CONVERSE CONSULTANTS WEST

Preliminary Geotechnical Report
Proposed Metro Rail Mid-City Segment
Wilshire/Western Station to
Pico/San Vicente Station
Los Angeles Rail Rapid Transit Project

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Proposed Metro Rail Mid-City Segment
Wilshire/Western Station to
Pico/San Vicente Station
Los Angeles Rail Rapid Transit Project

CONDUCTED FOR:

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CCW Project No. 91-31-208-01

September 14, 1992

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PROPOSED METRO RAIL MID-CITY SEGMENT
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CCW Project No. 91-31-208-01

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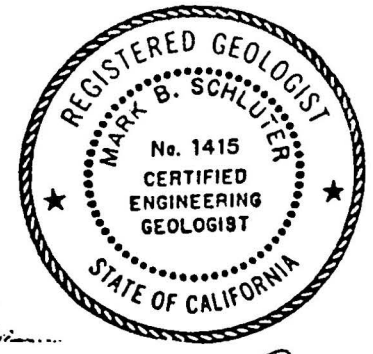
Preliminary Geotechnical Report
Proposed Metro Rail Mid-City Segment
Wilshire/Western Station to
Pico/San Vicente Station
Los Angeles Rail Rapid Transit Project
CCW Project No. 91-31-208-01
September 14, 1992



Mark B. Schluter
Senior Geologist, CEG 1415

This report has been prepared by Converse Consultants West under the professional supervision of the soils engineer and engineering geologist whose seals and signatures appear hereon.

The findings, recommendations, specifications or professional opinions are presented, within the limits prescribed by the client, after being prepared in accordance with generally accepted professional engineering and geologic principles and practice. There is no other warranty, either express or implied.



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S.0 EXECUTIVE SUMMARY

S.1 Proposed Project

This report presents the results of a preliminary geotechnical investigation by Converse Consultants West (CCW) for the proposed Los Angeles Metro Rail Mid-City Segment. The Mid-City Segment consists of the Crenshaw/Olympic and Pico/San Vicente Stations and about 2.3 miles of underground tunnel line. The Mid-City Segment extends from the Wilshire/Western Station westerly along Wilshire Boulevard then turns in a southwesterly direction along Crenshaw Boulevard to the Crenshaw/Olympic Station. The line continues along Crenshaw Boulevard then proceeds west along Pico to the interim terminal at the Pico/San Vicente Station (Figure S.1).

The stations will be constructed by cut-and-cover methods and extend in depth up to 85 feet below the existing ground surface. The underground tunnel line between the Stations will be constructed by tunnelling methods and will have variable depths of cover above the crowns of the single track tunnels varying from about 30 feet to 95 feet. Construction will occur predominantly in old alluvium and San Pedro Sand having variable groundwater and gas conditions.

S.2 Crenshaw/Olympic Station

The subsurface conditions at the Crenshaw/Olympic station generally consists of 70 to 85 feet of alluvium and San Pedro sand overlying siltstone and claystone of the Fernando Formation. The alluvium consists primarily of 40 to 50 feet of randomly alternating layers of silts, clays, clayey sands, silty sands and sand. Underlying the alluvium the explorations encountered the San Pedro sand and gravel layer varying in thickness between 30 to 35 feet. The San Pedro sand is in turn underlain by interbedded siltstone and claystone of the Fernando Formation. Groundwater was encountered within the alluvium at depths of 18 to 20 feet below the existing ground surface.

Localized areas of soil and groundwater contamination have been reported and were encountered in the vicinity of the Chevron service station located on the southwest corner of Crenshaw and Olympic Boulevards. Petroleum hydrocarbons were detected in the Boring MC-5 drilled on Crenshaw Boulevard near the service station.

Natural gases were encountered at shallow depth at the Crenshaw/Olympic Station. Methane and hydrogen sulfide gases were detected in nearly all of the borings drilled for the subway station. Hazardous and explosive levels of gas emissions were detected at the open top of the hollow-stem auger during drilling and monitoring well installation at several of the boring locations.

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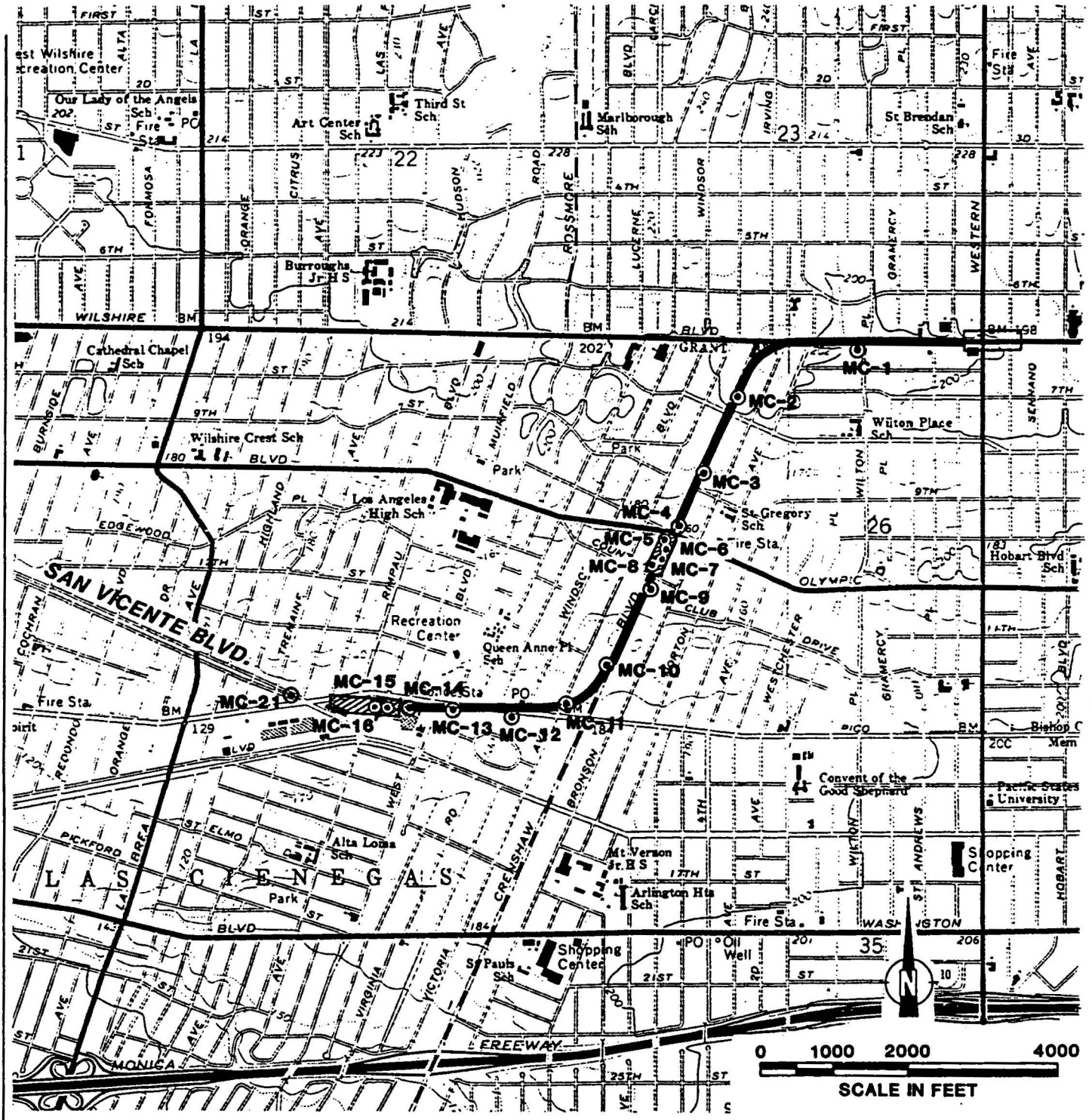

REFERENCE:
Portion of USGS Hollywood
7.5-minute Quadrangle,
1966, Photorevised 1981

EXPLANATION

- MID-CITY SEGMENT ALIGNMENT
- STATION UNDER CONSTRUCTION
- PROPOSED STATION(S)
- MC-1 ⊙ SOIL BORING LOCATION(S)

LOCATION OF THE METRO RAIL MID-CITY SEGMENT

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Converse Consultants West

Figure No.
S-1

Station construction on Crenshaw Boulevard will consist of an excavation approximately 715 feet long, 60 to 70 feet wide and up to 70 feet deep. A station entrance structure is located on the southwest corner of Olympic and Crenshaw Boulevards. The Crenshaw/Olympic Station excavation occurs entirely within alluvial soils and San Pedro sand.

Temporary support of the Station excavations will be either flexible or rigid type vertical wall systems with internal bracing or external tieback systems. Successful installation of tiebacks will require certain precautions to maintain the stability of excavations below groundwater elevations. Lateral pressures and other guidelines for design of temporary support systems are provide in the report.

Certain fractions of the alluvium are more pervious than other fractions. Therefore, exterior and/or interior dewatering installations are anticipated to be necessary to control groundwater seepage and loss of ground along the excavation faces and to maintain the stability of the bottom of the excavations.

The undisturbed San Pedro sand will adequately support the permanent reinforced concrete Station structure. Design lateral pressures for permanent structures under varying earth and hydrostatic loading conditions are outlined in the text of the report. Station design and construction will be complicated by the presence of shallow groundwater, natural gases, and localized areas of soil and groundwater contamination. Special design and construction provisions including construction dewatering, waterproofing, corrosion and gas control measures would be required.

S.3 Pico/San Vicente Station

The subsurface conditions at the Pico/San Vicente Station generally consists of alluvium with depths greater than maximum depth of exploration (110 feet). The alluvium consists primarily of 40 to 70 feet of randomly alternating layers of silts, clays, clayey sands, silty sands and sand. Underlying the alluvium the explorations encountered the San Pedro sand and gravel layer. The contact between the San Pedro sand and underlying Fernando Formation was greater than the maximum depth of exploration. Groundwater was encountered within the alluvium. Localized perched groundwater zones were encountered 20 feet below existing surface during drilling. Static groundwater level was measured about 65 feet below existing surface in monitoring well MC-15.

The soils exploration program for the Pico/San Vicente Station was not completed at the time this report was prepared. Permission to conduct field exploration had not been received from the owner and tenant of the Builder's Emporium property located at 4650 Pico Boulevard.

Natural gases were encountered at shallow depth at the Pico/San Vicente Station. Methane and hydrogen sulfide gases were detected in nearly all of the borings drilled for the station. Hazardous and explosive levels of gas emissions were detected at the open top of the hollow-stem auger during drilling of Boring MC-21 located just west of the station.

The proposed station location is presently occupied by a number of buildings and structures including the Builder's Discount department store, the RTD Terminal 40 bus station and the Builder's Emporium retail store. The proposed station location is also crossed by an existing 11-foot by 9.5-foot storm drain and 69-inch diameter sanitary sewer, which would need to be supported in place or relocated.

Station construction will consist of demolition of existing buildings and excavations approximately 950 feet long, 60 to 70 feet wide, and up to 85 feet deep. The Pico/San Vicente Station excavation occurs entirely within the alluvial type soils and San Pedro sand.

Temporary support of the Station excavations will be either flexible or rigid type vertical wall systems with internal bracing or external tieback systems. Successful installation of tiebacks will require certain precautions to maintain the stability of excavations below groundwater elevations. Lateral pressures and other guidelines for design of temporary support systems are provide in the report.

Certain fractions of the alluvium are more pervious than other fractions. Therefore, exterior and/or interior dewatering installations are anticipated to be necessary to control groundwater seepage and loss of ground along the excavation faces and to maintain the stability of the bottom of the excavations.

The undisturbed San Pedro sand will adequately support the permanent reinforced concrete Station structure. Design lateral pressures for permanent structures under varying earth and hydrostatic loading conditions are outlined in the text of the report. Station design and construction will be complicated by the presence of existing structures, shallow groundwater and natural gases. Special design and construction provisions including construction dewatering, waterproofing, corrosion and gas control measures would be required.

S.4 Tunnels and Cross Passages

The majority of the Mid-City tunnel alignment will pass through horizons of differing alluvium sediments. The invert of the tunnels will penetrate the San Pedro sands , underlying the alluvium, for a significant length of the alignment. Groundwater levels encountered in the soil borings lie above the proposed tunnel grades. Therefore, some flowing ground conditions at the face are likely, and the potential for blow-outs at the invert should be anticipated. It is, therefore, anticipated that construction shield tunnelling methods will require means for the utilization of polling and/or breast boarding techniques to maintain stability of the face. In addition, surface and/or local subsurface dewatering measures will be required to control seepage inflows and to provide for the stability of the soils at the face and invert of the tunnels along certain portions of the tunnel alignment.

Hazardous and explosive levels of natural gases were encountered in soil borings drilled along tunnel alignments beneath Crenshaw and Pico Boulevards. Methane and hydrogen sulfide gases were detected in soil borings drilled along these routes. Naturally occurring tar sands were encountered in Borings MC-2 and MC-3 at depths below 70 feet. The petroleum bearing sediments were discolored, sticky and had a strong petroleum odor.

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The limits and extent of the tar sands between and beyond soil borings MC-2 and MC-3 is not known.

Localized areas of near surface soil and groundwater contamination have been reported. A former gasoline station site located on the southwest corner of Wilshire Boulevard and Wilton Place is currently undergoing site remediation for hydrocarbon contamination.

A sand layer containing petroleum hydrocarbons was encountered in Boring MC-9 at a depth of about 15 feet. The limits and extent of this petroleum contaminated layer is not known. For further information on hazardous materials and estimated cost for abatement, see Converse Environmental West's, September 1992, "Environmental Assessment Report".

S.5 Underpinning

Guidelines for assessing the need for underpinning of buildings adjacent to the Station construction and along the tunnel alignments are discussed in the report. Detailed analyses to identify and recommend which buildings and/or facilities shall be underpinned will be carried out by the project design team.

S.6 Seismic Considerations

Analysis of the gradational characteristics and in-situ relative density of the granular soils indicate that liquefaction of such soils during a maximum design earthquake has a low probability. Soil borings containing potentially liquefiable sediments were identified for the Maximum Design Earthquake (MDE) and Operating Design Earthquake (ODE) using Standard Penetration Test "N" values.

Design procedures and criteria for underground structures under earthquake loading conditions are defined in the SCRTD report entitled "Guidelines for Seismic Design of Underground Structures" dated March 1984. Seismological conditions which may impact the project and the operating and maximum design earthquakes which may be anticipated in the Los Angeles area are described in the SCRTD report entitled "Seismological Investigations and Design Criteria" dated May, 1983. This report complements and supplements the 1983 and 1984 reports. Site specific static and dynamic properties for materials in the Mid-City Segment are given in the report.

S.7 Work Scope Exclusions

This study did not include evaluations of the potential for soil and/or groundwater contamination or natural gas potential along the proposed Mid-City Segment alignment. Information pertaining to the potential for soil and groundwater contamination is presented in a separate report by Converse Environmental West, September 1992. Information pertaining to evaluation of potential gas conditions along the proposed alignment is presented in a separate final report by Engineering-Science, Inc. dated August 1992.

1.0 INTRODUCTION

1.1 Project Summary

This report presents results of a preliminary geotechnical investigation by Converse Consultants West (CCW) for the 2.3-mile two-station underground Metro Rail Mid-City Segment. The Mid-City Segment consists of the Crenshaw/Olympic Station, Pico/San Vicente Station, and about 2.3 miles of subsurface track line (Figure 1). The line extends from the Wilshire/Western Station (Station 373+53.14) westerly under Wilshire Boulevard, then turns in a southwesterly direction along Crenshaw Boulevard to Crenshaw/Olympic Station. The line continues southwesterly along Crenshaw Boulevard then proceeds west along Pico Boulevard and continues west to the interim terminal at the Pico/San Vicente Station (Station 478+58.74).

The purpose of the preliminary investigation was to evaluate and better define subsurface soil, bedrock and groundwater conditions along the Mid-City Segment. The work performed for this report includes soil borings, laboratory tests, engineering analysis, and development of preliminary recommendations for design and construction of the proposed stations and tunnels.

This report was written specifically for design of the proposed project described herein and intended for use by Parsons Brinckerhoff Quade & Douglas, Inc. and associated design professionals in developing plans and specifications. Since this report is intended for use by the designer(s), it should be recognized that it is impossible to include all construction details in this report at this phase in the project. Additional consultation may be prudent to interpret these findings for contractors or possibly refine these recommendations based upon the final design and actual conditions encountered during construction.

1.2 Previous Reports

Additional geotechnical information for portions of the Mid-City Segment along Wilshire Boulevard are included in previous reports for the Metro Rail Project. A number of design changes and modifications have been made to the tunnel alignments, tunnel grades, station locations, and service structures locations since publication of the previous reports which span a period of 30 years. Care should be exercised in extrapolating subsurface conditions and geotechnical information between or beyond the original design locations described and shown in each report.

Previous reports which contain supplemental geotechnical information applicable to the Mid-City Segment include:

- "Geotechnical Report, Metro Rail Project, Design Unit A220"
  Prepared by Converse Consultants, Inc., Earth Sciences Associates, and Geo/Resource Consultants
  Dated March 1984
  CCI Project No. 83-1140

- "Geotechnical Report, Metro Rail Project, Design Unit 240"
  Prepared by Converse Consultants, Inc., Earth Sciences Associates, and Geo/Resource Consultants
  Dated April 1984
  CCI Project No. 83-1101

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- "Draft Report of Man-Size Borings, Metro Rail Project"
  Prepared by Converse Consultants, Inc.
  Dated August 29, 1983
  CCI Project No. 83-110-22

- "Geotechnical Investigation Report, Volumes I and II"
  Prepared by Converse Ward Davis Dixon, Earth Sciences Associates, Geo/Resource Consultants
  Dated November 1981
  CWDD Project No. 80-1280

- "Test Boring Logs", Volume IV, Book 3
  Prepared by Kaiser Engineers
  Dated 1962

1.3 Previous Borings

Borings drilled for the previous investigations and utilized in this report for interpretation of subsurface conditions for portions of the Mid-City Segment along Wilshire Boulevard are listed in Table 1-1. Copies of the boring log summaries are presented in Appendix A.

TABLE 1-1

BORINGS PERFORMED FOR PREVIOUS INVESTIGATIONS

Boring No.	Date Drilled	Report
15 (CEG 15)	1981: January 26 - 28	Design Unit A220
15A	1983: November 8	Design Unit A220/Man-Sized Boring
15-1	1983: September 22 - 23	Design Unit A220
15-2	1983: September 21 - 22	Design Unit A220
15-3	1983: September 28	Design Unit A220
16 (CEG 16)	1981: January 20 - 27	Design Units A220/A240
16A	1983: February 22	Design Units A220/A240/Man-Sized Boring
16-5	1983: October 3 - 4	Design Units A220/A240
16-6	1983: October 23 - 24	Design Units A220/A240
WC-59	1962: March 23	Kaiser Engineers - Volume IV
WC-60	1962: March 22	Kaiser Engineers - Volume IV
WC-61	1962: March 21	Kaiser Engineers - Volume IV
WC-62	1962: March 19	Kaiser Engineers - Volume IV
WC-63	1962: March 16	Kaiser Engineers - Volume IV
WC-64	1962: March 20	Kaiser Engineers - Volume IV

2.0 WORK SCOPE

This preliminary geotechnical investigation included subsurface exploration, soil and sedimentary bedrock sampling, laboratory testing, engineering and geologic analyses and preparation of this report. Each of these tasks were governed in large part by the requirements and unit quantities agreed upon in our April 6, 1992 Contract for Preliminary Engineering and Final Supplemental Environmental Impact Statement/Report of the Metro Rail Mid-City Segment with Parsons, Brinckerhoff, Quade & Douglas, Inc. The scope of work included the following tasks:

- Research and review of available geologic and geotechnical information and documents.

- Drilling of 17 exploratory soil borings to depths ranging between 80 and 110 feet below street surface grades. Permission to drill 4 of these borings on Builder's Emporium property had not been obtained at the time this report was prepared. The borings were advanced using hollow-stem auger and rotary wash drilling methods equipped for soil and sedimentary rock sampling. Locations of these borings are shown on Drawings 1, 2 and 3.

- Continuously logging the subsurface conditions as encountered in the exploratory borings at the time of drilling. Boring log summaries are presented in Appendix A.

- Obtaining relatively undisturbed samples of the subsurface materials from borings at about 5-foot intervals near tunnel grades for laboratory testing. Samples were obtained using a California drive sampler and splitspoon (SPT) sampler to achieve maximum recovery. Recovered samples were carefully handled and stored in containers for transport to the laboratory for testing and analysis.

- Conducting laboratory tests on selected soil samples obtained from the test borings. These tests included unconsolidated, unconfined compression tests, moisture-density determinations, shear strength tests, Atterberg limits, and grain-size distribution. Results of the laboratory tests are presented in Appendix B.

- Conducting chemical analysis on soil samples obtained from selected borings, groundwater samples obtained from monitoring wells in boring MC-1 and MC-4 to evaluate water quality. Groundwater samples were analyzed for chloride, nitrates, sulfate, pH, CAM metals, and petroleum hydrocarbons. Results of the laboratory tests are presented in Appendix C.

- Preparation of this report which presents the results of our field exploration, laboratory testing, and preliminary recommendations for design and construction of the proposed stations and tunnels.

This study did not include evaluation of the potential for soil and/or groundwater contamination or natural gas potential along the proposed Mid-City Segment alignment.

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Information pertaining to the potential for soil and groundwater contamination is presented in a separate report by Converse Environmental West. Information pertaining to evaluation of potential gas conditions along the proposed alignment is presented in a separate final report by Engineering-Science dated August 1992.

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3.0 PROJECT DESCRIPTION

3.1 General

The proposed Metro Rail Mid-City Segment consists of the Crenshaw/Olympic Station, the Pico/San Vicente Station, and about 2.3 miles of subsurface tunnel line. The line extends from the Metro Red Line Wilshire/Western Station westerly under Wilshire Boulevard, then turns in a southwesterly direction along Crenshaw Boulevard to the Crenshaw/Olympic Station. The line continues along Crenshaw Boulevard then proceeds west along Pico Boulevard and continues west to the interim terminal at the Pico/San Vicente Station (Drawings 1, 2, and 3).

The existing ground surface elevations along the proposed segment vary between approximately 214 feet near Wilshire and Crenshaw Boulevards to approximately 135 feet at the Pico/San Vicente Station. Local ground surface variations in the form of broad swales or channel features occurs where the alignment crosses the former Ballona Creek and its related drainage tributaries. Such topographic features infer the location of former southwest trending drainage courses which gradually incised younger channel features into the old alluvium. Topographic expression of these channel features is still somewhat visible although they have been obscured by extensive residential and commercial development along the Mid-City Segment.

The Mid-City segment extends from the Wilshire/Western Station, currently under construction, westerly under Wilshire Boulevard for approximately 2,300 feet. The Wilshire corridor is highly developed on both sides with low, medium and high rise commercial buildings. The alignment turns southwest along Crenshaw Boulevard beneath a number of multi-story office and apartment buildings. The segment along Crenshaw Boulevard consists primarily of low-rise, mixed commercial, office and residential structures. The alignment proceeds west along Pico Boulevard beneath a number of residential structures and strip commercial areas characterized primarily by low-rise buildings.

No mid-tunnel vent or emergency exit structures are planned at this time.

3.2 Crenshaw/Olympic Station

The proposed Crenshaw/Olympic Station is a center platform station located beneath Crenshaw Boulevard just south of Olympic Boulevard (Drawings 4 and 5). The station excavation would extend south of Country Club Drive from Station 428+91 to Station 436+06. The existing ground surface along Crenshaw Boulevard varies from Elevation 159 feet near Olympic Boulevard to Elevation 156 feet near Country Club Drive. A number of low-rise, mixed commercial, office and retail buildings are located on both sides of Crenshaw Boulevard.

