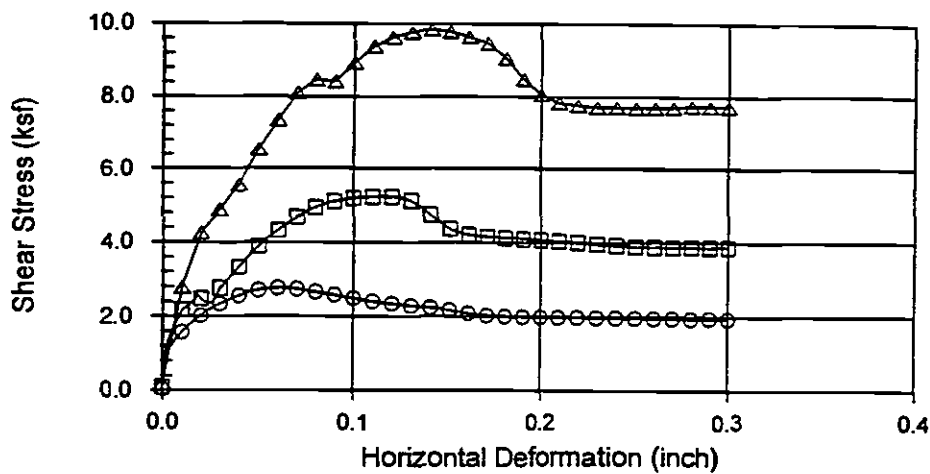
GeoTransit
Consultants

Project No. 95-8347-23
 Eastside Extension
 Metro Redline III

ATTERBERG LIMITS, PARTICLE-SIZE CURVE
 UNCONFINED COMPRESSIVE STRENGTH
 (ASTM D4318, D422, D2166)

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Figure B-108



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
3.000	○ 2.775	● 1.945
6.000	□ 5.252	■ 3.881
12.000	△ 9.845	▲ 7.738

Boring No. : DD-13
Sample No. : D-17B
Depth (ft.) : 70.2
Sample Type : Undisturbed Ring
Soil Type : Olive Silty Sand (SM)

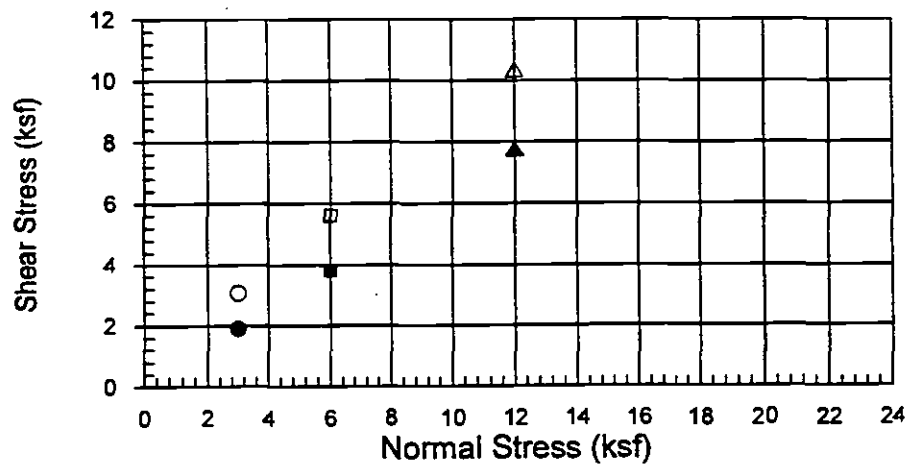
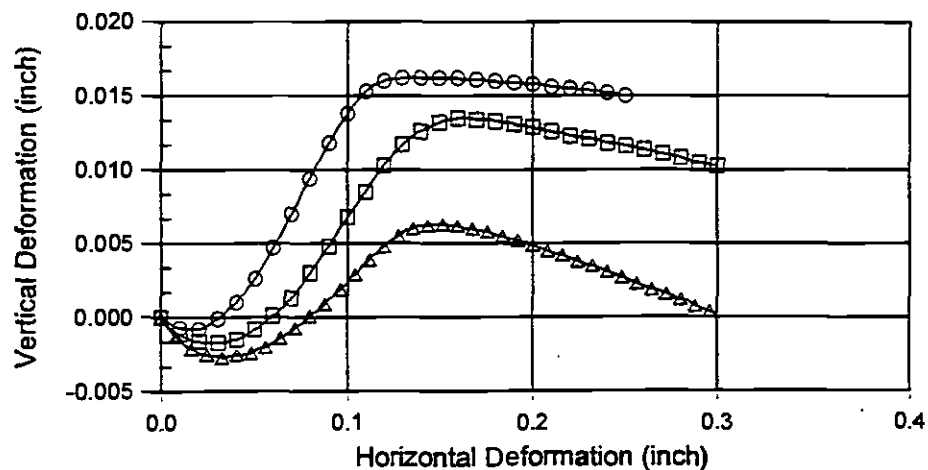
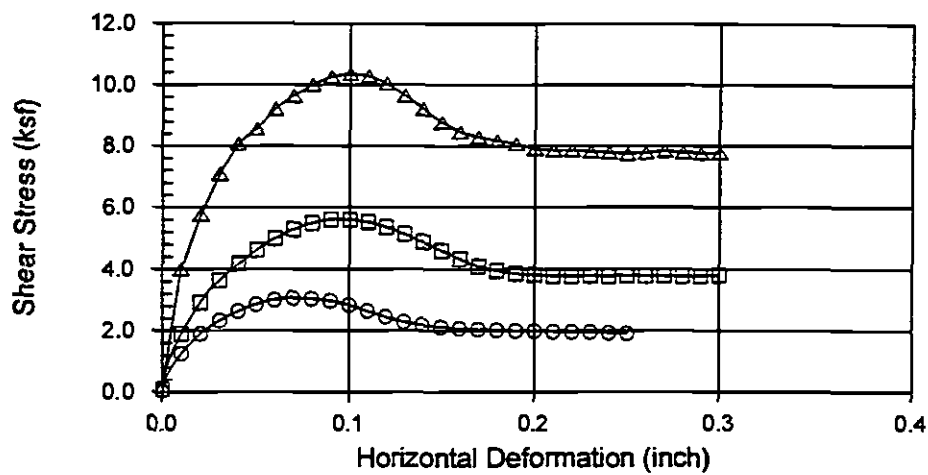


Project No. 95-8347-23
Eastside Extension
Metro Redline III

DIRECT SHEAR TEST RESULTS (ASTM D3080)

11-95

Figure B-109



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
3.000	○ 3.072	● 1.908
6.000	□ 5.620	■ 3.798
12.000	△ 10.357	▲ 7.784

Boring No. : DD-15
 Sample No. : D-17
 Depth (ft.) : 62.0
 Sample Type : Undisturbed Ring
 Soil Type : Olive Yellow Poorly Graded Sand (SP)

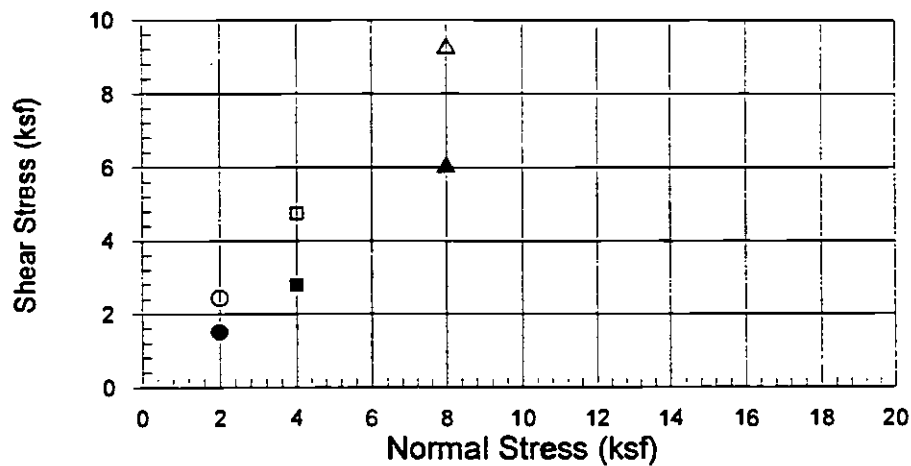
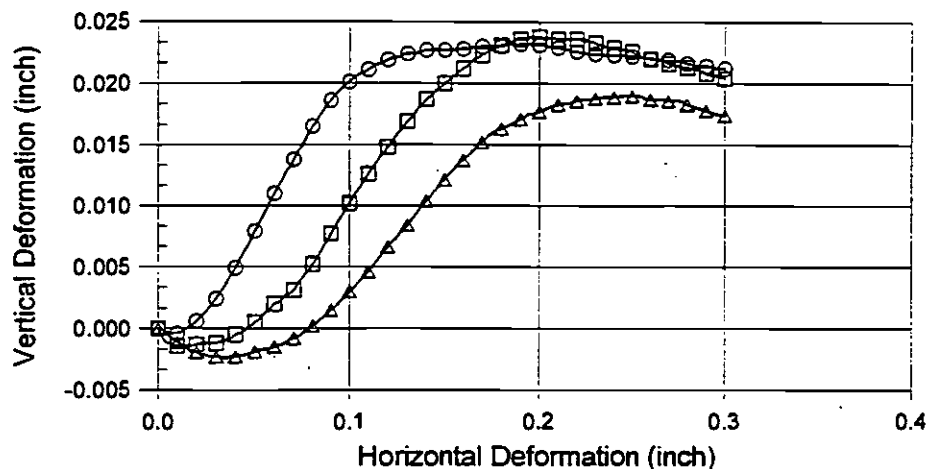
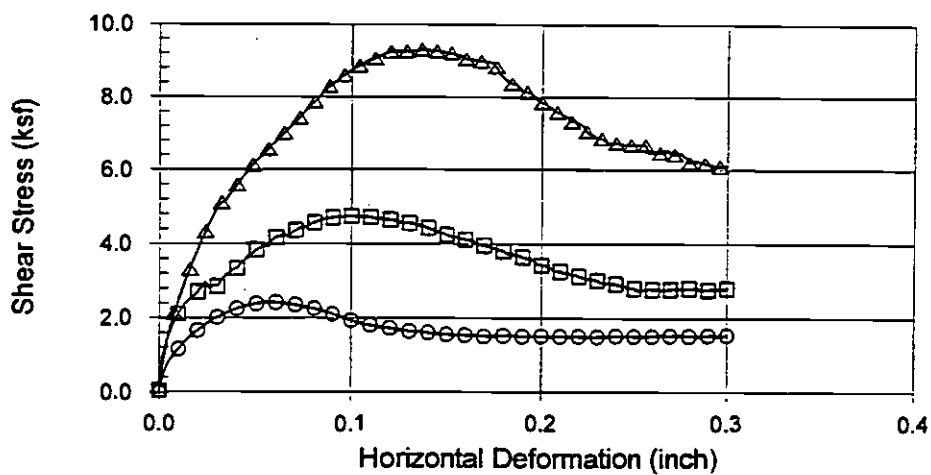


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 Eastside Extension
 Metro Redline III

DIRECT SHEAR TEST RESULTS (ASTM D3080)

11-95

Figure B-110



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
2.000	○ 2.429	● 1.515
4.000	□ 4.749	■ 2.788
8.000	△ 9.306	▲ 6.085

Boring No. : DD-52
 Sample No. : D-16B
 Depth (ft.) : 53.0
 Sample Type : Undisturbed Ring
 Soil Type : Dark Grey Poorly Graded Sand with Silt (SP-SM)



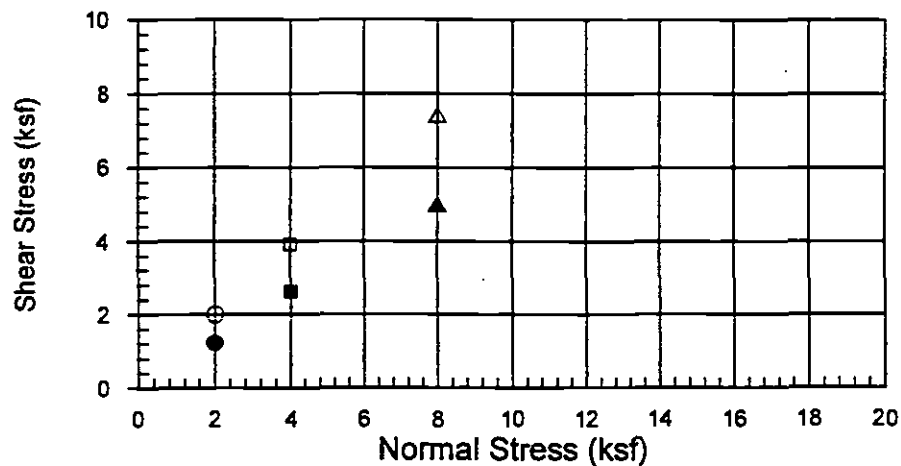
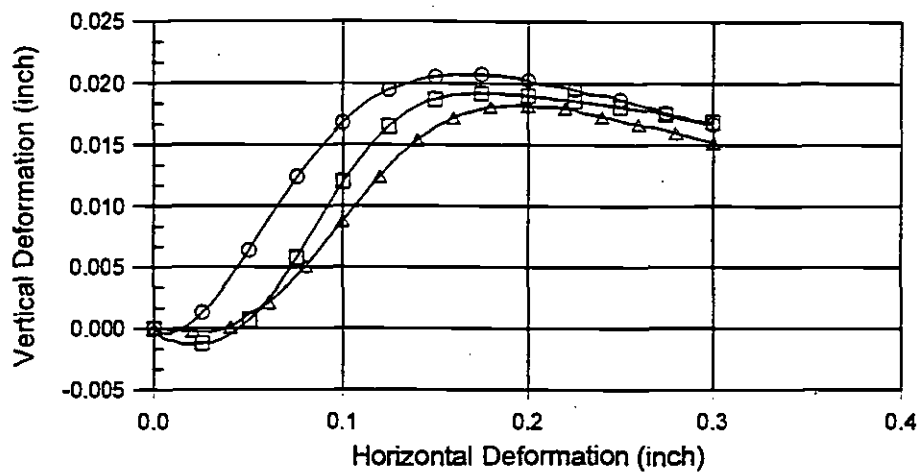
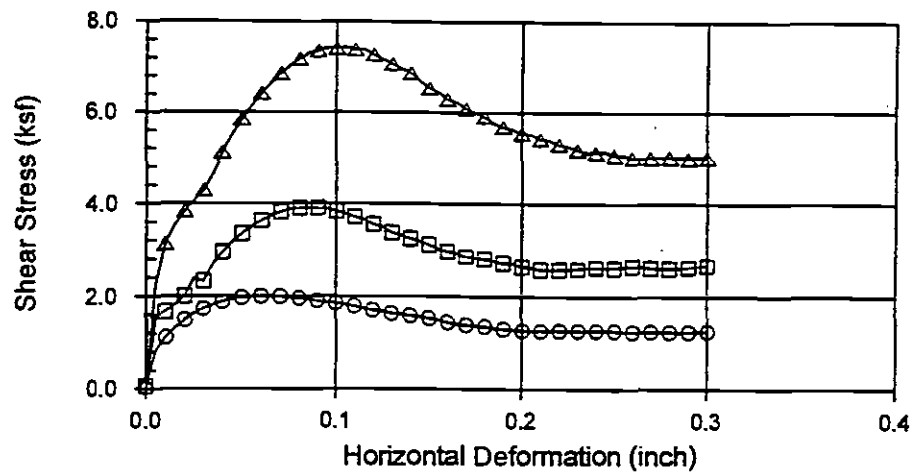
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 Metro Redline
 Eastside Extension III

DIRECT SHEAR TEST RESULTS (ASTM D3080)

11-95

Figure B-111



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
2.000	○ 2.011	● 1.254
4.000	□ 3.922	■ 2.623
8.000	△ 7.436	▲ 5.023

Boring No. : DD56-1
 Sample No. : D-14
 Depth (ft.) : 50.0
 Sample Type : Undisturbed Ring
 Soil Type : Olive Brown Poorly Graded Sand with Silt (SP-SM)

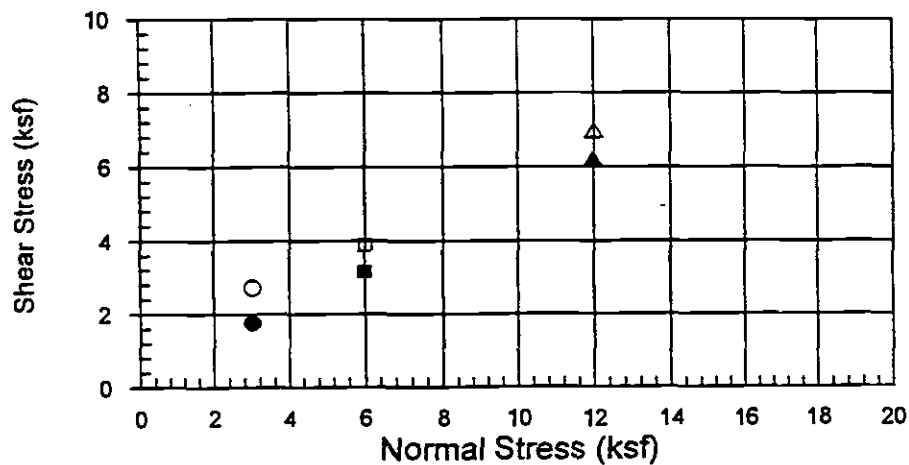
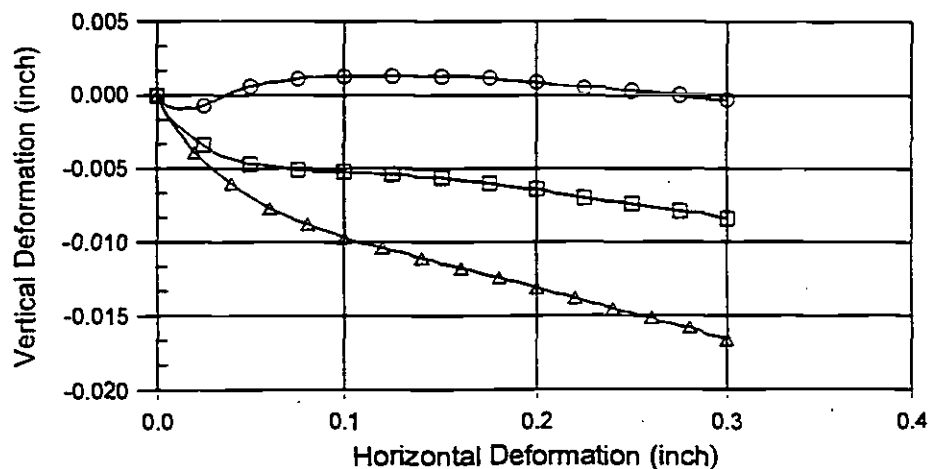
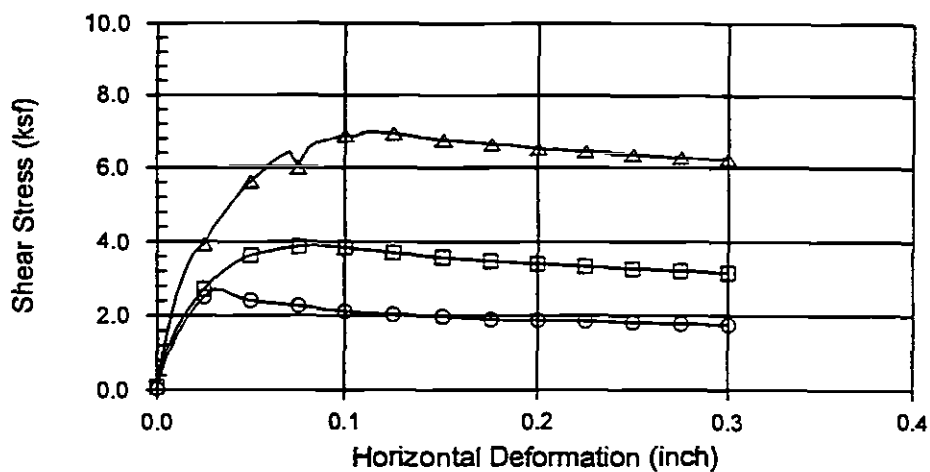


Project No. 95-8347-23
 Eastside Extension
 Metro Redline III

DIRECT SHEAR TEST RESULTS (ASTM D3080)

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Figure B-112



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
3.000	○ 2.717	● 1.761
6.000	□ 3.900	■ 3.164
12.000	△ 6.989	▲ 6.231

Boring No. : SD-6
 Sample No. : D-14
 Depth (ft.) : 62.0
 Sample Type : Undisturbed Ring
 Soil Type : Olive Lean Clay (CL) with Sand



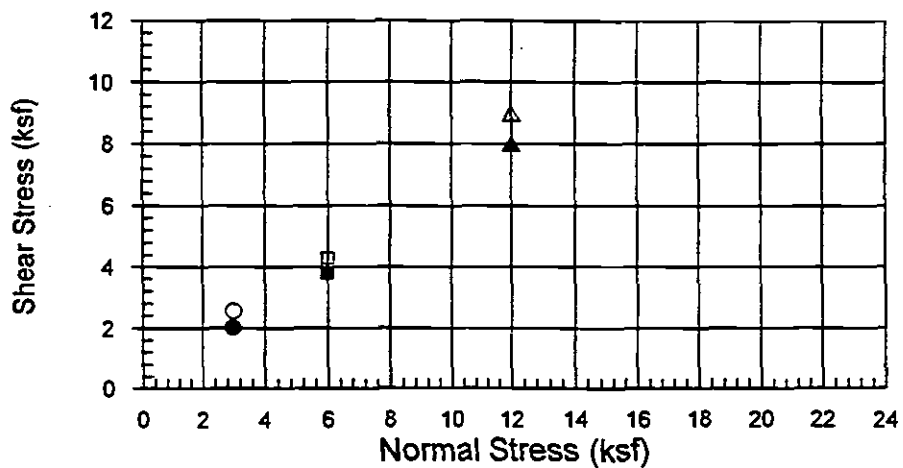
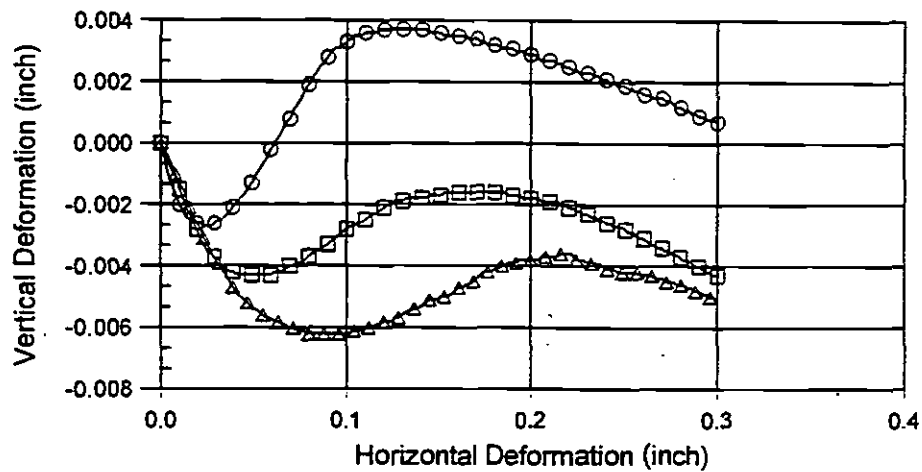
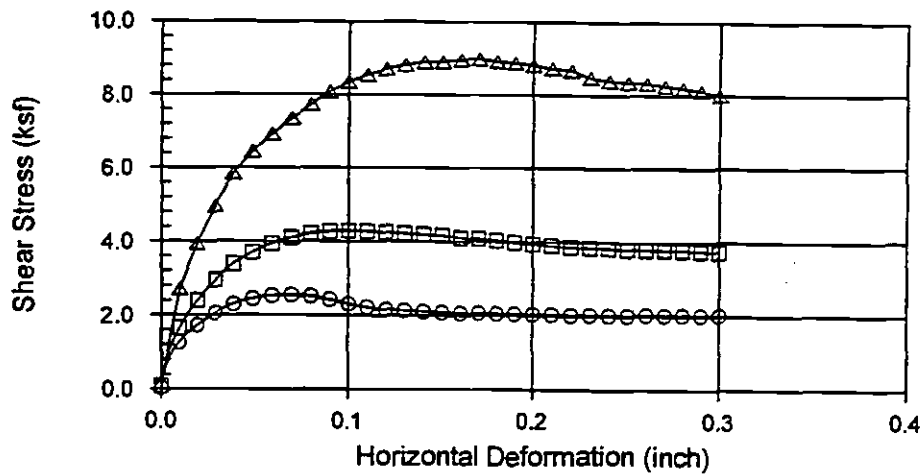
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 Eastside Extension
 Metro Redline III

DIRECT SHEAR TEST RESULTS (ASTM D3080)

11-95

Figure B-113



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
3.000	○ 2.561	● 2.030
6.000	□ 4.300	■ 3.783
12.000	△ 8.985	▲ 8.021

Boring No. : SD7
 Sample No. : D12
 Depth (ft.) : 60.0
 Sample Type : Undisturbed Ring
 Soil Type : Olive Brown Clayey Sand (SC)

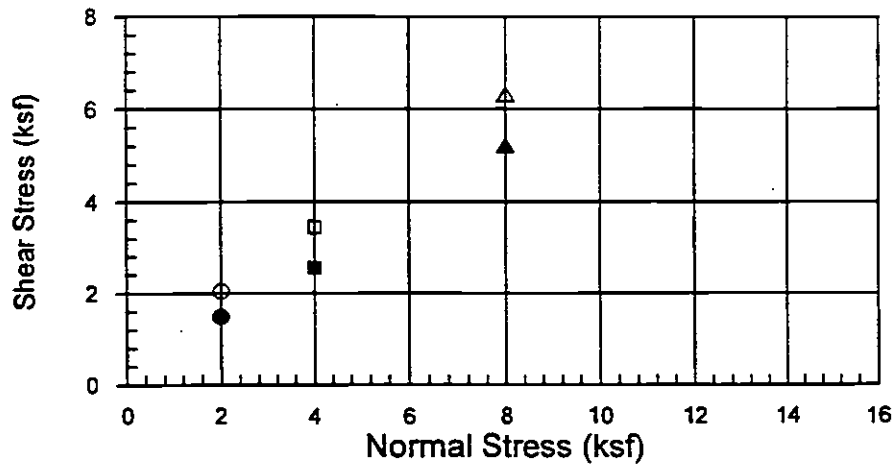
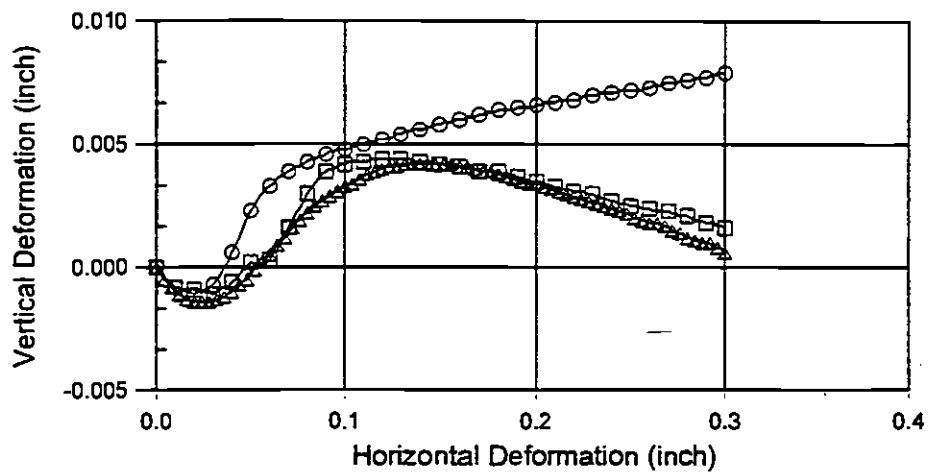
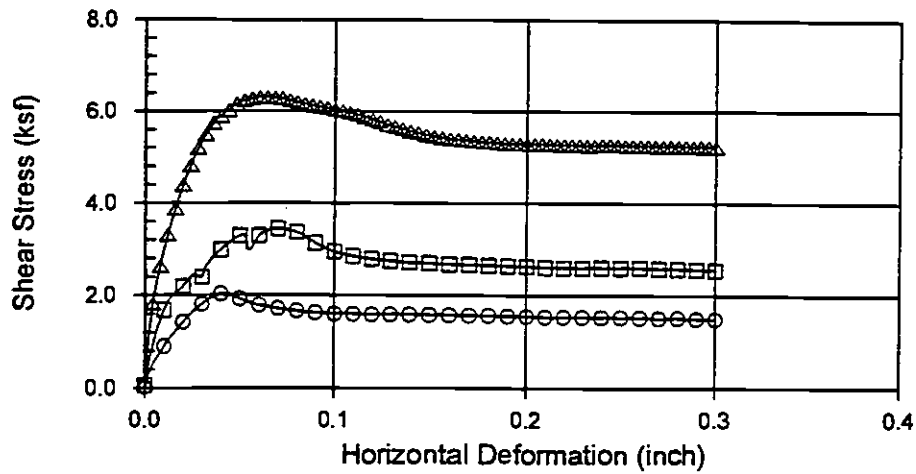


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DIRECT SHEAR TEST RESULTS (ASTM D3080)

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Figure B-114



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
2.000	○ 2.041	● 1.494
4.000	□ 3.449	■ 2.556
8.000	△ 6.322	▲ 5.232

Boring No. : SD-8
 Sample No. : D-6
 Depth (ft.) : 30.0
 Sample Type : Undisturbed Ring
 Soil Type : Brown Silty Sand (SM)



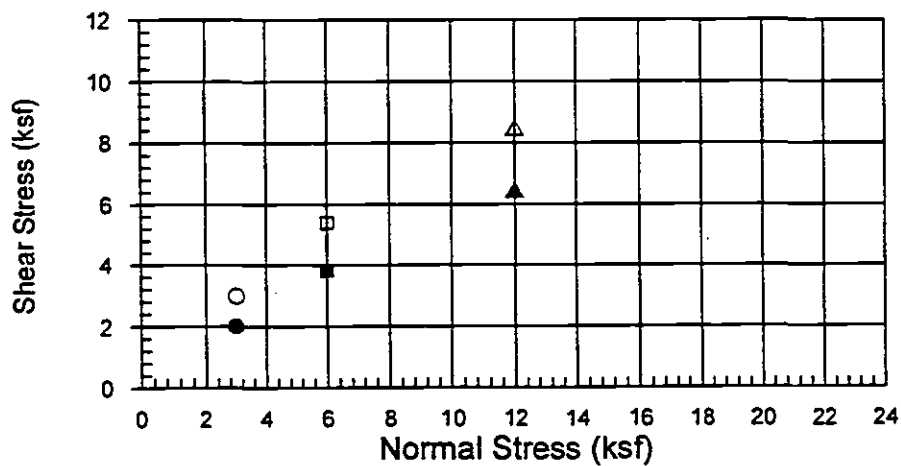
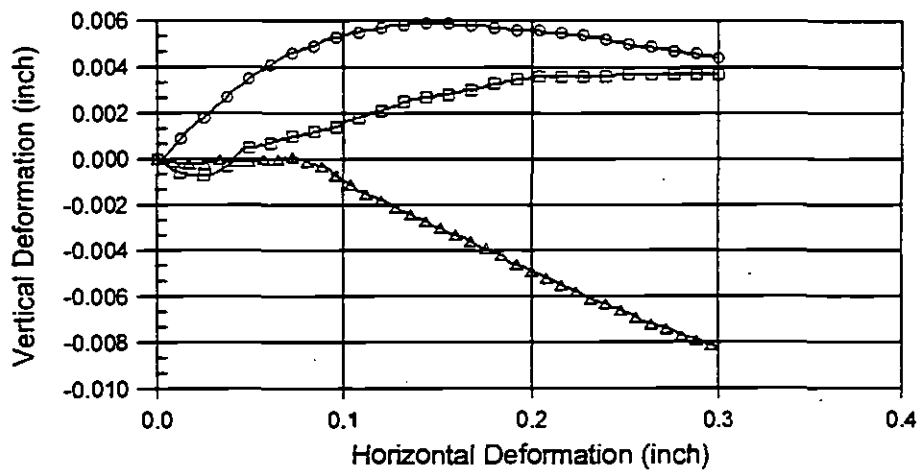
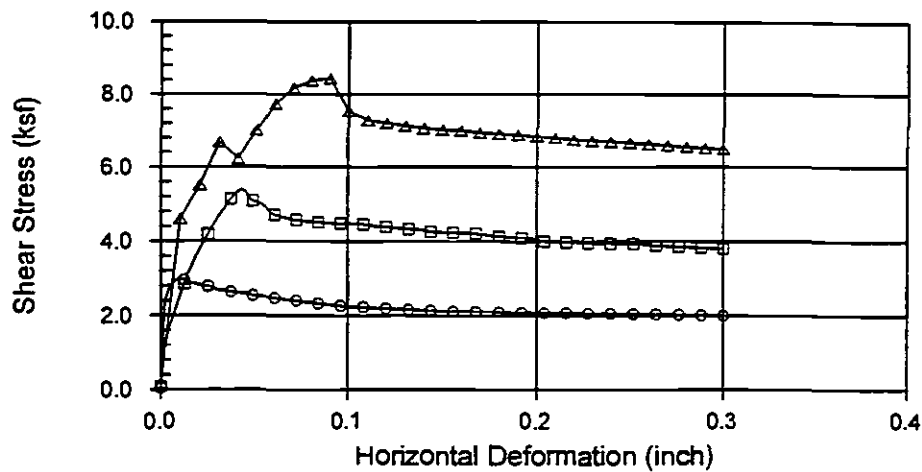
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Project No. 95-8347-23
 Eastside Extension
 Metro Redline III

DIRECT SHEAR TEST RESULTS (ASTM D3080)

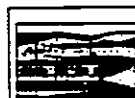
11-95

Figure B-115



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
3.000	○ 2.987	● 2.013
6.000	□ 5.397	■ 3.822
12.000	△ 8.491	▲ 6.480

Boring No. : SD-9
 Sample No. : P-14
 Depth (ft.) : 61.0
 Sample Type : Undisturbed Shelby Tube
 Soil Type : Olive Brown Lean Clay (CL)



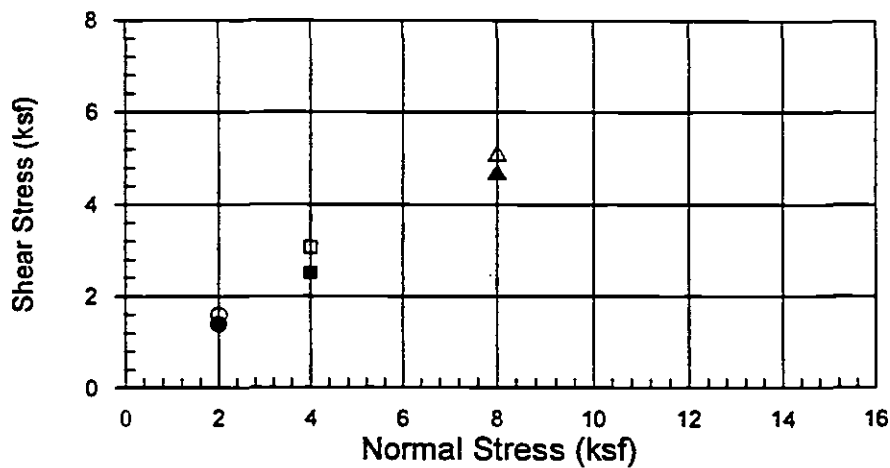
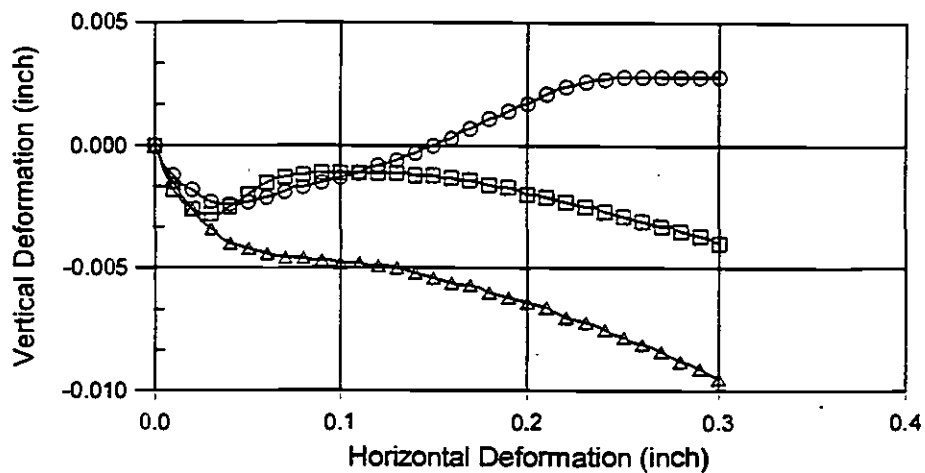
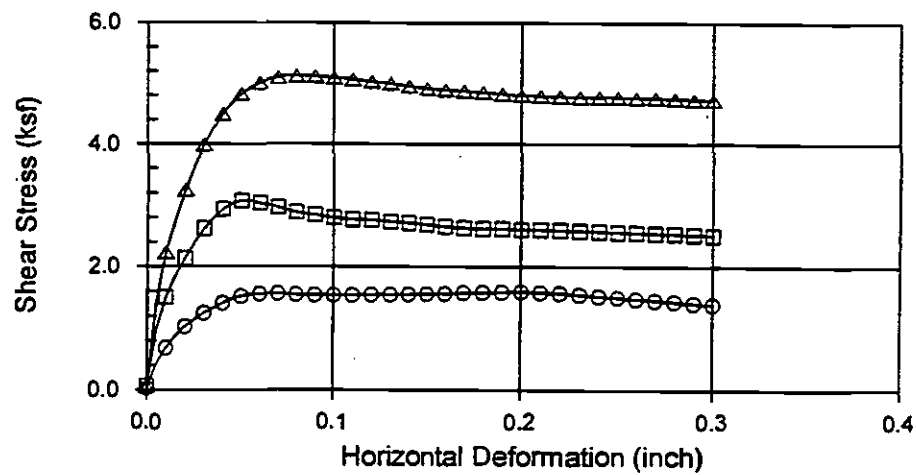
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 Metro Redline III

DIRECT SHEAR TEST RESULTS (ASTM D3080)

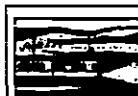
12-95

Figure B-116



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
2.000	○ 1.596	● 1.397
4.000	□ 3.079	■ 2.510
8.000	△ 5.124	▲ 4.726

Boring No. : SD-10
 Sample No. : D-6
 Depth (ft.) : 30.0
 Sample Type : Undisturbed Ring
 Soil Type : Yellowish Brown Sandy Clay (CL)



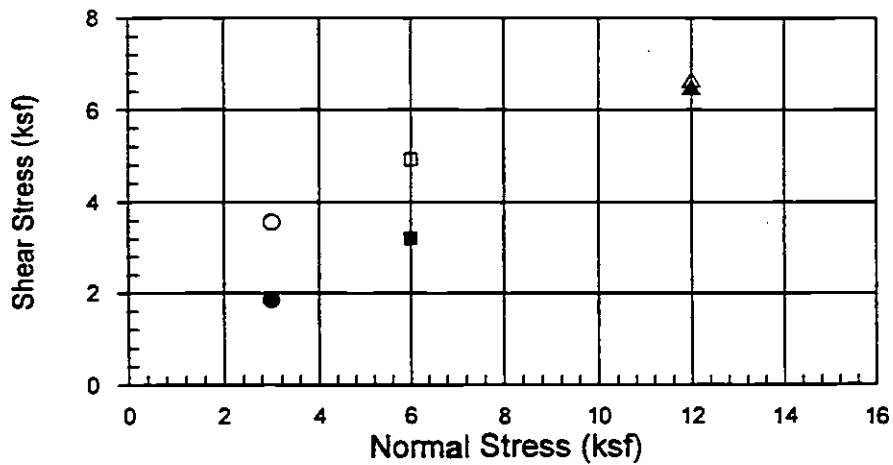
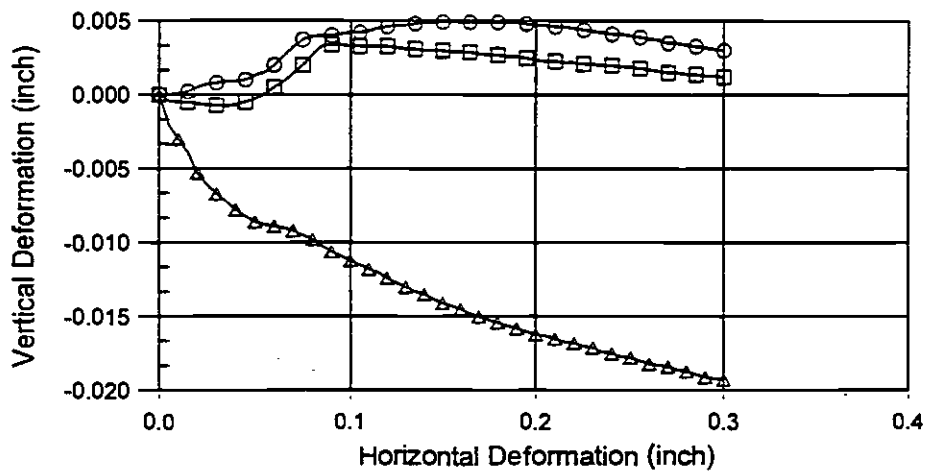
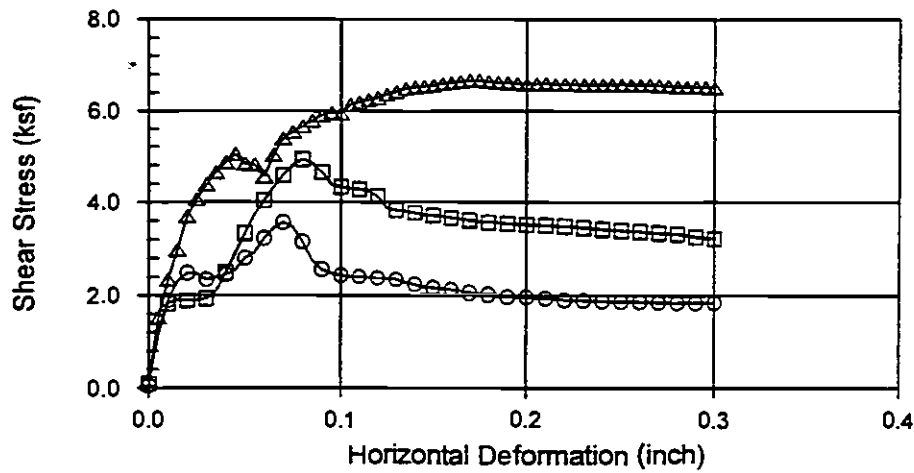
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DIRECT SHEAR TEST RESULTS (ASTM D3080)

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Figure B-117



Normal Stress (ksf)	Peak Shear Stress (ksf)	Residual Shear Stress (ksf)
3.000	○ 3.568	● 1.850
6.000	□ 4.927	■ 3.220
12.000	△ 6.674	▲ 6.512

Boring No. : SD-10
 Sample No. : D-22
 Depth (ft.) : 84.0
 Sample Type : Undisturbed Ring
 Soil Type : Olive Grey Lean Clay (CL) with fine Sand



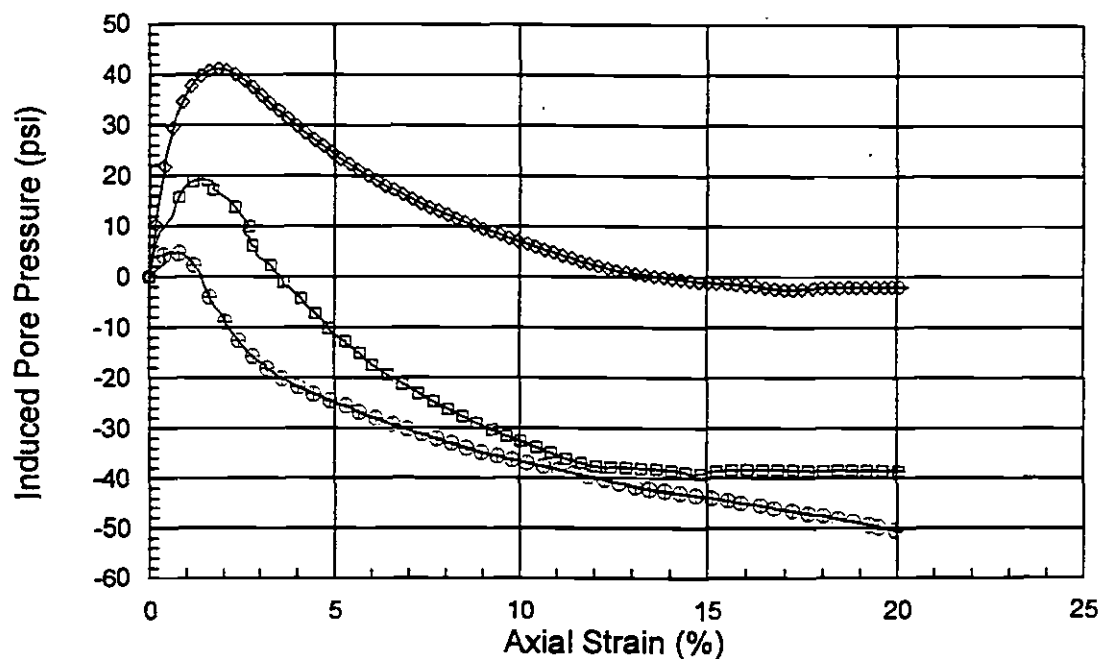
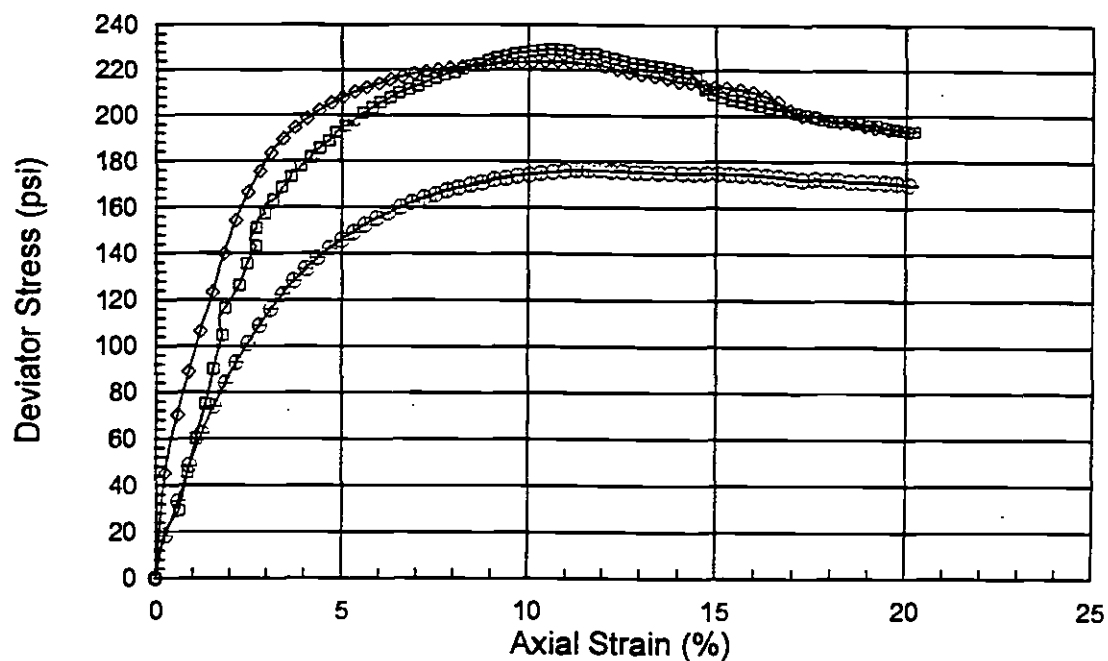
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Project No. 95-8347-23
 Eastside Extension
 Metro Redline III

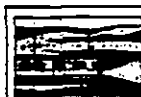
DIRECT SHEAR TEST RESULTS (ASTM D3080)

12-95

Figure B-118



Boring No.	Sample No.	Depth (ft.)	Eff. Conf. Pressure (psi)	Max. Dev. Stress (psi)
⊕ SD-9	P-24	84.5-85.1	20.0	176.5
□ SD-9	P-24	85.1-85.7	40.0	229.4
◇ SD-9	P-24	85.7-86.3	80.0	223.9