The Crenshaw/Olympic Station will be a reinforced concrete box structure about 715 feet long and 60 to 70 feet wide (outside wall dimensions). The station has been planned with one entrance on the southwest corner of Olympic and Crenshaw Boulevards. Patrons would use stairs, escalators and a handicapped elevator to enter a passageway leading to a mezzanine level and lower train access platform. Ancillary space is proposed at each end of the station. The top of rail varies about Elevation 100 feet at the north end of the

station to about Elevation 95 feet at the south end of the station. The bottom of the station structure is located between Elevation 92 feet and Elevation 86 feet. This is approximately 66 feet below existing grade at the north end of the station and 70 feet below existing grade at the south end of the station. After the station is constructed approximately 20 to 25 feet of fill will be placed above the cut-and-cover station structure. Design loads for the Crenshaw/Olympic structure were not available at the time of this report.

3.3 Pico/San Vicente Station

The proposed Pico/San Vicente Station is a center platform station located south of Pico Boulevard between San Vicente Boulevard and Muirfield Road (Drawings 6 and 7). The proposed station site is presently developed. Existing buildings and structures now occupying the site include the Builder's Discount retail store and garden center, the RTD Terminal 40 bus facility, and the Builder's Emporium retail store. The Builder's Discount store was formerly a Sears Department store built in the late 1930s with a basement level. Existing ground surface along the proposed site varies from Elevation 141 feet at the east to Elevation 136 feet at the west end.

The Pico/San Vicente Station will be a reinforced concrete box structure about 949 feet long and approximately 60 to 70 feet wide (outside wall dimensions). The station platform is about 450 feet long with a double track cross over about 499 feet long located along the east side of the station. Three station entrances are planned, one to serve the west mezzanine level and two to serve the east mezzanine level. One of the easterly entrances would be situated near the centrally located bus transfer center. Access to the station's mezzanine and train platform levels would be provided by stairs, escalators and elevators.

Ancillary space is proposed at each end of the station. The top of rail varies from about Elevation 66 feet at the east end of the double track crossover to about Elevation 63 feet at the west end of the station. The bottom of the station structure is located between Elevation 58 feet and Elevation 55 feet. This is approximately 84 feet below existing grade at the east end of the double track crossover and 81 feet below existing grade at the west end of the station. After the station is constructed approximately 34 to 37 feet of fill will be placed above the cut and cover station structure. Construction will be complicated by an 11-foot by 9.5-foot buried storm drain and 69-inch diameter sanitary sewer which cross diagonally above the proposed station location and would have to be supported in place. Design loads for the Pico/San Vicente Station were not available at the time of this report.

3.4 Tunnel Alignment

As shown on Drawings 1, 2 and 3, the tunnel line for the Mid-City Segment is about 2.3 miles long starting at the Wilshire/Western Station (Station 373+53) and ending at the Pico/San Vicente Station (Station 478+09). The tunnel lines consist of twin bore tunnels having an outside diameter of approximately 21 feet. The minimum depth of cover above the proposed tunnel crown is approximately 30 feet and the maximum depth of cover approaches 95 feet. A total of 13 cross passages are planned for emergency egress between tunnels at approximately 750 foot spacing.

The Mid-City tunnel alignment will pass beneath existing buildings and residential structures where it turns southwest from Wilshire Boulevard to Crenshaw Boulevard (Station 395+00 to 407+00), then again as it turns west from Crenshaw Boulevard to Pico Boulevard (Station 445+00 to 463+00), and as it approaches the interim terminus at the Pico/San Vincente Station. (Station 473+00 to 478+09).

The turn from Wilshire Boulevard to Crenshaw Boulevard will pass beneath a number of multi-story office and apartment buildings. The proposed tunnel crown is located about 55 to 65 feet below ground surface along this portion of the alignment, (Drawing 1).

The turn from Crenshaw Boulevard to Pico Boulevard will pass beneath a number of apartment buildings and older residential structures considered to be of historic value. The proposed tunnel crown is located about 70 to 90 feet below ground surface along this portion of the alignment, (Drawing 2).

The tunnel approach to the east end of Pico/San Vicente Station and track cross-over passes beneath two commercial buildings and a public swimming center located on the south side of Pico Boulevard west of West Boulevard. The proposed tunnel crown is located about 60 to 80 feet below ground surface along this portion of the alignment, (Drawing 3).

4.0 FIELD EXPLORATION AND LABORATORY TESTING

4.1 Drilling and Sampling of Borings

Locations of 17 of 21 exploratory borings drilled and sampled to evaluate subsurface conditions along the Mid-City Segment are shown on the Plan and Profile Drawing 1, 2, and 3. The boring numbers, locations, surface elevations, total depths and dates drilled are shown in Table 4-1.

TABLE 4-1

SUMMARY OF MID-CITY (MC) SOIL BORINGS

Boring No.	Location	Station Number	Surface Elevation (feet)	Total Depth (feet)	Remarks	Date Drilled
MC-1	Wilshire Blvd. and Wilton Place	387+25	187	70.5	Converted to monitoring well	06/01-02/92
MC-2	730 Crenshaw Blvd.	407+10	203	90	Converted to monitoring well	06/03-04/92
MC-3	882 Crenshaw Blvd.	418+92	190	100	Backfilled	06/10/92
MC-4	Crenshaw and Olympic Blvds.	426+59	160	80	Converted to monitoring well	06/08/92 06/23/92
MC-5	Crenshaw and Olympic Blvds.	429+55	159	100	Backfilled	06/30/92 to 07/06/92
MC-6	Crenshaw Blvd. south of Olympic Blvd.	431+00	158	91.5	Backfilled	06/05/92 06/24/92
MC-7	Crenshaw Blvd. south of Olympic Blvd.	432+58	158	100.5	Backfilled	06/26/92
MC-8	Crenshaw Blvd. and Country Club Drive	433+72	156	81.5	Converted to monitoring well	05/28-29/92
MC-9	Crenshaw Blvd. south of Country Club Drive	438+62	158	100	Backfilled	06/29/92
MC-10	1191 Crenshaw Blvd.	447+10	175	100	Backfilled	06/09/92
MC-11	Victoria Ave. north of Pico Boulevard	455+50	179	101.5	Converted to monitoring well	05/26-27/92
MC-12	Pico Blvd. and Windsor Blvd.	462+75	180	100	Backfilled	06/03/92
MC-13	Pico Blvd. east of West Blvd.	471+02	165	101.5	Converted to monitoring well	06/5-8/92
MC-14	Builders Discount Truck Alley	476+87	143	112.5	Backfilled	07-08-92
MC-15	Builders Discount Garden Center	480+50	139.5	102.5	Converted to monitoring well	07/09-13/92
MC-16	RTD Terminal 40 Bus Facility	482+50	137.5	102	Backfilled	06/29-30/92
MC-17	Builder's Emporium East Parking Lot	Permission to drill on private property was not obtained.				
MC-18	Builder's Emporium Central Parking Lot	Permission to drill on private property was not obtained.				

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Boring No.	Location	Station Number	Surface Elevation (feet)	Total Depth (feet)	Remarks	Date Drilled
MC-19	Builder's Emporium West Parking Lot	Permission to drill on private property was not obtained.				
MC-20	Builder's Emporium West Parking Lot	Permission to drill on private property was not obtained.				
MC-21	Pico and San Vicente Blvds.	492+50±	134	55	Backfilled	05/29/92

Note: Boring Station location, elevation, and depth based on 1 inch = 40 feet Mid-City Segment Plan and Profile Drawings, undated.

Exploratory borings MC-1, MC-2, MC-3, MC-4, MC-5, MC-8, MC-9, MC-10, MC-11, MC-12, MC-13, MC-14, MC-15 and MC-21 were drilled using a CME 75 hollow-stem auger drilling machine equipped with 8-inch and 10-inch diameter flight augers. After coring through the surface pavement and concrete, each boring was probed with a hand-auger in the upper 8 feet to check for buried utilities or substructures. Soil sampling within this near surface interval was limited to visual classification of auger cuttings and grab samples.

Exploratory borings MC-6, MC-7 and MC-16 were drilled with a Failing 750 rotary wash drilling machine. Rotary wash drilling methods were used to control hazardous and explosive gas emissions from the borings by filling the hole with drilling fluids. After coring through the surface pavement and concrete, each boring was probed with a hand-auger in the upper 8 feet to check for buried utilities or substructures. Soil sampling within this near surface interval was limited to visual classification of auger cuttings and grab samples. The drilling fluid tub was set and the boring advanced using rotary wash drilling methods.

Soils encountered in the borings were continuously logged by a geologist and classified in the field by visual examination in accordance with the Unified Soil Classification System. Field descriptions have been modified, where appropriate, to reflect laboratory test results. Boring log summaries are presented in Appendix A.

Relatively undisturbed samples of the subsurface soils and Fernando Formation were obtained at 5-foot intervals near tunnel grades using a California drive-sampler and a splitspoon (SPT) sampler.

Samples of the soils and Fernando Formation were obtained in the borings using a California drive sampler (2.4-inch inside diameter, 3-inch outside diameter) lined with sample rings. This steel sampler was driven into the bottom of the borehole with successive 30-inch drops of a 140-pound driving weight. Blow counts were recorded for each 6-inch interval of penetration or fraction thereof up to 12 inches. Blow counts are shown on the boring log sheets in the column labeled "Blows (6")". Sampler penetration and blow counts were limited in materials with high sampling resistance (gravels and dense soils) to minimize disturbance to the samples. The recovered soil and bedrock samples were retained in brass rings (2.4 inches in diameter, 1.0 inch in height). The

lower portion of the sample was retained and carefully sealed in waterproof plastic containers for shipment to the laboratory.

Standard penetration tests (SPT) were performed at frequent intervals in the soil strata of each of the borings. The SPT sampler was driven into the bottom of the borehole with successive 30-inch drops of a 140-pound drive weight at the surface. An automatic drive hammer, rotating cat head with two rope wraps and a hydraulically driven winch with steel cable was used to provide the lifting apparatus. Blow counts were recorded for each 6-inch interval of penetration or fraction thereof up to 18 inches or refusal. Blow counts are shown on the boring log sheets in the column labeled "Blows (6")".

The "standard" refusal blow count cutoffs of standard penetration test include the following:

- A total of 50 blow was applied during one of the three 6-inch increments,
- A total of 100 blows was applied,
- There was no observed advance of the sampler during application of 10 successive blows of the hammer.

The number of hammer blows needed to drive the sampler often went well above the "standard" refusal blow count cutoffs. After sampling, the SPT sampler was disassembled and the recovered contents were visually classified and logged. The sample was then retained in plastic bag for shipment to the laboratory.

At the completion of drilling and sampling, the holes were backfilled with water-activated bentonite chips or pressure grouted with a tremie pipe to the bottom of the boring. The following day the boring was backfilled and tamped with bentonite chips and mortar mix to the surface subgrade. The hole was then capped with concrete the thickness of the existing street or sidewalk surface.

Monitoring wells were installed in borings MC-1, MC-2, MC-4, MC-8, MC-11, MC-13 and MC-15. Borings MC-1, MC-2, MC-4, MC-8, MC-11 and MC-13 were reamed with 10-inch diameter hollow-stem augers to permit installation of 4-inch diameter, flush threaded, Schedule 40 PVC casing. Boring MC-15 monitoring well was constructed of 2-inch diameter, flush threaded, Schedule 40 PVC casing installed with 8-inch diameter hollow-stem augers. Solid and machine-slotted screen depth intervals are shown on the boring logs in Appendix A. The annulus between the well casing and well bore was backfilled with No. 30 Lone Star sand. A traffic rated hole cover was then concreted in-place over each monitoring well flush with the existing street or planter surface.

Static water level readings were periodically made during field exploration to monitor groundwater levels.

Monitoring well MC-1 and monitoring well MC-4 were developed to obtain representative water samples for chemical analysis and to determine the depth to groundwater. Locations of these monitoring wells are shown on Drawings 1 and 2. The water level within the well was permitted to recover prior to sampling and measurement of the water level. The well was then recapped and the cover replaced for further use.

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4.2 Geotechnical Laboratory Testing

Geotechnical laboratory tests were conducted on representative soil and Fernando Formation samples for the purpose of classification and determination of their physical properties and engineering characteristics. Selected samples recovered from each of the borings were tested in the laboratory to verify field classifications, determine grain-size distribution, moisture content, dry density, permeability, shear strengths and compressibility/swelling characteristics of the underlying earth materials. A description and results of the various laboratory tests conducted during this investigation for classification and engineering purposes is presented in Appendix B.

4.3 Chemical Analysis

Two soil samples were selected from borings MC-2 and MC-9 for laboratory analysis. The soil samples were observed to have a petroleum hydrocarbon odor and were discolored. The sample from Boring MC-2 was a tar sand sample recovered from a depth of 69 to 70 feet. The sample from Boring MC-9 was sampled from a near-surface soil layer containing significant levels of petroleum hydrocarbons. The two samples were analyzed for total recoverable petroleum hydrocarbons (TRPH) by EPA Method 418.1. Analytical results indicated high levels of petroleum hydrocarbons were detected in both samples. Table 4-2 summarizes the concentrations of total recoverable hydrocarbons detected in borings MC-2 and MC-9. Laboratory test reports are presented in Appendix C.

TABLE 4-2

SUMMARY OF DETECTED TOTAL RECOVERABLE PETROLEUM HYDROCARBONS

EPA METHOD 418.1

Mid-City Boring Number	Sample Depth (feet)	Concentration (mg/kg)	Detection Limit (mg/kg)
MC-2	69 - 70	48,000.0	10.0
MC-9	14 - 15	30,000.0	10.0

Groundwater Samples

Laboratory analysis of the groundwater samples collected from monitoring wells in borings MC-1 and MC-4 were analyzed for EPA Test Method 80156G/8020 ppb Total Volatile and Aromatic Hydrocarbons, CAC Metals, Chloride, Nitrate, pH, Sulfide and Sulfate-Detection limits for each compound tested are shown on the laboratory test reports in Appendix C.

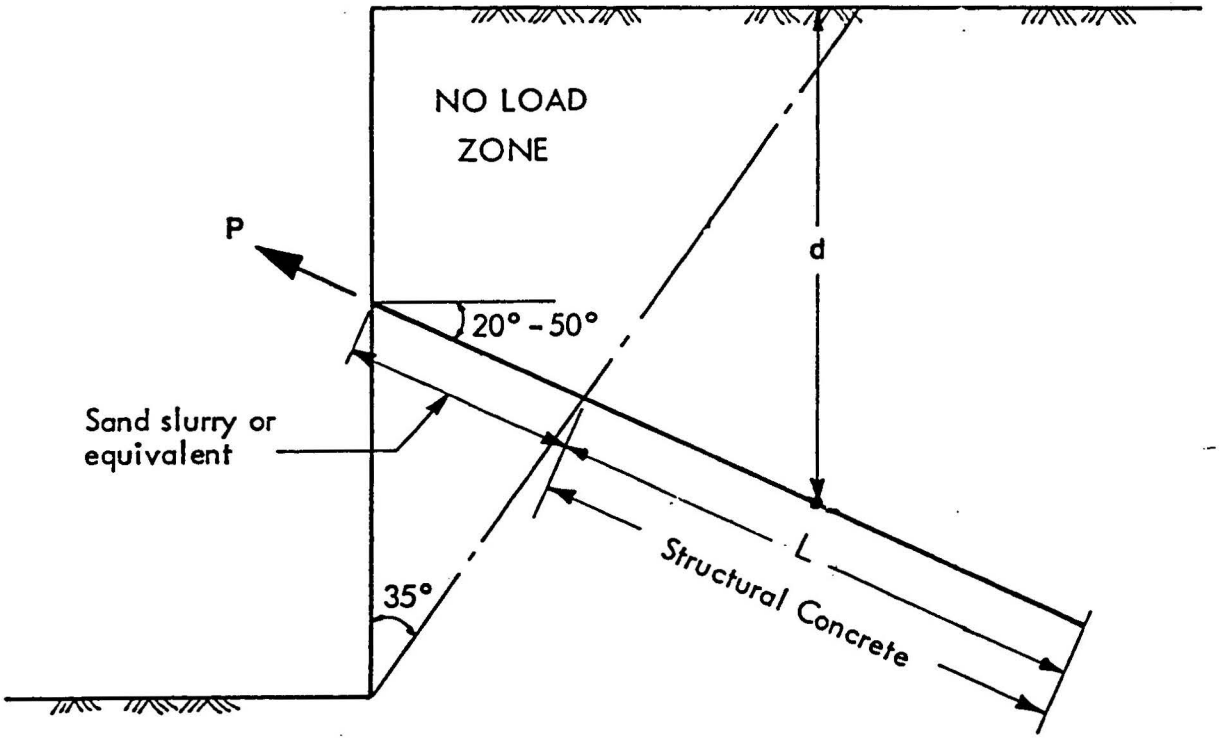
Laboratory analysis of the groundwater samples indicated non-detectable concentrations for EPA Test Method 8015G/8020 ppb. CAC metals analysis revealed detected levels of Barium in low concentrations.

The water quality was generally poor and potentially corrosive. Groundwater samples obtained from boring MC-1 contained a sulfate content of 540 mg/l and a chloride content of 130 mg/l. Samples from boring MC-4 contained a sulfate content of 200 mg/l

and chloride content of 210 mg/l. These concentrations exceed allowable limits for discharge into storm drains per City of Los Angeles Sanitation Bureau and the California Regional Water Quality Board, Los Angeles Region. Groundwater discharge from construction dewatering would require treatment to meet all the applicable standards, conditions and requirements imposed by the City of Los Angeles Sanitation Bureau and the California Regional Water Quality Board, Los Angeles Region. Regulatory requirements are generally imposed on a case-by-case basis specific to conditions of each particular project site.

A sulfate content of about 150 mg/l is generally regarded as deleteriously reactive to concrete lining requiring sulfate resistant concrete and appropriate corrosion protection.

A chloride content of about 200 mg/l is generally regarded as moderately corrosive and wouid require appropriate corrosion mitigation measures.



The design adhesion value, q, can be evaluated by:

$q = 20d \leq 750$ psf (in alluvium)

d = Average depth of anchor in feet beyond the no-load zone

The total anchor capacity can be estimated by:

$P = \pi DLq$

See also Section 6.4.4.4

STRAIGHT SHAFT TIEBACK ANCHOR CAPACITY

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Figure No.
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no-load zone. Placement of the anchor grout should be done by pumping the concrete through a tremie or pipe extending to the bottom of the shaft. The anchor shaft between the no-load zone and the face of the shoring must be backfilled with a sand slurry or equivalent after concrete placement. Alternatively, special bond breakers can be applied to the strands or bars in the no-load zone and the entire shaft filled with concrete.

For tieback anchor installations, the contractor should be required to use a method which will minimize loss of ground due to caving. Significant caving problems are not expected during installation of the majority of the anchors. However, caving from sand layers with the alluvium should be expected due to vibration from the drilling equipment and/or groundwater effects. Caving not only causes installation problems but results in surface subsidence and settlement of overlying buildings. To minimize caving, casing should be installed as the hole is advanced but must be pulled as the concrete is poured. Alternatively, the hole may be maintained full of slurry or a hollow stem auger could be used.

It is recommended that each tieback anchor be test-loaded to 150% of the design load and then locked off at the design load. At 150% of the design load, the anchor elongation should not exceed 0.1 inches over a 15-minute period. In addition, 5% to 10% of the anchors should be test-loaded to 200% of the design load and then locked off at the design load. At 200% of design load the anchor elongation should not exceed 0.15 inches over a 15-minute period. The rate of elongation should consistently decrease and become nearly zero or zero within the test period. If the rate of elongation does not decrease and/or does not become zero (or nearly zero), the test should not be considered satisfactory.

6.4.5 Anticipated Ground Movements: The ground movements associated with a shored excavation depend on many factors including the contractors procedures and schedule, and therefore, the distribution and magnitude of ground movements are difficult to predict. Based on shoring performance data for documented excavations combined with our engineering judgement, we estimate that the ground movements associated with properly designed and carefully constructed shoring systems will be as follows:

- Conventional Wall With Tieback Anchors: The maximum horizontal wall deflection will range between about 0.1% to 0.2% of the excavation depth. The maximum horizontal movement should occur near the top of the wall and decrease with depth. The maximum settlement behind the wall should be equal to about 50% to 100% of the maximum horizontal movement and will probably occur at a distance behind the wall equal to about 25% to 50% of the excavation depth.

- Conventional Wall With Internal Bracing: The magnitude of the maximum ground movement will be similar to that anticipated for tiebacks. However, the maximum horizontal movement will probably occur near the bottom of the excavation decreasing to about 25% of the maximum at the surface.

- Conservative Wall With Tiebacks: We believe that the higher design pressure presented for conservative walls will reduce ground movements and limit the maximum horizontal and vertical movements to about 0.1% of the excavation depth.

- Conservative Wall With Internal Bracing: Similar to that described above for the conservative tieback supported wall.

6.5 Support of Temporary Decking

If temporary street decking requires center support piles, the piles should extend below the maximum proposed excavation level. At these depths, the piles would be founded within the San Pedro layer or the weathered bedrock. These materials are suitable for supporting such pile loads.

Since the shoring contractor will probably install soldier piles to support the excavation, we believe that he may use similar piles to support the center decking. Accordingly, we evaluated the allowable loads on these types of piles for several typical diameters. The recommended allowable design loads are shown on Figure 6-11. These values include both end bearing and shaft friction.

6.6 Instrumentation of the Excavation

In our opinion the proposed station excavations should be instrumented to reduce liability (by having documentation of performance), to validate design and construction requirements, to identify problems before they become critical, and to supplement previous data which in conjunction with the new data can be valuable for future designs.

We recommend the following instrumentation program:

- Preconstruction Survey: A qualified civil engineer should complete a visual and photographic log of all streets and structures adjacent to the sites prior to construction. This will minimize the risks associated with claims against the owner/contractor. If substantial cracks are noted in the existing structures, they should be measured and periodically remeasured during the construction period.

- Surface Survey Control: it is recommended that several locations around the excavations and on any nearby structures be surveyed prior to any construction activity and then periodically to monitor potential vertical and horizontal movement to the nearest 0.01 feet. In addition, survey markers should be placed at the top of piles. Marker spacing should be no more than every fourth pile or 25 feet, whichever is less.