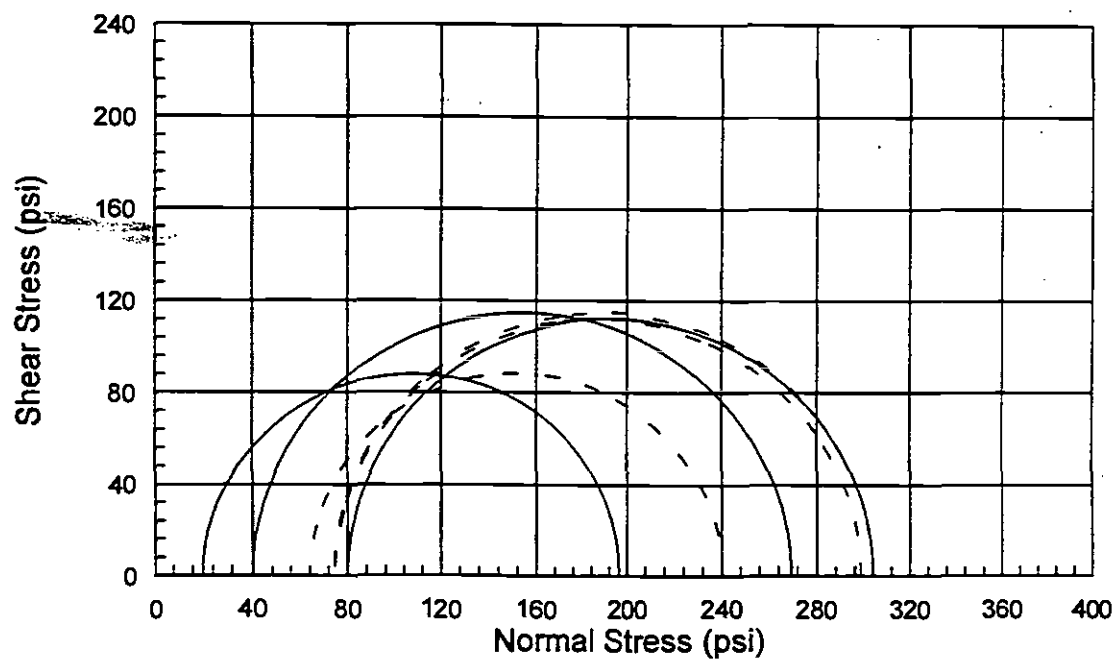
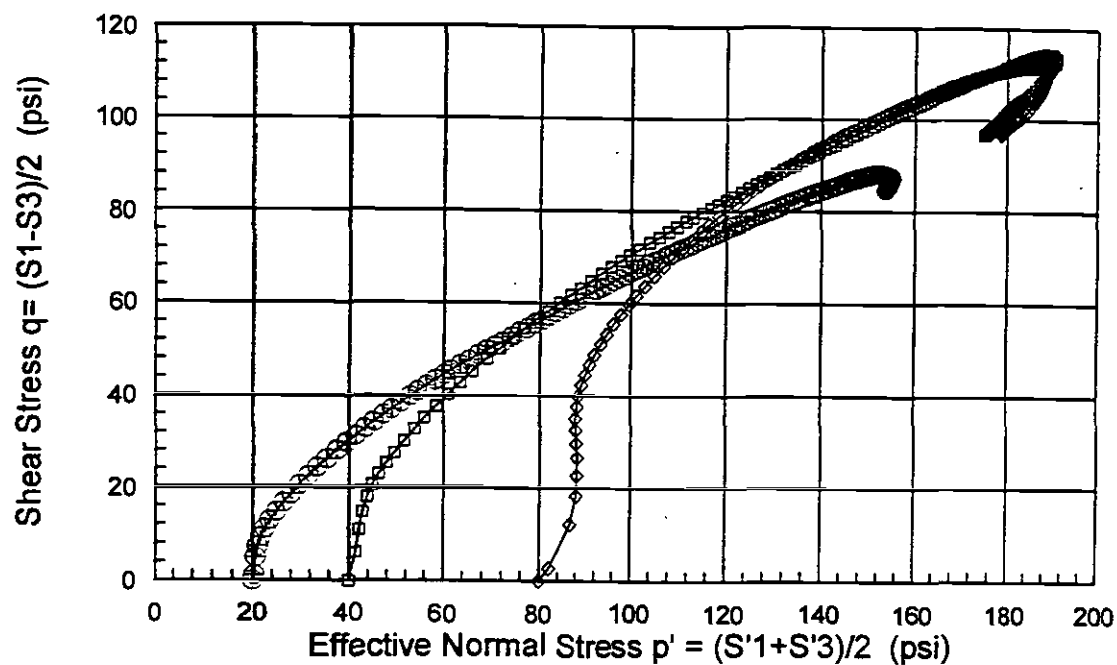
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Project No.: 95-8347-23
Eastside Extension
Metro Redline III

Consolidated-Undrained
Triaxial Compression Test
[ASTM D 4767/EM 1110-2-1906(X)]

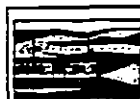
12-95

Figure B-119a



Boring No.	Sample No.	Depth (ft.)	Eff. Conf. Pressure (psi)	Max. Dev. Stress (psi)
⊕SD-9	P-24	84.5-85.1	20.0	176.5
□SD-9	P-24	85.1-85.7	40.0	229.4
◇SD-9	P-24	85.7-86.3	80.0	223.9

——— Mohr Circle based on Total Stress
 - - - Mohr Circle based on Effective Stress



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Project No.: 95-8347-23
 Eastside Extension
 Metro Redline III

Consolidated-Undrained
 Triaxial Compression Test
 [ASTM D 4767/EM 1110-2-1906(X)]

12-95

Figure B-119b

EPA METHOD 300
CHLORIDE

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED:  NA
MATRIX:      WATER                       DATE ANALYZED:  12/04/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
DD-15-5	K123-05	47	10	2
MBLK1W	ICL001WB	ND	1	.2

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	BK01RN01	DATE EXTRACTED:	NA
CONTROL NO.:	L013-01	DATE ANALYZED:	12/04/95

ACCESSION: 95K100 95K122 95K123 95K131 95K134 95L006
95L012 95L013

PARAMETER	SAMPLE (mg/L)	DUP. SAMPLE (mg/L)	RPD (%)
-----	-----	-----	-----
Chloride	ND	ND	0

QC LIMIT: 20

CKY QUALITY CONTROL DATA
SPIKE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

BATCH NO.: 95K123 DATE RECEIVED: NA
SAMPLE ID: BK01RN01 DATE EXTRACTED: NA
CONTROL NO.: L013-01 DATE ANALYZED: 12/04/95

ACCESSION: 95K100 95K122 95K123 95K131 95K134 95L006
95L012 95L013

PARAMETER	SAMPLE RESULT (mg/L)	SPIKE CONC. (mg/L)	SPIKE RESULT (mg/L)	SPIKE RECRY. (%)
Chloride	ND	5.00	2.10	42+

QC LIMIT: 75-125

+ Out of QC limit. Matrix interference is suspected. No action taken since LCSW was within limits.

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	ICL001WL	DATE ANALYZED:	12/04/95
ACCESSION:	95K100 95K122 95K123 95K131 95K134 95L006		
	95L012 95L013		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
Chloride	5.00	4.60	92

QC LIMIT: 85-115

EPA METHOD 300
SULFATE

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED:   NA
MATRIX:      WATER                      DATE ANALYZED:    12/05/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
DD-15-5	K123-05	120	10	10
MBLK1W	ICL002WB	ND	1	1

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	11/29/95
SAMPLE ID:	DD-15-5	DATE EXTRACTED:	NA
CONTROL NO.:	K123-05	DATE ANALYZED:	12/12/95
ACCESSION:	95K123 95K134		

PARAMETER	SAMPLE* (mg/L)	DUP. SAMPLE (mg/L)	RPD (%)
-----	-----	-----	-----
Sulfate	120	113	6

QC LIMIT: 20

* Analyzed on 12/05/95



CKY QUALITY CONTROL DATA
SPIKE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA METHOD 300
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	11/29/95
SAMPLE ID:	DD-15-5	DATE EXTRACTED:	NA
CONTROL NO.:	K123-05	DATE ANALYZED:	12/12/95
ACCESSION:	95K123 95K134		

PARAMETER	SAMPLE RESULT* (mg/L)	SPIKE CONC. (mg/L)	SPIKE RESULT (mg/L)	SPIKE RECRY. (%)
-----	-----	-----	-----	-----
Sulfate	120	200	312	96

QC LIMIT: 75-125

* Analyzed on 12/05/95

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	ICL002WL	DATE ANALYZED:	12/05/95
ACCESSION:	95K123 95K134		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
Sulfate	10.00	8.69	87

QC LIMIT: 75-125

EPA METHOD 376.1
TOTAL SULFIDE

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 11/29/95
BATCH NO.:   95K123                      DATE EXTRACTED:  NA
MATRIX:      WATER                       DATE ANALYZED:  12/07/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
DD-15-6	K123-06	.6	1	.2
MBLK1W	SDL001WB	ND	1	.2

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 376.1
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	11/29/95
SAMPLE ID:	DD-15-6	DATE EXTRACTED:	NA
CONTROL NO.:	K123-06	DATE ANALYZED:	12/07/95
ACCESSION:	95K123		

PARAMETER	SAMPLE (mg/L)	DUP. SAMPLE (mg/L)	RPD (%)
-----	-----	-----	-----
Sulfide	0.60	0.60	0

QC LIMIT: 20

CKY QUALITY CONTROL DATA
SPIKE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 376.1
MATRIX: WATER

BATCH NO.: 95K123
SAMPLE ID: DD-15-6
CONTROL NO.: K123-06
DATE RECEIVED: 11/29/95
DATE EXTRACTED: NA
DATE ANALYZED: 12/07/95
ACCESSION: 95K123

PARAMETER	SAMPLE RESULT (mg/L)	SPIKE CONC. (mg/L)	SPIKE RESULT (mg/L)	SPIKE RECRY. (%)
Sulfide	0.60	4.40	4.37	86

QC LIMIT: 75-125

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 376.1
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	SDL001WL	DATE ANALYZED:	12/07/95
ACCESSION:	95K123		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
Sulfide	1272	1200	94

QC LIMIT: 85-115

EPA METHOD 300
NITRATE/NITRITE

=====

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	11/29/95
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	11/29/95
BATCH NO.:	95K123	DATE EXTRACTED:	NA
MATRIX:	WATER	DATE ANALYZED:	12/04/95

=====

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
DD-15-7	K123-07	4.7	10	1
MBLK1W	ICL001WB	ND	1	.1

MDL: Method Detection Limit



CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA.
SAMPLE ID:	BK01RN01	DATE EXTRACTED:	NA
CONTROL NO.:	L013-01	DATE ANALYZED:	12/04/95

ACCESSION: 95K100 95K122 95K123 95K131 95K134 95L006
95L012 95L013

PARAMETER	SAMPLE (mg/L)	DUP. SAMPLE (mg/L)	RPD (%)
-----	-----	-----	-----
Nitrate/Nitrite	ND	ND	0
QC LIMIT:			20

CKY QUALITY CONTROL DATA
SPIKE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

BATCH NO.: 95K123 DATE RECEIVED: NA
SAMPLE ID: BK01RN01 DATE EXTRACTED: NA
CONTROL NO.: L013-01 DATE ANALYZED: 12/04/95

ACCESSION: 95K100 95K122 95K123 95K131 95K134 95L006
95L012 95L013

PARAMETER	SAMPLE RESULT (mg/L)	SPIKE CONC. (mg/L)	SPIKE RESULT (mg/L)	SPIKE RECRY. (%)
Nitrate/Nitrite	ND	5.00	5.50	110

QC LIMIT: 75-125

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	ICL001WL	DATE ANALYZED:	12/04/95
ACCESSION:	95K100 95K122 95K123 95K131 95K134 95L006		
	95L012 95L013		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
Nitrate/Nitrite	5.00	5.30	106

QC LIMIT: 85-115

EPA 405.1
BOD

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED:   NA
MATRIX:      WATER                       DATE ANALYZED:    11/30/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
DD-15-8	K123-08	ND	1	1
MBLK1W	BDK002WB	ND	1	1

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 405.1
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	11/29/95
SAMPLE ID:	DD-15-8	DATE EXTRACTED:	NA
CONTROL NO.:	K123-08	DATE ANALYZED:	11/30/95
ACCESSION:	95K123 95K134		

PARAMETER	SAMPLE (mg/L)	DUP. SAMPLE (mg/L)	RPD (%)
-----	-----	-----	-----
BOD	ND	ND	0

QC LIMIT: 20

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 405.1
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	11/30/95
CONTROL NO.:	BDK002WL	DATE ANALYZED:	12/05/95
ACCESSION:	95K123 95K134		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
BOD	89.90	84.80	94

QC LIMIT: 85-115

EPA 160.5
SETTLEABLE SOLIDS

=====

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	11/29/95
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	11/29/95
BATCH NO.:	95K123	DATE EXTRACTED:	NA
MATRIX:	WATER	DATE ANALYZED:	11/30/95

=====

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
DD-15-8	K123-08	2	1	.5
MBLK1W	STK001WB	ND	1	.5

MDL : Method Detection Limit

EPA METHOD 150.1
PH

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED:  NA
MATRIX:      WATER                       DATE ANALYZED:  11/30/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (pH unit)	DILUTION FACTOR	MDL (pH unit)
DD-15-8	K123-08	7.5	1	.1

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 150.1
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	11/29/95
SAMPLE ID:	DD-15-8	DATE EXTRACTED:	NA
CONTROL NO.:	K123-08	DATE ANALYZED:	11/30/95
ACCESSION:	95K115 95K123		

PARAMETER	SAMPLE (pH unit)	DUP. SAMPLE (pH unit)	RPD (%)
-----	-----	-----	-----
pH	7.50	7.50	0

QC LIMIT: 20

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 150.1
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	PHK004WL	DATE ANALYZED:	11/30/95
ACCESSION:	95K115 95K123		

PARAMETER	TRUE VALUE (pH unit)	FOUND VALUE (pH unit)	LCS RECOVERY (%)
-----	-----	-----	-----
pH	9.09	9.00	99

QC LIMIT: 85-115

EPA METHOD 160.2
TOTAL SUSPENDED SOLIDS

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED:  NA
MATRIX:      WATER                       DATE ANALYZED:  11/30/95
=====
```

SAMPLE ID	CONTROL NO.	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
DD-15-8	K123-08	653	1	10
MBLK1W	SSK003WB	ND	1	10

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 160.2
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	11/29/95
SAMPLE ID:	DD-15-8	DATE EXTRACTED:	NA
CONTROL NO.:	K123-08	DATE ANALYZED:	11/30/95
ACCESSION:	95K123		

PARAMETER	SAMPLE (mg/L)	DUP. SAMPLE (mg/L)	RPD (%)
-----	-----	-----	-----
TSS	653	646	1

QC LIMIT: 20

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 160.2
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	SSK003WL	DATE ANALYZED:	11/30/95
ACCESSION:	95K123		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
TSS	59.80	55.00	92

QC LIMIT: 75-125

EPA METHOD 160.1
TOTAL DISSOLVED SOLIDS

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED:   NA
MATRIX:      WATER                       DATE ANALYZED:    11/30/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
DD-15-8	K123-08	710	1	10
MBLK1W	DSK002WB	ND	1	10

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 160.1
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	11/29/95
SAMPLE ID:	DD-15-8	DATE EXTRACTED:	NA
CONTROL NO.:	K123-08	DATE ANALYZED:	11/30/95
ACCESSION:	95K123		

PARAMETER	SAMPLE (mg/L)	DUP. SAMPLE (mg/L)	RPD (%)
-----	-----	-----	-----
TDS	710	705	1

QC LIMIT: 20

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 160.1
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	DSK002WL	DATE ANALYZED:	11/30/95
ACCESSION:	95K123		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
TDS	850	870	102

QC LIMIT: 85-115



EPA METHOD 413.2
OIL & GREASE

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED: 12/08/95
MATRIX:     WATER                       DATE ANALYZED: 12/09/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	----	-----	-----
DD-15-9	K123-09	ND	1	1
MBLK1W	OGL001WB	ND	1	1

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 413.2
MATRIX: WATER

BATCH NO.: 95K123
SAMPLE ID: LCS1W/LCS1WD
CONTROL NO.: OGL001WL/C
DATE RECEIVED: NA
DATE EXTRACTED: 12/08/95
DATE ANALYZED: 12/09/95
ACCESSION: 95K123

PARAMETER	SAMPLE CONC (mg/L)	SPIKE ADDED (mg/L)	LCS CONC (mg/L)	LCS % REC	SPIKE ADDED (mg/L)	LCSD CONC (mg/L)	LCSD % REC	% RPD
TROG	ND	5.00	5.67	113	5.00	5.78	116	

QC LIMIT: 75-125 75-125 3

EPA METHOD 602
BTEX

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED:   NA
SAMPLE ID:   DD-15-10,11                 DATE ANALYZED:   12/08/95
CONTROL NO.: K123-10                     MATRIX:         WATER
% MOISTURE:  NA                           DILUTION FACTOR: 1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Benzene	ND	1
Toluene	ND	1
Ethylbenzene	ND	1
Total Xylenes	ND	3

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	88	65-135

MDL: Method Detection Limit

EPA METHOD 602
BTEX

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  NA
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  NA
BATCH NO.:   95K123                     DATE EXTRACTED:   NA
SAMPLE ID:   MBLK1W                     DATE ANALYZED:    12/07/95
CONTROL NO.: VAL087B                    MATRIX:         WATER
% MOISTURE:  NA                         DILUTION FACTOR:  1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Benzene	ND	1
Toluene	ND	1
Ethylbenzene	ND	1
Total Xylenes	ND	3

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	92	65-135

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 602
MATRIX: WATER

BATCH NO.: 95K123
SAMPLE ID: LCS1W/LCS1WD
CONTROL NO.: VAL087L/C

DATE RECEIVED: NA
DATE EXTRACTED: NA
DATE ANALYZED: 12/07/95

ACCESSION: 95K123

PARAMETER	SAMPLE CONC (ug/L)	SPIKE ADDED (ug/L)	LCS CONC (ug/L)	% LCS REC	SPIKE ADDED (ug/L)	LCSD CONC (ug/L)	% LCSD REC	% RPD
Benzene	ND	20.00	18.10	91	20.00	21.30	107	16
Toluene	ND	20.00	19.20	96	20.00	20.20	101	5
Ethylbenzene	ND	20.00	19.70	99	20.00	20.70	104	5
Total Xylenes	ND	60.00	55.60	93	60.00	58.90	98	6

QC LIMIT: 70-125 70-125 30

EPA METHOD 601
HALOGENATED VOLATILE ORGANICS

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED:  NA
SAMPLE ID:   DD-15-10,11                 DATE ANALYZED:  12/08/95
CONTROL NO.: K123-10                     MATRIX:       WATER
% MOISTURE:  NA                          DILUTION FACTOR: 1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Dichlorodifluoromethane	ND	5
Chloromethane	ND	5
Vinyl Chloride	ND	5
Bromomethane	ND	5
Chloroethane	ND	5
Trichlorofluoromethane	ND	11
1,1-Dichloroethene	ND	1
Methylene Chloride	ND	5
cis-1,2-Dichloroethene	ND	1
trans-1,2-Dichloroethene	ND	1
1,1-Dichloroethane	ND	1
Chloroform	35	1
1,1,1-Trichloroethane	1.6	1
Carbon Tetrachloride	ND	1
1,2-Dichloroethane	ND	1
Trichloroethene	ND	1
1,2-Dichloropropane	ND	1
Dibromomethane	ND	1
Bromodichloromethane	12	1
2-Chloroethyl vinylether	ND	1
trans-1,3-Dichloropropene	ND	1
cis-1,3-Dichloropropene	ND	1
1,1,2-Trichloroethane	ND	1
Tetrachloroethene	ND	1
1,3-Dichloropropane	ND	1
1,1,1,2-Tetrachloroethane	ND	1
Dibromochloromethane	3.7	1
Ethylene Dibromide	ND	1
Chlorobenzene	ND	1
Bromoform	ND	1
1,1,2,2-Tetrachloroethane	ND	1
Chlorotoluene	ND	1
1,3-Dichlorobenzene	ND	1
1,4-Dichlorobenzene	ND	1
1,2-Dichlorobenzene	ND	1
Benzylchloride	ND	1
SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	84	65-135

MDL: Method Detection Limit

EPA METHOD 601
HALOGENATED VOLATILE ORGANICS

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  NA
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  NA
BATCH NO.:   95K123                     DATE EXTRACTED:   NA
SAMPLE ID:   MBLK1W                     DATE ANALYZED:    12/07/95
CONTROL NO.: VAL087B                   MATRIX:         WATER
% MOISTURE:  NA                         DILUTION FACTOR:  1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Dichlorodifluoromethane	ND	5
Chloromethane	ND	5
Vinyl Chloride	ND	5
Bromomethane	ND	5
Chloroethane	ND	5
Trichlorofluoromethane	ND	1
1,1-Dichloroethene	ND	1
Methylene Chloride	ND	5
cis-1,2-Dichloroethene	ND	1
trans-1,2-Dichloroethene	ND	1
1,1-Dichloroethane	ND	1
Chloroform	ND	1
1,1,1-Trichloroethane	ND	1
Carbon Tetrachloride	ND	1
1,2-Dichloroethane	ND	1
Trichloroethene	ND	1
1,2-Dichloropropane	ND	1
Dibromomethane	ND	1
Bromodichloromethane	ND	1
2-Chloroethyl vinylether	ND	1
trans-1,3-Dichloropropene	ND	1
cis-1,3-Dichloropropene	ND	1
1,1,2-Trichloroethane	ND	1
Tetrachloroethene	ND	1
1,3-Dichloropropane	ND	1
1,1,1,2-Tetrachloroethane	ND	1
Dibromochloromethane	ND	1
Ethylene Dibromide	ND	1
Chlorobenzene	ND	1
Bromoform	ND	1
1,1,2,2-Tetrachloroethane	ND	1
Chlorotoluene	ND	1
1,3-Dichlorobenzene	ND	1
1,4-Dichlorobenzene	ND	1
1,2-Dichlorobenzene	ND	1
Benzylchloride	ND	1
SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	90	65-135

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 601
MATRIX: WATER

BATCH NO.: 95K123 DATE RECEIVED: NA
SAMPLE ID: LCS1W/LCS1WD DATE EXTRACTED: NA
CONTROL NO.: VAL087L/C DATE ANALYZED: 12/07/95

ACCESSION: 95K123 95L046

PARAMETER	SAMPLE CONC (ug/L)	SPIKE ADDED (ug/L)	LCS CONC (ug/L)	LCS % REC	SPIKE ADDED (ug/L)	LCSD CONC (ug/L)	LCSD % REC	% RPD
1,1-DCE	ND	20.00	19.50	98	20.00	20.90	105	7
TCE	ND	20.00	20.90	105	20.00	22.00	110	5
Chlorobenzene	ND	20.00	19.60	98	20.00	21.50	108	5

QC LIMIT: 70-125 70-125 30





CKY incorporated Analytical Laboratories

Date: 10-30-1995
CKY Batch No.: 95J033

Attn.: Grant Miller

Earth Technology Corp.
2121 Alton Parkway, Suite 100
Irvine, CA 92714

Subject: Laboratory Report
Project: Metro Redline Eastside Extens.

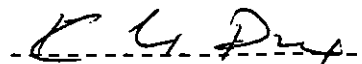
Enclosed is the Laboratory report for samples received on 10/13/95. The samples were received in coolers with ice and intact; the chain-of-custody forms were properly filled out. The data reported include :

Sample ID	Control No.	Matrix	Analysis
PE-21-1	J033-01	Water	EPA 625
PE-21-2	J033-02	Water	EPA 601 EPA 602
PE-21-3	J033-03	Water	EPA 418.1
PE-21-4	J033-04	Water	EPA M8015
PE-21-5	J033-05	Water	Metals Mercury
PE-21-6	J033-06	Water	Settleable Solids
PE-21-7	J033-07	Water	Sulfide
PE-21-8	J033-08	Water	Nitrate/Nitrite
PE-21-9	J033-09	Water	BOD
PE-21-12	J033-10	Water	EPA 601 EPA 602
PE-21-13	J033-11	Water	EPA 601 EPA 602
PE-21-10	J033-12	Water	Oil & Grease
PE-21-11	J033-13	Water	Chloride pH Sulfate TDS EPA 160.2 (TSS) Turbidity

The results are summarized on the following pages.

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

Sincerely yours,



Kam Y. Pang, Ph.D.
Laboratory Director

P.S. - All analyses requested for the above referenced project have been completed. Therefore, unless instructed, the remaining portions of the samples will be disposed after fifteen (15) days from the date of this report.

EPA METHOD 625
SEMI VOLATILE ORGANICS BY GC/MS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
BATCH NO.: 95J033
SAMPLE ID: PE-21-1
CONTROL NO.: J033-01
% MOISTURE: NA

DATE COLLECTED: 10/13/95
DATE RECEIVED: 10/13/95
DATE EXTRACTED: 10/16/95
DATE ANALYZED: 10/25/95
MATRIX: WATER
DILUTION FACTOR: 1

PARAMETERS	(ug/L)		PARAMETERS	(ug/L)	
	RESULT	RL		RESULT	RL
N-Nitrosodimethylamine	ND	(10)	3-Nitroaniline	ND	(25)
Pyridine	ND	(10)	Acenaphthene	ND	(10)
Aniline	ND	(10)	2,4-Dinitrophenol	ND	(25)
Phenol	ND	(10)	4-Nitrophenol	ND	(25)
bis(2-Chloroethyl) ether	ND	(10)	Dibenzofuran	ND	(10)
2-Chlorophenol	ND	(10)	2,4-Dinitrotoluene	ND	(10)
1,3-Dichlorobenzene	ND	(10)	Diethylphthalate	ND	(10)
1,4-Dichlorobenzene	ND	(10)	4-Chlorophenyl-phenylether	ND	(10)
Benzyl Alcohol	ND	(10)	Fluorene	ND	(10)
1,2-Dichlorobenzene	ND	(10)	1,2-Diphenylhydrazine	ND	(25)
2-Methylphenol	ND	(10)	4-Nitroaniline	ND	(25)
2,2'-oxybis(1-Chloropropane)	ND	(10)	4,6-Dinitro-2-methylphenol	ND	(25)
4-Methylphenol (2)	ND	(10)	N-Nitrosodiphenylamine (1)	ND	(10)
N-Nitroso-di-n-propylamine	ND	(10)	4-Bromophenyl-phenylether	ND	(10)
Hexachloroethane	ND	(10)	Hexachlorobenzene	ND	(10)
Nitrobenzene	ND	(10)	Pentachlorophenol	ND	(25)
Isophorone	ND	(10)	Benizidine	ND	(25)
2-Nitrophenol	ND	(10)	Phenanthrene	ND	(10)
2,4-Dimethylphenol	ND	(10)	Anthracene	ND	(10)
Benzoic Acid	ND	(25)	Carbazole	ND	(10)
bis(2-Chloroethoxy) methane	ND	(10)	Di-n-butylphthalate	ND	(10)
2,4-Dichlorophenol	ND	(10)	Fluoranthene	ND	(10)
1,2,4-Trichlorobenzene	ND	(10)	4,4'-Methylene Dianiline	ND	(25)
Naphthalene	ND	(10)	Pyrene	ND	(10)
1-Chloroaniline	ND	(10)	Bisphenol-A	ND	(10)
Hexachloro-1,3-butadiene	ND	(10)	Butylbenzylphthalate	ND	(10)
4-Chloro-3-methylphenol	ND	(10)	3,3'-Dichlorobenzidine	ND	(10)
2-Methylnaphthalene	ND	(10)	Benzo(a)anthracene	ND	(10)
Hexachlorocyclopentadiene	ND	(10)	Chrysene	ND	(10)
2,4,6-Trichlorophenol	ND	(10)	bis(2-Ethylhexyl)phthalate	ND	(10)
2,4,5-Trichlorophenol	ND	(25)	Di-n-octylphthalate	ND	(10)
2-Chloronaphthalene	ND	(10)	Benzo(b)fluoranthene	ND	(10)
1-Chloronaphthalene	ND	(10)	Benzo(k)fluoranthene	ND	(10)
2-Nitroaniline	ND	(25)	Benzo(a)pyrene	ND	(10)
Dimethylphthalate	ND	(10)	Indeno(1,2,3-cd)pyrene	ND	(10)
Acenaphthylene	ND	(10)	Dibenzo(a,h)anthracene	ND	(10)
2,6-Dinitrotoluene	ND	(10)	Benzo(g,h,i)perylene	ND	(10)

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Nitrobenzene-d5	114	35-114
2-Fluorobiphenyl	93	43-116
Terphenyl-d14	84	33-141
Phenol-d5	97	10-94
2-Fluorophenol	99	21-110
2,4,6-Tribromophenol	89	10-123

RL : Reporting Limit
(1): Cannot be separated from Diphenylamine
(2): Cannot be separated from 3-Methylphenol

EPA METHOD 625
SEMI VOLATILE ORGANICS BY GC/MS

```
=====
CLIENT:      Earth Technology Corp.
PROJECT:     Metro Redline Eastside Extens.
BATCH NO.:  95J033
SAMPLE ID:   MBLK1W
CONTROL NO.: SVJ011WB
% MOISTURE:  NA

DATE COLLECTED: NA
DATE RECEIVED:  NA
DATE EXTRACTED: 10/16/95
DATE ANALYZED:  10/17/95
MATRIX:         WATER
DILUTION FACTOR: 1
=====
```

		(ug/L)				(ug/L)	
PARAMETERS	RESULT	RL	PARAMETERS	RESULT	RL	PARAMETERS	RESULT
N-Nitrosodimethylamine	ND	(10)	3-Nitroaniline	ND	(25)		
Pyridine	ND	(10)	Acenaphthene	ND	(10)		
Aniline	ND	(10)	2,4-Dinitrophenol	ND	(25)		
Phenol	ND	(10)	4-Nitrophenol	ND	(25)		
bis(2-Chloroethyl) ether	ND	(10)	Dibenzofuran	ND	(10)		
2-Chlorophenol	ND	(10)	2,4-Dinitrotoluene	ND	(10)		
1,3-Dichlorobenzene	ND	(10)	Diethylphthalate	ND	(10)		
1,4-Dichlorobenzene	ND	(10)	4-Chlorophenyl-phenylether	ND	(10)		
Benzyl Alcohol	ND	(10)	Fluorene	ND	(10)		
1,2-Dichlorobenzene	ND	(10)	1,2-Diphenylhydrazine	ND	(25)		
2-Methylphenol	ND	(10)	4-Nitroaniline	ND	(25)		
2,2'-oxybis(1-Chloropropane)	ND	(10)	4,6-Dinitro-2-methylphenol	ND	(25)		
4-Methylphenol (2)	ND	(10)	N-Nitrosodiphenylamine (1)	ND	(10)		
N-Nitroso-di-n-propylamine	ND	(10)	4-Bromophenyl-phenylether	ND	(10)		
Hexachloroethane	ND	(10)	Hexachlorobenzene	ND	(10)		
Nitrobenzene	ND	(10)	Pentachlorophenol	ND	(25)		
Isophorone	ND	(10)	Benzidine	ND	(25)		
2-Nitrophenol	ND	(10)	Phenanthrene	ND	(10)		
2,4-Dimethylphenol	ND	(10)	Anthracene	ND	(10)		
Benzoic Acid	ND	(25)	Carbazole	ND	(10)		
bis(2-Chloroethoxy)methane	ND	(10)	Di-n-butylphthalate	ND	(10)		
2,4-Dichlorophenol	ND	(10)	Fluoranthene	ND	(10)		
1,2,4-Trichlorobenzene	ND	(10)	4,4'-Methylene Dianiline	ND	(25)		
Naphthalene	ND	(10)	Pyrene	ND	(10)		
4-Chloroaniline	ND	(10)	Bisphenol-A	ND	(10)		
Hexachloro-1,3-butadiene	ND	(10)	Butylbenzylphthalate	ND	(10)		
4-Chloro-3-methylphenol	ND	(10)	3,3'-Dichlorobenzidine	ND	(10)		
2-Methylnaphthalene	ND	(10)	Benzo(a)anthracene	ND	(10)		
Hexachlorocyclopentadiene	ND	(10)	Chrysene	ND	(10)		
2,4,6-Trichlorophenol	ND	(10)	bis(2-Ethylhexyl)phthalate	ND	(10)		
2,4,5-Trichlorophenol	ND	(25)	Di-n-octylphthalate	ND	(10)		
2-Chloronaphthalene	ND	(10)	Benzo(b)fluoranthene	ND	(10)		
1-Chloronaphthalene	ND	(10)	Benzo(k)fluoranthene	ND	(10)		
2-Nitroaniline	ND	(25)	Benzo(a)pyrene	ND	(10)		
Dimethylphthalate	ND	(10)	Indeno(1,2,3-cd)pyrene	ND	(10)		
Acenaphthylene	ND	(10)	Dibenzo(a,h)anthracene	ND	(10)		
2,6-Dinitrotoluene	ND	(10)	Benzo(g,h,i)perylene	ND	(10)		

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Nitrobenzene-d5	64	35-114
2-Fluorobiphenyl	66	43-116
Terphenyl-d14	66	33-141
Phenol-d5	27	10-94
2-Fluorophenol	33	21-110
2,4,6-Tribromophenol	97	10-123

```
=====
RL : Reporting Limit
(1) : Cannot be separated from Diphenylamine
(2) : Cannot be separated from 3-Methylphenol
=====
```

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 8270
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W/LCS1WD	DATE EXTRACTED:	10/16/95
CONTROL NO.:	SVJ011WL/C	DATE ANALYZED:	10/17/95
ACCESSION:	95J033 95J035		

Parameter	SAMPLE CONC (ug/L)	SPIKE ADDED (ug/L)	LCS CONC (ug/L)	LCS % REC	SPIKE ADDED (ug/L)	LCSD CONC (ug/L)	LCSD % REC	% RPD
Phenol	ND	150	33	22	150	39	26	19
2-Chlorophenol	ND	150	65	43	150	76	51	17
1,4-DCB	ND	100	46	46	100	63	63	31
N-Nitroso-di-n	ND	100	68	68	100	81	81	18
1,2,4-TCB	ND	100	50	50	100	62	62	22
4-Chl-3-Methy	ND	150	85	56	150	98	65	15
Acenaphthene	ND	100	61	61	100	72	72	16
4-Nitrophenol	ND	150	24	16	150	33	22	33
2,4-Dinitrotol	ND	100	80	80	100	89	89	11
Pentachlorophe	ND	150	147	98	150	168	112	13
Pyrene	ND	100	64	64	100	65	65	3

QC LIMIT:

Phenol	5-112	5-112
2-Chlorophenol	23-134	23-134
1,4-DCB	20-124	20-124
N-Nitroso-di-n	D-230	D-230
1,2,4-TCB	44-142	44-142
4-Chl-3-Methy	22-147	22-147
Acenaphthene	47-145	47-145
4-Nitrophenol	D-132	D-132
2,4-Dinitrotol	39-139	39-139
Pentachlorophe	14-179	14-179
Pyrene	52-115	52-115



EPA METHOD 601
HALOGENATED VOLATILE ORGANICS

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:  95J033                      DATE EXTRACTED:  NA
SAMPLE ID:   PE-21-2                    DATE ANALYZED:  10/18/95
CONTROL NO.: J033-02                    MATRIX:       WATER
% MOISTURE:  NA                          DILUTION FACTOR: 1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Dichlorodifluoromethane	ND	5
Chloromethane	ND	5
Vinyl Chloride	ND	5
Bromomethane	ND	5
Chloroethane	ND	5
Trichlorofluoromethane	ND	1
1,1-Dichloroethene	ND	1
Methylene Chloride	ND	5
cis-1,2-Dichloroethene	ND	1
trans-1,2-Dichloroethene	ND	1
1,1-Dichloroethane	ND	1
Chloroform	ND	1
1,1,1-Trichloroethane	ND	1
Carbon Tetrachloride	ND	1
1,2-Dichloroethane	ND	1
Trichloroethene	ND	1
1,2-Dichloropropane	ND	1
Dibromomethane	ND	1
Bromodichloromethane	ND	1
2-Chloroethyl vinylether	ND	1
trans-1,3-Dichloropropene	ND	1
cis-1,3-Dichloropropene	ND	1
1,1,2-Trichloroethane	ND	1
Tetrachloroethene	ND	1
1,3-Dichloropropane	ND	1
1,1,1,2-Tetrachloroethane	ND	1
Dibromochloromethane	ND	1
Ethylene Dibromide	ND	1
Chlorobenzene	ND	1
Bromoform	ND	1
1,1,2,2-Tetrachloroethane	ND	1
Chlorotoluene	ND	1
1,3-Dichlorobenzene	ND	1
1,4-Dichlorobenzene	ND	1
1,2-Dichlorobenzene	ND	1
Benzylchloride	ND	1
SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	99	65-135

MDL: Method Detection Limit

EPA METHOD 601
HALOGENATED VOLATILE ORGANICS

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED:  NA
SAMPLE ID:   PE-21-12                   DATE ANALYZED:  10/18/95
CONTROL NO.: J033-10                     MATRIX:        WATER
% MOISTURE:  NA                         DILUTION FACTOR: 1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Dichlorodifluoromethane	ND	5
Chloromethane	ND	5
Vinyl Chloride	ND	5
Bromomethane	ND	5
Chloroethane	ND	5
Trichlorofluoromethane	ND	1
1,1-Dichloroethene	ND	1
Methylene Chloride	ND	5
cis-1,2-Dichloroethene	ND	1
trans-1,2-Dichloroethene	ND	1
1,1-Dichloroethane	ND	1
Chloroform	ND	1
1,1,1-Trichloroethane	ND	1
Carbon Tetrachloride	ND	1
1,2-Dichloroethane	ND	1
Trichloroethene	ND	1
1,2-Dichloropropane	ND	1
Dibromomethane	ND	1
Bromodichloromethane	ND	1
2-Chloroethyl vinylether	ND	1
trans-1,3-Dichloropropene	ND	1
cis-1,3-Dichloropropene	ND	1
1,1,2-Trichloroethane	ND	1
Tetrachloroethene	ND	1
1,3-Dichloropropane	ND	1
1,1,1,2-Tetrachloroethane	ND	1
Dibromochloromethane	ND	1
Ethylene Dibromide	ND	1
Chlorobenzene	ND	1
Bromoform	ND	1
1,1,2,2-Tetrachloroethane	ND	1
Chlorotoluene	ND	1
1,3-Dichlorobenzene	ND	1
1,4-Dichlorobenzene	ND	1
1,2-Dichlorobenzene	ND	1
Benzylchloride	ND	1
SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	108	65-135

MDL: Method Detection Limit

EPA METHOD 601
HALOGENATED VOLATILE ORGANICS

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED:  NA
SAMPLE ID:   PE-21-13                   DATE ANALYZED:  10/18/95
CONTROL NO.: J033-11                     MATRIX:        WATER
% MOISTURE:  NA                          DILUTION FACTOR: 1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Dichlorodifluoromethane	ND	5
Chloromethane	ND	5
Vinyl Chloride	ND	5
Bromomethane	ND	5
Chloroethane	ND	5
Trichlorofluoromethane	ND	1
1,1-Dichloroethene	ND	1
Methylene Chloride	ND	5
cis-1,2-Dichloroethene	ND	1
trans-1,2-Dichloroethene	ND	1
1,1-Dichloroethane	ND	1
Chloroform	ND	1
1,1,1-Trichloroethane	ND	1
Carbon Tetrachloride	ND	1
1,2-Dichloroethane	ND	1
Trichloroethene	ND	1
1,2-Dichloropropane	ND	1
Dibromomethane	ND	1
Bromodichloromethane	ND	1
2-Chloroethyl vinylether	ND	1
trans-1,3-Dichloropropene	ND	1
cis-1,3-Dichloropropene	ND	1
1,1,2-Trichloroethane	ND	1
Tetrachloroethene	ND	1
1,3-Dichloropropane	ND	1
1,1,1,2-Tetrachloroethane	ND	1
Dibromochloromethane	ND	1
Ethylene Dibromide	ND	1
Chlorobenzene	ND	1
Bromoform	ND	1
1,1,2,2-Tetrachloroethane	ND	1
Chlorotoluene	ND	1
1,3-Dichlorobenzene	ND	1
1,4-Dichlorobenzene	ND	1
1,2-Dichlorobenzene	ND	1
Benzylchloride	ND	1
SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	102	65-135

MDL: Method Detection Limit

EPA METHOD 601
HALOGENATED VOLATILE ORGANICS

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  NA
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  NA
BATCH NO.:   95J033                     DATE EXTRACTED:   NA
SAMPLE ID:   MBLK1W                     DATE ANALYZED:    10/18/95
CONTROL NO.: VOJ2301B                   MATRIX:         WATER
% MOISTURE:  NA                         DILUTION FACTOR: 1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Dichlorodifluoromethane	ND	5
Chloromethane	ND	5
Vinyl Chloride	ND	5
Bromomethane	ND	5
Chloroethane	ND	5
Trichlorofluoromethane	ND	1
1,1-Dichloroethene	ND	1
Methylene Chloride	ND	5
cis-1,2-Dichloroethene	ND	1
trans-1,2-Dichloroethene	ND	1
1,1-Dichloroethane	ND	1
Chloroform	ND	1
1,1,1-Trichloroethane	ND	1
Carbon Tetrachloride	ND	1
1,2-Dichloroethane	ND	1
Trichloroethene	ND	1
1,2-Dichloropropane	ND	1
Dibromomethane	ND	1
Bromodichloromethane	ND	1
2-Chloroethyl vinylether	ND	1
trans-1,3-Dichloropropene	ND	1
cis-1,3-Dichloropropene	ND	1
1,1,2-Trichloroethane	ND	1
Tetrachloroethene	ND	1
1,3-Dichloropropane	ND	1
1,1,1,2-Tetrachloroethane	ND	1
Dibromochloromethane	ND	1
Ethylene Dibromide	ND	1
Chlorobenzene	ND	1
Bromoform	ND	1
1,1,2,2-Tetrachloroethane	ND	1
Chlorotoluene	ND	1
1,3-Dichlorobenzene	ND	1
1,4-Dichlorobenzene	ND	1
1,2-Dichlorobenzene	ND	1
Benzylchloride	ND	1
SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	97	65-135

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
SPIKE/SPIKE DUPLICATE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 601
MATRIX: WATER

```
=====
BATCH NO.: 95J033          DATE RECEIVED: NA
SAMPLE ID: SA15CPT3-5     DATE EXTRACTED: NA
CONTROL NO.: J036-02      DATE ANALYZED: 10/18/95
ACCESSION: 95J033 95J036
```

Parameter	SAMPLE CONC (ug/L)	SPIKE ADDED (ug/L)	MS CONC (ug/L)	MS % REC	SPIKE ADDED (ug/L)	MSD CONC (ug/L)	MSD % REC	% RPD
1,1-DCE	ND	50.00	51.30	103	50.00	53.60	107	4
TCE	ND	50.00	47.60	95	50.00	49.80	100	5
Chlorobenzene	ND	50.00	47.80	96	50.00	51.70	103	8
QC LIMIT:				65-135			65-135	30

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 601
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	VOJ2301L	DATE ANALYZED:	10/18/95
ACCESSION:	95J033		

PARAMETER	TRUE VALUE (ug/L)	FOUND VALUE (ug/L)	LCS RECOVERY (%)
-----	-----	-----	-----
1,1-DCE	20.00	21.50	108
TCE	20.00	21.80	109
Chlorobenzene	20.00	22.40	112

QC LIMIT: 70-125

EPA METHOD 602
BTEX

```

=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED:  NA
SAMPLE ID:   PE-21-2                     DATE ANALYZED:  10/18/95
CONTROL NO.: J033-02                     MATRIX:       WATER
% MOISTURE:  NA                          DILUTION FACTOR: 1
=====
  
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Benzene	ND	1
Toluene	ND	1
Ethylbenzene	ND	1
Total Xylenes	ND	3

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	99	65-135

MDL: Method Detection Limit

EPA METHOD 602
BTEX

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED:  NA
SAMPLE ID:   PE-21-12                   DATE ANALYZED:  10/18/95
CONTROL NO.: J033-10                     MATRIX:       WATER
% MOISTURE:  NA                           DILUTION FACTOR: 1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Benzene	ND	1
Toluene	ND	1
Ethylbenzene	ND	1
Total Xylenes	ND	3

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	108	65-135

MDL: Method Detection Limit

EPA METHOD 602
BTEX

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED:  NA
SAMPLE ID:   PE-21-13                   DATE ANALYZED:  10/18/95
CONTROL NO.: J033-11                     MATRIX:       WATER
% MOISTURE:  NA                         DILUTION FACTOR: 1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Benzene	ND	1
Toluene	ND	1
Ethylbenzene	ND	1
Total Xylenes	ND	3

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	102	65-135

MDL: Method Detection Limit

EPA METHOD 602
BTEX

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  NA
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  NA
BATCH NO.:   95J033                     DATE EXTRACTED:   NA
SAMPLE ID:   MBLK1W                     DATE ANALYZED:   10/18/95
CONTROL NO.: VOJ2301B                   MATRIX:        WATER
% MOISTURE:  NA                         DILUTION FACTOR: 1
=====
```

PARAMETERS	RESULTS (ug/L)	MDL (ug/L)
Benzene	ND	1
Toluene	ND	1
Ethylbenzene	ND	1
Total Xylenes	ND	3

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Bromofluorobenzene	97	65-135

MDL: Method Detection Limit
Sample was analyzed by GC/MS.

CKY QUALITY CONTROL DATA
SPIKE/SPIKE DUPLICATE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 602
MATRIX: WATER

BATCH NO.: 95J033 DATE RECEIVED: NA
SAMPLE ID: SA15CPT3-5 DATE EXTRACTED: NA
CONTROL NO.: J036-02 DATE ANALYZED: 10/18/95
ACCESSION: 95J033 95J036

Parameter	SAMPLE CONC (ug/L)	SPIKE ADDED (ug/L)	MS CONC (ug/L)	MS % REC	SPIKE ADDED (ug/L)	MSD CONC (ug/L)	MSD % REC	% RPD
Benzene	ND	50.00	51.50	103	50.00	53.60	107	4
Toluene	ND	50.00	52.00	104	50.00	52.60	105	1

QC LIMIT: 65-135 65-135 30

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 602
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	VOJ2301L	DATE ANALYZED:	10/18/95
ACCESSION:	95J033		

PARAMETER	TRUE VALUE (ug/L)	FOUND VALUE (ug/L)	LCS RECOVERY (%)
-----	-----	-----	-----
Benzene	20.00	23.60	118
Toluene	20.00	23.90	120
Ethylbenzene	20.00	22.50	113
Total Xylenes	60.00	63.60	106

QC LIMIT: 70-125

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

=====

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	10/13/95
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	10/13/95
BATCH NO.:	95J033	DATE EXTRACTED:	10/16/95
MATRIX:	WATER	DATE ANALYZED:	10/17/95

=====

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
PE-21-3	J033-03	1.4	1	1
MBLK1W	TRJ003WB	ND	1	1

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 418.1
MATRIX: WATER

```
=====
BATCH NO.:      95J033          DATE RECEIVED:   NA
SAMPLE ID:      LCS1W/LCS1WD    DATE EXTRACTED:  10/16/95
CONTROL NO.:    TRJ003WL/C      DATE ANALYZED:   10/17/95
ACCESSION:      95J033
```

Parameter	SAMPLE CONC (mg/L)	SPIKE ADDED (mg/L)	LCS CONC (mg/L)	LCS % REC	SPIKE ADDED (mg/L)	LCSD CONC (mg/L)	LCSD % REC	% RPD
TRPH	ND	5.00	6.10	122	5.00	6.30	126	3

QC LIMIT: 75-125 75-125 30

EPA METHOD M8015
TOTAL PETROLEUM HYDROCARBONS BY EXTRACTION

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	10/13/98
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	10/13/98
BATCH NO.:	95J033	DATE EXTRACTED:	10/16/98
MATRIX:	WATER	DATE ANALYZED:	10/17/98

SAMPLE ID	CONTROL NO	RESULT (mg/L)	H-C RANGE	% RECOVERY SURRE1	SURRE2	DL FACTOR	MDL (mg/L)
PE-21-4	J033-04	ND	NA	86	116	1	.05
MBLK1W	DSJ006WB	ND	NA	88	117	1	.05

QC LIMIT: 65-135 60-140

SURRE1 : Bromobenzene
SURRE2 : Hexacosane
MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA M8015
MATRIX: WATER

```
=====
BATCH NO.: 95J033          DATE RECEIVED: NA
SAMPLE ID: LCS1W/LCS1WD    DATE EXTRACTED: 10/16/95
CONTROL NO.: DSJ006WL/C    DATE ANALYZED: 10/17/95
ACCESSION: 95J033
```

Parameter	SAMPLE CONC (mg/L)	SPIKE ADDED (mg/L)	LCS CONC (mg/L)	LCS % REC	SPIKE ADDED (mg/L)	LCSD CONC (mg/L)	LCSD % REC	% RPD
DIESEL	ND	1.00	1.11	111	1.00	1.16	116	4

QC LIMIT: 60-140 60-140 30

EPA METHOD 3005/6010
CAM METALS BY ICP

```

=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:  95J033                      DATE EXTRACTED: 10/16/95
SAMPLE ID:   PE-21-5                     DATE ANALYZED: 10/16/95
CONTROL NO.: J033-05                     MATRIX:      WATER
% MOISTURE:  NA                          DILUTION FACTOR: 1
=====

```

Element	Det Limit (ug/L)	RESULT (ug/L)
Antimony	60	ND
Arsenic	100	ND
Barium	10	30.2
Beryllium	5	ND
Cadmium	5	ND
Chromium	10	ND
Cobalt	10	ND
Copper	10	ND
Lead	100	ND
Molybdenum	50	ND
Nickel	20	ND
Selenium	200	ND
Silver	10	ND
Thallium	500	ND
Vanadium	10	ND
Zinc	10	25.1

EPA METHOD 3005/6010
CAM METALS BY ICP

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  NA
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  NA
BATCH NO.:   95J033                     DATE EXTRACTED:   10/16/95
SAMPLE ID:   MBLK1W                     DATE ANALYZED:    10/16/95
CONTROL NO.: IPJ016WB                   MATRIX:         WATER
% MOISTURE:  NA                         DILUTION FACTOR:  1
=====
```

Element	Det Limit (ug/L)	RESULT (ug/L)
-----	-----	-----
Antimony	60	ND
Arsenic	100	ND
Barium	10	ND
Beryllium	5	ND
Cadmium	5	ND
Chromium	10	ND
Cobalt	10	ND
Copper	10	ND
Lead	100	ND
Molybdenum	50	ND
Nickel	20	ND
Selenium	200	ND
Silver	10	ND
Thallium	500	ND
Vanadium	10	ND
Zinc	10	ND

CKY QUALITY CONTROL DATA
SPIKE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 3005/6010
MATRIX: WATER

BATCH NO.: 95J033 DATE RECEIVED: 10/13/95
SAMPLE ID: PE-21-5 DATE EXTRACTED: 10/16/95
CONTROL NO.: J033-05 DATE ANALYZED: 10/16/95

ACCESSION: 95J033 95J034 95J035 95J015

PARAMETER	SAMPLE RESULT (ug/L)	SPIKE CONC. (ug/L)	SPIKE RESULT (ug/L)	SPIKE RECRY. (%)
Antimony	ND	500	475	95
Arsenic	ND	1000	910	91
Barium	30.2	1000	929	90
Beryllium	ND	1000	889	89
Cadmium	ND	1000	920	92
Chromium	ND	1000	896	90
Cobalt	ND	1000	889	89
Copper	ND	1000	908	91
Lead	ND	1000	909	91
Molybdenum	ND	1000	907	91
Nickel	ND	1000	894	89
Selenium	ND	1000	924	92
Silver	ND	1000	914	91
Thallium	ND	1000	868	87
Vanadium	ND	1000	902	90
Zinc	25.1	1000	991	97