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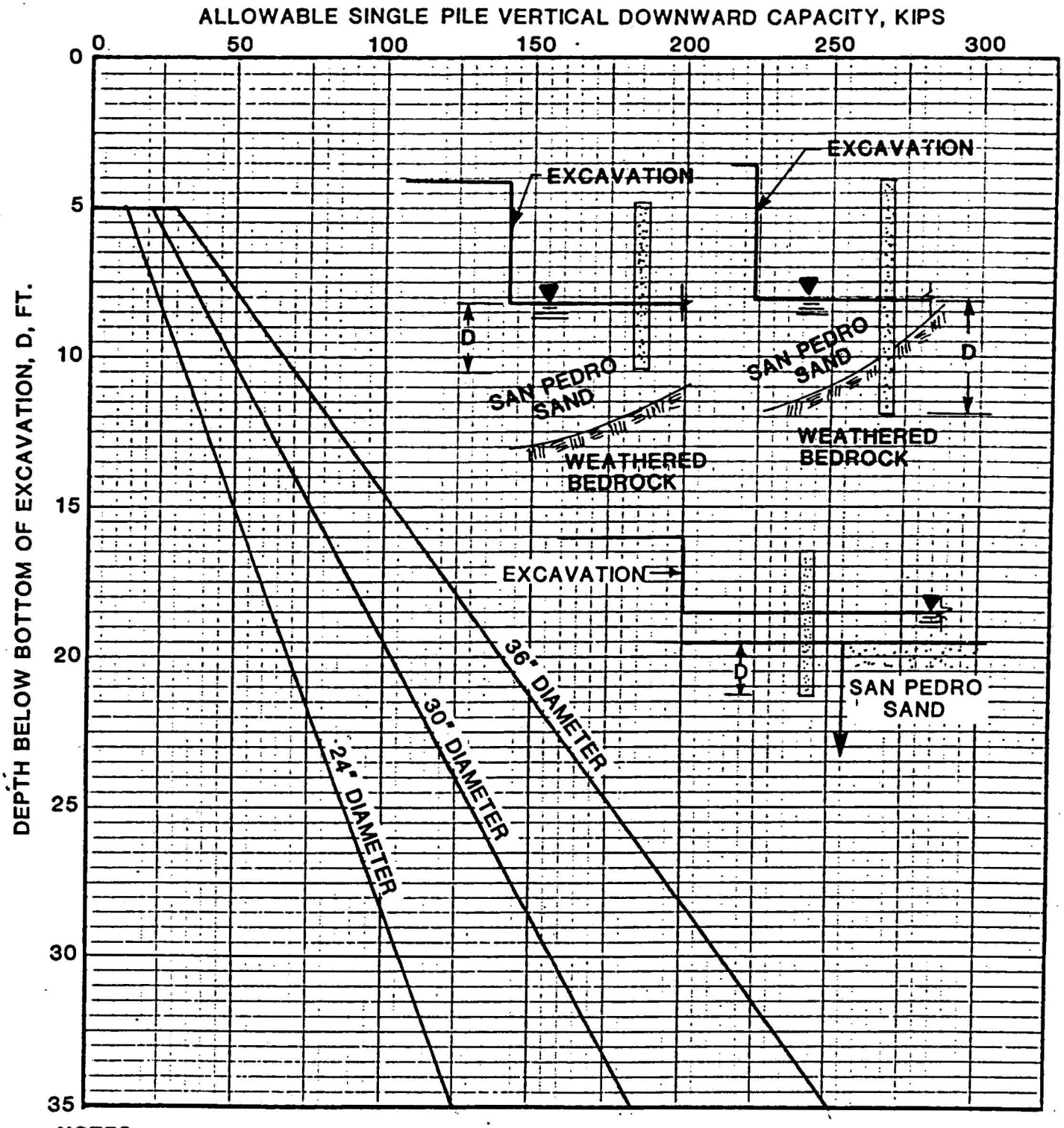

NOTES

1. All piles must penetrate at least 5 feet into the San Pedro Sand or Weathered Bedrock.
2. End-bearing and friction included in above curves

VERTICAL CAPACITY OF PILES FOR DECKING (SAN PEDRO OR WEATHERED BEDROCK)

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Figure No.
6-11

- Tiltmeters: tiltmeters are used to monitor the verticality of buildings adjacent to the excavation and can provide a forewarning of distress. Normally, ceramic plates are glued to the building walls and read using a portable tiltmeter containing the same type of tilt sensors used in inclinometers. It is recommended that a few tiltmeters be placed on the exterior walls of buildings which are located within the underpinning zones defined on Figure 6-1. Baseline readings should be made prior to all construction activity, and subsequent readings should be made at several excavation/construction stages through the end of construction.

- Inclinometers: It is recommended that several inclinometers be installed and monitored around the station excavation. Inclinometers should be located on each side of the excavation. The casing could be installed within the soldier pile holes or in separate holes immediately adjacent to the shoring wall. Baseline readings of the inclinometers should be made immediately upon installation. Subsequent readings should be made at regular time intervals during excavation and construction.

- Heave Monitoring: The magnitude of the total ground heave should be measured. This information will be valuable in determining the ground response to load change and as in indirect check on the magnitude of the predicted settlement of the station structure.

  We recommend that heave gages be installed prior to construction along the longitudinal centerline of the excavation on about 200-foot centers. The devices could consist of conical steel points, installed in a borehole, and monitored with a probing rod that mates with the top of the conical point. The borehole should be filled with a thick colored slurry to maintain an open hole and allow for easy hole location. The top of the points should be at least 2 feet below the bottom of the final excavation to protect them from equipment, yet allow for easy access should the hole collapses.

  The points should be installed and surveyed prior to starting excavation. Once the excavation begins, readings should be taken at about two-week intervals until the excavation is completed and all heave has stopped.

- Convergence Measurements: We recommend the use of tape extensometers to measure the convergence between points at opposite faces of the excavation during various stages of excavation. These measurements provide inexpensive data to supplement the inclinometer and survey information.

- Measurements of Strut Loads: If internal bracing is used, we recommend that the loads on at least four struts at each support level be monitored periodically during the construction period. These measurements provide data on support loads and a forewarning of load reductions which would result in excessive ground movements. There are several methods to obtain these data. A commonly used method involves vibrating wire strain gages mounted on studs welded to the struts. For full measurements of maximum stresses, a minimum of three gages is needed

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on a pipe strut and four on a wide flange strut. However, two gages are often used to simplify the installation and monitoring effort with acceptable results. There should be a means of measuring the strut temperature at the time of the strain readings.

- Frequency of Readings: An appropriate frequency of instrumentation readings depends on many factors including the construction progress, the results of the instrumentation readings (i.e., if any unusual readings are obtained), costs, and other factors which cannot be generalized. The devices should be installed and initial readings should be taken as early as possible. Readings should then be taken as frequently as necessary to determine the behavior being monitored. For ground movements this should be no greater than one to two-week intervals during the major excavation phases of the work. Strut load measurements should be more frequent, possibly even daily, when significant construction activity is occurring near the strut (such as excavation, placement of another level of struts, etc.).

In our opinion, it is important that the installation and measurement of the instrumentation devices be under the direction and control of the Engineer. Experience has shown when the instrumentation program has been included in the bid package as a furnish and install item, the quality of the work has often been inadequate such that the data are questionable. By defining Support Work (Contractor) and Specialist Work (Engineer) in the bid documents, LACTC could allow the contractor to provide support to the Engineer in installing the instrumentation.

6.7 Excavation Heave and Settlement of the Station Structures

The proposed excavations will substantially change the ground stresses below and adjacent to the excavations. The proposed 70-foot excavation at Crenshaw/Olympic Station will decrease the effective vertical ground stresses by about 5,300 psf. The proposed 85-foot deep excavation at Pico/San Vicente station will result in a reduction of effective vertical ground stresses of about 6,800 psf. Stress reduction caused by the excavation will result in rebound or heave of materials below the excavations. This response is not due to the occurrence of any type of swelling soils or high hydraulic gradients but simply an elastic response to stress unloading. Since the excavations will be open for an extended period, the elastic heave is expected to be completed prior to construction of the stations. The station structures and subsequent backfilling will reload the soil. We estimate that the net Station loads will be about 2,000 to 4,000 psf. This load will cause the ground to reconsolidate or settle. Thus, even though the weight of the excavated soil exceeds the weight of the final structure, the structure will experience some settlement due to recompression of the elastic heave.

We estimate that the maximum rebound at the center of both excavations will range between about 2 to 4 inches. We also believe that the majority of this heave will occur as the excavation is being performed. Due to the high density of the San Pedro Sand, the majority of the deformation is expected to be elastic rebound. These values agree well with observed behavior in similar excavations in the Los Angeles area (Evans, 1968).

It is estimated that the expected imposed loads from the structures and backfill will induce settlements of approximately 1 to 2-1/2 inches. Due to the long, narrow shape of the imposed load, the theoretical differential settlement is relatively small, approximately 1/3 inch over the width of the structures. This correlates to an angular rotation of only about 1:1,100.

The above estimates assume a uniform foundation bearing pressure which could result only from a uniformly loaded and perfectly flexible structure. We understand that the Stations will be structurally quite stiff. Thus the actual differential settlement will be less than the theoretical settlement of a flexible foundation.

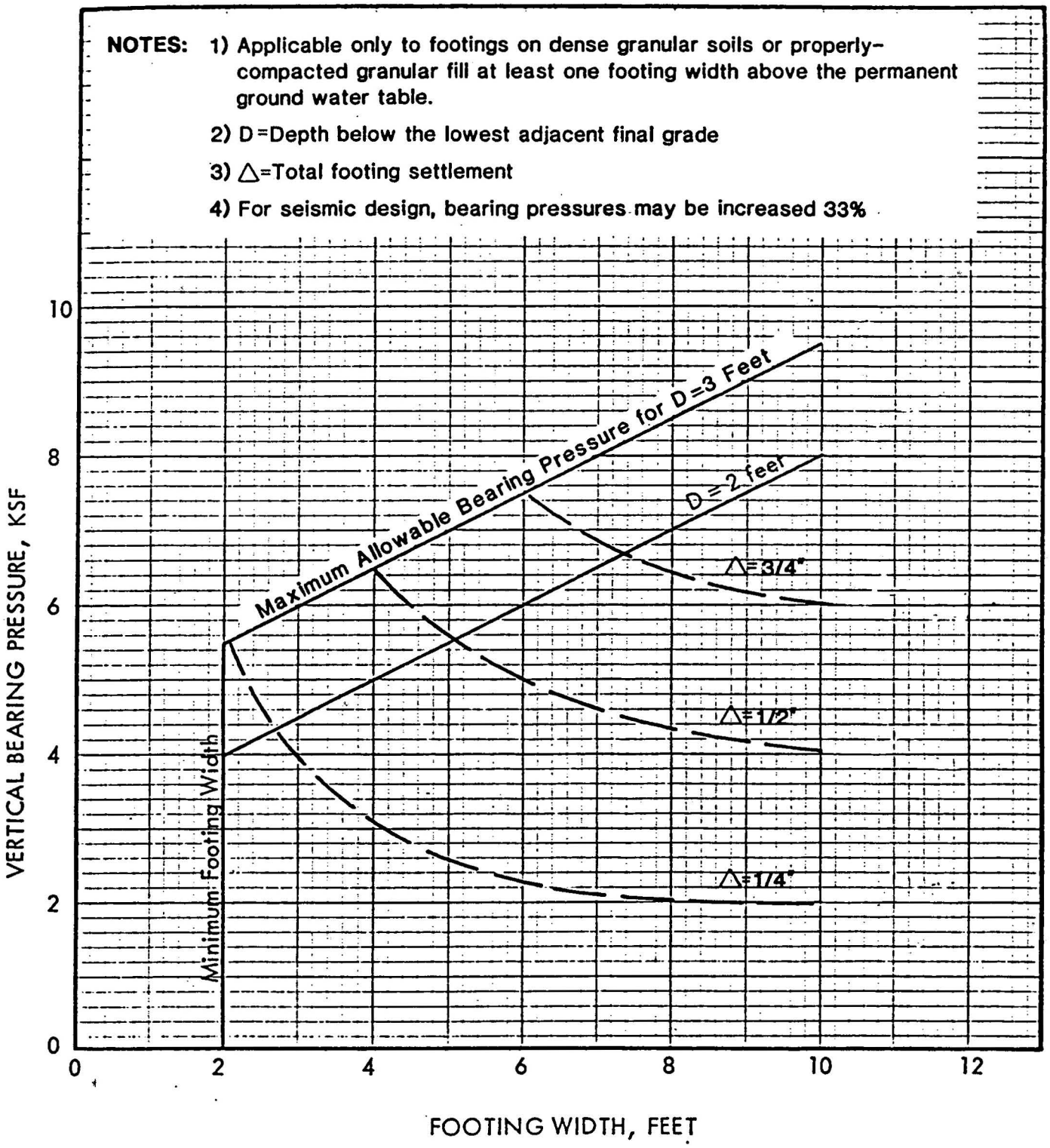
6.8 Foundation Systems

6.8.1 Main Stations: It is understood that the proposed stations will be supported on thick base slabs which will function as massive mat foundations. We estimate that the net mat foundation bearing pressures will range between about 2,000 to 4,000 psf. In our opinion the stations can be adequately supported on mat foundations bearing on undisturbed soil subgrade materials. Section 6.7 presents estimated settlements for the proposed station structures.

6.8.2 Support of New Surface Structures: New surface structures can be generally supported on conventional spread footings founded on undisturbed stiff or dense natural soils. If suitable natural soils do not exist at the surface structure site, footings may be founded on a zone of properly compacted structural fill (see Appendix D). Allowable bearing pressures and estimated total settlements of spread footings bearing on the natural soils or compacted fill can be determined based on Figures 6-12 and 6-13. These figures are based on analytical procedures and experience in the Los Angeles area but are generally conservative due to lack of detailed information on structural loadings and site-specific conditions at the surface structure location. Detailed site-specific studies should be performed to provide final design recommendations for specific structures.

All spread footing foundations should be founded at least 2 feet below the lowest adjacent final grade and should be at least 2 feet wide. The bearing values shown on Figures 6-12 and 6-13 are for full dead load and frequently applied live loads. For transient loads, including seismic and wind loads, the bearing values may be increased by 33%. Differential settlements between adjacent footings should be estimated as 1/2 of the average total settlements or the difference in the estimated total settlements shown on Figures 6-12 and 6-13, whichever is larger.

For design, resistance to lateral loads for surface structures may be assumed to be provided by passive earth pressure and friction acting on the foundations. An allowable passive pressure of 350 psf/ft may be used for the sides of footings poured neat against dense or stiff natural soils or properly compacted fill. Frictional resistance at the base of foundations should be determined using a frictional coefficient of 0.4 with dead load forces.



SPREAD FOOTING BEARING/SETTLEMENT ON GRANULAR SOILS

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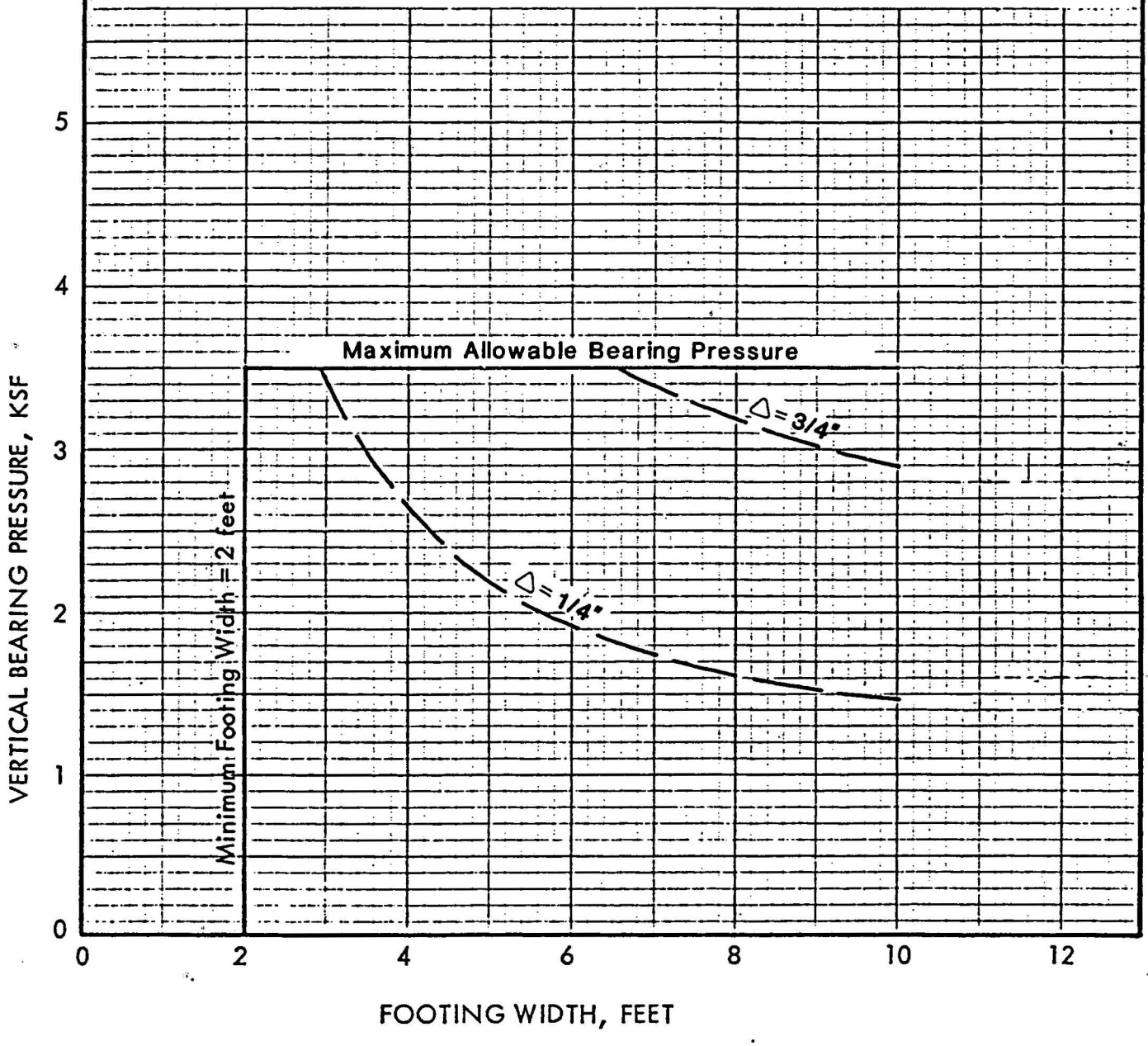
Figure No.
6-12

NOTES: 1) Applicable only to footing on undisturbed stiff natural fine-grained soils with undrained strength Su ≥2000 psf.

2) △ = Total footing settlement

3) For seismic design, bearing pressures may be increased 33%.



SPREAD FOOTING BEARING/SETTLEMENT ON FINE-GRAINED SOILS

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Figure No.
6-13

6.9 Permanent Groundwater Provisions

We understand that the stations will be designed to be water-tight and to resist the full permanent hydrostatic pressures. We recommend that full waterproofing be carried at least 5 feet above the maximum groundwater levels shown in the geologic cross sections. Thus, the entire station structures will require waterproofing because of the high groundwater condition.

6.10 Loads on Slab and Walls

6.10.1 Hydrostatic Pressures: The existing groundwater levels as measured at the boring locations were at about Elevation 140 feet at the Crenshaw/Olympic site and about Elevation 75 feet to 100 feet at the Pico/San Vicente site. It is recommended that the following groundwater levels be assumed for determining hydrostatic pressures:

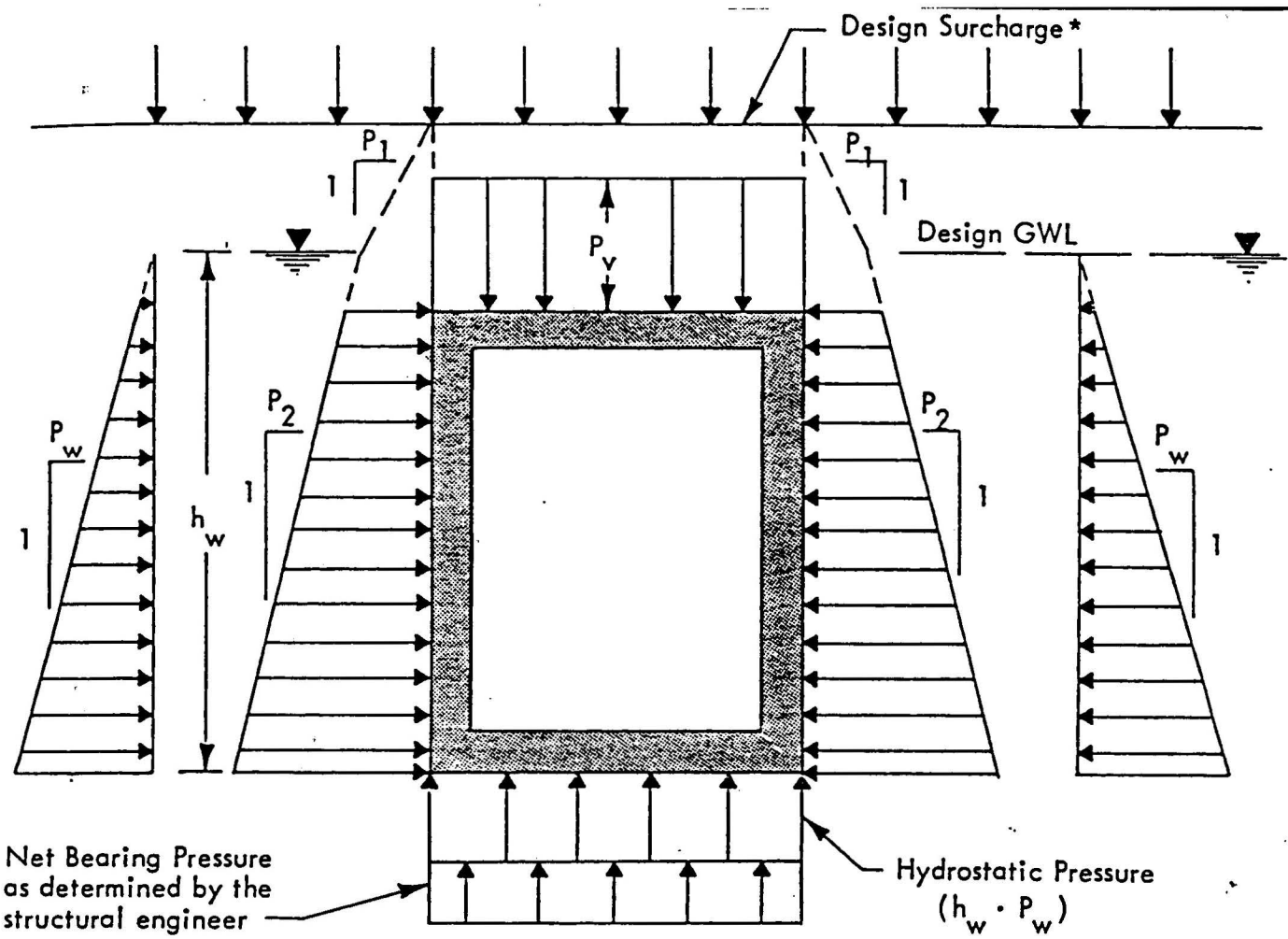
Location	Elevation (feet)
Crenshaw/Olympic	150
Pico/San Vicente	105

6.10.2 Permanent Static Earth Pressures: Figure 6-14 presents lateral earth pressure diagrams recommended for design of permanent subsurface walls.

Vertical earth pressures on the roof should be assumed to be due to the full moist and/or saturated weight of overburden soil plus surcharge. A total unit weight of 130 pcf may be used

6.10.3 Surcharge Loads: Lateral surcharge loads from existing buildings not underpinned must be added to the lateral design earth pressure loads. The lateral surcharge loads are identical to those recommended for temporary walls. Procedures for computing these are presented on Figure 6-7. Vertical surcharge loads due to surface traffic, etc. should also be included in roof design. In addition, consideration should be given to loads imposed by earthmoving equipment during backfill operations.

6.11 Seismic Considerations: Design procedures and criteria for underground structures under earthquake loading conditions are defined in the Southern California Rapid Transit District (SCRTD) report entitled "Guidelines for Design of Underground Structures", dated March, 1984. Evaluations of the seismological conditions which may impact the project and the probable maximum credible earthquakes which may be anticipated in the Los Angeles area are described in the SCRTD report entitled "Seismological Investigation and Design Criteria", dated May, 1983, prepared by Converse Consultants, et al. The 1984 report complements and supplements the 1983 report.



LOADING CONDITION	DESIGN LOAD PARAMETERS				
	P_1 (psf)	P_2 (psf)	P_w (psf)	P_v	GWL
End Construction	40	20	62.4	*	**
Long Term	60	30	62.4	*	***
Side sway †	40/60	20/30	62.4	*	**

* P_v = Full overburden pressure (depth x total density) plus design surcharge: distribution and magnitude of design surcharge to be determined by section designer.

** Designer should use a GWL (between the base of slab and long-term water elevation) which will be critical for the loading condition.

*** Elevation 150 feet at Crenshaw/Olympic Station and elevation 105 feet at Pico/San Vicente Station.

† Sidesway condition assumes "End Construction" pressure on one side of the structure and "Long Term" on the other.

LOADS ON PERMANENT WALLS

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Figure No.
6-14

Dynamic Material Properties: Values of apparent wave propagation velocities for use in traveling wave analyses have been previously recommended in the May, 1983, Seismological Investigation and Design Criteria Report. Other dynamic soil parameters required for input into the various types of analyses recommended in the seismic design criteria report are also given. These include values of dynamic Youngs' modulus, dynamic constrained modulus, and dynamic shear modulus at low strain levels.