QC LIMIT: 75-125

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 3005/6010
MATRIX: WATER

BATCH NO.: 95J033 DATE RECEIVED: 10/13/95
SAMPLE ID: PE-21-5 DATE EXTRACTED: 10/16/95
CONTROL NO.: J033-05 DATE ANALYZED: 10/16/95
ACCESSION: 95J033 95J034 95J035 95J015

PARAMETER	SAMPLE RESULT (ug/L)	DUP SAMPLE RESULT (ug/L)	RPD RESULT (%)
Antimony	ND	ND	0
Arsenic	ND	ND	0
Barium	30.2	31	3
Beryllium	ND	ND	0
Cadmium	ND	ND	0
Chromium	ND	ND	0
Cobalt	ND	ND	0
Copper	ND	ND	0
Lead	ND	ND	0
Molybdenum	ND	ND	0
Nickel	ND	ND	0
Selenium	ND	ND	0
Silver	ND	ND	0
Thallium	ND	ND	0
Vanadium	ND	ND	0
Zinc	25.1	56.5	77+

QC LIMIT:

20

+ Out of QC limits

EPA METHOD 7470
MERCURY BY COLD VAPOR

=====

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	10/13/95
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	10/13/95
BATCH NO.:	95J033	DATE EXTRACTED:	10/16/95
MATRIX:	WATER	DATE ANALYZED:	10/16/95

=====

SAMPLE ID	CONTROL NO	RESULT (ug/L)	DILUTION FACTOR	MDL (ug/L)
PE-21-5	J033-05	ND	1	.2
MBLK1W	HGJ008WB	ND	1	.2

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 7470
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W/LCS1WD	DATE EXTRACTED:	10/16/95
CONTROL NO.:	HGJ008WL/C	DATE ANALYZED:	10/16/95
ACCESSION:	95J033		

Parameter	SAMPLE CONC (ug/L)	SPIKE ADDED (ug/L)	LCS CONC (ug/L)	% LCS REC	SPIKE ADDED (ug/L)	LCSD CONC (ug/L)	% LCSD REC	% RPD
Mercury	ND	4.90	5.14	105	4.90	5.08	104	1

QC LIMIT:		75-125		75-125	20

CKY QUALITY CONTROL DATA
MATRIX SPIKE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 7470
MATRIX: WATER

BATCH NO.: 95J033
SAMPLE ID: PE-21-5
CONTROL NO.: J033-05
DATE RECEIVED: 10/13/95
DATE EXTRACTED: 10/16/95
DATE ANALYZED: 10/16/95
ACCESSION: 95J033

Parameter	SAMPLE CONC (ug/L)	SPIKE ADDED (ug/L)	MS CONC (ug/L)	MS % REC
Mercury	ND	5.00	5.08	102

QC LIMIT: 75-125

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 7470
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	10/13/95
SAMPLE ID:	PE-21-5	DATE EXTRACTED:	10/16/95
CONTROL NO.:	J033-05	DATE ANALYZED:	10/16/95
ACCESSION:	95J033		

PARAMETER	Sample (ug/L)	Dup. Sample (ug/L)	RPD (%)
-----	-----	-----	-----
Mercury	ND	ND	0
QC LIMIT:			20

EPA 160.5
SETTLEABLE SOLIDS

=====

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	10/13/95
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	10/13/95
BATCH NO.:	95J033	DATE EXTRACTED:	NA
MATRIX:	WATER	DATE ANALYZED:	10/13/95

=====

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
PE-21-6	J033-06	1.5	1	.5
MBLK1W	STJ001WB	ND	1	.5

MDL : Method Detection Limit

EPA METHOD 376.1
TOTAL SULFIDE

=====

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	10/13/95
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	10/13/95
BATCH NO.:	95J033	DATE EXTRACTED:	NA
MATRIX:	WATER	DATE ANALYZED:	10/16/95

=====

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
PE-21-7	J033-07	ND	1	.2
MBLK1W	SDJ002WB	ND	1	.2

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
SPIKE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 376.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	10/13/95
SAMPLE ID:	PE-21-7	DATE EXTRACTED:	NA
CONTROL NO.:	J033-07	DATE ANALYZED:	10/16/95
ACCESSION:	95J033		

PARAMETER	Sample Result (mg/L)	Spike Conc. (mg/L)	Spike Result (mg/L)	Spike Recovery (%)
-----	-----	-----	-----	-----
Sulfide	ND	4.38	4.15	95

QC LIMIT: 75-125

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 376.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	SDJ002WL	DATE ANALYZED:	10/16/95
ACCESSION:	95J033		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
Sulfide	825	812	98

QC LIMIT: 85-115

EPA METHOD 300
NITRATE/NITRITE

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED:  NA
MATRIX:      WATER                       DATE ANALYZED:  10/16/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
PE-21-8	J033-08	8.99	5	.5
MBLK1W	ICJ002WB	ND	1	.1

MDL : Method Detection Limit

EPA METHOD 300
SULFATE

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED:  NA
MATRIX:      WATER                       DATE ANALYZED:  10/16/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
PE-21-11	J033-13	511	50	50
MBLK1W	ICJ002WB	ND	1	1

MDL : Method Detection Limit

EPA METHOD 300
CHLORIDE

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED:  NA
MATRIX:      WATER                       DATE ANALYZED:  10/16/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
PE-21-11	J033-13	203	50	10
MBLK1W	ICJ002WB	ND	1	.2

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	10/13/95
SAMPLE ID:	PE-21-8	DATE EXTRACTED:	NA
CONTROL NO.:	J033-08	DATE ANALYZED:	10/16/95
ACCESSION:	95J033		

PARAMETER	Sample (mg/L)	Dup. Sample (mg/L)	RPD (%)
-----	-----	-----	-----
Nitrate/Nitrite	8.99	7.67	16

QC LIMIT: 20

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	10/13/95
SAMPLE ID:	PE-21-11	DATE EXTRACTED:	NA
CONTROL NO.:	J033-13	DATE ANALYZED:	10/16/95
ACCESSION:	95J033		

PARAMETER	Sample (mg/L)	Dup. Sample (mg/L)	RPD (%)
-----	-----	-----	-----
Sulfate	511	510	0
Chloride	203	203	0

QC LIMIT: 20

CKY QUALITY CONTROL DATA
SPIKE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	10/13/95
SAMPLE ID:	PE-21-8	DATE EXTRACTED:	NA
CONTROL NO.:	J033-08	DATE ANALYZED:	10/16/95
ACCESSION:	95J033		

PARAMETER	Sample Result (mg/L)	Spike Conc. (mg/L)	Spike Result (mg/L)	Spike Recovery (%)
-----	-----	-----	-----	-----
Nitrate/Nitrite	8.99	20.00	30.70	109

QC LIMIT: 75-125

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 300
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	ICJ002WL	DATE ANALYZED:	10/16/95
ACCESSION:	95J033		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
Sulfate	20.00	19.12	96
Chloride	5.00	5.18	104
Nitrate/Nitrite	5.00	5.09	102

QC LIMIT: 85-115

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 405.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	BDJ001WL	DATE ANALYZED:	10/13/95
ACCESSION:	95J031 95J033		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
BOD	67.90	63.17	93

QC LIMIT: 85-115

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 405.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	MW117B-WQ4	DATE EXTRACTED:	NA
CONTROL NO.:	J031-04	DATE ANALYZED:	10/13/95
ACCESSION:	95J031 95J033		

PARAMETER	Sample (mg/L)	Dup. Sample (mg/L)	RPD (%)
-----	-----	-----	-----
BOD	1.10	1.10	0

QC LIMIT: 20



EPA METHOD 413.2
OIL & GREASE

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED: 10/16/95
MATRIX:      WATER                      DATE ANALYZED: 10/17/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
PE-21-10	J033-12	1.2	1	1
MBLK1W	OGJ001WB	ND	1	1

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 413.2
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W/LCS1WD	DATE EXTRACTED:	10/16/95
CONTROL NO.:	OGJ001WL/C	DATE ANALYZED:	10/17/95
ACCESSION:	95J033		

Parameter	SAMPLE CONC (mg/L)	SPIKE ADDED (mg/L)	LCS CONC (mg/L)	LCS % REC	SPIKE ADDED (mg/L)	LCSD CONC (mg/L)	LCSD % REC	% RPD
TROG	ND	5.00	5.50	110	5.00	5.50	110	0
QC LIMIT:				75-125			75-125	30

EPA METHOD 150.1
PH

=====

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	10/13/95
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	10/13/95
BATCH NO.:	95J033	DATE EXTRACTED:	NA
MATRIX:	WATER	DATE ANALYZED:	10/13/95

=====

SAMPLE ID	CONTROL NO	RESULT (pH unit)	DILUTION FACTOR	MDL (pH unit)
PE-21-11	J033-13	6.9	1	.1

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 150.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	PHJ003WL	DATE ANALYZED:	10/13/95
ACCESSION:	95J033		

PARAMETER	TRUE VALUE (pH unit)	FOUND VALUE (pH unit)	LCS RECOVERY (%)
----- pH	----- 9.09	----- 9.07	----- 100

QC LIMIT: 85-115

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 150.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	10/13/95
SAMPLE ID:	PE-21-11	DATE EXTRACTED:	NA
CONTROL NO.:	J033-13	DATE ANALYZED:	10/13/95
ACCESSION:	95J033		

PARAMETER	Sample (pH unit)	Dup. Sample (pH unit)	RPD (%)
-----	-----	-----	-----
pH	6.90	6.90	0

QC LIMIT: 20

EPA METHOD 160.1
TOTAL DISSOLVED SOLIDS

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:      Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:    95J033                     DATE EXTRACTED:  NA
MATRIX:      WATER                       DATE ANALYZED:  10/18/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
PE-21-11	J033-13	1640	1	10
MBLK1W	DSJ003WB	ND	1	10

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 160.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	DSJ003WL	DATE ANALYZED:	10/18/95
ACCESSION:	95J033		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
TDS	655	605	92

QC LIMIT: 85-115

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 160.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	10/13/95
SAMPLE ID:	PE-21-11	DATE EXTRACTED:	NA
CONTROL NO.:	J033-13	DATE ANALYZED:	10/18/95
ACCESSION:	95J033		

PARAMETER	Sample (mg/L)	Dup. Sample (mg/L)	RPD (%)
-----	-----	-----	-----
TDS	1640	1655	1

QC LIMIT: 20

EPA METHOD 160.2
TOTAL SUSPENDED SOLIDS

=====

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	10/13/95
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	10/13/95
BATCH NO.:	95J033	DATE EXTRACTED:	NA
MATRIX:	WATER	DATE ANALYZED:	10/17/95

=====

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
-----	-----	-----	-----	-----
PE-21-11	J033-13	628	1	10
MBLK1W	SSJ002WB	ND	1	10

MDL : Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 160.2
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	SSJ002WL	DATE ANALYZED:	10/17/95
ACCESSION:	95J033		

PARAMETER	TRUE VALUE (mg/L)	FOUND VALUE (mg/L)	LCS RECOVERY (%)
-----	-----	-----	-----
TSS	59.80	54.00	90

QC LIMIT: 75-125

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 160.2
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	10/13/95
SAMPLE ID:	PE-21-11	DATE EXTRACTED:	NA
CONTROL NO.:	J033-13	DATE ANALYZED:	10/17/95
ACCESSION:	95J033		

PARAMETER	Sample (mg/L)	Dup. Sample (mg/L)	RPD (%)
-----	-----	-----	-----
TSS	628	719	14

QC LIMIT: 20

APPENDIX D
EARTH WORK GUIDELINES

APPENDIX D EARTHWORK GUIDELINES

Earthwork and site preparation activities will encompass clearing and grubbing, subgrade preparation for pavements and structural support, excavation for foundations, utility line relocations, and fill placement. The following guidelines are provided for earthwork associated with the First/Boyle station.

Clearing and Grubbing

Fill material, trash and any vegetation should be removed from the site area to be graded. Subsurface conditions at the site may differ from those observed in the borings and, therefore, a qualified geotechnical engineer should inspect 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 5.5 of this report. Temporary shallow excavations to a depth of 5 feet can be expected to remain stable with 1H:1V (one horizontal to one vertical) slopes for short periods. Temporary excavations deeper than 5 feet should be shored or sloped back at 1-1/2H:1V. Recommendations for sloped excavations deeper than 5 feet are presented in Section 5.5 of this report. Due to the granular nature of the alluvium, raveling and running conditions should be anticipated.

Fill Materials and Placement

Fill materials may consist of excavated onsite granular soils or approved clean granular soils free of expansive materials, debris, organic contaminants or rock fragments larger than 6 inches.

The following specifications are recommended for fill placement.

- All areas that are to receive compacted fill shall be observed and approved by a geotechnical engineer
- Prior to fill placement, exposed soil surfaces shall be scarified to a depth of 6 inches, moisture conditioned as necessary and compacted to at least 90 percent of the maximum dry density as determined by procedure ASTM D1557

- All fill materials shall be placed in horizontal lifts not exceeding 8 inches in loose thickness, moisture conditioned to a moisture content 1 to 3 percent above optimum moisture content and mechanically compacted to at least 90 percent of the maximum dry density as determined by ASTM procedure D1557. Each lift should be compacted before the next lift is placed.
- A geotechnical engineer or an experienced soils technician shall observe fill placement and compaction and conduct in-place field density tests on the compacted fill to verify the adequacy of compaction.

In deep fill areas or fill areas, and structure foundation subgrade areas, the compaction requirement shall be increased to 95 percent of the maximum dry density (ASTM D1557), as directed by a qualified geotechnical engineer.

Subgrade Preparation

Subgrade for shallow footings shall be overexcavated to a minimum depth equal to the footing width and replaced with properly compacted fill. Overexcavation shall extend a minimum distance equal to half the width or 2 feet, whichever is larger, beyond the perimeter of the footing. Fill shall be compacted to at least 95 percent of the maximum dry density as determined by ASTM Procedure D-1557.

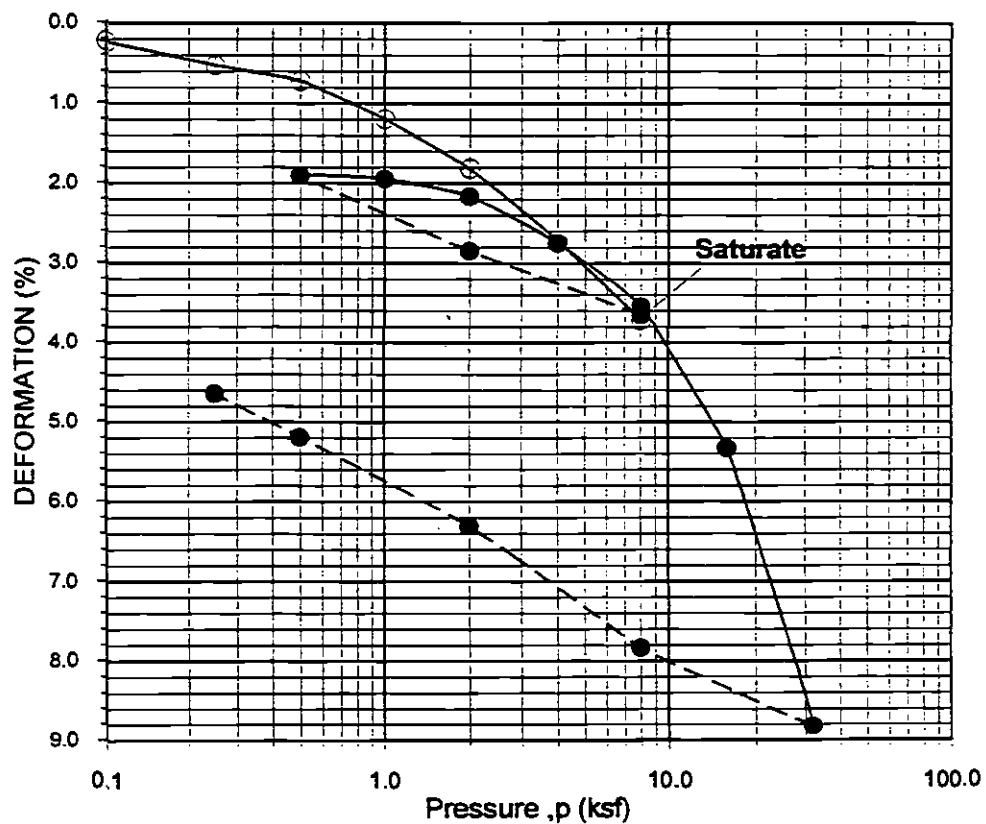
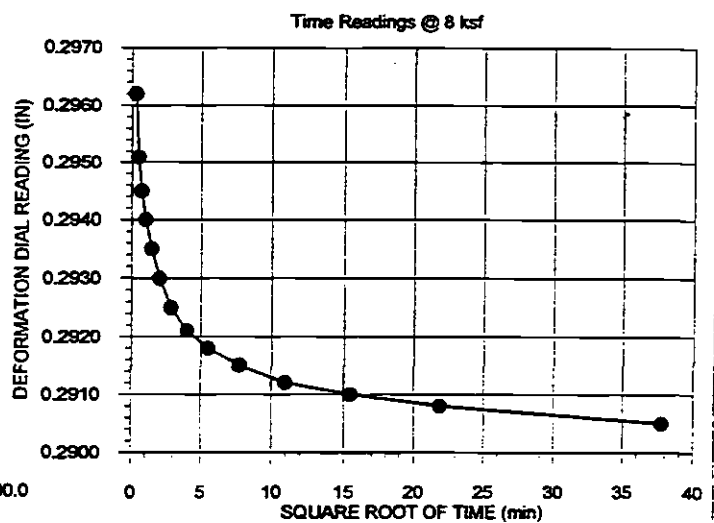
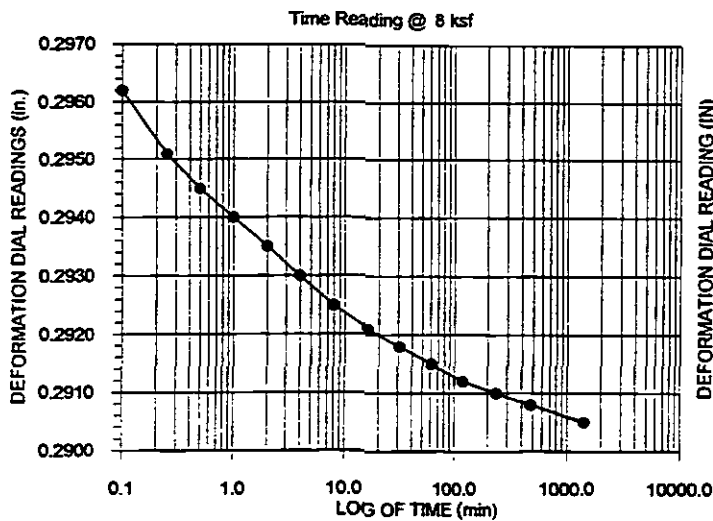
In the absence of specific information on loads, dimensions and locations of structures, Figure 5-6 is provided as a general guideline for foundation support needs. Structure specific foundation recommendations should be provided when such information becomes available.

The mat foundation shall be underlain by a minimum 2-foot-thick dense granular material with an in situ density of at least 95 percent of maximum dry density as per ASTM D-1557. In granular alluvium this may be achieved by proof rolling the excavated subgrade with a heavy vibratory roller or by overexcavating and compacting in layers, the 2-foot zone below the foundations. In fine grained material, the exposed subgrade shall be overexcavated at least 2 feet below the design grade and replaced with fill compacted to project specifications. If the mat is directly placed on the native materials, rock fragments larger than 6 inches should not be allowed in the exposed subgrade. The compacted fill blanket should extend a minimum of 5 feet beyond the foundation perimeter.

Overexcavations and subgrade preparation shall be observed by the Geotechnical Engineer. Based on exposed field conditions, overexcavation depths may be increased by the Geotechnical Engineer.

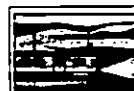
Site Drainage

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 compacted fill. Fine grained alluvium excavated at the site will be suitable for this purpose.



BORING NO.	SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT (%) Initial / Final	DRY DENSITY (pcf) Initial / Final	VOID RATIO Initial / Final	DEGREE OF SATURATION (%) Initial / Final
SD-6	D-14	62.0	25.4 / 26.5	96.7 / 100.2	0.744 / 0.663	92 / 100

SOIL DESCRIPTION: Olive Lean Clay (CL), stiff, moist



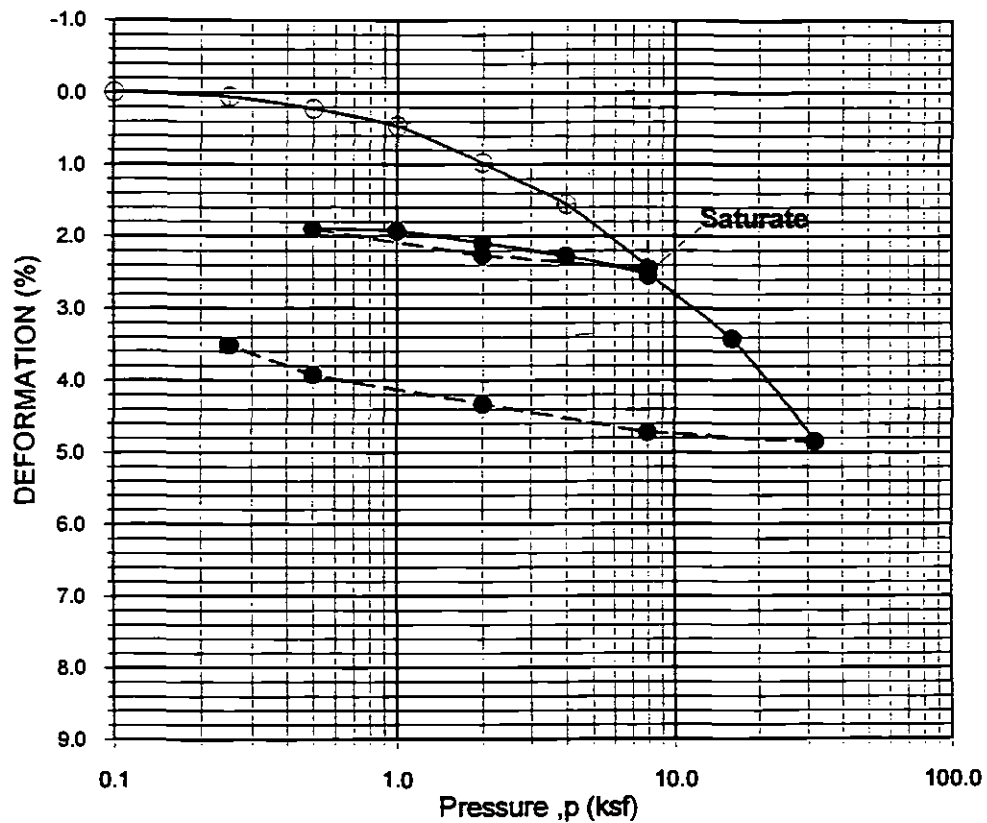
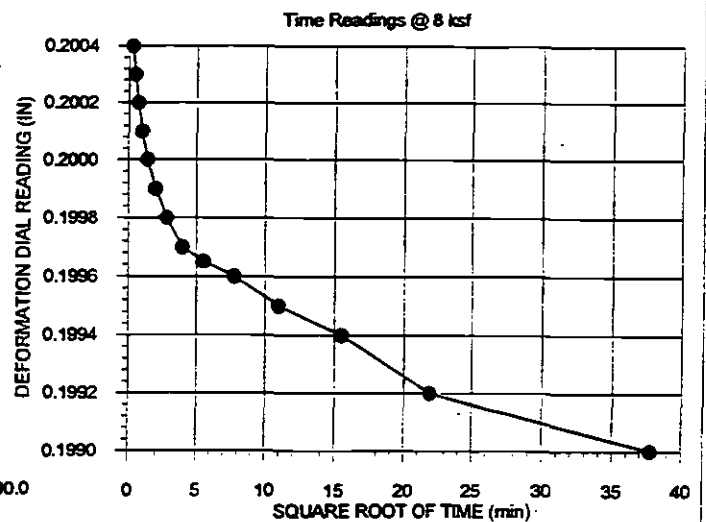
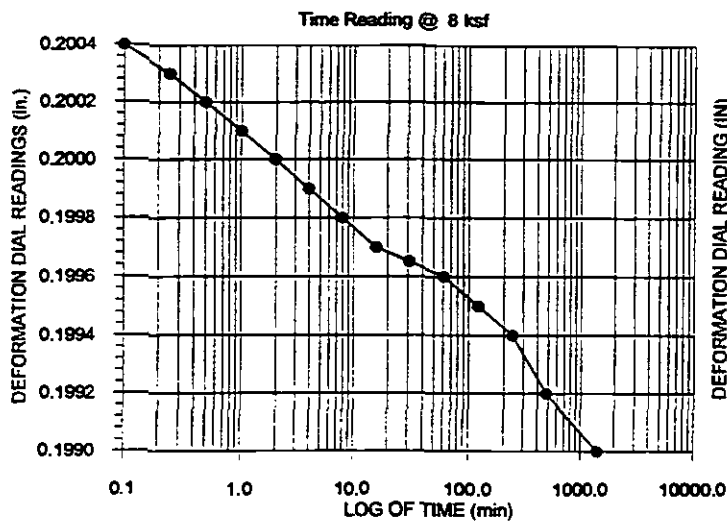
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Project No. 95-8347-23
Metro Redline
Eastside Extension III

ONE-DIMENSIONAL CONSOLIDATION
PROPERTIES OF SOILS
(ASTM D 2435)

11-95

Figure B-120



BORING NO.	SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT (%) Initial / Final	DRY DENSITY (pcf) Initial / Final	VOID RATIO Initial / Final	DEGREE OF SATURATION (%) Initial / Final
SD-7	D-18	89.1	21.7 / 19.5	103.3 / 107.0	0.632 / 0.575	93 / 92

SOIL DESCRIPTION: Olive Silty Sand (SM)



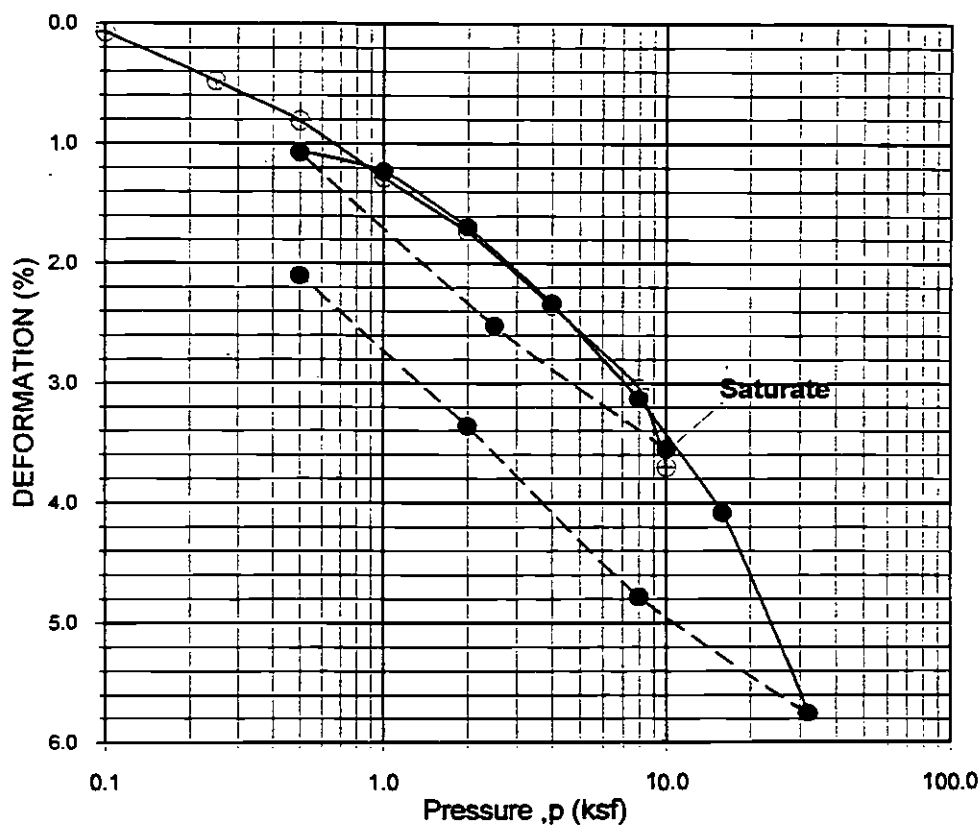
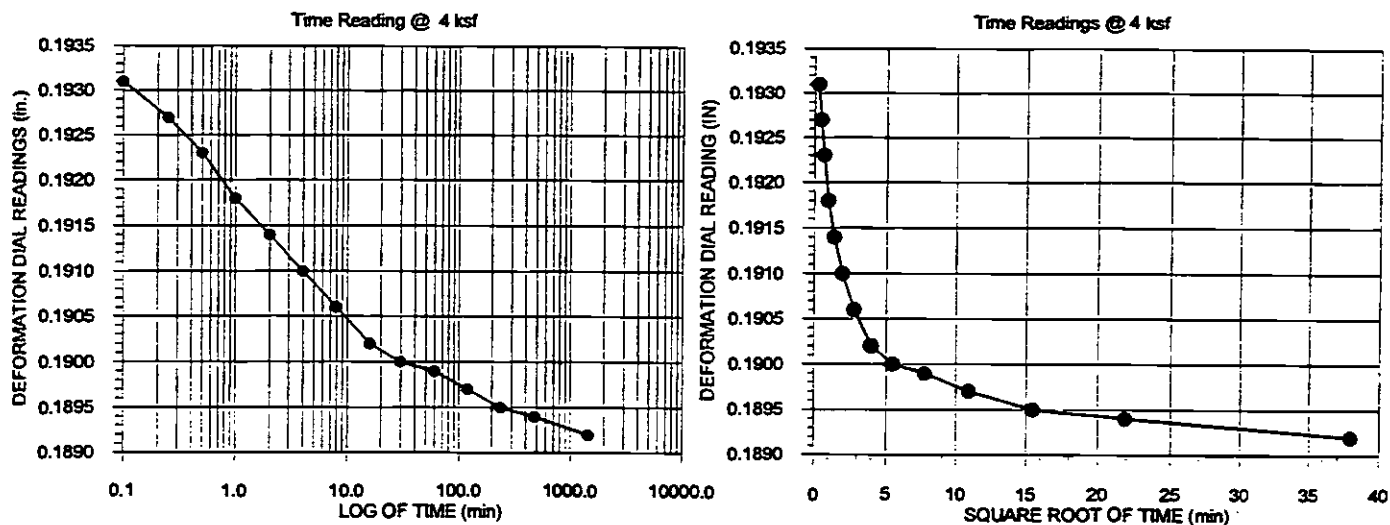
GeoTrans
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Project No. 95-8347-23
Metro Redline
Eastside Extension III

ONE-DIMENSIONAL CONSOLIDATION
PROPERTIES OF SOILS
(ASTM D 2435)

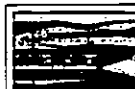
11-95

Figure B-121



BORING NO.	SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT (%) Initial / Final	DRY DENSITY (pcf) Initial / Final	VOID RATIO Initial / Final	DEGREE OF SATURATION (%) Initial / Final
SD-9	P-24	84.0	25.8 / 26.3	97.9 / 99.9	0.722 / 0.686	97 / 100

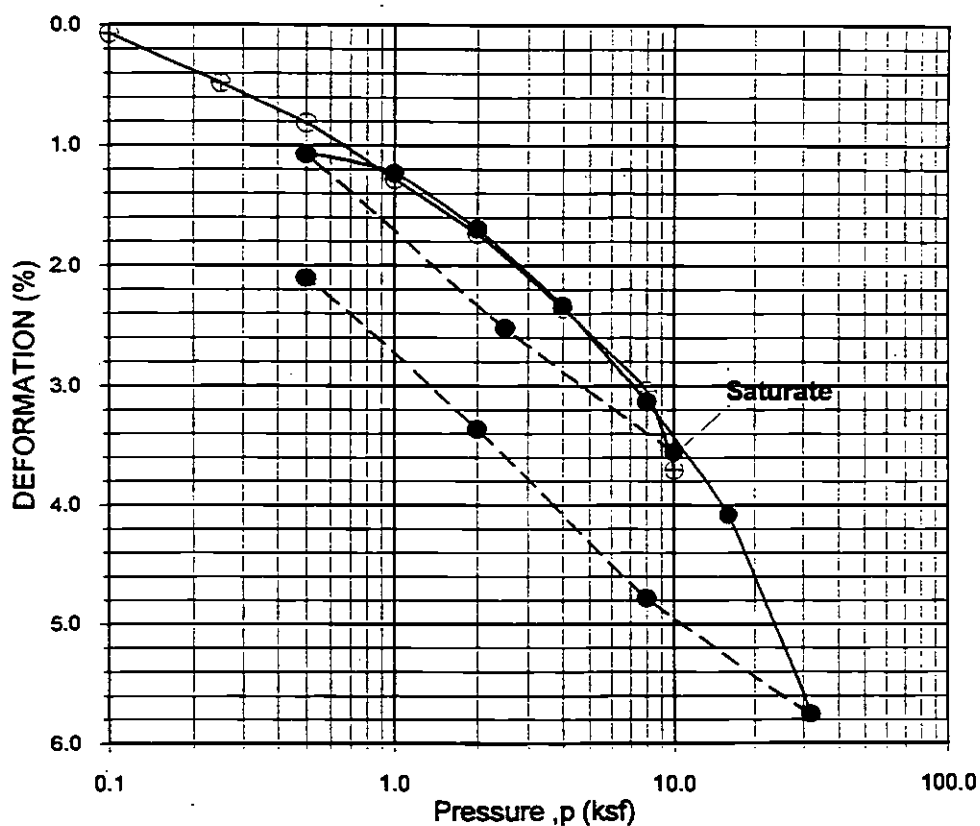
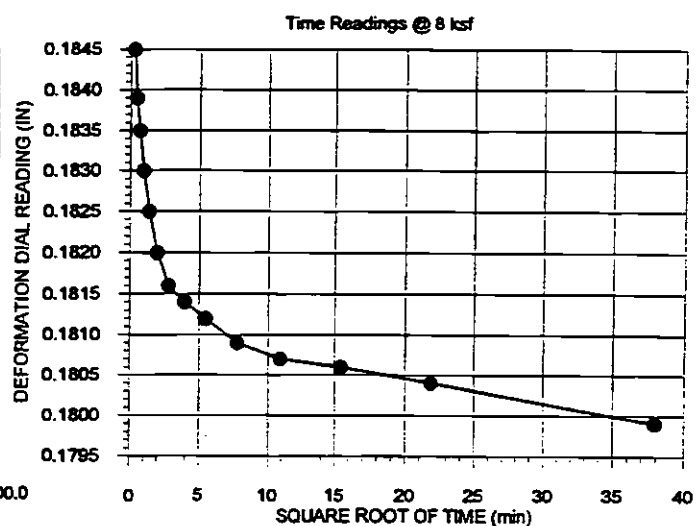
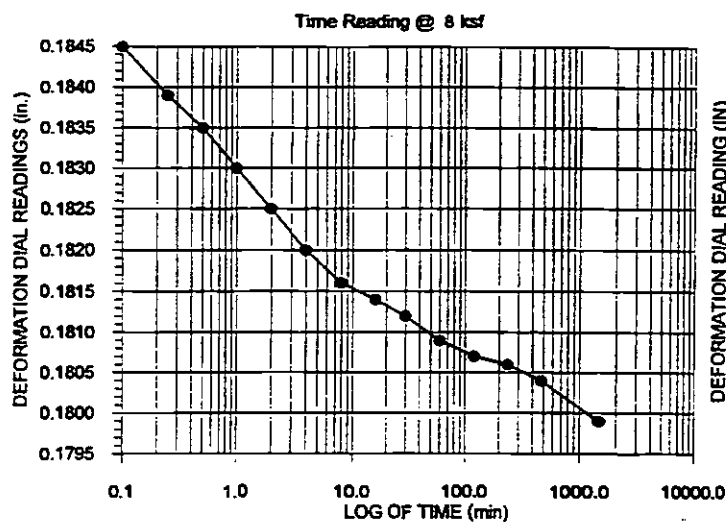
SOIL DESCRIPTION: Olive Lean Clay (CL)



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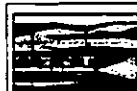
Project No. 95-8347-23
Metro Redline
Eastside Extension III

ONE-DIMENSIONAL CONSOLIDATION
PROPERTIES OF SOILS
(ASTM D 2435)



BORING NO.	SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT (%) Initial / Final	DRY DENSITY (pcf) Initial / Final	VOID RATIO Initial / Final	DEGREE OF SATURATION (%) Initial / Final
SD-9	P-24	84.0	25.8 / 26.3	97.9 / 99.9	0.722 / 0.686	97 / 100

SOIL DESCRIPTION: Olive Lean Clay (CL)



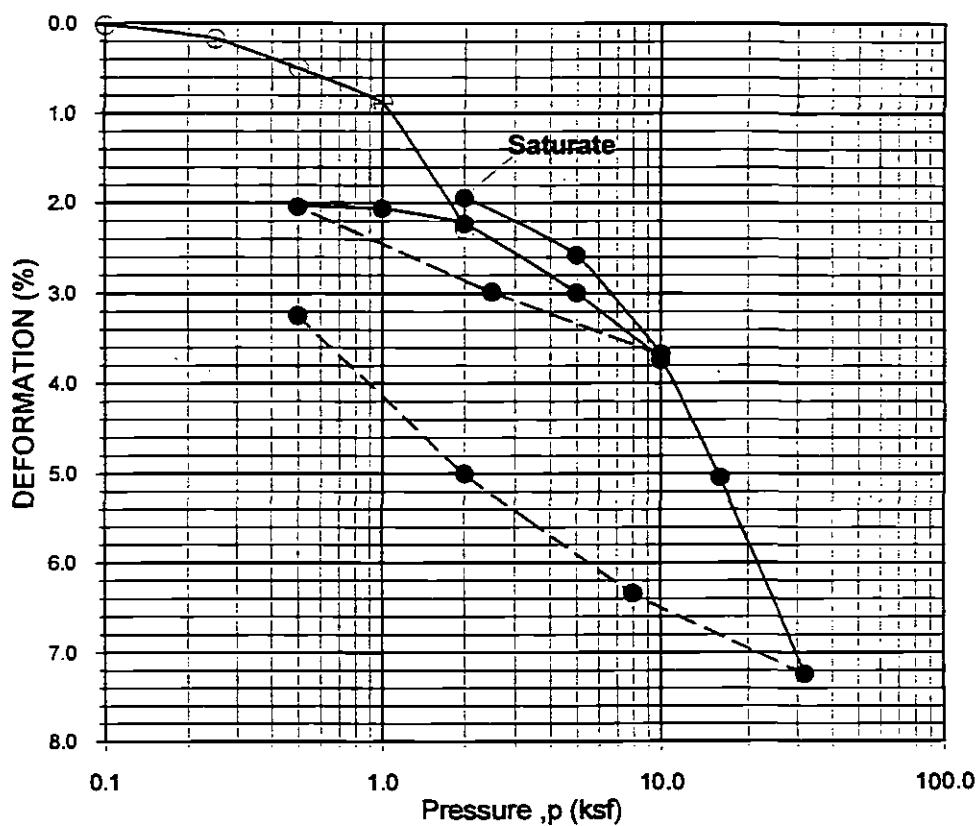
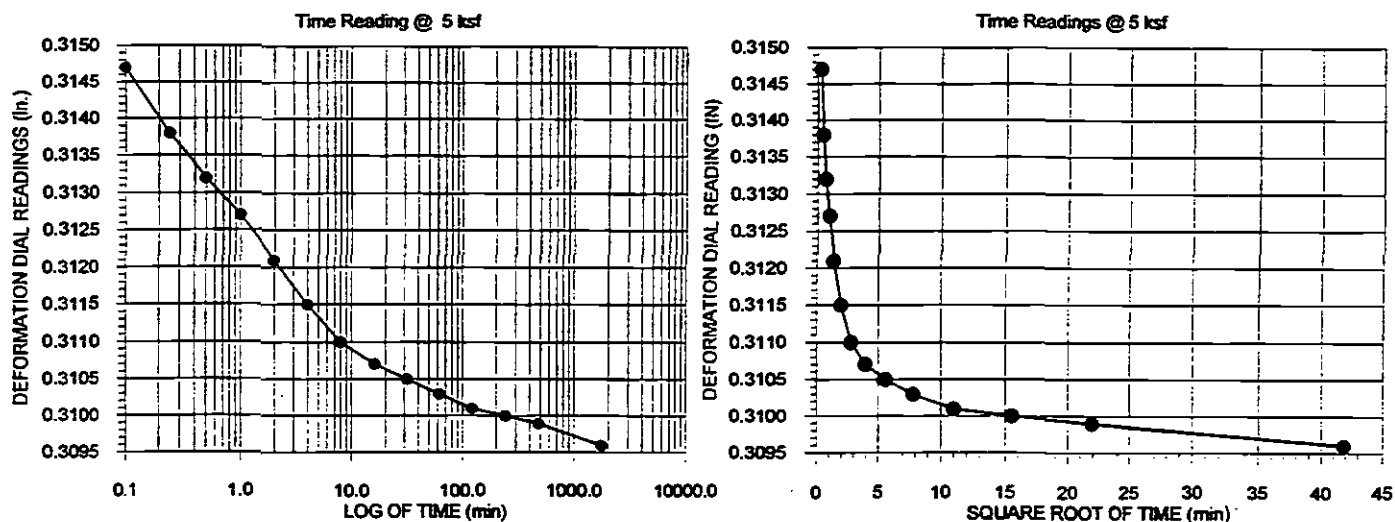
GeoTransit
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Project No. 95-8347-23
Metro Redline
Eastside Extension III

ONE-DIMENSIONAL CONSOLIDATION
PROPERTIES OF SOILS
(ASTM D 2435)

12-95

Figure B-122b



BORING NO.	SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT (%) Initial / Final	DRY DENSITY (pcf) Initial / Final	VOID RATIO Initial / Final	DEGREE OF SATURATION (%) Initial / Final
SD-9	D-27	95.0	26.4 / 28.0	95.9 / 98.6	0.757 / 0.700	94 / 100

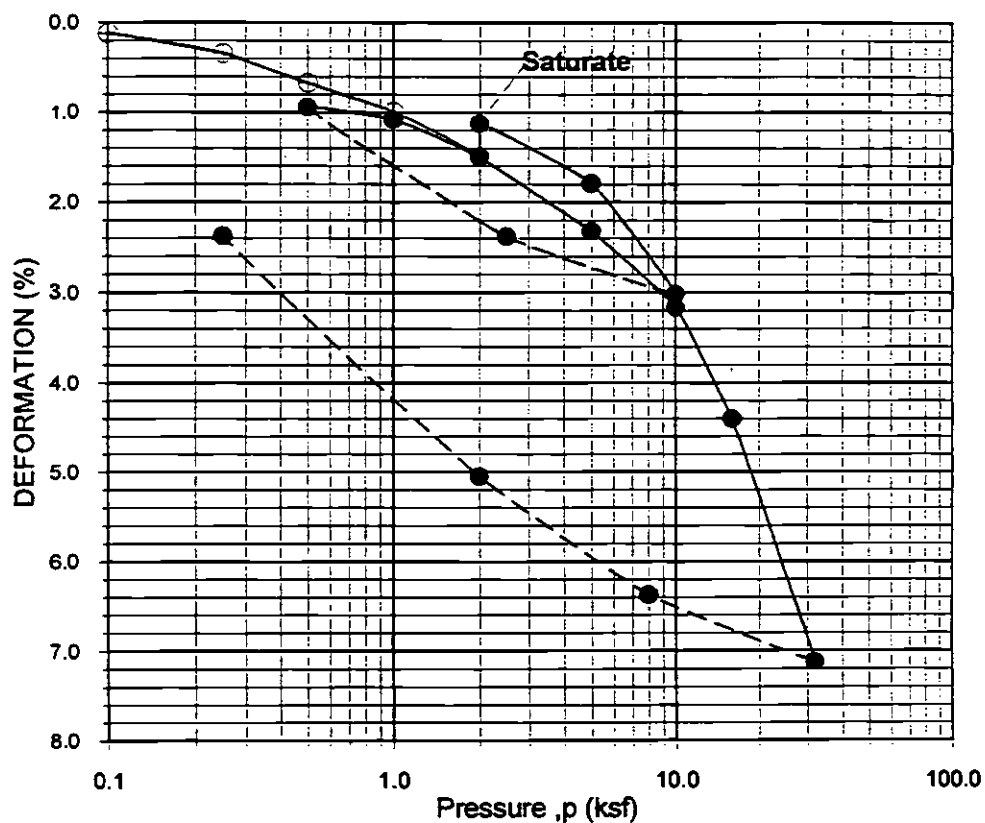
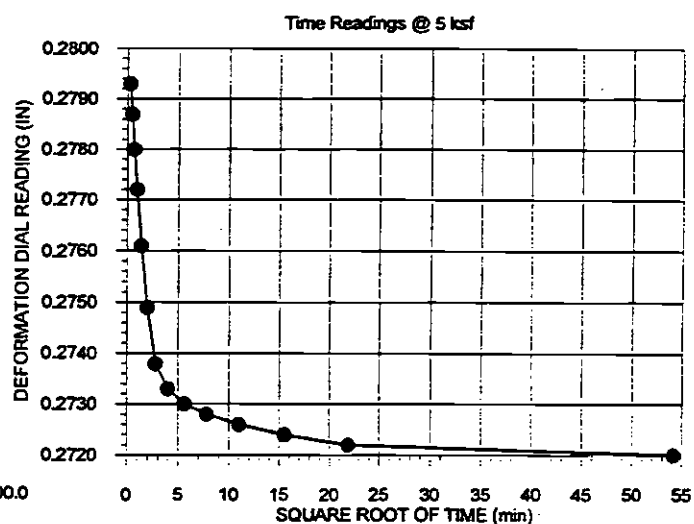
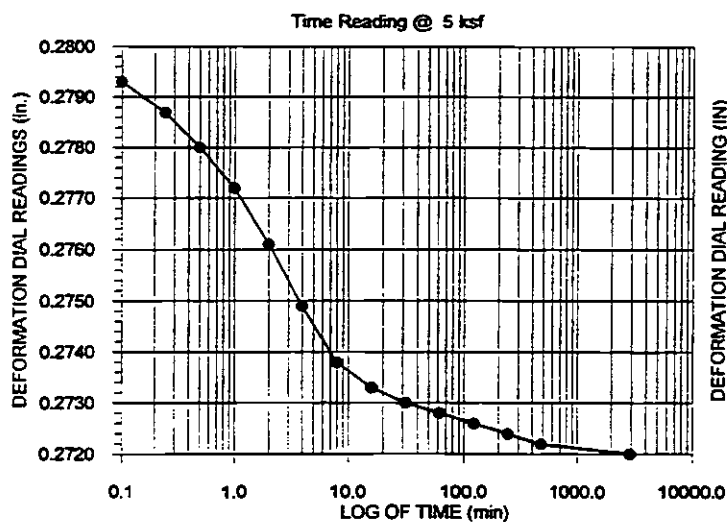
SOIL DESCRIPTION: Olive Grey Silty Lean Clay (CL), moist, stiff



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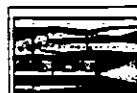
Project No. 95-8347-24
Metro Redline
Eastside Extension III

ONE-DIMENSIONAL CONSOLIDATION
PROPERTIES OF SOILS
(ASTM D 2435)



BORING NO.	SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT (%) Initial / Final	DRY DENSITY (pcf) Initial / Final	VOID RATIO Initial / Final	DEGREE OF SATURATION (%) Initial / Final
SD-10	D-24	90.0	24.1 / 24.0	100.7 / 102.8	0.674 / 0.635	96 / 100