Average values of compression wave velocity and shear wave velocity based on interpretation of limited downhole geophysical surveys performed in Borings CEG-14 and CEG-15 and other borings in similar materials during the 1981 investigation (Converse, Ward, Davis, Dixon, et al) are presented in Table 6-1. These velocities have been used together with the corresponding values of density and Poisson's ratio to establish moduli at low strain levels. Computed moduli for the various geologic units present at the station sites, are tabulated in Table 6-1.

TABLE 6-1

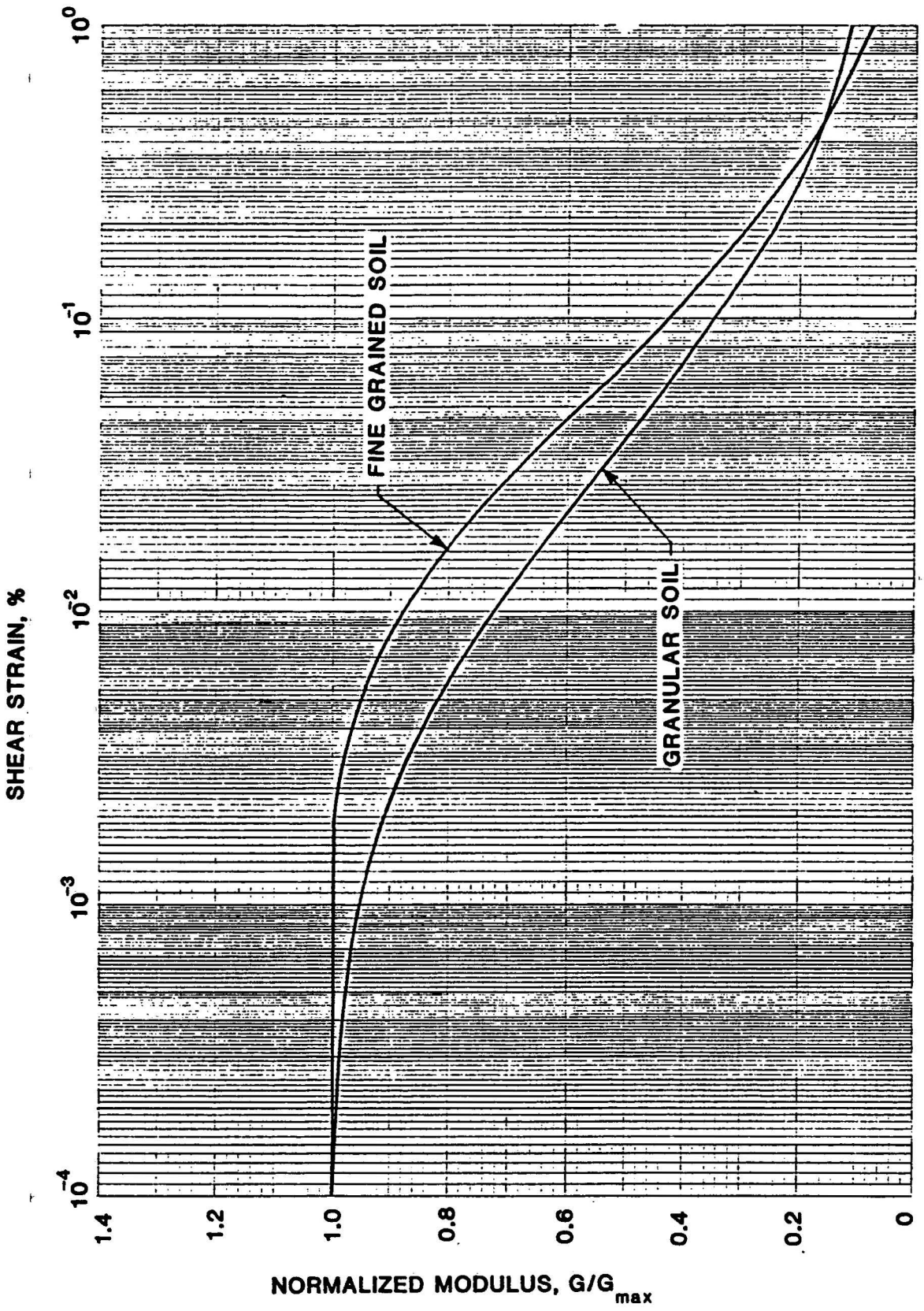
RECOMMENDED DYNAMIC MATERIAL PROPERTIES FOR USE IN DESIGN

		Alluvium	San Pedro Sand	Fernando Bedrock
Average Compression Wave velocity, v_c (ft/sec)	moist	4,000		5,700
	saturated	5,000	5,000	
Average Shear Wave Velocity, v_s (ft/sec)		950	960	1,300
*Poisson's Ratio		0.40	0.35	0.35
**Young's Modulus, E, (psi)	moist	207,000		530,000
	saturated	185,000	185,000	
**Shear Modulus, G_{max}, (psi)		25,000	25,000	45,000

* For saturated alluvium, use value of 0.45.

** All modulus values are for low strain levels (10^{-4}%).

The variation of dynamic shear modulus, expressed as the ratio of G/G_{max}, with the level of shear strain is presented in Figure 6-15 for the various geologic units. Similar relationships for soil hysteretic damping are presented in Figure 6-16.



RECOMMENDED DYNAMIC SHEAR MODULUS RELATIONSHIPS

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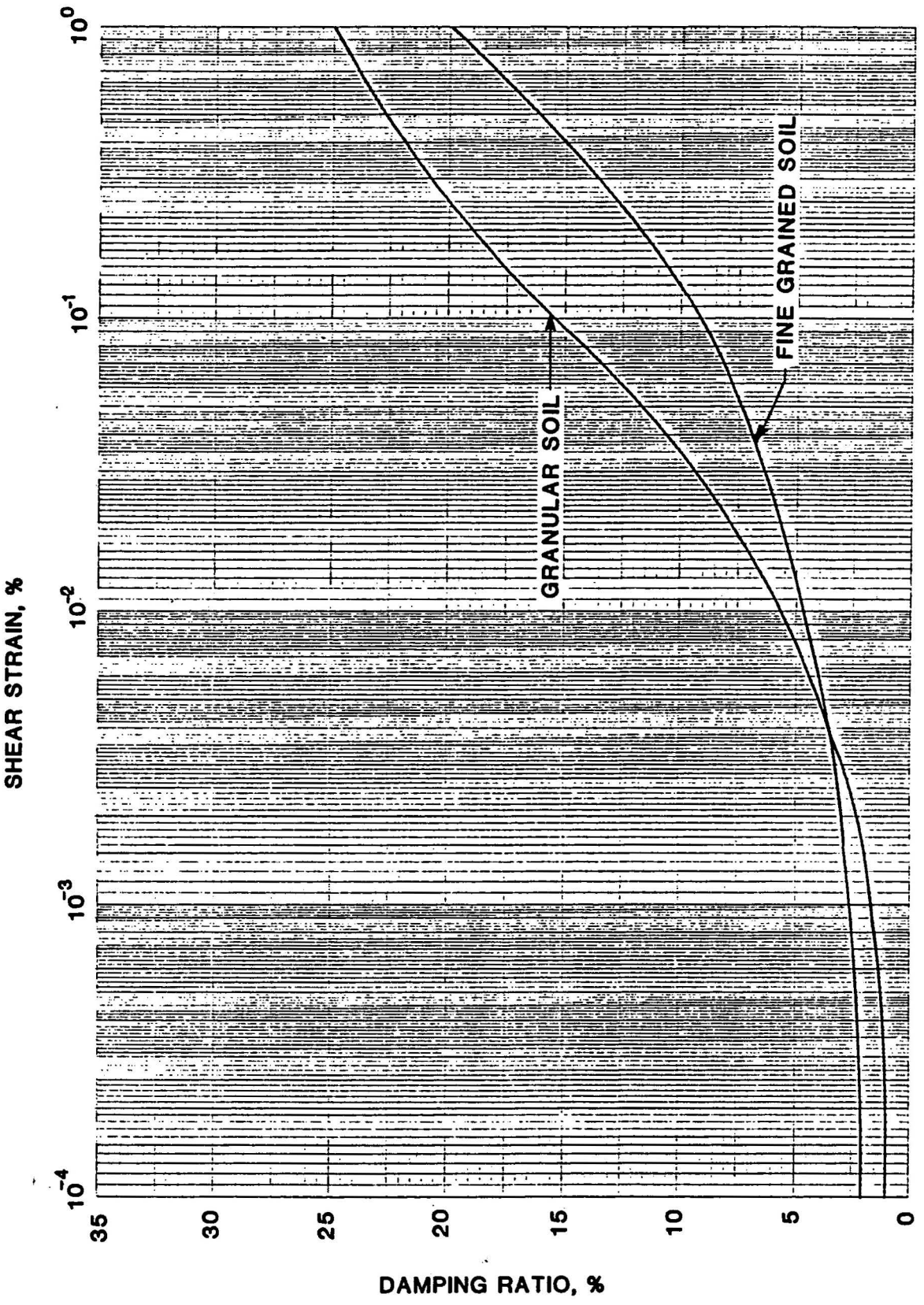
Figure No.
6-15



RECOMMENDED DYNAMIC DAMPING RELATIONSHIPS

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Figure No.
6-16

Liquefaction Potential: The generalized subsurface cross section has been described in Section 5.0 and is shown in Drawings 1 through 3. The groundwater level has a downward gradient from the Wilshire/Western station to a low area at about Wilshire Boulevard and Van Ness Avenue. West of Van Ness and around the curve into Crenshaw Boulevard the water elevation rises about 10 feet.

Starting from boring MC-2 the groundwater level continues to drop all the way on the alignment to the Pico/San Vicente station. The tunnel is below the groundwater level throughout the entire project. The soils below groundwater consist of the recent and old alluvium and the San Pedro Sands.

Our liquefaction evaluation is based on procedures published by Seed et al., (1985) which utilizes Standard Penetration Test N values and sieve analysis results to evaluate liquefaction potential in sandy soils. Clayey soils are generally considered non-liquefiable, but there are correlations between classification tests (Atterberg Limits, moisture content, and grain size distribution) and liquefaction potential of clayey soils. Index property tests of the clayey alluvium compared with index properties of soils vulnerable to liquefaction indicated the fine-grained soils to be non-liquefiable.

Published correlations of SPT data and liquefaction potential have historically been made for granular soils. Measured SPT "N" values in the San Pedro Sands were all greater than 30 to 100 blows (refusal) and, therefore, these materials are considered to have a very low liquefaction potential even under the MDE.

Corrected "N" values (normalized to 2 ksf overburden pressure) for 49 SPT tests in saturated granular alluvium ranged from 11 to refusal. Determination of dynamic strength was based on an M7.5 earthquake event.

Eleven of the SPT N values were low enough to indicate liquefaction was likely with the MDE; however, with the lessor shaking involved with the ODE only 4 of the N values indicated liquefaction was likely and only two of those were at station sites. The results of the analysis are presented in Table 6-2.

TABLE 6-2
LIQUEFACTION POTENTIAL OF SELECTED SPT N VALUES/MID-CITY SOIL BORINGS

Boring	Depth of SPT (feet)	Liquefaction Likely	
		ODE	MDE
MC-1	26		X
	31		X
	36		X
	41		X
	61		X
MC-5	21	X	X
	26		X
MC-7	22	X	X
MC-9	21	X	X
	26	X	X
MC-15	37		X

Based on the boring logs and the Table 6-2 results, it can be inferred that liquefaction-prone layers or zones are relatively thin in boring MC-1 at about 61 feet of depth, and in borings MC-5, MC-7, and MC-15. It should particularly be noted that sands run into the hollow stem auger during drilling boring MC-1 within the zone about 61 feet of depth, despite this zone is between soils with higher blow counts. Since the stations will extend to depths greater than the potentially liquefiable zones, and these zones are relatively thin, and the soils above the station roof will be removed and replaced, there should be little impact on the stations due to liquefaction. Liquefaction effects are not expected to affect more the station structures than other structures within the region of the project.

6.12 Earthwork Criteria

Site development is expected to consist primarily of excavation for the subterranean structure but will also include general site preparation, foundation preparation for near surface structures, slab subgrade preparation, and backfill for subterranean walls and footings and utility trenches. Recommendations for major temporary excavations and dewatering are presented in Sections 6.2 and 6.4. Suggested guidelines for site preparation, subgrade preparation, site drainage, and utility trench backfill are presented in Appendix D. Recommended specifications for compaction of fill are also presented in Appendix D. Construction specifications should clearly establish the responsibilities of the contractor for construction safety in accordance with CALOSHA requirements.

Excavated granular alluvium (sand, silty sand, gravelly sand, sandy gravel) are considered suitable for re-use as compacted fill, provided it is at a suitable moisture content and can be placed and compacted to the required density. The excavated existing fills, and fine-grained soils are not considered suitable because these fine-grained materials will make compaction difficult and could lead to fill settlement problems after construction. If the

granular alluvium materials cannot be stockpiled, imported granular soils could be used for fill, subject to approval by the geotechnical engineer.

7.0 TUNNEL ALIGNMENT - GEOTECHNICAL EVALUATION AND TUNNELING CONDITIONS

In general, construction of the Mid-City Segment tunnels will involve approximately 1.8 mi. of tunneling in two reaches: 1) between the Wilshire/Western station and Crenshaw/Olympic station (1.0 mi), and 2) between the Crenshaw/Olympic station and Pico/San Vicente station (0.8 mi). Tunneling is expected to be in alluvium and San Pedro Sand below the groundwater table. These materials are described in sections 5.2 and 5.3 of this report and are shown in profile on Drawings 1-3. Groundwater quality information is given in section 5.4.1. The average depth of ground cover above the crown is around 65 feet, varying between a minimum of 30 feet in the vicinity of station 386+00 and a maximum of 95 feet in the vicinity of station 465+00. Following is a brief description of the anticipated subsurface conditions along each reach with emphasis on stratigraphy, groundwater, gas and other tunneling conditions.

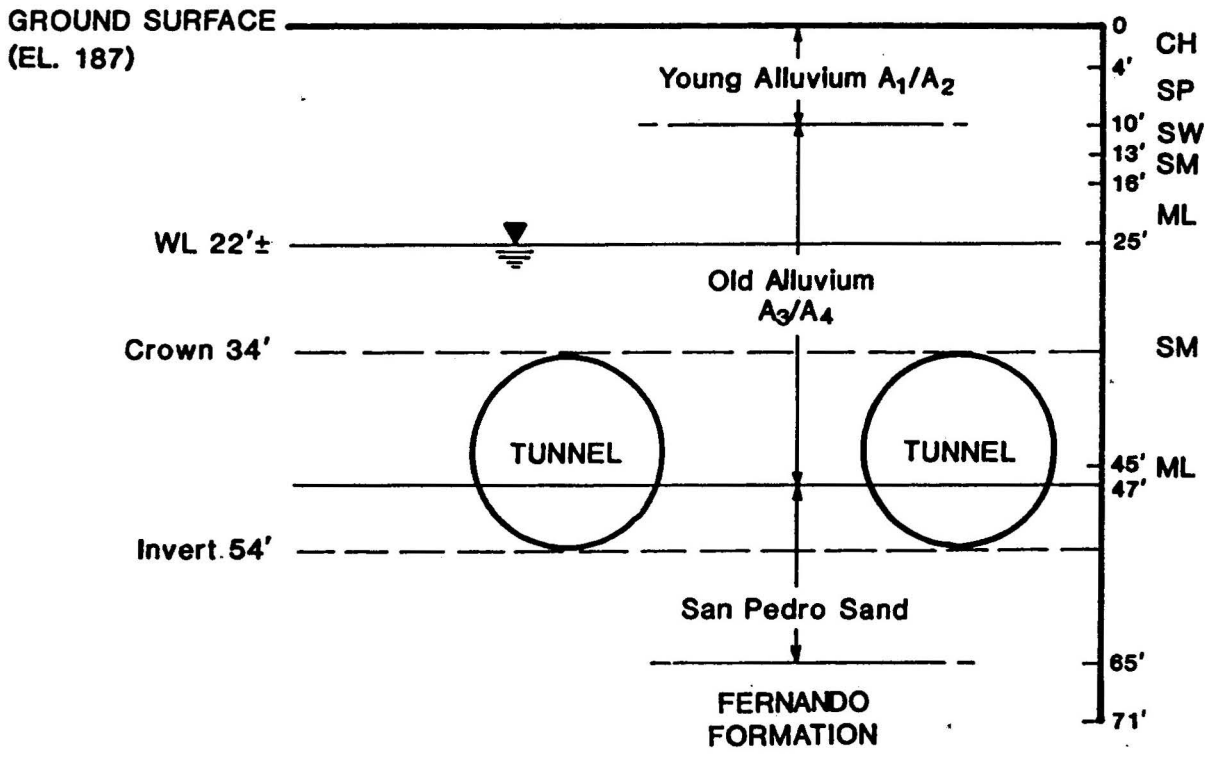
7.1 Stratigraphy, Groundwater, Gas and Tunneling Conditions

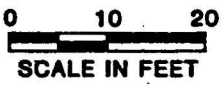
7.1.1 Station 373+53 to 428+30 (5,477 feet - Drawings 1 and 2): It is anticipated the tunnels between Wilshire/Western and Crenshaw/Olympic stations will encounter mixed face conditions consisting of alluvium and San Pedro Sand (see Figure 7-1). Mixed face herein is defined as two materials differing in tunneling properties; i.e., alluvium which stands well and Sand Pedro Sands which tends to cave/run. The location of the contact between these two soil types will vary from invert to crown, but should be exposed in the heading along the entire reach except in the vicinity of boring MC-4 (station 426+50) where the heading will be entirely in San Pedro Sand (see Figure 7-3). Alluvium in this reach of the tunnel is expected to consist primarily of silty sand and silt with lesser amounts of sand and gravel.

The San Pedro Sand consists primarily of cohesionless sand with discontinuous lenses of silty sand, silt, and gravel. This is the unit which elsewhere forms the famous LaBrea Tar Sands. The San Pedro Sand is very dense with uncorrected N-values typically greater than 50. Although dense, this non-cohesive sand is likely to cave during excavation above the water table and run during excavation below the water table. The depth of soil cover varies from about 38 feet to 65 feet.

Between stations 390+00 - 403+00 and 423+00 - 428+30 the inverts of the tunnels are within approximately 10 feet of the contact between San Pedro Sand and the underlying Fernando Formation. The location of the contact is based on interpolation between exploratory borings, and should be considered approximate. It is possible that portions of the tunnel headings may encounter the Fernando Formation below the spring line. The Fernando consists of massive to laminated siltstone and claystone with lesser amounts of sandstone. Bedding dips from 20° to 45° dip orientation is unknown. For strength and other characteristics, see Section 5.3.4.

BORING MC-1
(STA. 387+30)





EXAMPLES OF STRATIGRAPHIC VARIATIONS

METRO RAIL MID CITY SEGMENT

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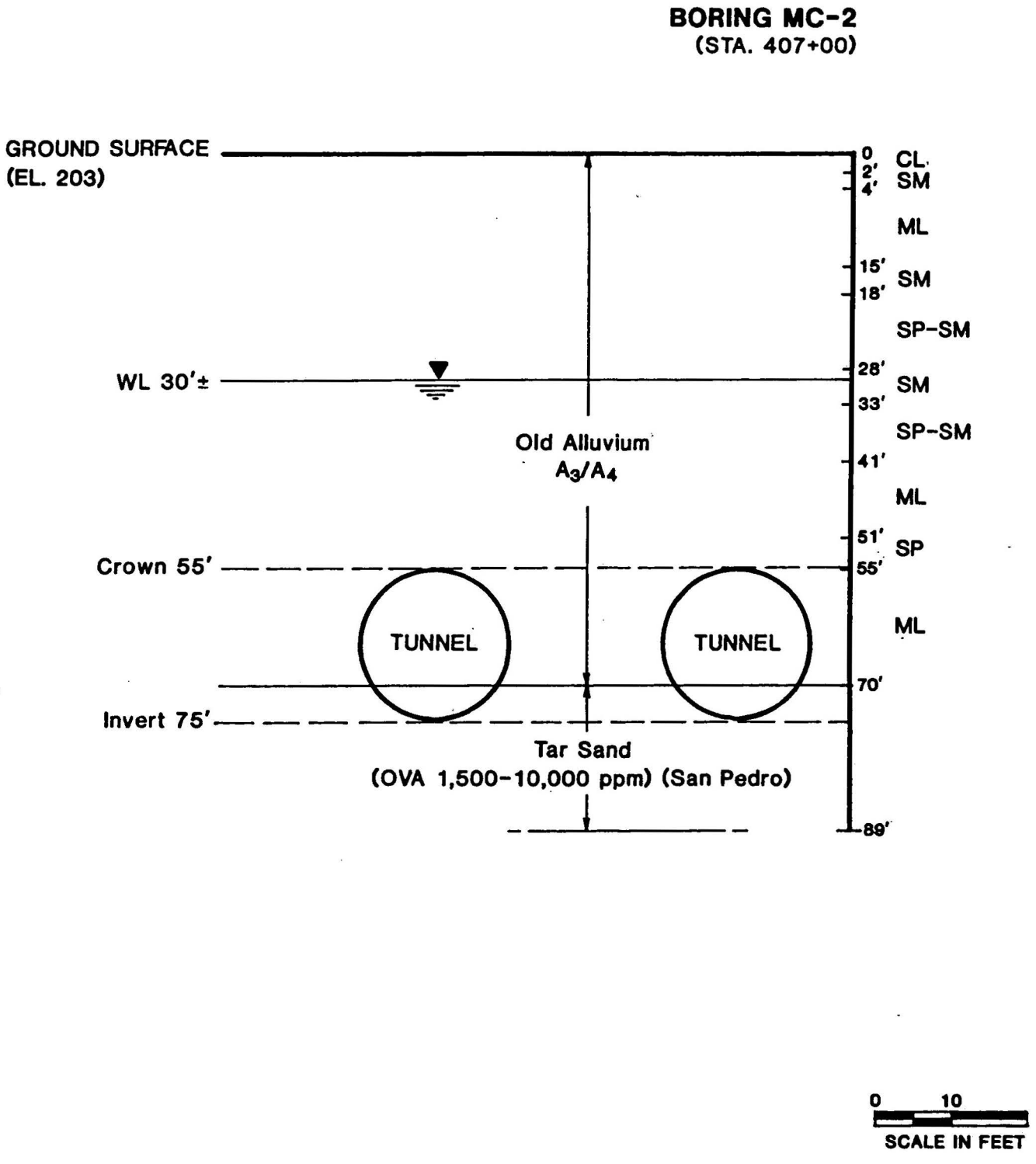
Figure No.
7-1



EXAMPLES OF STRATIGRAPHIC VARIATIONS

METRO RAIL MID CITY SEGMENT

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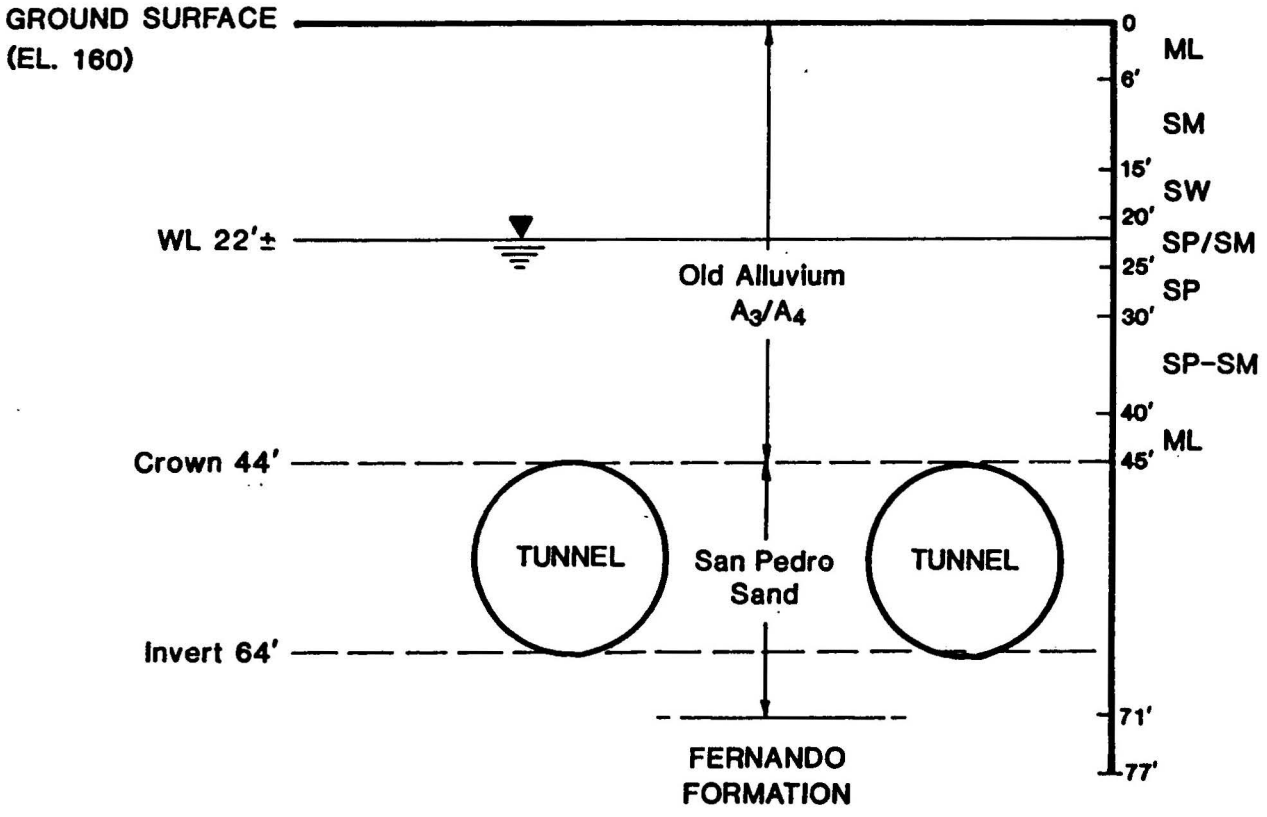
Figure No.
7-2

BORING MC-4
(STA. 426+50)





EXAMPLES OF STRATIGRAPHIC VARIATIONS

METRO RAIL MID CITY SEGMENT

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Figure No.
7-3

The groundwater level varies from approximately 34 feet to 10 feet above the crown. Flowing ground conditions are likely to be encountered along this entire reach. In addition, stratigraphic horizons within either the alluvium or San Pedro Sand may be under significant hydrostatic pressure, creating the potential for blow-outs in the tunnels.