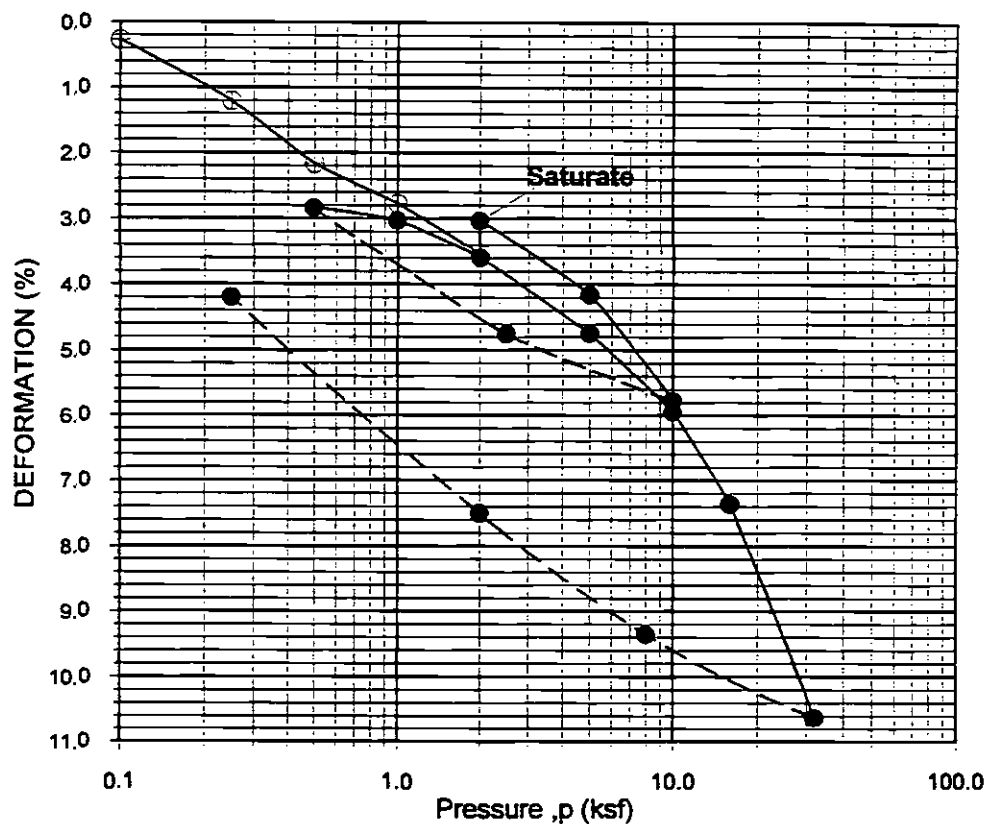
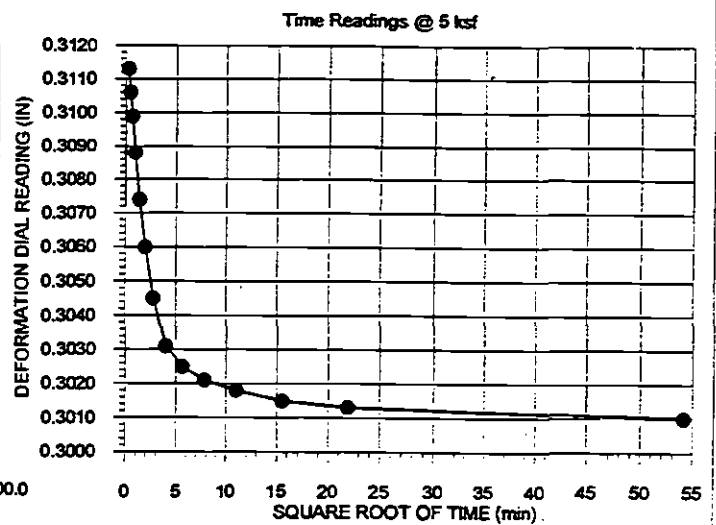
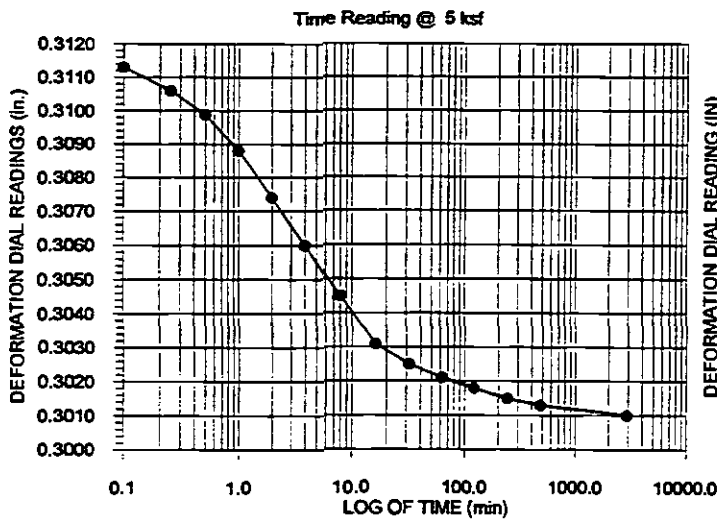
SOIL DESCRIPTION: Olive Grey Silty Lean Clay (CL), moist, stiff



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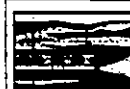
Project No. 95-8347-24
Metro Redline
Eastside Extension III

ONE-DIMENSIONAL CONSOLIDATION
PROPERTIES OF SOILS
(ASTM D 2435)



BORING NO.	SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT (%) Initial / Final	DRY DENSITY (pcf) Initial / Final	VOID RATIO Initial / Final	DEGREE OF SATURATION (%) Initial / Final
SD-10	D-28	105.0	25.1 / 26.4	97.5 / 101.1	0.729 / 0.657	93 / 100

SOIL DESCRIPTION: Olive Grey Fat Clay (CH), stiff, moist



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Project No. 95-8347-24
Metro Redline
Eastside Extension III

ONE-DIMENSIONAL CONSOLIDATION
PROPERTIES OF SOILS
(ASTM D 2435)

4-96

Figure B-125

Laboratory Test Results

Measurement of Collapse Potential of Soils (ASTM D5333)

PROJECT NAME: Metro Rail Redline-- Eastside Extension (I, II, III) EARTH TECH NO.: 96-370-90006
 CLIENT PROJECT NO.: 95-8347-24 CLIENT: EARTH TECH, INC. - Irvine
 SUMMARIZED BY: sp DATE: February 22, 1996 CHECKED BY: 2/23/96 DATE: 2-23-96

BORING NO.: DD-15 Sample No.: D-5
 Dry Density (pcf): 106.4 DEPTH(ft): 25.0
 Soil Description: Light Olive Brown Poorly Graded Sand (SP)
 Initial Moisture (%): 6.1 Final Moisture (%): 19.7
 Initial Length (in.): 1.0000 Final Dry Density (pcf): 105.6
 Initial Dial Reading: 0.3330 Initial Void Ratio: 0.585
 Diameter(in): 2.425 Specific Gravity: (assumed) 2.70
 Initial Saturation (%): 27.9 Final Saturation (%): 89.3

PRESSURE (p) (ksf)	FINAL READING (in)	APPARENT THICKNESS (in)	APPARATUS COMPLIANCE (%)	SWELL (+) SETTLEMENT (-) % OF SAMPLE THICKNESS	VOID RATIO	CORRECTED SWELL (+) SETTLEMENT (-) (%)
0.10	0.3329	1.0000	0.00	0.00	0.585	0.00
0.25	0.3311	0.9982	0.04	-0.18	0.583	-0.22
0.50	0.3281	0.9952	0.06	-0.48	0.578	-0.54
1.00	0.3219	0.9890	0.12	-1.10	0.569	-1.22
2.00	0.3150	0.9821	0.19	-1.79	0.559	-1.98
3.00	0.3097	0.9768	0.24	-2.32	0.552	-2.56
H2O	0.3069	0.9740	0.24	-2.60	0.547	-2.84

Swell / Collapse Potential, percent **-0.28**

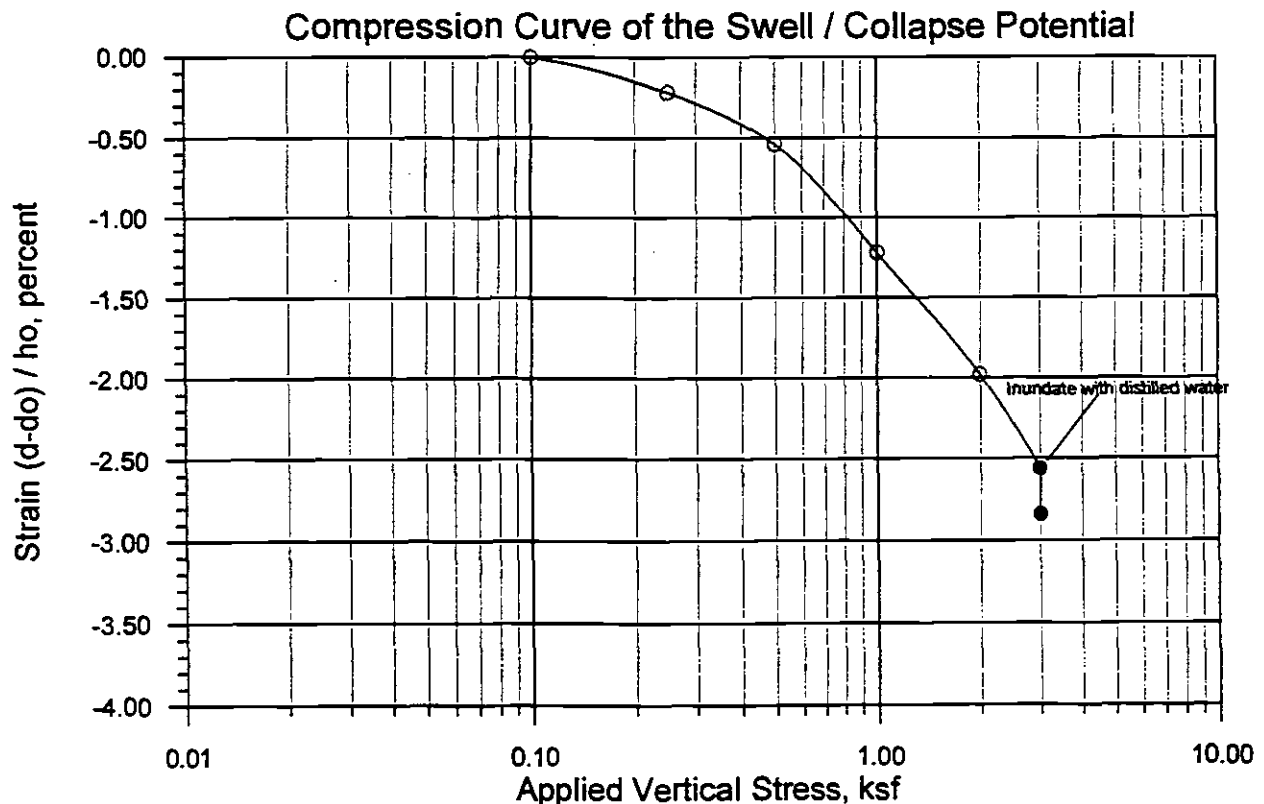


Figure B-126a

BORING NO.: DD-15

Sample No. :

D-5

DEPTH(ft.):

25.0

Calculation

Sample Diameter(in):	2.425
Sample Thickness(in.):	1.000
Weight of Sample + ring(gm):	182.47
Weight of Ring(gm):	45.71
Height after consolidation(in.):	0.9716

Before Test

Weight of Wet Sample + Cont. (gm):	173.31
Weight of Dry Sample + Cont. (gm):	167.34
Weight of Container(gm):	68.69

After Test

Weight of Wet Sample + Cont. + Ring (gm):	271.15
Weight of Dry Sample + Cont. + Ring (gm):	246.61
Weight of Container(gm):	76.54
Vertical Rdg. (in): Initial	0.3330
Vertical Rdg. (in): Final	0.3069
Specific Gravity:	2.70

Water Density(pcf):	62.43
Wet density(pcf):	112.8

Final Saturation (%)	89.3
Final Dry Density (pcf)	105.6

TIME READING

Elapsed Time	Dial Rdgs.
0.10	0.3096
0.25	0.3096
0.50	0.3096
1	0.3095
2	0.3094
4	0.3093
8	0.3091
16	0.3089
30	0.3086
60	0.3084
120	0.3082
240	0.3079
1423	0.3072
3013	0.3069

0.100 0.000

0.250 -0.220

0.500 -0.540

1.000 -1.220

2.000 -1.980

3.000 -2.560

3.000

-2.840

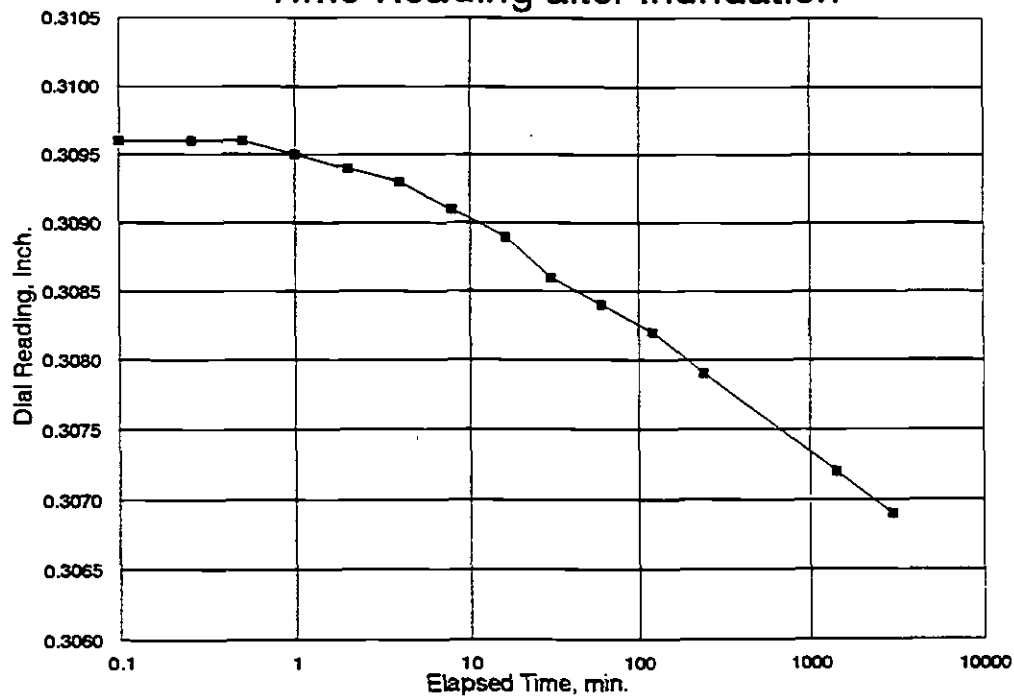
Time Reading after Inundation

Figure B-126b

TABLE B-9
SATURATED HYDRAULIC CONDUCTIVITY
(TRIAXIAL CELL)
 TEST PROCEDURE NO. ASTM D 5084/EPA 9100
 FALLING HEAD METHOD

Project Name:	Eastside Ext. - Metro Redline III	Cell Pressure:	102.2 psi	Initial Sample Height:	3.0183 in
Project No:	95-8347-23	Bottom Pressure (Pb):	83.2 psi	Initial Area of Sample:	4.6186 sq. in.
Boring No.:	DD-14	Top Pressure (Pt):	82.2 psi	Final Sample Ht. * (L):	2.9983 in
Depth (ft):	23.0	Consolidation Pressure:	20.0 psi	Final Sample Area (A)*:	4.5569 sq. in.
Sample No.:	D-5	Burette Area (influent) (Ai):	0.415 sq. in.	Tested by:	TM / PAA Date: 11/06/95
Sample Type:	Drive	Burette Area (effluent) (Ao):	0.374 sq. in.	Input Checked by:	LF Date: 11-9-95
Sample Description:	O. Brown, P. G. Sand w/ Silt, (SP Vol. Change During Consol.):		0.278 cu. in.		

* After Consolidation

	Time	Incremental Elapsed Time (t) (min)	Temp. °C	Water Height Influent Burette (hi) (cm)	Water Height Effluent Burette (ho) (cm)	Uncorrected Hydraulic Conductivity (k) (cm/sec)	Corrected Conductivity at 20 °C (cm/sec)	Inflow Rate/ Outflow Rate	Remarks
08-Nov-95	08:41 AM	0		27.3	3.0				Initial Reading
08-Nov-95	08:41 AM	0.5	23.8	23.4	7.0	9.6E-04	8.7E-04	1.08	Average Last 4 rdgs= 7.0E-04
08-Nov-95	08:42 AM	0.5	23.8	20.0	10.5	9.1E-04	8.3E-04	1.08	Upper Limit= 8.8E-04
08-Nov-95	08:42 AM	0.5	23.8	16.9	13.7	9.0E-04	8.2E-04	1.07	Lower Limit= 5.3E-04
08-Nov-95	08:43 AM	0.5	23.8	14.7	16.4	7.6E-04	6.9E-04	0.90	
08-Nov-95	08:43 AM	0.5	23.8	12.2	19.0	8.5E-04	7.7E-04	1.07	
08-Nov-95	08:44 AM	0.5	23.8	10.0	21.1	7.7E-04	7.0E-04	1.16	
08-Nov-95	08:44 AM	0.5	23.8	8.0	23.0	7.5E-04	6.8E-04	1.17	
08-Nov-95	08:45 AM	0.5	23.8	6.3	24.8	7.2E-04	6.6E-04	1.05	

$$k = \frac{A_i A_o L \ln(h_1/h_2)}{A_t (A_i + A_o)}$$

where $h_1, h_2 = ((P_b - P_t)/Y) + (h_i - h_o)$ at t_0 - (change in h_i + change in h_o) at t_1 and t_2

Y = Water Density

TABLE B-10
SATURATED HYDRAULIC CONDUCTIVITY
 (TRIAxIAL CELL)
 TEST PROCEDURE NO. ASTM D 5084/EPA 9100
 FALLING HEAD METHOD

Project Name:	Eastside Ext. - Metro Redline III	Cell Pressure:	106.6 psi	Initial Sample Height:	3.0133 in
Project No:	95-8347-23	Bottom Pressure (Pb):	73.7 psi	Initial Area of Sample:	4.5996 sq. in.
Boring No.:	DD-52	Top Pressure (Pt):	71.6 psi	Final Sample Ht.* (L):	2.9747 in
Depth(ft):	41	Consolidation Pressure:	35.0 psi	Final Sample Area (A)*:	4.4802 sq. in.
Sample No.:	D-12A	Burette Area (Influent) (A _I):	0.036 sq. in.	Tested by:	KIAT
Sample Type:	Drive	Burette Area (effluent) (A _o):	0.036 sq. in.	Date:	11/09/95
Sample Description:	Olive Silty Sand (SM)	Vol. Change During Consol.:	0.533 cu. in.	Input Checked by:	LF
				Date:	11/14/95

* After Consolidation

	Time	Incremental Elapsed Time (t) (min)	Temp. ° C	Water Height Influent Burette (h ₁) (cm)	Water Height Effluent Burette (h ₂) (cm)	Uncorrected Hydraulic Conductivity(k) (cm/sec)	Corrected Conductivity at 20 °C (cm/sec)	Inflow Rate/ Outflow Rate	Remarks
09-Nov-95	10:01 AM	0		28.1	2.2				Initial Reading
09-Nov-95	10:19 AM	18	24.7	27.3	3.0	2.6E-07	2.4E-07	1.00	Average Last 4 rdgs= 1.9E-07
09-Nov-95	10:54 AM	35	24.5	25.9	4.4	2.4E-07	2.2E-07	1.00	Upper Limit= 2.4E-07
09-Nov-95	11:29 AM	35	24.4	24.6	5.7	2.3E-07	2.0E-07	1.00	Lower Limit= 1.4E-07
09-Nov-95	12:01 PM	32	24.4	23.4	6.9	2.3E-07	2.1E-07	1.00	
09-Nov-95	01:12 PM	71	24.3	20.8	9.3	2.2E-07	2.0E-07	1.08	
09-Nov-95	02:10 PM	58	24.3	18.9	11.1	2.1E-07	1.9E-07	1.06	
09-Nov-95	02:55 PM	45	24.3	17.4	12.5	2.1E-07	1.9E-07	1.07	
09-Nov-95	04:14 PM	79	24.2	15.0	14.8	2.0E-07	1.8E-07	1.04	
09-Nov-95	04:43 PM	29	24.2	14.1	15.7	2.2E-07	2.0E-07	1.00	

$$k = \frac{A_I A_o L}{A \ln(h_1/h_2)} \frac{1}{t} \frac{(A_I + A_o)}{A}$$

where $h_1, h_2 = ((P_b - P_t)/\gamma + (h_1 - h_2))$ at $t_0 = (\text{change in } h_1 + \text{change in } h_2) \text{ at } t_0$ and $t_1 = (\text{change in } h_1 + \text{change in } h_2) \text{ at } t_1$

TABLE B-11
SATURATED HYDRAULIC CONDUCTIVITY
 (TRIAXIAL CELL)

TEST PROCEDURE NO. ASTM D 5084/EPA 9100
 FALLING HEAD METHOD

Project Name:	Eastside Ext. - Metro Redline III	Cell Pressure:	122.5 psi	Initial Sample Height:	2.0117 in
Project No:	95-8347-23	Bottom Pressure (Pb):	83.4 psi	Initial Area of Sample:	4.6186 sq. in.
Boring No.:	DD-56-1	Top Pressure (Pt):	82.4 psi	Final Sample Ht.* (L):	2.0028 in
Depth(ft):	50	Consolidation Pressure:	40.1 psi	Final Sample Area (A)*:	4.5778 sq. in.
Sample No.:	D-14	Burette Area (Influent) (Ai):	0.408 sq. in.	Tested by:	TM / PAA Date: 11/13/95
Sample Type:	Drive	Burette Area (effluent) (Ao):	0.389 sq. in.	Input Checked by:	Date:
Sample Description:	O. Brown, P. G. Sand w/ Silt, (SP) Vol. Change During Consol.: 0.123 cu. in.				

* After Consolidation

	Time	Incremental Elapsed Time (t) (min)	Temp. ° C	Water Height Influent Burette (hi) (cm)	Water Height Effluent Burette (ho) (cm)	Uncorrected Hydraulic Conductivity (k) (cm/sec)	Corrected Conductivity at 20 °C (cm/sec)	Inflow Rate/ Outflow Rate	Remarks
15-Nov-95	08:39 AM	0		27.6	2.5				Initial Reading
15-Nov-95	08:41 AM	2	22.9	26.2	3.8	5.3E-05	4.9E-05	1.13	Average Last 4 rdgs= 3.4E-05
15-Nov-95	08:43 AM	2	22.9	25.0	5.1	5.0E-05	4.7E-05	0.97	Upper Limit= 4.3E-05
15-Nov-95	08:45 AM	2	22.9	24.0	6.3	4.6E-05	4.3E-05	0.87	Lower Limit= 2.6E-05
15-Nov-95	08:47 AM	2	22.9	23.1	7.3	4.0E-05	3.8E-05	0.94	
15-Nov-95	08:49 AM	2	22.9	22.2	8.3	4.1E-05	3.8E-05	0.94	
15-Nov-95	08:51 AM	2	22.9	21.3	9.3	4.2E-05	3.9E-05	0.94	
15-Nov-95	08:53 AM	2	22.9	20.5	10.2	3.8E-05	3.6E-05	0.93	
15-Nov-95	08:55 AM	2	22.9	19.8	11.0	3.5E-05	3.2E-05	0.92	
15-Nov-95	08:58 AM	3	22.9	18.6	12.2	3.8E-05	3.5E-05	1.05	
15-Nov-95	09:01 AM	3	23.0	17.4	13.3	3.7E-05	3.5E-05	1.14	
15-Nov-95	09:04 AM	3	23.0	16.4	14.4	3.5E-05	3.3E-05	0.95	
15-Nov-95	09:07 AM	3	23.0	15.4	15.5	3.6E-05	3.4E-05	0.95	
15-Nov-95	09:10 AM	3	23.0	14.4	16.6	3.7E-05	3.5E-05	0.95	

$$k = A_i A_o L \ln(h_1/h_2) / (A \cdot t \cdot (A_i + A_o))$$

where $h_1, h_2 = ((P_b - P_t) / Y + (h_i - h_o))$ at t_0 - (change in h_i + change in h_o) at t_1 and t_2

Y = Water Density

TABLE B-12
SATURATED HYDRAULIC CONDUCTIVITY
 (TRIAxIAL CELL)

TEST PROCEDURE NO. ASTM D 5084/EPA 9100
 FALLING HEAD METHOD

Project Name:	Eastside Ext. - Metro Redline III	Cell Pressure:	146.3 psi	Initial Sample Height:	3.0127 in
Project No:	95-8347-23	Bottom Pressure (Pb):	82.3 psi	Initial Area of Sample:	4.5958 sq. in.
Boring No.:	SD-8	Top Pressure (Pt):	81.3 psi	Final Sample Ht. * (L):	2.9968 in
Depth(ft):	75.0	Consolidation Pressure:	65.0 psi	Final Sample Area (A)*:	4.5470 sq. in.
Sample No.:	D-16	Burette Area (influent) (Ai):	0.387 sq. in.	Tested by:	RA Date: 11/14/95
Sample Type:	Drive	Burette Area (effluent) (Ao):	0.398 sq. in.	Input Checked by:	Date: 11/16/95
Sample Description:	Dark Yell Brwn, Silty Sand (SM) Vol. Change During Consol.: 0.219 cu. in.				

* After Consolidation

	Time	Incremental Elapsed Time (t)	Temp.	Water Height Influent Burette (hi)	Water Height Effluent Burette (ho)	Uncorrected Hydraulic Conductivity(k)	Corrected Conductivity at 20 °C	Inflow Rate/ Outflow Rate	Remarks
	(min)	(min)	° C	(cm)	(cm)	(cm/sec)	(cm/sec)		
16-Nov-95	09:15 AM	0		27.1	1.8				Initial Reading
16-Nov-95	09:16 AM	1	23.1	24.5	4.4	3.1E-04	2.8E-04	0.97	Average Last 4 rdgs= 1.7E-04
16-Nov-95	09:18 AM	2	23.1	19.9	8.9	2.9E-04	2.7E-04	0.99	Upper Limit= 2.1E-04
16-Nov-95	09:19 AM	1	23.1	18.0	10.9	2.7E-04	2.5E-04	0.92	Lower Limit= 1.3E-04
16-Nov-95	09:20 AM	1	23.1	16.0	12.7	2.8E-04	2.6E-04	1.08	
16-Nov-95	09:21 AM	1	23.1	14.3	14.4	2.6E-04	2.4E-04	0.97	
16-Nov-95	09:22 AM	1	23.1	12.8	15.9	2.4E-04	2.2E-04	0.97	
16-Nov-95	09:23 AM	1	23.1	11.3	17.3	2.4E-04	2.2E-04	1.04	
16-Nov-95	09:25 AM	2	23.1	8.7	19.8	2.3E-04	2.1E-04	1.01	
16-Nov-95	09:26 AM	1	23.1	7.6	20.8	2.0E-04	1.8E-04	1.07	
16-Nov-95	09:27 AM	1	23.1	6.5	21.9	2.1E-04	2.0E-04	0.97	
16-Nov-95	09:28 AM	1	23.1	5.5	22.9	2.0E-04	1.9E-04	0.97	
16-Nov-95	09:29 AM	1	23.1	4.6	23.8	1.9E-04	1.8E-04	0.97	
16-Nov-95	09:30 AM	1	23.1	3.8	24.5	1.6E-04	1.5E-04	1.11	
16-Nov-95	09:31 AM	1	23.1	3.0	25.2	1.7E-04	1.6E-04	1.11	

$$k = \frac{A_i A_o}{A} \ln(h_1/h_2) / (A t (A_i + A_o))$$

where $h_1 = h_2 = (P_b - P_t) / \gamma$ (hi, ho) at t = 0, (change hi, ho) at t = t

APPENDIX C

CHEMICAL LABORATORY TEST RESULTS

CHEMICAL LABORATORY TEST RESULTS

The laboratory test results pertaining to chemical analyses of groundwater samples collected from Monitoring Wells DD-15 and PE-21 in this appendix. Groundwater samples collected from the above Monitoring Wells and Borings were transported to CKY, Inc. of Torrance, California, for a limited characterization of potential chemical contamination.