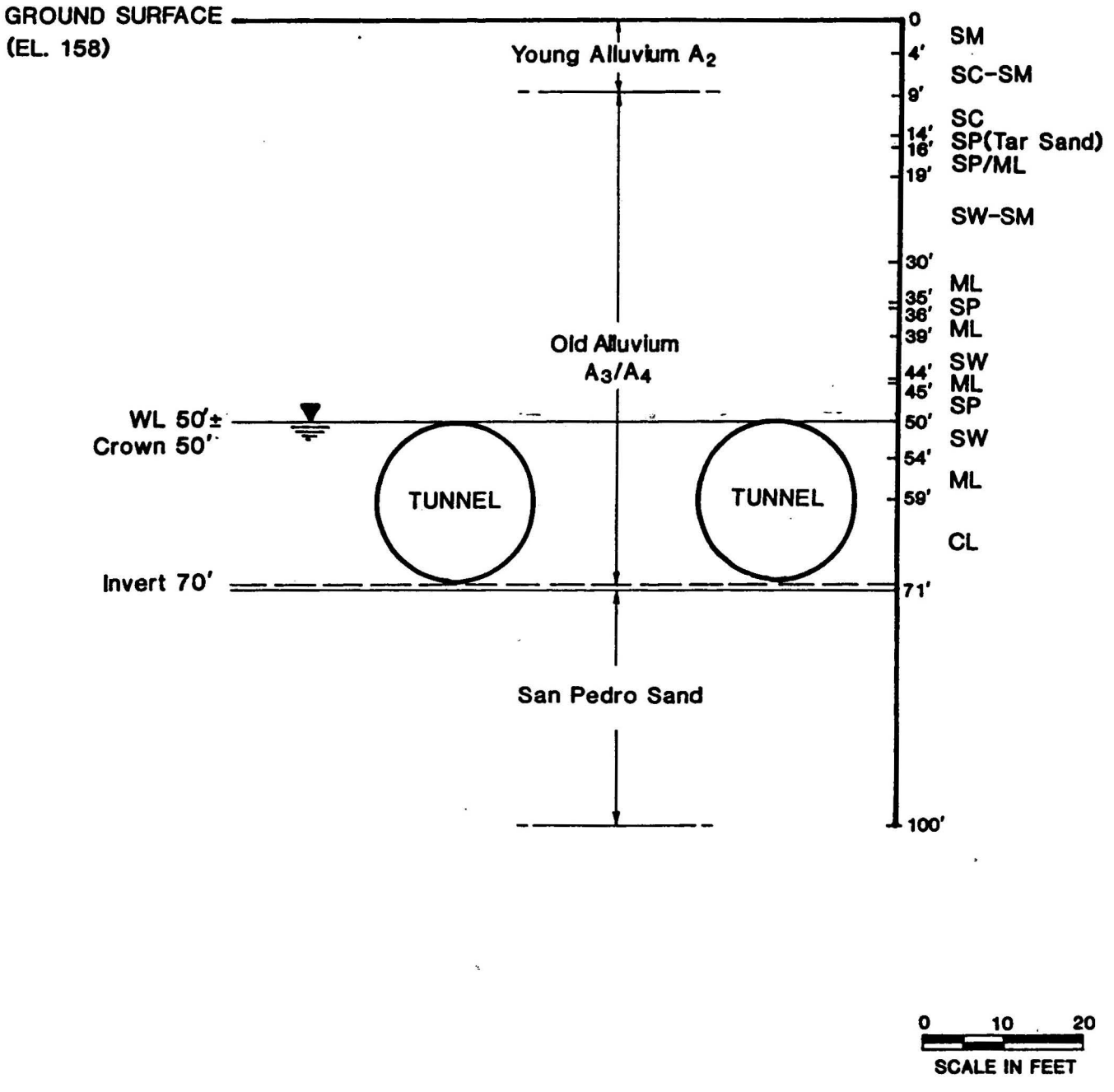
In borings MC-2 and MC-3, located near stations 407+10 and 419+00, natural tar sands were encountered about 70 feet below surface grade, near the tunnel invert elevation (see Figure 7-2). The sands had a strong petroleum odor and were discolored by the tar. Analytical tests on recovered samples detected high levels of petroleum hydrocarbons. Organic Vapor Analyzer (OVA) readings taken in the field during drilling, were as high as 1,500-10,000 ppm methane gas (see Figure 7-2). The exact vertical and lateral extent of the gas and tar sands are unknown. A list of naturally occurring gasses and tar sands encountered in the exploratory borings is presented in Table 7-1. Natural tar sand muck excavated during tunneling may require disposal at a landfill approved for hazardous materials; a costly procedure. More specific information on gas is contained in Engineering-Science's August 1992 "Final Report Subsurface Gas Investigation Metro Rail Red Line Mid-City Segment".

7.1.2 Station 434+40 to 478+30 (4,390 feet - Drawings 2 and 3): Tunneling between Crenshaw/Olympic and Pico/San Vicente stations is expected to be similar to the Wilshire/Western and Crenshaw/Olympic reach. Mixed-face conditions involving alluvium and San Pedro Sand are also anticipated in this reach. The alluvium/San Pedro contact will be exposed at various locations within the heading along this entire reach except in the vicinity of Boring MC-9 (station 438+70) where the heading will be entirely in alluvium (see Figure 7-4). Alluvium will consist primarily of silt with lesser amounts of silty sand and sand. The San Pedro Sand is as previously described. The depth of soil cover varies approximately from 46 feet to 95 feet.

The groundwater level varies approximately from 30 feet to 6 feet above the crown except in the vicinity of borings MC-10 and MC-14 (stations 447+05 and 477+65) where groundwater levels were recorded between crown and springline elevations. Again, running ground conditions are likely to be encountered and stratigraphic horizons within the San Pedro Sand may be under significant hydrostatic pressure.

OVA readings recorded in many of the borings along this reach of the alignment indicated numerous zones of moderate to high concentrations of methane gas. Locally, methane concentrations exceeded 10,000 ppm. Weak to strong "rotten egg" odors indicative of hydrogen sulfide gas were also common (see Figure 7-5). In boring MC-6 (Station 431+00), located about midway in the Crenshaw/Olympic station, hollow stem auger drilling was terminated at a depth of 50 feet because of discharges of methane and hydrogen sulfide gasses through the top of the auger stem. Ambient air measurements around the drill site indicated oxygen depletion with a lower explosive limit instrument reading of 100% (>5% methane

BORING MC-9
(STA. 438+70)



EXAMPLES OF STRATIGRAPHIC VARIATIONS

METRO RAIL MID CITY SEGMENT

Project No.
91-31-208-01

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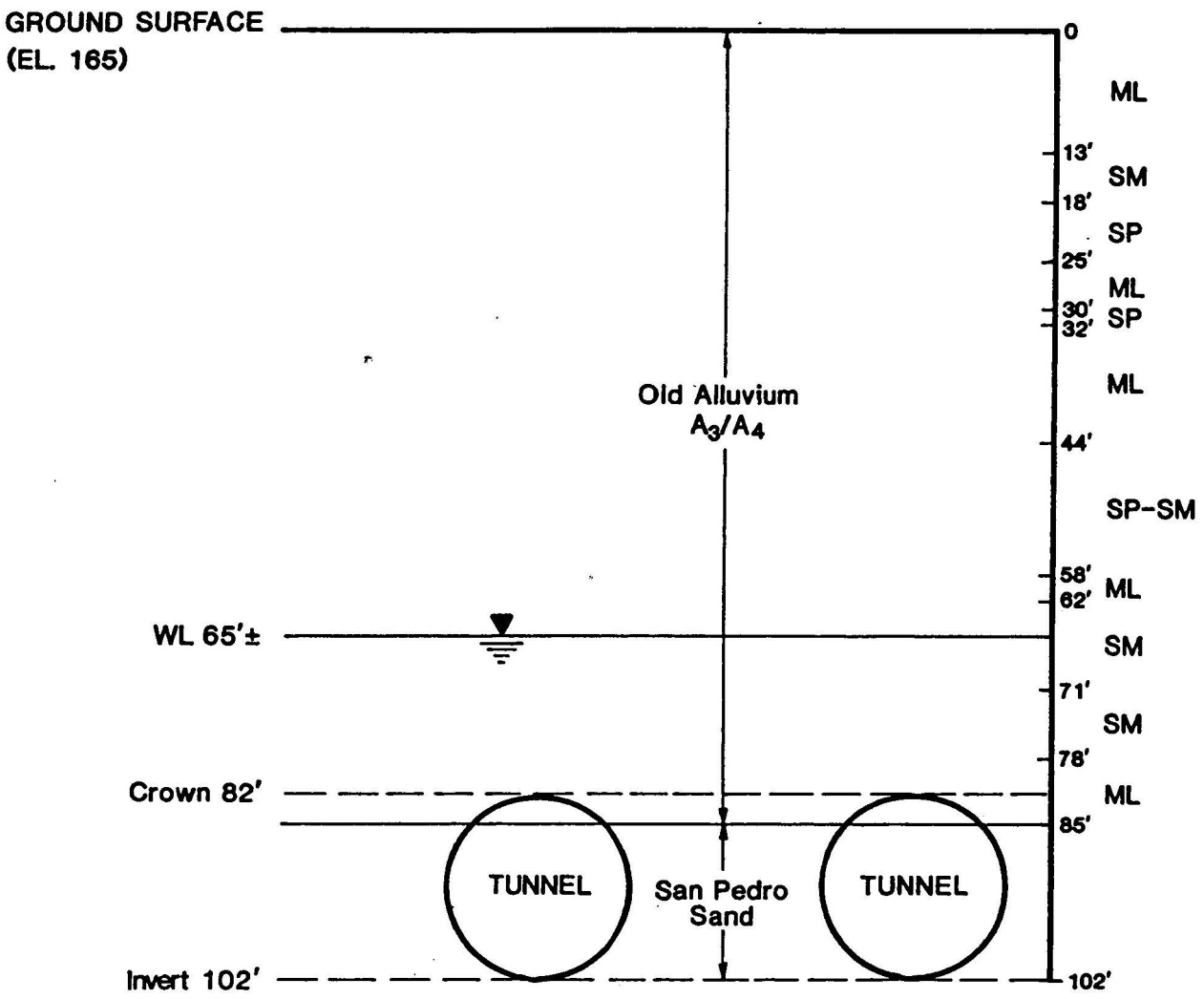
Figure No.
7-4

BORING MC-13
(STA. 471+00)



NOTE:
Moderate to strong H_2S gas odor emissions detected at the surface during monitoring well installation

0 10 20
SCALE IN FEET

EXAMPLES OF STRATIGRAPHIC VARIATIONS

METRO RAIL MID CITY SEGMENT

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Figure No.
7-5

Table 7-1 Naturally Occurring Gasses and Tar Sands Detected in Exploratory Borings

BORING	DEPTH TO			DEPTH TO TUNNEL INVERT	REMARKS
	METHANE (CH_4)	HYDROGEN SULFIDE (H_2S)	TAR SAND		
MC-2	70'+	---	---	75'	OVA readings to 10,000+ ppm.
MC-3	78'+	---	78'+	82'	OVA readings from 75 to 1,500 ppm. Tar present as dark brown blobs and horizontal layers.
MC-5	20'+	45'+	---	70'	Gasoline floating on water table at 20'. OVA readings to 10,000+ ppm.
MC-6	15'+	45'+	---	70'	Hollow stem drilling terminated at 50' due to high volume discharges of methane and H_2S from top of augers.
MC-7	---	56'+	---	70'	Moderate to strong H_2S odor.
MC-8	50'-60'	---	---	70'	Strong petroleum odor.
MC-9	15'	70'+	---	70'	Strong petroleum odor at 15'. Slight to moderate H_2S odor 70'+.
MC-10	85'+	90'+	---	95'	OVA readings from 80 to 200 ppm. Ambient air reading at drill rig at 91' indicated 32% lel, 43 ppm H_2S, and O_2depletion.
MC-12	---	41'	---	113'	H_2S odor at 41'.
MC-13	---	---	---	103'	Moderate to strong H_2S odor at drill rig during monitoring well installation.
MC-14	65'+	65'-75'	---	80'	OVA readings from 100 to 5,000 ppm. Weak to moderate H_2S odor at 65'-75' and strong odor while pulling augers.
MC-15	---	---	---	83'	Weak to moderate H_2S odor while pulling augers.
MC-16	---	55'	60'	82'	H_2S and petroleum odors around 55'. Natural petroleum inclusions at 60'.
MC-21	20'+	20'+	---	77'	Boring terminated due to high volume discharges of methane and H_2S from top of augers. Ambient air readings at drill rig indicated 100% lel, 245 ppm H_2S, and O_2 depletion.

concentration), and a hydrogen sulfide concentration of 240 ppm. Similar conditions were encountered in boring MC-21, located in the vicinity of station 492+50. There is a high probability of encountering natural gas under pressure along this reach of the alignment. Concentrations and levels of pressure are discussed in Engineering-Science's August 1992 report on Subsurface Gas.

7.1.3 Faulting: The Las Cienegas and associated minor faults cross well below tunnel invert between stations 450+00 and 490+00, based on mapping by the California Division of Oil and Gas (see Figure 5-1). These faults are the structural traps that form the Las Cienegas Oil Field. Cross sections prepared by the Division of Oil and Gas indicate that the faults are truncated within the Fernando Formation approximately 1,500 feet below ground surface. This coincides with the boundary between the upper and lower Pliocene, roughly 3.4 million years ago. These faults do not intersect the tunnel grade and will not impact tunnel construction. These faults are Pre-Quaternary in age and are not active faults based on State of California criteria. The definition of an active fault in California is a fault that has "had surface displacement within Holocene time (about the last 11,000 years").

7.1.4 Conclusions and Recommendations: The anticipated soil conditions between the Wilshire/Western and Crenshaw/Olympic stations and the Crenshaw/Olympic and Pico/San Vicente stations are suitable for use of soft ground tunneling techniques utilizing a shield with hand and/or mechanical excavation equipment. Tunneling without a shield is not advised. Means should be provided for fore polling and/or breast boarding support techniques down to the springline to maintain stability of the face, prevent loss of ground, and avoid surface settlement along the alignment. An array of surface and subsurface monuments should be installed and monitored to detect ground movements during construction. We believe the entire tunnel is below the permanent groundwater table. Control of seepage may require installation of a dewatering system in advance of the heading for both reaches of the alignment. Preliminary analysis of the subsoils indicates that a dewatering system should be successful, although site specific pump tests are recommended prior to design of the dewatering system(s). Further, construction dewatering can not be designed on present boring data. Thus, about 5 additional borings are recommended for this purpose at locations between Stations 440+00 - 447+00 and Stations 465+00 - 478+00. The four proposed borings for the Pico-San Vicente Station; i.e., MC-17, MC-18, MC-19 and MC-20, should also be drilled. They were not drilled for this study because permits could not be obtained from the owner of the private property.

Hydrostatic pressures should be monitored to prevent excess pressure build up and blow-outs. Grouting of the San Pedro Sand is considered feasible utilizing chemical and/or cement injection methods. Even though grouting of the alluvium may be more difficult, due to its heterogeneous makeup and significant silt and clay content, it was successfully done at Commercial Street in MOS-1.

Methane and hydrogen sulfide (H_2S) gas will be encountered during tunneling (and cut-and-cover station in excavations) necessitating special design and construction procedures by designers/contractors. Removal of hydrogen sulfide from the tunnel ventilating exhaust, as well as removal from the groundwater, will be required. Even low hydrogen sulfide emissions into the atmosphere would probably cause objectionable ("rotten egg") odors in the immediate vicinity of the discharge (Engineering-Science, 1992). The City of Los Angeles Department of Sanitation requires zero parts per million (O ppm) discharge of sulfur into their sewer system. Thus groundwater discharge will require treatment similar to H_2S water in the vicinity of Union Station. The subsurface combustible gas and hydrogen sulfide concentrations along the Mid-City Segment of the Red Line are equal to, or greater than, those found along Wilshire Boulevard west of Crenshaw (Engineering-Science, 1992). For further conclusions and recommendations on gas along the alignment, please refer to Engineering Science's August 1992, "Final Report Subsurface Gas Investigation"and Converse Environmental West's September 1992 "Environmental Assessment Report".

Groundwater should be tested for the presence of desulfurizing bacteria. If steel is allowed to contact the H_2S-laden groundwater, corrosion will occur at the poles of the galvanic cells set up on the surface of the steel. The anodes of the cells will be depolarized by the bacteria; i.e., the hydrogen ions will be removed from the anodes. The corrosion process will accelerate tremendously by destroying any exposed steel in a very few years.

Appropriate ventilation should be provided for control of large volume inflows of naturally occurring volatile and highly toxic gasses including methane and hydrogen sulfide. A magnetometer probe should be advanced in front of the headings to detect abandoned well casings, etc.

- Magnetometer Survey: The tunnel crosses the Las Cienegas Oil Field (Pacific Electric Area) thus we recommend a magnetometer survey to help improve underground safety. The survey consists of drilling magnetometer survey exploratory holes from the face, installing casing, conducting location survey of the drilled exploratory hole, performing the magnetometer surveys about 200 feet ahead of the tunnel face to locate possible abandoned oil well casings, and testing the exploratory hole for the presence of gas.

- Geotechnical Instrumentation: To assure early detection of ground and structure movement, we also recommend installation and monitoring of the following geotechnical instruments and groundwater monitoring devices:

  1) Borehole extensometers
  2) Tape extensometers
  3) Deep benchmarks
  4) Building settlement reference points, within 100 feet of the centerline of the tunnels

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5) Ground surface settlement reference points, within 100 feet of the centerline of the tunnels
6) Groundwater observation wells

7.2 Cross Passages

A total of 13 cross passages are planned between Wilshire/Western and Pico/San Vicente stations. These passages are located between the two tunnel bores at stations 380+00, 387+50, 395+00, 401+50, 409+00, 416+50, 424+00, 440+00, 447+50, 455+50, 460+50, 467+50, and 475+00. Geologic conditions at these passages are similar to those previously described for the two tunnel reaches. Materials that will be encountered include alluvium and San Pedro Sand. The cross passages will be located below the water table in areas with a high probability of encountering natural gas. Excavation of the passages with hand or mechanical equipment will require support down to the springline and groundwater control to maintain the stability of the passages along with adequate ventilation to assure a healthy and safe working environment.

7.3 Design For Earthquakes

Design procedures and criteria for underground structures under earthquake loading conditions are defined in the Southern California Rapid Transit District (SCRTD) report titled "Guidelines for Design of Underground Structures", dated March, 1984. Evaluations of the seismologic conditions which may impact the project and the probable and maximum credible earthquakes, which may be anticipated in the Los Angeles area, are described in Converse's report to SCRTD titled "Seismological Investigation and Design Criteria", dated May, 1983. The 1984 report complements and supplements the 1983 report. The tunnel is not known to cross any active faults. In our opinion, the tunnel does not need to be designed for fault rupture across the tunnel alignment.

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5.0 SUBSURFACE CONDITIONS

5.1 Regional Geologic Framework

The Los Angeles basin is an elongate northwest-trending alluviated coastal plain bounded on the north by the Santa Monica Mountains and the Elysian, Repetto, and Puente Hills and on the east and southeast by the Santa Ana Mountains and San Joaquin Hills (Yerkes, et al, 1965). The lowland plain slopes gently south or seaward and is interrupted by a line of low hills and mesas extending from Newport Bay northwest to Beverly Hills. The basin is underlain by a major structural depression that has seen nearly continuous marine deposition since the middle Miocene (Lamar, 1970). The basin is notable for its great structural relief and complexity and for prolific oil production (Johnson, 1966; Yerkes, et al, 1965).

Faulting in the basin is dominated by two major, convergent systems: 1) Northwest-trending, high angle strike slip faults associated with the northern terminus of the Peninsular ranges, and 2) East-trending, low angle reverse or reverse-oblique faults associated with the transverse ranges (Yerkes, et al., 1965; Davis, et al., 1989; Crook, et al., 1987). Both are Quaternary systems, and both have at least one fault zone with recorded historic activity (Jennings, 1975; Ziony and Jones, 1989; Hauksson and Jones, 1989).

5.2 Local Geologic Setting

The sequence of geologic materials underlying the Mid-City Segment consists of fill, younger and older alluvium, San Pedro sand, and Fernando Formation bedrock. The areal distribution of materials is shown on Drawings 1-3 which also show geologic profiles along the alignment. Detailed plans and profiles of the proposed stations are shown on Drawings 4 through 7. Following is a brief discussion of the geologic materials with emphasis on their engineering characteristics.

5.3 Earth Materials

5.3.1 Artificial Fill: Fill soils were encountered in each of the exploratory borings. The borings were drilled from street surface grades and encountered between 4 to 15 feet of fill soils. These fill soils are believed associated with numerous utility trench backfills, substructure backfills, basement backfills, and street subgrades at the boring locations. Locations of fills are not shown on the plan and profile drawings. A limited amount of information concerning depths, extent, and variability of fills exists making accurate interpolation or extrapolation of fills beyond the immediate boring vicinity difficult to impossible.

Fill soils encountered typically consisted of dark brown to black, sandy clay or silt. The soil is generally moist to the touch and firm with uncorrected N-values between 6 and 9. Wood or brick fragments are common.

A number of high-rise office buildings with basement structures are located on both sides of Wilshire Boulevard along the beginning of the Mid-City Segment alignment. Deeper fill soils associated with basement and substructure backfills are expected

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to be encountered during excavation of the Mid-City Segment and should be anticipated.

A number of buildings with shoring systems and tie-back anchors left in place are expected to exist along the proposed Mid-City Alignment. These buried structures should be anticipated when excavating.

5.3.2 Younger and Older Alluvium: Alluvial soils underlie the Mid-City Segment in variable thickness from 45 to 85 feet deep. The alluvium consists of layers of sand, silty sand, and clayey sand randomly alternating with layers of silt and clay (see the profiles). The layers vary from several feet to 45 feet thick and may be laterally continuous for hundreds of feet. The consistency of the fine-grained soils varies from stiff to hard with uncorrected N-values from 10 to well over 30. The compactness of the sandy layers varies from medium dense to very dense with N-values from around 15 to 50+. The color varies from brown to black and blue-green to gray.

Local ground surface variations in the form of small arroyos or channel features occur where the alignment crosses the former Ballona Creek and its related drainage tributaries. The topographic expression of these channel features is still somewhat visible although they have been obscured by extensive development along the Mid-City Segment. Such topographic features infer the location of former southwest trending drainage courses which have gradually dissected the old alluvial deposits. These arroyos and channel features are roughly located between Stations 381+00 to 391+50, Stations 424+00 to 441+00, and Station 475+00 to the end of the subject alignment. While geologically different, the two alluvial soil types are indistinguishable in the subsurface borings, and for engineering purposes will simply be referred to as alluvium.

5.3.3 San Pedro Sand: San Pedro Sand unconformably underlies the alluvium and is present along the entire alignment. It is between 25 to 50 feet thick and consists primarily of sand with lesser amounts of silty sand, gravel, and local silt layers. It is laminated to massive and locally contains organic fragments. The sand is very dense with N-values typically greater than 50. The color varies from blue-green to gray and black.

Tar sands were encountered in borings MC-2 and MC-3 at depths ranging between 69 to 77 feet below surface grades. Analytical tests performed on recovered samples detected high levels of petroleum hydrocarbons. The soils had a strong petroleum odor and were darkly discolored by the natural petroleum and tar. The lateral extent and depths of tar sands between and beyond the boring locations could not be determined. Excavated materials within the Mid-City Segment may contain petroleum hydrocarbons which may require disposal at a facility for disposal or recycling of hazardous waste.

5.3.4 Fernando Formation: Sandy siltstone and claystone of the Fernando Formation unconformably underlies the San Pedro Sand at depths between 65 and

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90 feet starting from station 370+00 to station 430+50. Past station 430+50 depth to bedrock increases beyond the depth of exploration. The siltstone\claystone is massive to laminated and locally weathered. N-values were variable from 27 to 50+. The color varies from dark-gray to black.

The Fernando Formation is locally recognized and often referred to as "bedrock" in various publications, maps, and at places within this report. It is generally categorized as a "soft rock" or "soft-ground" tunneling material with the exception of hard, cemented beds and nodules. Soft rock is a very subjective categorization in between the more familiar and commonly understood categories of soil and bedrock.

5.4 Groundwater

To determine depth to groundwater along the proposed alignment, seven borings were converted to piezometers. Groundwater information was also collected in the majority of the remaining borings during drilling. Table 5-1 lists groundwater levels as measured in the piezometers. Groundwater levels were determined by periodically measuring the depth to water within the piezometers after well installation until the water depth stabilized and yielded constant readings during the monitoring period.

Groundwater levels beneath the project site are subject to seasonal and long-term variations and fluctuations resulting from precipitation, infiltration and groundwater spreading, recharge and pumping activities.

Table 5-1

Groundwater Levels Measured on 7-14-92.

BORING	LOCATION	STATION LOCATION	SURFACE ELEVATION (feet)	DEPTH TO GROUNDWATER (feet)	GROUNDWATER ELEVATION (feet)
MC-1	Wilton/Wilshire	387+25	187	21.9	165.1
MC-2	Crenshaw/ North 8th	407+10	203	29.9	173.1
MC-4	Crenshaw/ North Olympic	426+59	160	21.8	138.2
MC-8	Crenshaw/ Country Club	433+72	156	18	138
MC-11	Victoria/Pico	455+50	179	78.6	100.4
MC-13	Pico/West	471+02	165	65.3	99.7
MC-15	Builder's Discount (Pico/Rimpau)	482+50	139.5	64.1	75.4

It is important to note that groundwater levels are based on static water level measurements. Other data, including in-situ moisture tests and field observations made during drilling, suggest that localized perched groundwater zones exist above the static

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groundwater levels presented in Table 5-1. Perched groundwater conditions were observed to occur in granular sediments underlain by less permeable fine grain sediments. (Drawings 1, 2 and 3.) The continuity, lateral extent, and volume of groundwater that may be present within the perched zones is not known, but should be considered as significant. Additional monitoring wells and groundwater pump tests would be necessary to better define hydraulic parameters and characteristics of the alluvial sediments underlying the Mid-City Segment.

In general, depth to groundwater between stations 370+00 and 440+50 varies from 18 to 30 feet below surface grade. Past station 440+50 the depth to groundwater increases to 64 to 79 feet. Several perched zones have been identified in this area, but apparently these are local and discontinuous.

5.4.1 Groundwater Quality: Organic analyses performed on water samples collected from borings MC-1 and MC-4 indicated non detectable levels of total fuel hydrocarbons, benzenes, toluene, and xylenes (see Appendix B). Chemical analyses on the same samples are given below.

Table 5-2 Chemical analyses of groundwater samples.

BORING	Sulfate (ppm)	Sulfide (ppm)	pH (SU)	Chloride (ppm)	Nitrate (ppm) NO_3	Nitrate (ppm) N
MC-1	540	nd	7.2	130	2.3	nd
MC-4	220	nd	7.3	210	3.6	nd

ND = Not Detected

In general, groundwater quality is poor compared to drinking water standards. The measured concentrations of sulfate are generally considered to have a moderate potential for corrosivity of concrete. The chloride concentrations are considered to have a low to moderate potential for corrosivity of metals used in construction. The area is located close to existing oil fields and concentrations of chemical constituents may be widely variable. Local extreme concentrations are possible due to contamination by oil field brine.

5.5 Natural Oil and Gas

In relation to its area, the Los Angeles basin was the most prolific of California's oil-producing districts and was one of the most prolific in the world (Yerkes, et al., 1965). Portions of one of the basins oil fields underlie the Mid-City Segment - the Las Cienegas Field (Figure 5-1). The economic boundaries of the Las Cienegas Field cover approximately six square miles in a band roughly a mile and a quarter wide extending from Olympic and La Brea southeast to Adams and Main. The field was discovered in 1961 and has been in continuous production of oil and gas since that time (CDOG, 1991). Additional discoveries in the mid 60's expanded the field to its present size.

Prior to discovery, the area was fully developed for commercial and residential purposes. Because of this, discovery and production drilling were confined to several central drillsites. Each drillsite has a unique name and is designated as a subarea of the larger field. The Pacific Electric Drillsite is the only major drillsite in close proximity to the Mid-City Corridor. It is located south of Pico Boulevard approximately 700 feet west of the intersection of Pico and San Vicente. This is known as the Pacific Electric Area. Figure 5-1 is a typical cross section through the Las Cienegas Field.

The Pacific Electric Area taps two producing zones located between 4000 and 4500 feet below ground surface in sandstone and interbedded shale of the Upper Miocene Puente Formation (Mefferd, 1970; CDOG, 1991). A water-flood enhanced recovery project has been active since 1965. In adjacent subareas, gas injection has been employed. Peak oil production for the Pacific Electric Area was 466,464 bbl in 1962. The field was discovered after the California Division of Oil and Gas began collecting and maintaining records on well locations and developed regulations on abandonment procedures. However it is possible that unrecorded abandoned wells may be located along the alignment. If one is encountered during construction it should be abandoned in accordance with project specifications and applicable regulations.

Shallow Gas Encountered During Exploration: Organic Vapor Analyzer (OVA) readings recorded in many of the borings, indicated numerous zones of moderate to high concentrations of methane gas. Locally, methane concentrations exceeded 10,000 ppm. Weak to strong "rotten egg" odors indicative of hydrogen sulfide gas were also common. In boring MC-6 hollow stem auger drilling was terminated at a depth of 50 feet because of discharges of hazardous and explosive levels of methane and hydrogen sulfide gases through the top of the auger stem. Ambient air measurements around the drill site indicated oxygen depletion with a lower explosive limit of 100%, and a hydrogen sulfide concentration of 240 ppm. Similar conditions were encountered in boring MC-21. There is a high potential for shallow natural gas along the entire Mid-City Segment alignment.

5.6 Seismicity

5.6.1 Regional Seismicity

The Los Angeles Basin is situated at the boundary of two convergent crustal plates-the Pacific and North American. The relative motion of the two plates produces north-south compression and nearly continuous deformation along the boundary. The deformation is expressed by a complex grid of seismically active faults that define two major systems: 1) Northwest-trending high angle strike slip faults of the San Andreas system projecting from the northern terminus of the Peninsular Ranges, and 2) East-trending low angle reverse or reverse-oblique faults bounding the south margin of the Transverse Ranges (Ziony and Jones, 1989; Yerkes, 1965).

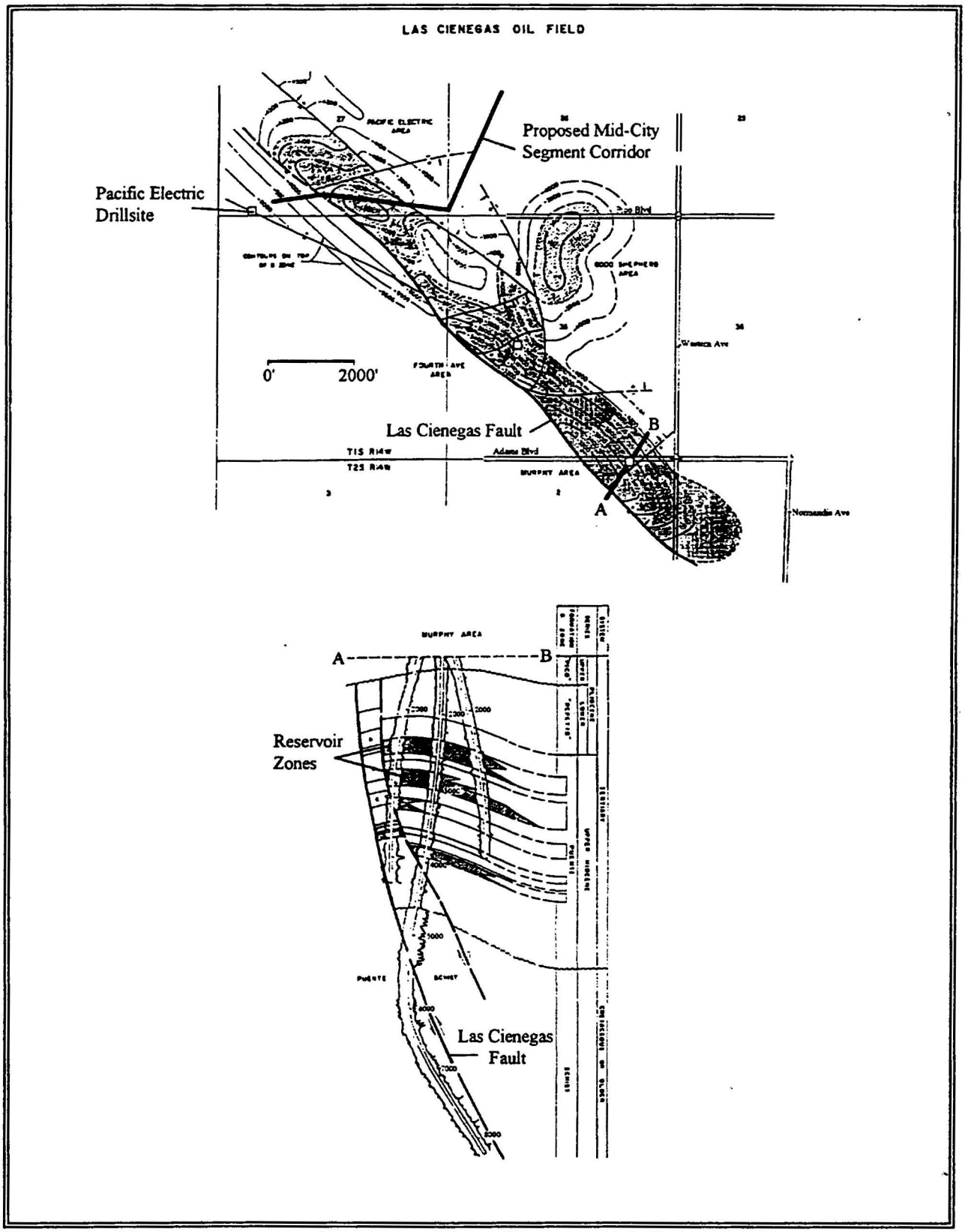


Figure 5-1 Typical cross section through Las Cienegas Oil Field (modified after CDOG, 1991). Note truncation of faults within Pliocene formations and Depth adjacent to well logs.

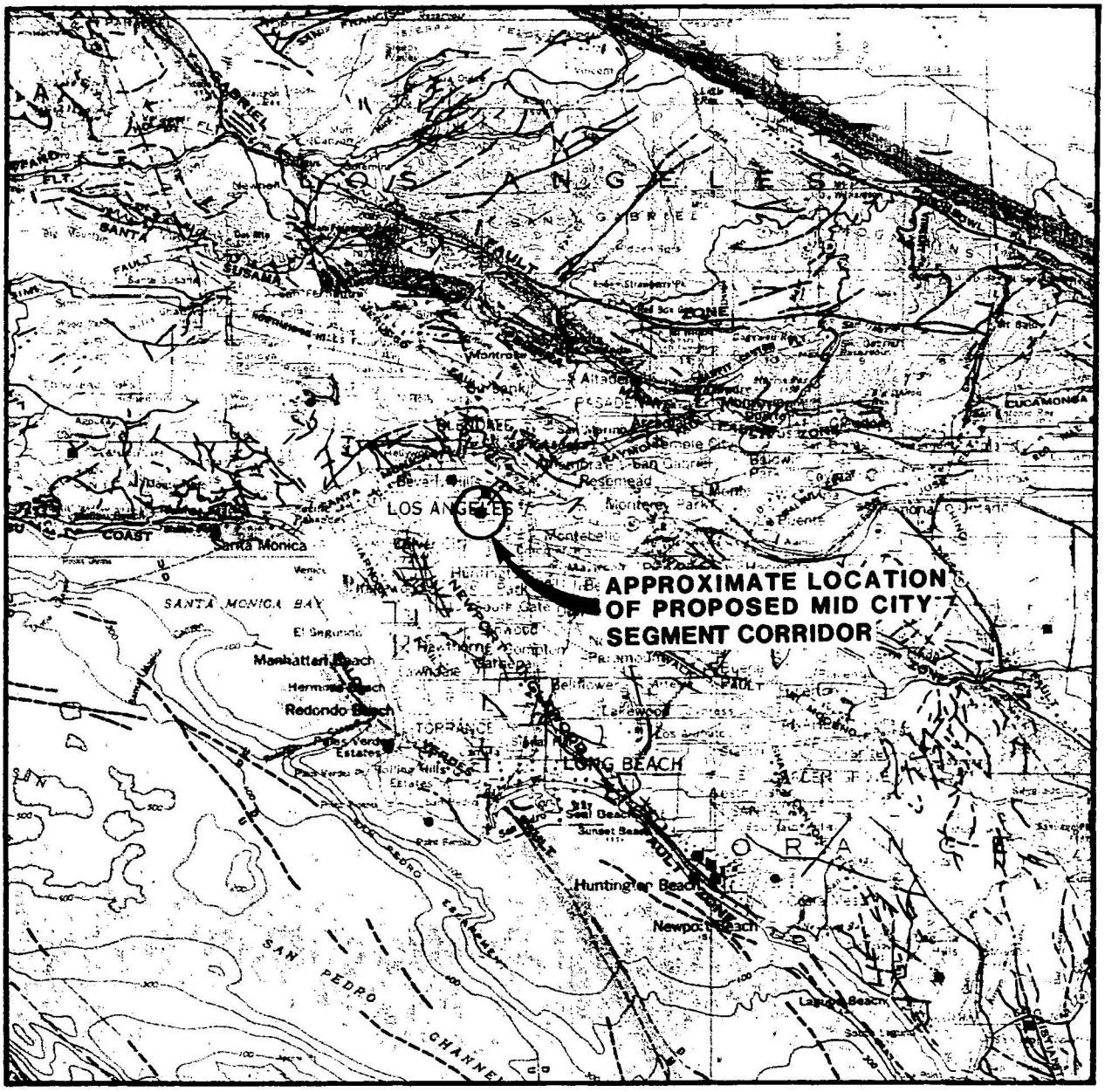
Faults in group one include the Palos Verdes, Newport-Inglewood, and the Whittier-Elsinore fault zones. Group two faults include the Santa Monica, Hollywood, and Sierra Madre fault zones. Since 1800, faults in these two systems have produced more than 40 damaging earthquakes in southern California (Ziony, 1985). Average rates of late Quaternary slip along these faults provide an index of their relative activity. The San Andreas fault has a slip rate of several millimeters per year, but most other faults have rates of about 1 mm/yr or less (Wesnousky, 1986; Ziony, 1985). Details concerning late Quaternary slip rates on most major faults are poorly known, partly because these faults often splay into a broad zone of discontinuous segments as they approach the earth's surface. Also, our data base (roughly 150 yrs) is small compared to the Holocene (0-11,000 years before present) activity of these faults. Figure 5-2 shows the site location and major Quaternary faults of the Los Angeles Basin.

Elysian Park Fold and Thrust Belt

A growing body of geologic and seismologic data supplemented by regional structural interpretations suggest that Pliocene to modern deformation in the Los Angeles Basin is partly accommodated by a developing basement-involved fold and thrust belt (Davis, et al., 1989; Hauksson and Jones, 1989). The fold and thrust belt is expressed at the ground surface by elongate low-lying bedrock ridges protruding through the basin sediments. The bedrock ridges are underlain by northwest-trending anticlinoria developing as fault propagation folds. At the core of these folds are low-angle, blind thrust faults rising off a basal detachment surface. The regional detachment surface coincides with the observed base of seismicity at a depth of 10-13 km (7-8 mi) below the basin (Hauksson, 1990).

The Santa Monica Mountains, Elysian Park, and Repetto Hills have recently been interpreted as a fault propagated fold associated with a seismically active blind thrust fault - the Elysian Park thrust -rising off the regional detachment surface (Davis, et al., 1989; Hauksson and Jones, 1989). The Mid-City Segment is located at the south margin of the Santa Monica Mountains at the edge of the newly designated Elysian Park Fold and Thrust Belt (Figure 5-3). The 1987 Whittier Narrows earthquake has been attributed to the Elysian Park thrust fault (Hauksson, 1990).

Details concerning the Elysian Park thrust are limited because the fault has no surface expression and has only recently been recognized. Because the fault is buried, it is not considered a hazard in terms of surface fault rupture. However, it can generate moderate to strong ground shaking as evidenced by the Whittier Narrows event. Based on retrodeformable cross sections, Davis calculates a cumulative slip of 10 km on the portion of the fault under the downtown area



RED = FAULTS WITH HISTORIC ACTIVITY (0-200 YEARS BEFORE PRESENT)

*ORANGE = FAULTS WITH QUATERNARY ACTIVITY (<2,000,000 YEARS BEFORE PRESENT)

BLACK = PRE-QUATERNARY

*MOST OF THE RECOGNIZED QUATERNARY FAULTS SHOWN ON THIS MAP HAVE PROBABLY BEEN ACTIVE WITHIN LATE QUATERNARY TIME (Within the last 300,000-500,000 years)

SCALE 1:750,000
(1 INCH EQUALS
APPROX. 12 MILES)

REFERENCE:

Jennings, C.W., 1975 Fault Map of California:
CDMG Geologic Data Map no. 1, 4th Printing, 1988

MAJOR QUATERNARY FAULTS OF THE LOS ANGELES BASIN

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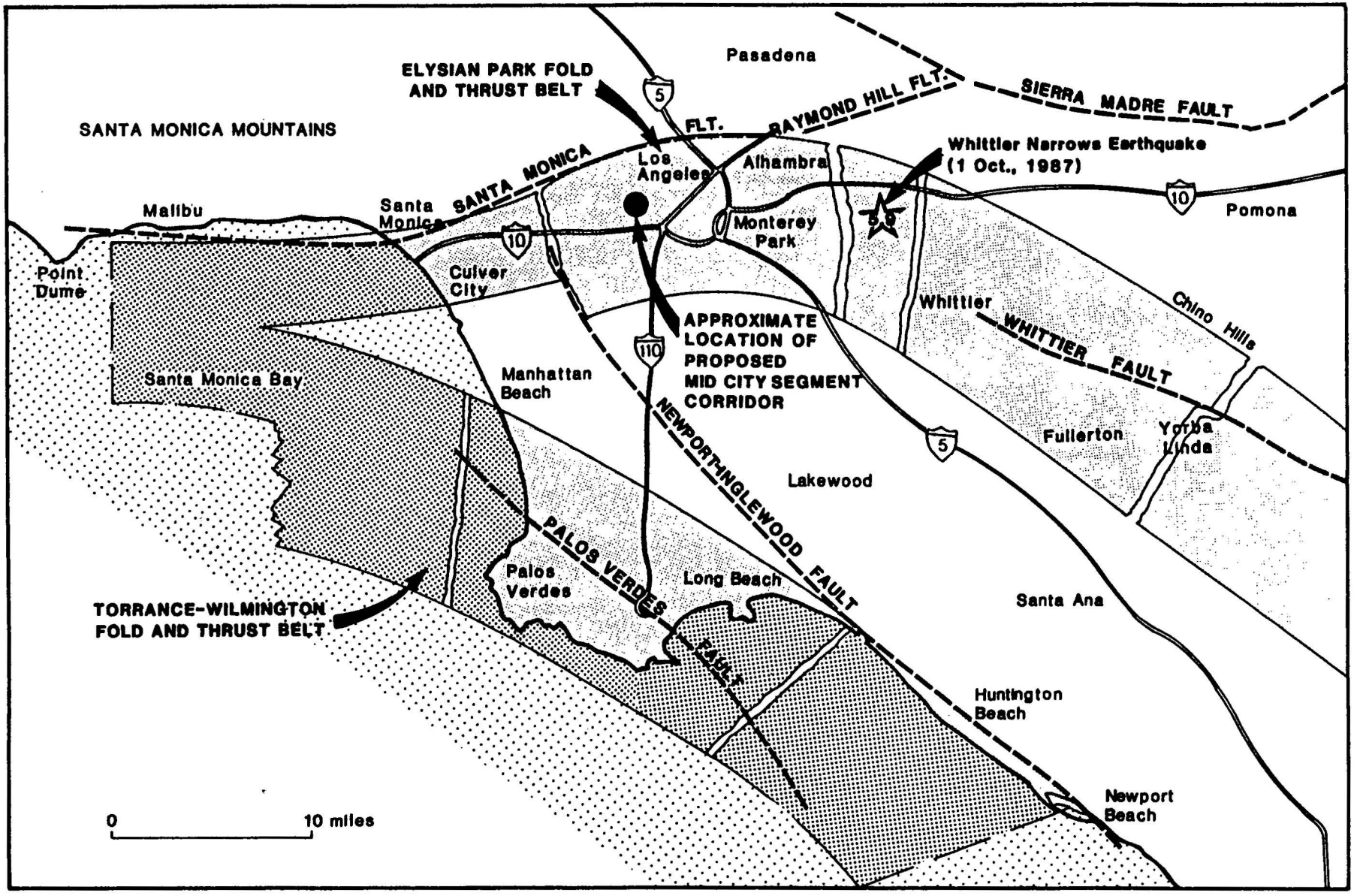
Figure No: 5-2



SKETCH MAP OF THE LOS ANGELES BASIN SHOWING THE APPROXIMATE LOCATION OF THE ELYSIAN PARK FOLD AND TRUST BELT

Figure 5-3 ELYSIAN PARK FOLD AND THRUST BELT

TABLE 5-3

SEISMIC CHARACTERISTICS OF REGIONAL FAULTS

Fault	Site Distance[a] (miles)	Fault Length (miles)	Maximum Credible Event (Richter Magnitude)	Slip Rate (mm/year)	Maximum[b] Peak Acceleration (g)	Strong[c] Ground Shaking (seconds)
Elysian Park	0	3+	6.0<M<7.5[d] 6.8	2.5 - 5.2[d]	~0.60	23 - 27
Malibu - Santa Monica	~2.5	39	7.5	0.4	~0.57	31 - 35
Hollywood	~3	8	6.5	0.1	~0.53	19 - 23
Newport -Inglewood	~3.5	42	7.0	0.5	~0.54	25 - 29
Raymond	~7	12	6.8	0.2	~0.37	23 - 27
Palos Verdes	~13	46	7.0	0.3	~0.32	23 - 27
Sierra Madre - La Canada	~13.5	8	7.0	3.0	~0.31	23 - 27
Sierra Madre - Pasadena	~14	12	7.0	3.0	~0.30	22 - 26
Sierra Madre - San Fernando	~16	13	7.0	0.3	~0.27	21 - 25
San Gabriel	~16.5	83	6.7	0.1	~0.24	15 - 19
Whittier	~17	32	6.5	2.0	~0.20	13 - 17
Simi - Santa Rosa	~18	28	6.5	0.1	~0.19	13 - 17
Sierra Madre - Glendora	~20	16	7.0	3.0	~0.23	21 - 25
Santa Susana	~20	14	6.5	1.0	~0.16	11 - 15
San Andreas Central	~34	220	8.0	37.0	~0.25	25 - 29

Notes:
[a] Closest approach.
[b] For stiff soil from Seed and Idriss, 1982
[c] From Bolt, 1977
[d] From Davis, et. al., 1989

Instrumental Earthquake Data (1933 - 1991): Instrumental earthquake data for 59 years from 1933 through 1991, was obtained from the comprehensive listing of the California Institute of Technology Seismological Laboratory. This data is complete and accurate and well suited for statistical analysis. It should be recognized that this 59-year record represents a very short time in Southern California geologic and seismic history.