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 180.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	NA
CONTROL NO.:	TUJ002WL	DATE ANALYZED:	10/13/95
ACCESSION:	95J033 95J031		

PARAMETER	TRUE VALUE (NTU)	FOUND VALUE (NTU)	LCS RECOVERY (%)
-----	-----	-----	-----
Turbidity	2.40	2.44	102

QC LIMIT: 85-115

EPA METHOD 180.1
TURBIDITY

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 10/13/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 10/13/95
BATCH NO.:   95J033                     DATE EXTRACTED:  NA
MATRIX:      WATER                       DATE ANALYZED:  10/13/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (NTU)	DILUTION FACTOR	MDL (NTU)
-----	-----	-----	-----	-----
PE-21-11	J033-13	270	8	8
MBLK1W	TUJ002WB	ND	1	1

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 180.1
MATRIX: WATER

=====

BATCH NO.:	95J033	DATE RECEIVED:	NA
SAMPLE ID:	MW133B-WQ4	DATE EXTRACTED:	NA
CONTROL NO.:	J031-16	DATE ANALYZED:	10/13/95
ACCESSION:	95J031 95J033		

PARAMETER	Sample (NTU)	Dup. Sample (NTU)	RPD (%)
-----	-----	-----	-----
Turbidity	ND	ND	0

QC LIMIT: 20



CKY incorporated Analytical Laboratories

Date: 12-12-1995
CKY Batch No.: 95K123

Attn.: Grant Miller

Earth Technology Corp.
2121 Alton Parkway, Suite 100
Irvine, CA 92714

Subject: Laboratory Report
Project: Metro Redline Eastside Extens.

Enclosed is the Laboratory report for samples received on 11/29/95. The samples were received in coolers with ice and intact; the chain-of-custody forms were properly filled out. The data reported include:

Sample ID	Control No.	Matrix	Analysis
DD-15-1	K123-01	Water	EPA 625
DD-15-2	K123-02	Water	EPA 418.1
DD-15-3	K123-03	Water	EPA M8015
DD-15-4	K123-04	Water	Dissolved Metals
DD-15-5	K123-05	Water	Mercury
DD-15-6	K123-06	Water	Chloride
DD-15-7	K123-07	Water	Sulfate
DD-15-8	K123-08	Water	Sulfide
			Nitrate/Nitrite
			BOD
			Settleable Solids
			pH
			EPA 160.2 (TSS)
			TDS
			Turbidity
DD-15-9	K123-09	Water	Oil & Grease
DD-15-10,11	K123-10	Water	EPA 601
			EPA 602

The results are summarized on the following pages.

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

Sincerely yours,


Kam Y. Pang, Ph.D.
Laboratory Director

P.S. - All analyses requested for the above referenced project have been completed. Therefore, unless instructed, the remaining portions of the samples will be disposed after fifteen (15) days from the date of this report.

EPA METHOD 3550/625
SEMI VOLATILE ORGANICS BY GC/MS

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	11/29/91
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	11/29/91
BATCH NO.:	95K123	DATE EXTRACTED:	12/01/91
SAMPLE ID:	DD-15-1	DATE ANALYZED:	12/03/91
CONTROL NO.:	K123-01	MATRIX:	WATER
% MOISTURE:	NA	DILUTION FACTOR:	1

PARAMETERS		(ug/L)	PARAMETERS		(ug/L)
RESULT	RL		RESULT	RL	
N-Nitrosodimethylamine	ND	10	3-Nitroaniline	ND	25
Pyridine	ND	10	Acenaphthene	ND	10
Aniline	ND	10	2,4-Dinitrophenol	ND	25
Phenol	ND	10	4-Nitrophenol	ND	25
bis(2-Chloroethyl) ether	ND	10	Dibenzofuran	ND	10
2-Chlorophenol	ND	10	2,4-Dinitrotoluene	ND	10
1,3-Dichlorobenzene	ND	10	Diethylphthalate	ND	10
1,4-Dichlorobenzene	ND	10	4-Chlorophenyl-phenylether	ND	10
Benzyl Alcohol	ND	10	Fluorene	ND	10
1,2-Dichlorobenzene	ND	10	1,2-Diphenylhydrazine	ND	25
2-Methylphenol	ND	10	4-Nitroaniline	ND	25
2,2'-oxybis(1-Chloropropane)	ND	10	4,6-Dinitro-2-methylphenol	ND	25
4-Methylphenol (2)	ND	10	N-Nitrosodiphenylamine (1)	ND	10
N-Nitroso-di-n-propylamine	ND	10	4-Bromophenyl-phenylether	ND	10
Hexachloroethane	ND	10	Hexachlorobenzene	ND	10
Nitrobenzene	ND	10	Pentachlorophenol	ND	25
Isophorone	ND	10	Benazidine	ND	25
2-Nitrophenol	ND	10	Phenanthrene	ND	10
2,4-Dimethylphenol	ND	10	Anthracene	ND	10
Benzoic Acid	ND	25	Carbazole	ND	10
bis(2-Chloroethoxy)methane	ND	10	Di-n-butylphthalate	ND	10
2,4-Dichlorophenol	ND	10	Fluoranthene	ND	10
1,2,4-Trichlorobenzene	ND	10	4,4'-Methylene Dianiline	ND	25
Naphthalene	ND	10	Pyrene	ND	10
4-Chloroaniline	ND	10	Bisphenol-A	ND	10
Hexachloro-1,3-butadiene	ND	10	Butylbenzylphthalate	ND	10
4-Chloro-3-methylphenol	ND	10	3,3'-Dichlorobenzidine	ND	10
2-Methylnaphthalene	ND	10	Benzo(a)anthracene	ND	10
Hexachlorocyclopentadiene	ND	10	Chrysene	ND	10
2,4,6-Trichlorophenol	ND	10	bis(2-Ethylhexyl)phthalate	ND	10
2,4,5-Trichlorophenol	ND	25	Di-n-octylphthalate	ND	10
2-Chloronaphthalene	ND	10	Benzo(b)fluoranthene	ND	10
1-Chloronaphthalene	ND	10	Benzo(k)fluoranthene	ND	10
2-Nitroaniline	ND	25	Benzo(a)pyrene	ND	10
Dimethylphthalate	ND	10	Indeno(1,2,3-cd)pyrene	ND	10
Acenaphthylene	ND	10	Dibenzo(a,h)anthracene	ND	10
2,6-Dinitrotoluene	ND	10	Benzo(g,h,i)perylene	ND	10

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Nitrobenzene-d5	46	35-114
2-Fluorobiphenyl	74	43-116
Terphenyl-d14	59	33-141
Phenol-d5	55	10-94
2-Fluorophenol	54	21-110
2,4,6-Tribromophenol	41	10-123

RL : Reporting Limit
(1) : Cannot be separated from Diphenylamine
(2) : Cannot be separated from 3-Methylphenol

EPA METHOD 3550/625
SEMI VOLATILE ORGANICS BY GC/MS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
ATCH NO.: 95K123
SAMPLE ID: MBLK1W
CONTROL NO.: SVL002WB
% MOISTURE: NA

DATE COLLECTED: NA
DATE RECEIVED: NA
DATE EXTRACTED: 12/01/95
DATE ANALYZED: 12/02/95
MATRIX: WATER
DILUTION FACTOR: 1

PARAMETERS		(ug/L)		PARAMETERS		(ug/L)	
RESULT	RL	RESULT	RL	RESULT	RL	RESULT	RL
N-Nitrosodimethylamine	ND	10	3-Nitroaniline	ND	25		
Pyridine	ND	10	Acenaphthene	ND	10		
Aniline	ND	10	2,4-Dinitrophenol	ND	25		
Phenol	ND	10	4-Nitrophenol	ND	25		
bis(2-Chloroethyl) ether	ND	10	Dibenzofuran	ND	10		
2-Chlorophenol	ND	10	2,4-Dinitrotoluene	ND	10		
1,3-Dichlorobenzene	ND	10	Diethylphthalate	ND	10		
1,4-Dichlorobenzene	ND	10	4-Chlorophenyl-phenylether	ND	10		
Benzyl Alcohol	ND	10	Fluorene	ND	10		
1,2-Dichlorobenzene	ND	10	1,2-Diphenylhydrazine	ND	25		
2-Methylphenol	ND	10	4-Nitroaniline	ND	25		
2,2'-oxybis(1-Chloropropane)	ND	10	4,6-Dinitro-2-methylphenol	ND	25		
4-Methylphenol (2)	ND	10	N-Nitrosodiphenylamine (1)	ND	10		
N-Nitroso-di-n-propylamine	ND	10	4-Bromophenyl-phenylether	ND	10		
Hexachloroethane	ND	10	Hexachlorobenzene	ND	10		
Nitrobenzene	ND	10	Pentachlorophenol	ND	25		
Isophorone	ND	10	Benzidine	ND	25		
2-Nitrophenol	ND	10	Phenanthrene	ND	10		
2,4-Dimethylphenol	ND	10	Anthracene	ND	10		
Benzoic Acid	ND	25	Carbazole	ND	10		
bis(2-Chloroethoxy) methane	ND	10	Di-n-butylphthalate	ND	10		
2,4-Dichlorophenol	ND	10	Fluoranthene	ND	10		
1,2,4-Trichlorobenzene	ND	10	4,4'-Methylene Dianiline	ND	25		
aphthalene	ND	10	Pyrene	ND	10		
1-Chloroaniline	ND	10	Bisphenol-A	ND	10		
Hexachloro-1,3-butadiene	ND	10	Butylbenzylphthalate	ND	10		
4-Chloro-3-methylphenol	ND	10	3,3'-Dichlorobenzidine	ND	10		
2-Methylnaphthalene	ND	10	Benzo(a)anthracene	ND	10		
Hexachlorocyclopentadiene	ND	10	Chrysene	ND	10		
2,4,6-Trichlorophenol	ND	10	bis(2-Ethylhexyl)phthalate	ND	10		
2,4,5-Trichlorophenol	ND	25	Di-n-octylphthalate	ND	10		
2-Chloronaphthalene	ND	10	Benzo(b)fluoranthene	ND	10		
1-Chloronaphthalene	ND	10	Benzo(k)fluoranthene	ND	10		
2-Nitroaniline	ND	25	Benzo(a)pyrene	ND	10		
Dimethylphthalate	ND	10	Indeno(1,2,3-cd)pyrene	ND	10		
Acenaphthylene	ND	10	Dibenzo(a,h)anthracene	ND	10		
2,6-Dinitrotoluene	ND	10	Benzo(g,h,i)perylene	ND	10		

SURROGATE PARAMETER	% RECOVERY	QC LIMIT
Nitrobenzene-d5	75	35-114
2-Fluorobiphenyl	79	43-116
Terphenyl-d14	75	33-141
Phenol-d5	64	10-94
2-Fluorophenol	59	21-110
2,4,6-Tribromophenol	84	10-123

RL : Reporting Limit
(1): Cannot be separated from Diphenylamine
(2): Cannot be separated from 3-Methylphenol

CKY QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 625
MATRIX: WATER
MOISTURE: NA

BATCH NO.: 95K123
SAMPLE ID: LCS1W/LCS1WD
CONTROL NO.: SVL002WL/C

DATE RECEIVED: NA
DATE EXTRACTED: 12/01/95
DATE ANALYZED: 12/02/95

ACCESSION: 95K123 95K132

PARAMETER	BLNK RSLT (ug/L)	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	RPD %	QC LIMIT %	RPD LIMIT %
Phenol	ND	150	83	55	150	80	53	4	5-112	42
2-Chlorophenol	ND	150	125	83	150	117	78	7	23-134	40
1,4-Dichlorobenzene	ND	100	77	77	100	72	72	7	20-124	28
N-Nitroso-di-n-propyl.	ND	100	63	63	100	61	61	3	D-230	38
1,2,4-Trichlorobenzene	ND	100	69	69	100	66	66	4	44-142	28
4-Chloro-3-Methylphenol	ND	150	88	59	150	83	55	6	22-147	42
Acenaphthene	ND	100	73	73	100	75	75	3	47-145	31
4-Nitrophenol	ND	150	59	39	150	62	41	5	D-132	50
2,4-Dinitrotoluene	ND	100	71	71	100	73	73	3	39-139	38
Pentachlorophenol	ND	150	76	51	150	76	51	0	14-179	50
Pyrene	ND	100	65	65	100	67	67	3	52-115	31

SURROGATE PARAMETER	SPIKE AMT (ug/L)	BS RSLT (ug/L)	BS % REC	SPIKE AMT (ug/L)	BSD RSLT (ug/L)	BSD % REC	QC LIMIT %
Nitrobenzene	100	50	50	100	45	45	35-114
Fluorobiphenyl	100	72	72	100	71	71	43-116
phenyl-d14	100	56	56	100	54	54	33-141
phenol-d5	150	93	62	150	85	57	10-94
2-Fluorophenol	150	92	61	150	83	55	21-100
2,4,6-Tribromophenol	150	57	38	150	60	40	10-123

EPA METHOD 418.1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

=====

CLIENT:	Earth Technology Corp.	DATE COLLECTED:	11/29/95
PROJECT:	Metro Redline Eastside Extens.	DATE RECEIVED:	11/29/95
BATCH NO.:	95K123	DATE EXTRACTED:	12/08/95
MATRIX:	WATER	DATE ANALYZED:	12/09/95

=====

SAMPLE ID	CONTROL NO	RESULT (mg/L)	DILUTION FACTOR	MDL (mg/L)
DD-15-2	K123-02	ND	1	1
MBLK1W	TRL002WB	ND	1	1

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 418.1
MATRIX: WATER

BATCH NO.: 95K123
SAMPLE ID: LCS1W/LCS1WD
CONTROL NO.: TRL002WL/C
DATE RECEIVED: NA
DATE EXTRACTED: 12/08/95
DATE ANALYZED: 12/09/95
ACCESSION: 95K123

PARAMETER	SAMPLE CONC (mg/L)	SPIKE ADDED (mg/L)	LCS CONC (mg/L)	LCS % REC	SPIKE ADDED (mg/L)	LCSD CONC (mg/L)	LCSD % REC	% RPD
TRPH	ND	5.00	5.82	116	5.00	5.86	117	
QC LIMIT:				75-125			75-125	30

EPA METHOD M8015
TOTAL PETROLEUM HYDROCARBONS BY EXTRACTION

```
=====
CLIENT:      Earth Technology Corp.          DATE COLLECTED: 11/29/9
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  11/29/9
BATCH NO.:   95K123                        DATE EXTRACTED: 12/01/9
MATRIX:      WATER                         DATE ANALYZED:  12/05/9
=====
```

SAMPLE ID	CONTROL NO	RESULT (mg/L)	H-C RANGE	% RECOVERY		DL FACTOR	MDL (mg/L)
				SURR1	SURR2		
DD-15-3	K123-03	ND	N.A.	83	96	1	.05
MBLK1W	DSL001WB	ND	N.A.	84	94	1	.05

```
QC LIMIT:                               65-135    60-140
SURR1    : Bromobenzene
SURR2    : Hexacosane
MDL      : Method Detection Limit
```

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA M8015
MATRIX: WATER

BATCH NO.: 95K123 DATE RECEIVED: NA
SAMPLE ID: LCS1W/LCS1WD DATE EXTRACTED: 12/01/95
CONTROL NO.: DSL001WL/C DATE ANALYZED: 12/05/95

ACCESSION: 95K123 95K126 95K132

PARAMETER	SAMPLE CONC (mg/L)	SPIKE ADDED (mg/L)	LCS CONC (mg/L)	LCS % REC	SPIKE ADDED (mg/L)	LCSD CONC (mg/L)	LCSD % REC	% RPD
Diesel	ND	1.00	0.97	97	1.00	0.90	90	7
Bromobenzene	ND	1.00	0.84	84	1.00	0.84	84	0
Hexacosane	ND	1.00	0.88	88	1.00	0.92	92	4

QC LIMIT: 65-135 65-135 30

SURROGATE QC LIMITS:

Bromobenzene	65-135	65-135
Hexacosane	60-140	60-140



EPA METHOD 3005/6010
CAM METALS BY ICP

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED: 11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED: 11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED: 11/28/95
SAMPLE ID:   DD-15-4                     DATE ANALYZED: 11/30/95
CONTROL NO.: K123-04                     MATRIX:      WATER
% MOISTURE:   NA                         DILUTION FACTOR: 1
=====
```

PARAMETER	DET LIMIT (ug/L)	RESULT (ug/L)
Antimony	60	ND
Arsenic	100	ND
Barium	10	43.7
Beryllium	5	ND
Cadmium	5	ND
Chromium	10	ND
Cobalt	10	ND
Copper	10	ND
Lead	100	ND
Molybdenum	50	ND
Nickel	20	ND
Selenium	200	ND
Silver	10	ND
Thallium	500	ND
Vanadium	10	ND
Zinc	10	16.7

EPA METHOD 3005/6010
CAM METALS BY ICP

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  NA
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  NA
BATCH NO.:   95K123                     DATE EXTRACTED:   11/28/95
SAMPLE ID:   MBLK1W                     DATE ANALYZED:    11/30/95
CONTROL NO.: IPK040WB                   MATRIX:         WATER
% MOISTURE:  NA                         DILUTION FACTOR:  1
=====
```

PARAMETER	DET LIMIT (ug/L)	RESULT (ug/L)
Antimony	60	ND
Arsenic	100	ND
Barium	10	ND
Beryllium	5	ND
Cadmium	5	ND
Chromium	10	ND
Cobalt	10	ND
Copper	10	ND
Lead	100	ND
Molybdenum	50	ND
Nickel	20	ND
Selenium	200	ND
Silver	10	ND
Thallium	500	ND
Vanadium	10	ND
Zinc	10	ND

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 3005/6010
MATRIX: WATER

BATCH NO.: 95K123
SAMPLE ID: CTO-276PW-1195
CONTROL NO.: K115-11
DATE RECEIVED: NA
DATE EXTRACTED: 11/28/95
DATE ANALYZED: 11/30/95
ACCESSION: 95K099 95K112 95K115 95K123 95K124 95K125 95K126

PARAMETER	SAMPLE RESULT (ug/L)	DUP SAMPLE RESULT (ug/L)	RPD RESULT (%)
Antimony	ND	ND	0
Arsenic	ND	ND	0
Barium	157	170	8
Beryllium	ND	ND	0
Cadmium	9.42	10.3	9
Chromium	ND	ND	0
Cobalt	34	43	23
Copper	ND	ND	0
Lead	ND	ND	0
Molybdenum	ND	ND	0
Nickel	61	68.7	12
Selenium	ND	ND	0
Silver	ND	ND	0
Thallium	ND	ND	0
Vanadium	ND	ND	0
Zinc	60.1	65.8	9
QC LIMIT:			20



CKY QUALITY CONTROL DATA
SPIKE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 3005/6010
MATRIX: WATER

BATCH NO.: 95K123 DATE RECEIVED: NA
SAMPLE ID: CTO-276PW-1195 DATE EXTRACTED: 11/28/95
CONTROL NO.: K115-11 DATE ANALYZED: 11/30/95

ACCESSION: 95K099 95K112 95K115 95K123 95K124 95K125 95K126

PARAMETER	SAMPLE RESULT (ug/L)	SPIKE CONC. (ug/L)	SPIKE RESULT (ug/L)	SPIKE RECRY. (%)
Antimony	ND	500	444	89
Arsenic	ND	1000	964	96
Barium	157	1000	1090	94
Beryllium	ND	1000	898	90
Cadmium	9.42	1000	941	93
Chromium	ND	1000	890	89
Cobalt	34	1000	925	89
Copper	ND	1000	977	98
Lead	ND	1000	899	90
Molybdenum	ND	1000	900	90
Nickel	61	1000	934	87
Selenium	ND	1000	1000	100
Silver	ND	1000	963	96
Thallium	ND	1000	886	89
Vanadium	ND	1000	909	91
Zinc	60.1	1000	998	94

QC LIMIT:

75-125

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 3005/6010
MATRIX: WATER

BATCH NO.: 95K123 DATE RECEIVED: NA
SAMPLE ID: LCS1W/LCS1WD DATE EXTRACTED: 11/28/95
CONTROL NO.: IPK040WL/C DATE ANALYZED: 11/30/95

ACCESSION: 95K099 95K112 95K115 95K123 95K124 95K125 95K126

PARAMETER	SAMPLE CONC (ug/L)	SPIKE ADDED (ug/L)	LCS CONC (ug/L)	% LCS REC	SPIKE ADDED (ug/L)	LCSD CONC (ug/L)	% LCSD REC	% RPD
Antimony	ND	500	484	97	500	461	92	5
Arsenic	ND	1000	994	99	1000	980	98	1
Barium	ND	1000	997	100	1000	1002	100	0
Beryllium	ND	1000	1000	100	1000	1003	100	0
Cadmium	ND	1000	1000	100	1000	1003	100	0
Chromium	ND	1000	1013	101	1000	1015	102	0
Cobalt	ND	1000	1018	102	1000	1014	101	0
Copper	ND	1000	997	100	1000	1003	100	1
Lead	ND	1000	1013	101	1000	1002	100	1
Molybdenum	ND	1000	983	98	1000	998	100	2
Nickel	ND	1000	1013	101	1000	1017	102	0
Selenium	ND	1000	1000	100	1000	981	98	2
Silver	ND	1000	1009	101	1000	1014	101	1
Thallium	ND	1000	1027	103	1000	984	98	4
Vanadium	ND	1000	995	100	1000	999	100	0
Zinc	ND	1000	1005	101	1000	1010	101	0

QC LIMIT: 75-125 75-125 20

EPA METHOD 7470
MERCURY BY COLD VAPOR

```
=====
CLIENT:      Earth Technology Corp.      DATE COLLECTED:  11/29/95
PROJECT:     Metro Redline Eastside Extens. DATE RECEIVED:  11/29/95
BATCH NO.:   95K123                     DATE EXTRACTED:   11/30/95
MATRIX:      WATER                       DATE ANALYZED:    11/30/95
=====
```

SAMPLE ID	CONTROL NO	RESULT (ug/L)	DILUTION FACTOR	MDL (ug/L)
DD-15-4	K123-04	ND	1	.2
MBLK1W	HGK040WB	ND	1	.2

MDL: Method Detection Limit

CKY QUALITY CONTROL DATA
DUPLICATE SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 7470
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	CTO-276PW-1195	DATE EXTRACTED:	11/30/95
CONTROL NO.:	K115-11	DATE ANALYZED:	11/30/95
ACCESSION:	95K115 95K123		

PARAMETER	SAMPLE (ug/L)	DUP. SAMPLE (ug/L)	RPD (%)
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Mercury	ND	ND	0

QC LIMIT: 20

CKY QUALITY CONTROL DATA
SPIKE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 7470
MATRIX: WATER

BATCH NO.: 95K123
SAMPLE ID: CTO-276PW-1195
CONTROL NO.: K115-11
DATE RECEIVED: NA
DATE EXTRACTED: 11/30/95
DATE ANALYZED: 11/30/95
ACCESSION: 95K115 95K123

PARAMETER	SAMPLE RESULT (ug/L)	SPIKE CONC. (ug/L)	SPIKE RESULT (ug/L)	SPIKE RECRY. (%)
Mercury	ND	5.00	4.40	88

QC LIMIT: 75-125

CKY QUALITY CONTROL DATA
LABORATORY CONTROL SAMPLE ANALYSIS

CLIENT: Earth Technology Corp.
PROJECT: Metro Redline Eastside Extens.
METHOD: EPA 7470
MATRIX: WATER

=====

BATCH NO.:	95K123	DATE RECEIVED:	NA
SAMPLE ID:	LCS1W	DATE EXTRACTED:	11/30/95
CONTROL NO.:	HGK040WL	DATE ANALYZED:	11/30/95
ACCESSION:	95K115 95K123		

PARAMETER	TRUE VALUE (ug/L)	FOUND VALUE (ug/L)	LCS RECOVERY (%)
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Mercury	6.67	5.80	87
QC LIMIT:			85-115