Non-Instrumental Earthquake Data (1800 - 1932): Non-instrumental earthquake data for 133 years, from 1800 through 1932, was obtained from Wood and Heck as reviewed by Eppley (1966). This catalog must be regarded as inaccurate and incomplete in two respects. (1) Many of the smaller, and probably several larger, earthquakes which have occurred are missing; and (2) maximum Modified Mercalli

intensities were reported in lieu of instrumental measurements, and corresponding epicenter locations are very approximate. The main advantage of this catalog is that it represents a time period about 2 1/4 times as long as the 59-year instrumental catalog.

Direct Geologic Evidence: A seismic fault model was developed assuming the occurrence of geologically credible earthquakes events on regional faults at estimated recurrence intervals. The magnitude recurrence relationships developed for these faults are approximations based on analyses of limited direct geologic evidence and regional tectonics. This record is an attempt to account for thousands of years of geologic evidence including fault locations, lengths and displacement rates.

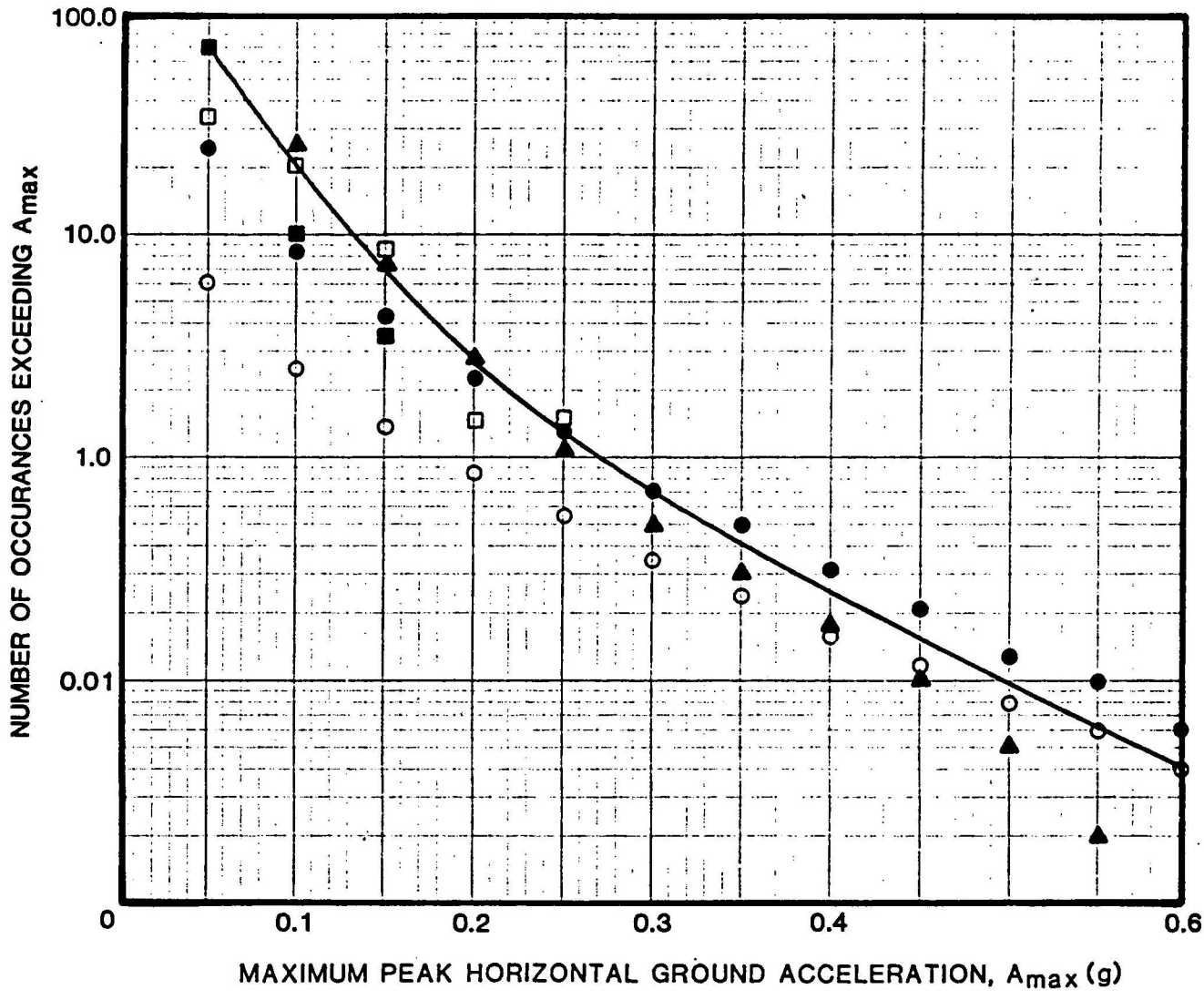
5.6.4 Seismic Risk Analyses: Three probabilistic analyses were performed using the catalogs described above. Attenuation curves for all three models are based on Seed and Idriss, 1982. Results are presented in Figure 5-4. The line represents our judgement as to the occurrences of ground acceleration during an average 100-year period. Following is a brief discussion of our seismic risk models.

Site Region Model (●): The site model was based on methods outlined by Marachi and Dixon (1972). Calculations were performed considering earthquakes of the instrumental and non-instrumental catalogs occurring within a 100-mile radius of the site. This model assumes random occurrence of earthquakes and independence of events and attenuation areas. Results should be regarded as an average for the site region.

Local Site Model (■): The local site model assumed the independence of events. Calculations were performed for earthquakes of the instrumental and non-instrumental catalogs occurring within 100-mile radius of the site. Results of this analysis are strongly site dependent.

Fault Model (▲): The fault model included the major faults listed in Table 5.6.2. Seismic characteristics of the faults were estimated based on direct geologic evidence, and judgment. Earthquakes were assumed to occur uniformly along known faults at estimated recurrence intervals. Results of this analysis are strongly site dependent.

Ground Motion Parameters: Two earthquakes were selected to represent a reasonable range of earthquake levels for the West Side Corridor. The definitions of the different levels and earthquake magnitudes are discussed below. Table 5-4 summarizes the ground motion characteristics of the Maximum Credible and Maximum Probable earthquakes.



● Site Region
■ Local Site
} Instrumental Seismicity Data (1933-1991)

○ Site Region
□ Local Site
} Historic Seismicity Data (1800-1932)

▲ Fault Model — Geologic Evidence

HORIZONTAL GROUND ACCELERATION - 100 YEAR PERIOD

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Figure No.
5-4

Maximum Credible Earthquake (MCE): This is intended to represent the governing maximum credible ground motion. Selection of the MCE was based on analysis of ground motion characteristics presented in Table 5-4. A magnitude 6.8 earthquake occurring immediately beneath the West Side Corridor on the Elysian park Thrust was selected as the MCE and is expected to generate the highest site-specific ground acceleration.

TABLE 5-4

SELECTED HORIZONTAL GROUND MOTION PARAMETERS

Earthquake Parameters	Maximum Credible	Maximum Probable
Richter Magnitude	6.8	6.5
Maximum Peak Horizontal Ground Acceleration (g)*	~0.60	~0.27
Duration of Strong Ground Shaking (seconds)**	23 - 27	21 - 25

NOTES:

* Based on Seed and Idriss (1982), for stiff soil.
** Based on Bolt (1977).

Maximum Probable Earthquake (MPE): This is defined in California Division of Mines and Geology (DMG) Note Number 43 as either the earthquake event which is expected to occur during a 100-year period, or the maximum earthquake that has occurred during historic time. An example of a Maximum Probable Earthquake would be a Magnitude 7.5 event epicentered on the San Fernando segment of the Sierra Madre fault zone approximately 16 mile away.

5.6.5 Secondary Seismic Hazards: The possible secondary effects of seismic activity include tsunamis, flooding or seiches, landslides, ground rupture, differential settlement, and liquefaction. The potential threat from secondary effects is summarized in Table 5-5 and discussed below.

Tsunamis: Tsunamis are tidal waves generated by fault displacement or major ground movement. Given the geographic location of the West Side Corridor, tsunamis do not pose a hazard.

Seiches: Seiches are large waves generated in enclosed bodies of water in response to ground shaking. The waves can top dams or reservoirs and flood down gradient areas. Review of the Hollywood Topographic Quadrangle (photorevised in 1981) indicates the Silver Lake and Rowena Reservoirs are located upgradient of the Mid-City Corridor. Portions of the corridor lie within their inundation areas as defined by the Los Angeles County Flood and Inundation Hazards Map (Leighton & Associates, 1990). However, because of the distance

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to the reservoirs (~ 4 miles) and the relatively small quantity of flood water that could be generated from a seiche, the potential for damage is considered very low.

Earthquake Induced Flooding: This is flooding caused by failure of dams or other water retaining structures due to earthquakes. Portions of the site lie within the inundation zones for the Silver Lake and Rowena Reservoirs. The Mid-City Corridor is located in relatively flat terrain. The potential for seismically induced landslides is considered very low.

Surface Fault Rupture: The site is not located within an Alquist-Priolo Special Studies Zone. Based on review of existing geologic information, no major surface faults project towards or through the site. The potential for surface rupture due to primary fault movement is considered low.

Differential Compaction: Based on review of boring log summaries, the potential for differential compaction is considered low to moderate for the Mid-City Alignment. Proposed tunnel lines and stations are to be founded on deeper, relatively homogenous alluvial soils consisting primarily of dense sands and silty sand mixtures with varying amounts of gravel. Upper near surface alluvial sediments which are submerged by shallow groundwater have an increased potential for differential compaction.

TABLE 5-5

POTENTIAL FOR DAMAGE DUE TO SECONDARY EFFECTS OF SEISMICITY

Hazard	Potential
Tsunamis	Nil
Seiches	Very Low
Earthquake Induced Flooding	Moderate - Low
Landslides	Very Low
Surface Fault Rupture	Low
Differential Compaction	Low - Moderate
Liquefaction	Low - Moderate

6.0 STATIONS - GEOTECHNICAL EVALUATION AND DESIGN CRITERIA

6.1 General

In general, construction of the Mid-City Segment (MC) stations will involve deep excavations through alluvium and San Pedro Sand to approximate depths of 70 feet and 85 feet below the ground surface at the Crenshaw/Olympic and Pico/San Vicente stations, respectively. Alluvium is comprised of alternated layers of stiff fine-grained soils and dense granular soils. San Pedro Sand is dense to very dense. Construction requirements are generally similar at both sites. The existence of high groundwater levels will require either dewatering or tight shoring for the construction excavations. The permeable San Pedro Sand layer below the alluvium must be dewatered to provide stability to the excavation. Based on interpreted subsurface exploration data, about two-thirds of the excavation at the Crenshaw/Olympic station site and one-half of the excavation at the Pico/San Vicente station site, respectively, will be below the groundwater level.

If the sites are dewatered, we believe that dewatering-related subsidence of unknown magnitude will likely occur over an area extending several hundred feet around the excavations. Considering the potential for general areal subsidence, it is our opinion that the use of dewatering and underpinning piles should be avoided where possible due to the potential for "downdrag" on underpinning piles and differential settlements between underpinned foundations and non-underpinned elements. Downdrag forces are greater within zones of fine-grained soils than within zones of granular soils. A conservative shoring system can be used to minimize or eliminate underpinning by limiting ground movements adjacent to the shoring to tolerable levels. Also, column pick-up techniques if used during the construction period generally avoid the need for underpinning.

An alternative to the dewatering and conservative shoring approach to the excavation would be a tight shoring system such as a slurry-trench diaphragm wall which should be considered where rock is shallow. Diaphragm walls were used for the construction of several BART subway stations in San Francisco and at Union Station for the Los Angeles Metro Rail. The diaphragm wall would be constructed in short segments and can form a part of the permanent station wall. Such a system would eliminate the need for dewatering provided it is extended into the bedrock to effectively cut-off groundwater flow from the alluvial and San Pedro sands. Without dewatering, related subsidence would not occur, and underpinning would be reduced and used only as necessary without the risk of "downdrag" on underpinning piles. However, the installation of HDPE membranes is expected to be more complicated in conjunction with the construction of a slurry-trench diaphragm wall. Since bedrock at the Crenshaw/Olympic station is close to the station bottom, the diaphragm wall is a desirable solution. Bedrock at the Pico/San Vicente station is probably at an impractical depth for diaphragm wall construction.

The permanent station structures will, in essence, be concrete boxes supported on and retaining the surrounding soils. The subgrade soil at the stations bottom generally will be San Pedro Sands. This sand is typically dense or very dense and, therefore, no significant differential settlement of the stations subgrade is expected.

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The following subsections present our further evaluations and recommendations for design and construction of the Crenshaw/Olympic and Pico/San Vicente Station structures.

6.2 Excavations Dewatering

6.2.1 General Evaluation: The construction of both the Crenshaw/Olympic and Pico/San Vicente Stations will require excavations extending approximately 50 feet below the measured groundwater levels and may require construction dewatering if tight shoring is not used. The nature of groundwater (perched or permanent) is addressed in Section 5.4 of this report. The subsurface conditions at both sites generally consist of alternated layers of fine-grained and granular alluvium overlying San Pedro Sand. Fernando Formation bedrock underlies the San Pedro Sand to depths between about 5 and 15 feet below the proposed bottom of the Crenshaw/Olympic Station, and to an unknown depth below the bottom of our exploratory borings at the Pico/San Vicente station site. At both sites, relatively permeable sands of the alluvium and the San Pedro strata will be exposed in the excavation sidewalls which must be dewatered to provide sidewall stability upon exposure. The bottom of the excavations will be within the San Pedro.

The dewatering system is required to lower hydraulic gradients within the permeable sands thus preventing "sand boils" or "blow-out" of the excavation bottom. Drawdown within the alluvial sand interbeds and the San Pedro is expected to be faster than within the fine-grained interbeds; thus, complete drawdown time for the excavation will be affected by the natural occurrence of fine-grained interbeds within the alluvium. Actual drawdown time will also depend on the dewatering system selected by the contractor. Geologic discontinuities, i.e., major variations in the alluvium or San Pedro are expected to cause variations in the phreatic surface especially during the early stages of dewatering. A drawdown surface of variable slope may extend 500 feet beyond the excavation. In our opinion, the best way to evaluate effects of possible subsurface variations in the drawdown rates and obtain reliable aquifer properties is by pump test(s) with separate observation test wells (piezometers) in the San Pedro Sand and alluvium where the degree of hydraulic connection and the probable effect of the dewatering on the phreatic surface should be directly assessed. The test wells(s) ideally should approximate characteristics of the dewatering wells. The number and locations of observation wells should be based on the known subsurface conditions and locations of areas in which settlement could be critical.

Changes in vertical pressures within the alluvium due to the reduction of buoyant forces via dewatering are estimated to result in surface settlement within the expected one year plus construction period. Based on laboratory consolidation test data for fine-grained soils and as an indication of variation of strain due to load in sands, total surface settlements due to dewatering could be 1 to 2 inches for 50 feet of drawdown and 1/2 to 1-1/3 inches for 20 feet of drawdown. Actual total settlements will depend on variations in subsurface conditions and the duration of construction (dewatering). Assuming uniform subsurface conditions, settlements due to drawdown should be relatively uniform. Differential settlements are

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expected to be about 1/4 inch per 100 feet for locations more than 20 feet from a dewatering well.

It will be essential that the dewatering wells be properly designed (and installed) to prevent piping of soil into the wells. Uncontrolled piping into the wells will result in loss of ground (settlement).

As an alternative to dewatering, tight shoring such as slurry-trench diaphragm wall construction penetrating into the underlying bedrock may be constructed to provide an effective groundwater barrier. Seepage will be reduced, but a barrier will not be provided, if the wall is not tied into bedrock or interlocking steel single sheeting is used in lieu of the wall. Chemical grout may also be considered to establish a groundwater cut off within the San Pedro Sands in conjunction with a soldier pile system. The diaphragm wall appears more feasible and more economical at the Crenshaw/Olympic station because the bedrock is relatively shallow below the bottom of the excavation. However, the system of installation of HDPE membrane will require special consideration. The wall would be constructed ahead of the excavation, can be left in place, and will reduce or eliminate the need for underpinning and dewatering. This wall is constructed by excavating adequately thick slots at appropriate depths, using bentonite slurry of appropriate density to support the walls of the slot, inserting reinforcement in form of cages or soldier beams, and placing tremie concrete.

6.2.2 Possible Dewatering System: Local practice in the site vicinity generally has been to use conventional deep well dewatering systems without apparent unfavorable subsidence effects. Thus, a system of deep wells should be considered for site dewatering. Pumping test(s) should be performed prior to dewatering. A possible dewatering system might consist of the following:

- Deep wells pumping from the San Pedro Sands around the perimeter of the excavations.
- Vertical drains through the alluvium which penetrate to the San Pedro Sands. These should be strategically located to drain known sand zones within the alluvium.
- Supplementary ditch drains and sumps within the excavation to handle localized inflows; e.g. from sand layers.

6.2.3 Criteria for Dewatering Systems: It is understood that the contractor will be responsible for designing, installing, and operating a suitable construction dewatering system subject to review and acceptance by the Metro Rail Construction Manager. The dewatering systems at both stations should satisfy the following criteria:

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- The system should maintain groundwater levels low enough to provide stability of the bottom of the excavation against a "blow-out" failure at all times during construction.

- To adequately draw down the water table, the dewatering system should be installed and in operation for a sufficient time period prior to when the excavation reaches the level of the static groundwater level. This period will depend on the pumping rate of the system and the hydraulic characteristics of the site.

- The dewatering system should maintain the groundwater levels low enough to prevent piping of the alluvial soils into the excavation. Inflow seepage should be reduced to quantities which can be accommodated by a drain/sump system and which allow excavation and construction to proceed.

- Dewatering wells must be designed and developed to eliminate loss of ground from piping of soils near the wells. The well operations should be constantly monitored for evidence of piping.

- The system should operate continuously. Emergency power and backup pumps should be required to ensure continual excavation dewatering.

6.3 Underpinning

6.3.1 Common Underpinning/Support Methods: We understand that excavations for the Crenshaw/Olympic Station will be performed near existing buildings that are expected to require underpinning. At the Pico/San Vicente Station area, most of the buildings will be demolished. Several methods for underpinning are commonly used. These include jacked piles, slant drilled piles, and hand-dug pit or pier underpinning. Another technique which has been used is the "column pick-up" method which provides a means of jacking up selected columns if settlements occur. Special care (as practicable) should be taken by the contractor at locations where groundwater is present. Various underpinning techniques are discussed below.

- Jacked Piles: These piles generally consist of H-sections or open-end pipe piles 6 to 18 inches in diameter. The piles are normally placed in 4- to 5-foot long sections by jacking beneath the underpinned footing. Jacked piles are commonly pre-loaded individually to 150% of the design load and then locked off.

- Slant Drilled Piles: This method consists of placing a steel pile in a shaft (generally 12- to 24-inch diameter) drilled from the side of the foundation. The shaft is drilled at a small angle or slant under the foundation and then back-reamed to provide a vertical slot below the foundation. A steel pile is placed under the foundation, and the shaft is filled with concrete. The actual connection to the footing can be made by shimming or "drypack"

concrete. Pre-loading could be accomplished using jacks and shims similar to jacked piles.

- Hand-Dug Pits: This method consists of excavating an approach pit adjacent to and beneath the footing and advancing square or rectangular shafts, normally 3 to 5 feet wide, down to the bearing stratum. The shaft excavations are lagged for the entire depth with the lagging normally left in place permanently. Reinforcement is placed, and concrete is tremied into the shaft(s).

- Column Pick-Up: This technique provides a method of releveling specific structural elements without underpinning in the event that excessive settlements occur. A structural break is made between the column (or wall) and its foundation. Special connections are made to transmit loads around the structural break and jacking, or other means, is used to relevel the column or wall. After completion of the excavation, a permanent connection between the building and foundation is re-established. Since this method does not transfer foundation loads to a lower stratum, both shoring and permanent walls must be designed for surcharge loads imposed by the existing structure.

6.3.2 Underpinning Construction: From an engineering standpoint, the need to underpin is evaluated on the basis of expected ground movements and potential for structural damage. Figure 6-1 presents general guidelines for evaluating if a structure may be within the influence zones of the excavation; however, further evaluation of expected ground movements should be made based upon the type of shoring proposed.

Dewatering is expected to result in areal subsidence extending for hundreds of feet beyond excavation limits. Effects of areal subsidence would include downdrag forces on underpinning piles and possible differential settlement between underpinning foundations and non-underpinned foundations. If dewatering is planned, underpinning should be avoided if possible, i.e., with conservative shoring, or the effects of subsidence on the underpinned structure should be accommodated in the design of underpinning. The "column pick-up" method described in 6.3.1 may be better adapted to the condition of areal settlement than the more conventional underpinning methods.

6.3.3 Design Criteria: Figures 6-2 thorough 6-6 present design criteria for jacked piles and slant drilled piles without dragdown loads. Figure 6-2 illustrates the

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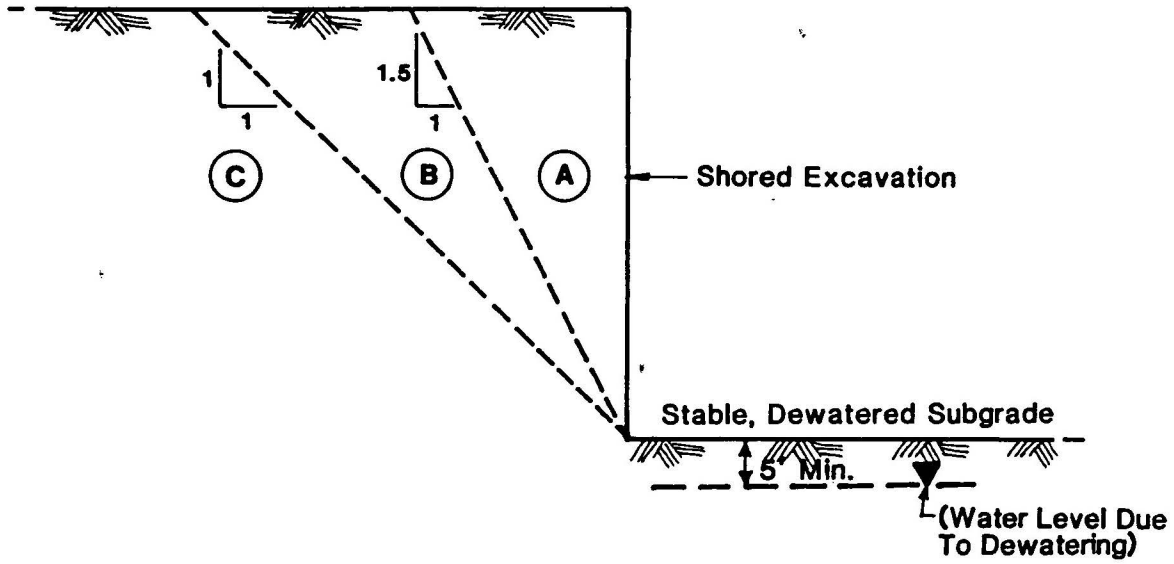

NOTES: 1. These guidelines are applicable only for stable ground conditions. Other soil and/or foundation conditions may require further analyses.

2. Settlement due to dewatering also must be considered.

3. For structure foundations bearing in zones A, B, or C, the following guidelines are presented:

ZONE (A) Special Provisions Required for Important Structures:

Underpinning or construction of conservative shoring system (designed to support lateral loads from building foundations with acceptably-small ground movements) must be considered.

ZONE (B) Generally No Special Provisions Required:

Properly-designed shoring system generally adequate without underpinning unless underlain by poor soils or adjacent to especially-sensitive structures.

ZONE (C) No Special Provisions

UNDERPINNING GUIDELINES

METRO RAIL MID-CITY SEGMENT

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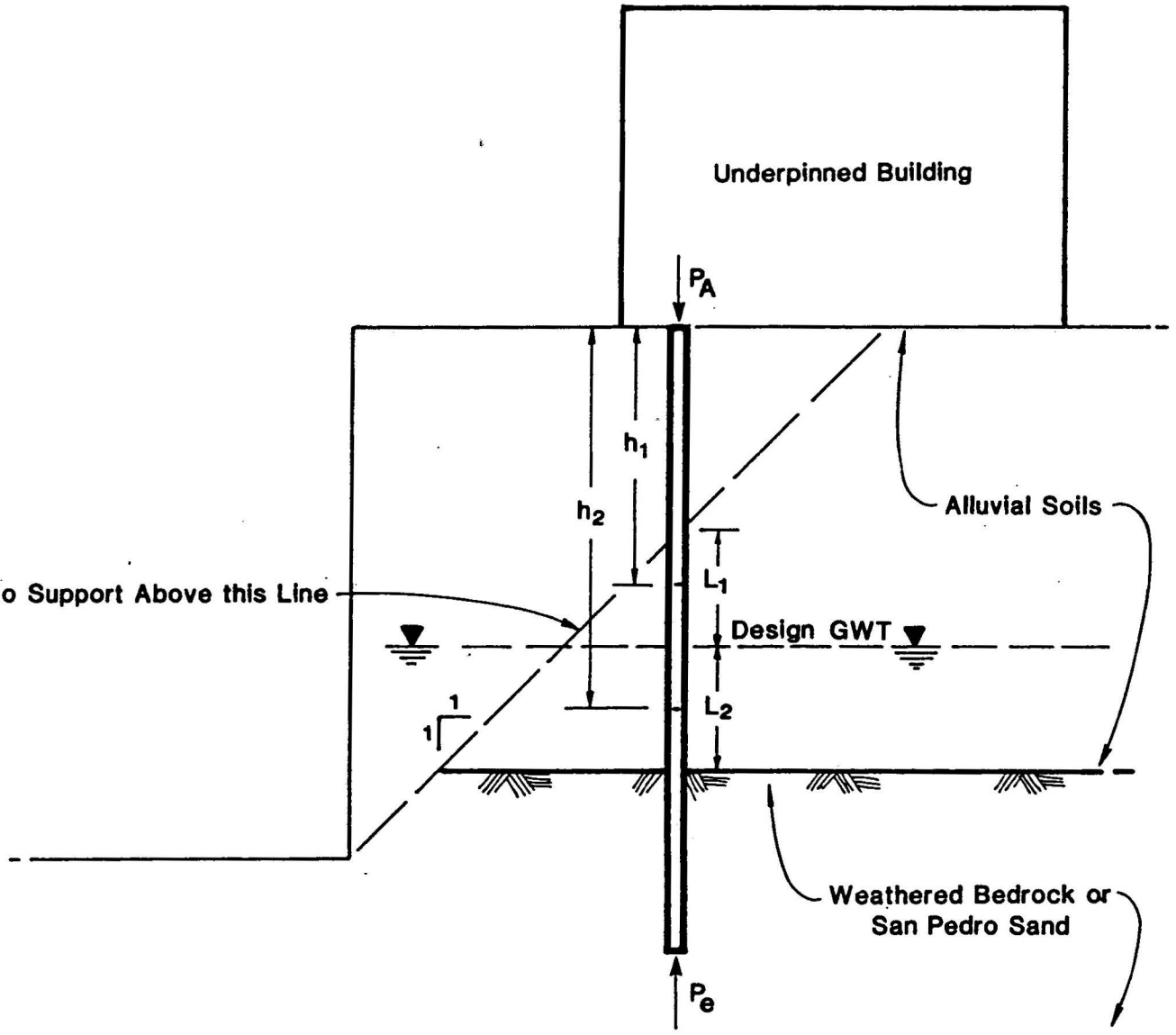
Figure No.
6-1



$P_A = p_1 \cdot L_1 + p_2 L_2 + P_e$

WHERE: *p_1 = average frictional resistance at h_1
*p_2 = average frictional resistance at h_2
**P_e = end resistance

* See Figure 6-3 through 6-6 for values of p_1 and p_2.
** For alluvium use P_e values given on Figure 6-3 through 6-6.
For San Pedro Sands or weathered bedrock use $P_e = KBA_T$ (kips)

WHERE: $K = \begin{cases} 50 \text{ for jacked piles} \\ 24 \text{ for cast-in-place piles} \end{cases}$ (Kips/sq.ft./ft.diameter)

B = pile diamater (ft.)

A_T = pile tip area ($ft.^2$)

UNDERPINNING - DESIGN CAPACITY CRITERIA

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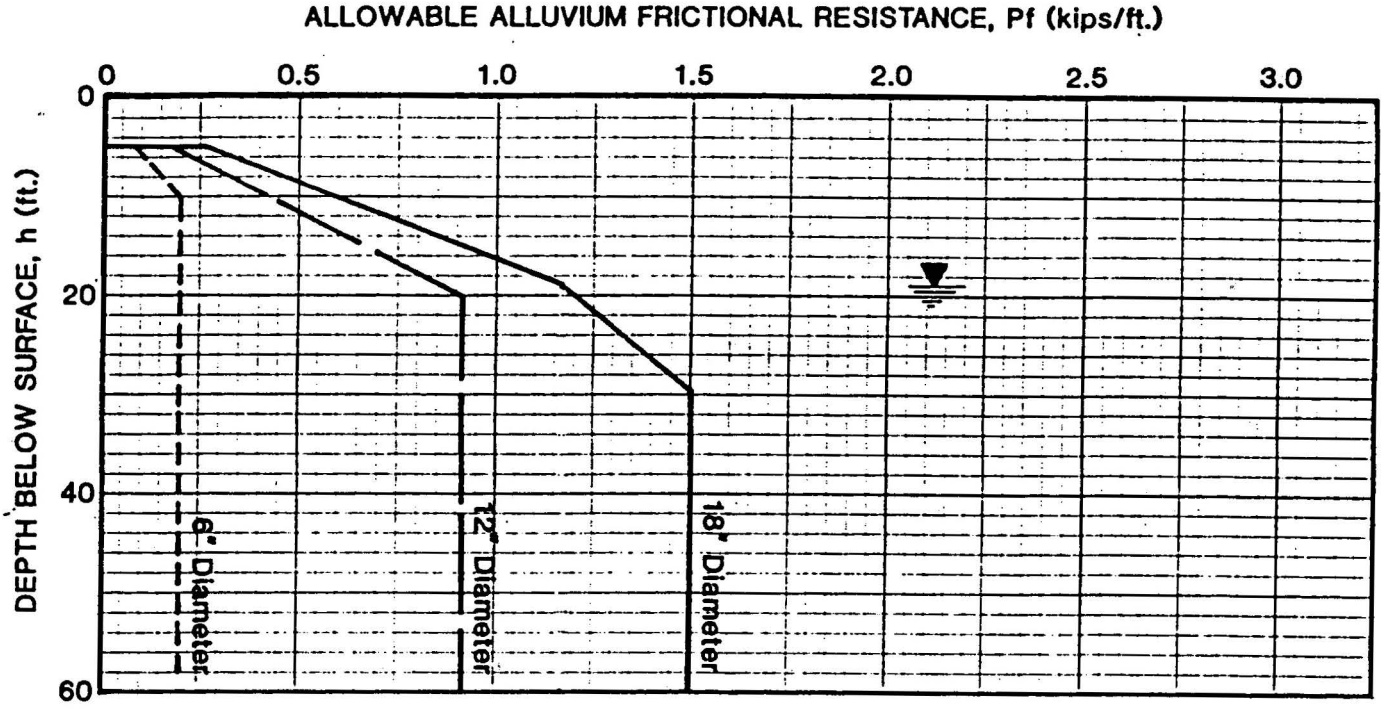
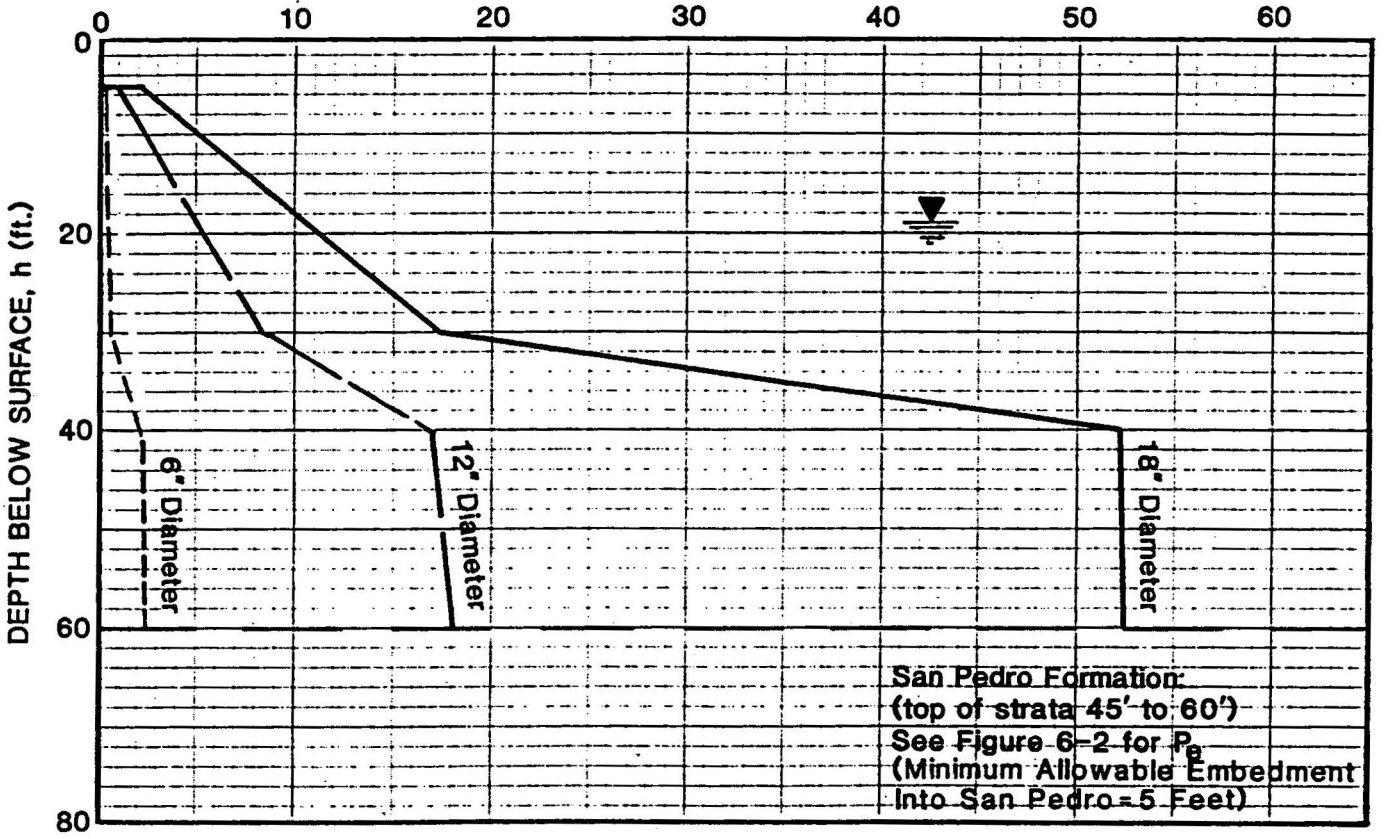
Figure No.
6-2





See Figure 6-2 for Determination of Total Capacity

UNDERPINNING - JACKED-PILE DESIGN PARAMETERS (Crenshaw/Olympic)

METRO RAIL MID-CITY SEGMENT

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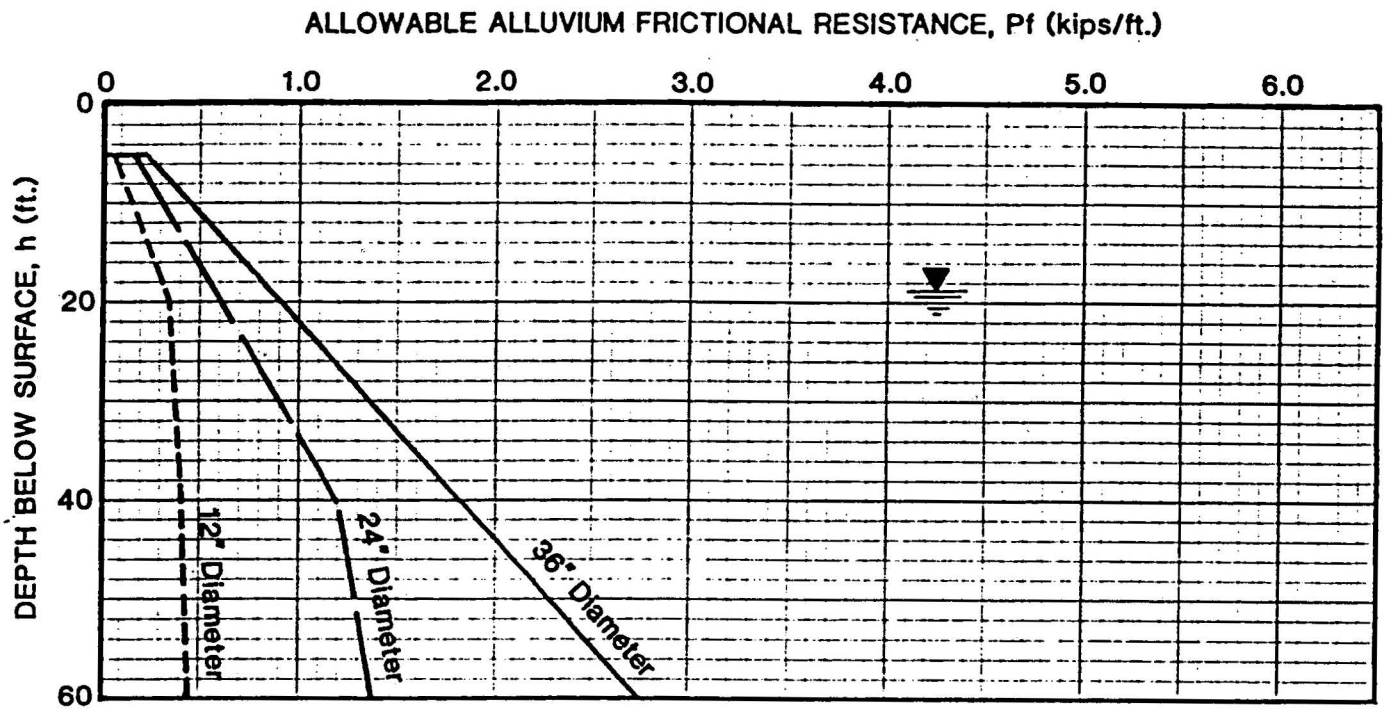
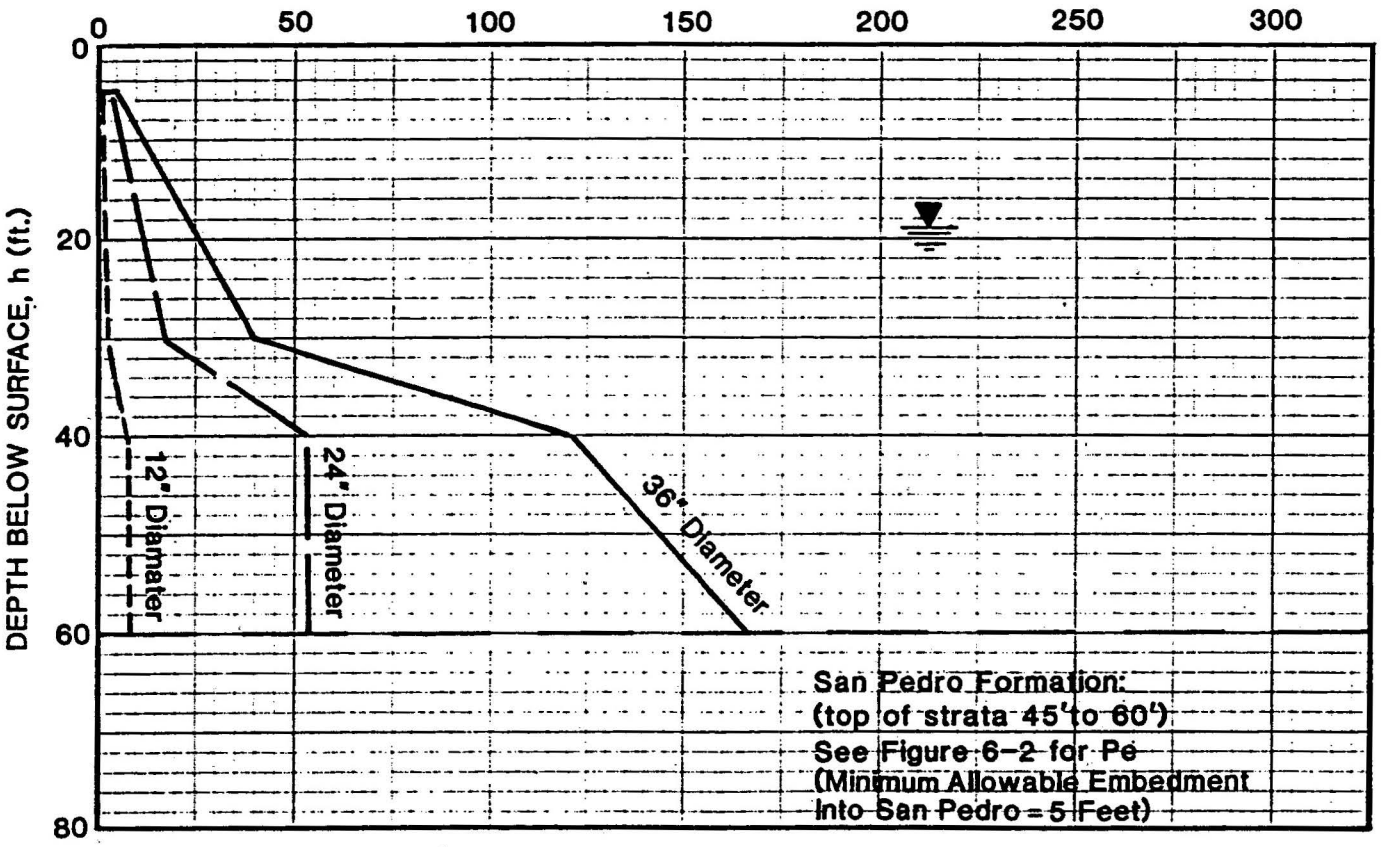
Figure No.
6-3





See Figure 6-2 for Determination of Total Capacity

UNDERPINNING - CAST-IN-PLACE PILE DESIGN PARAMETERS (Crenshaw/Olympic)

METRO RAIL MID-CITY SEGMENT

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91-31-208-01

Figure No.
6-4

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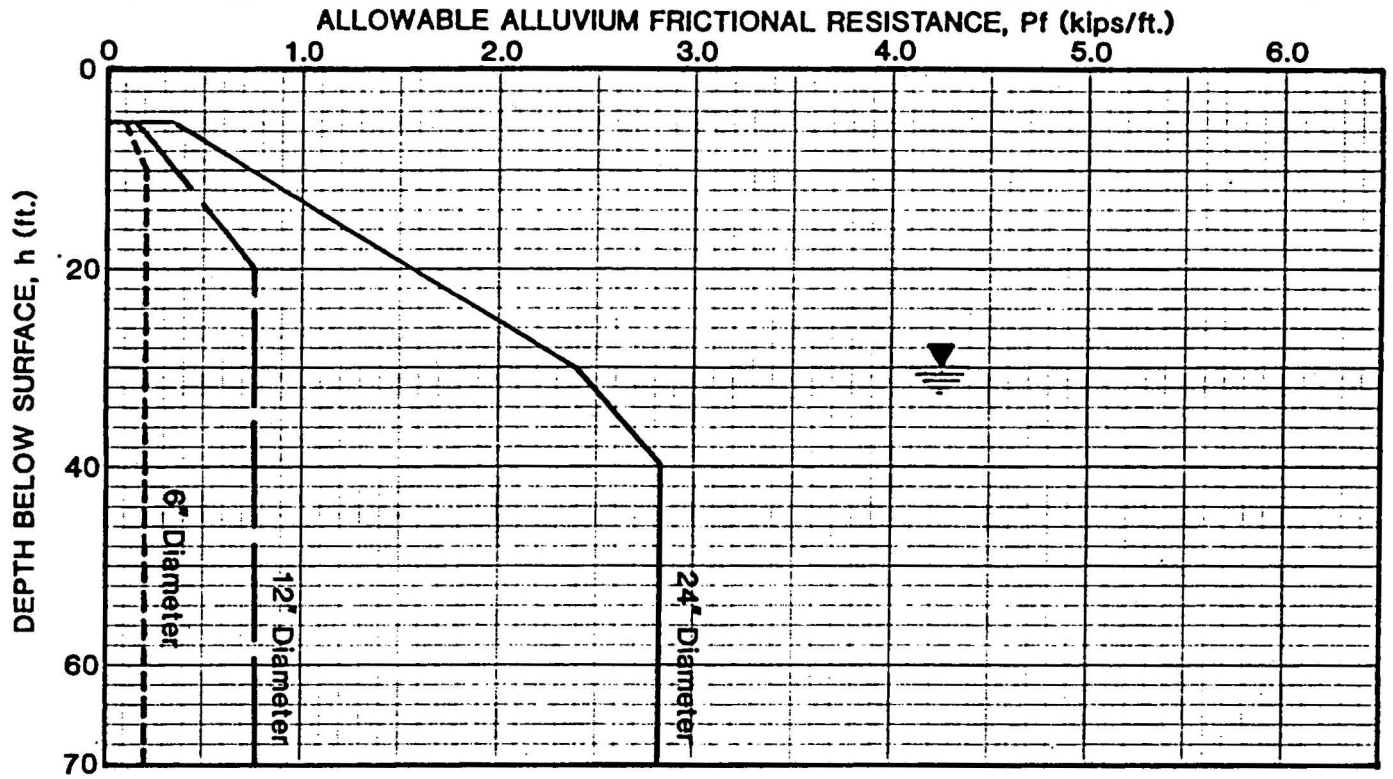

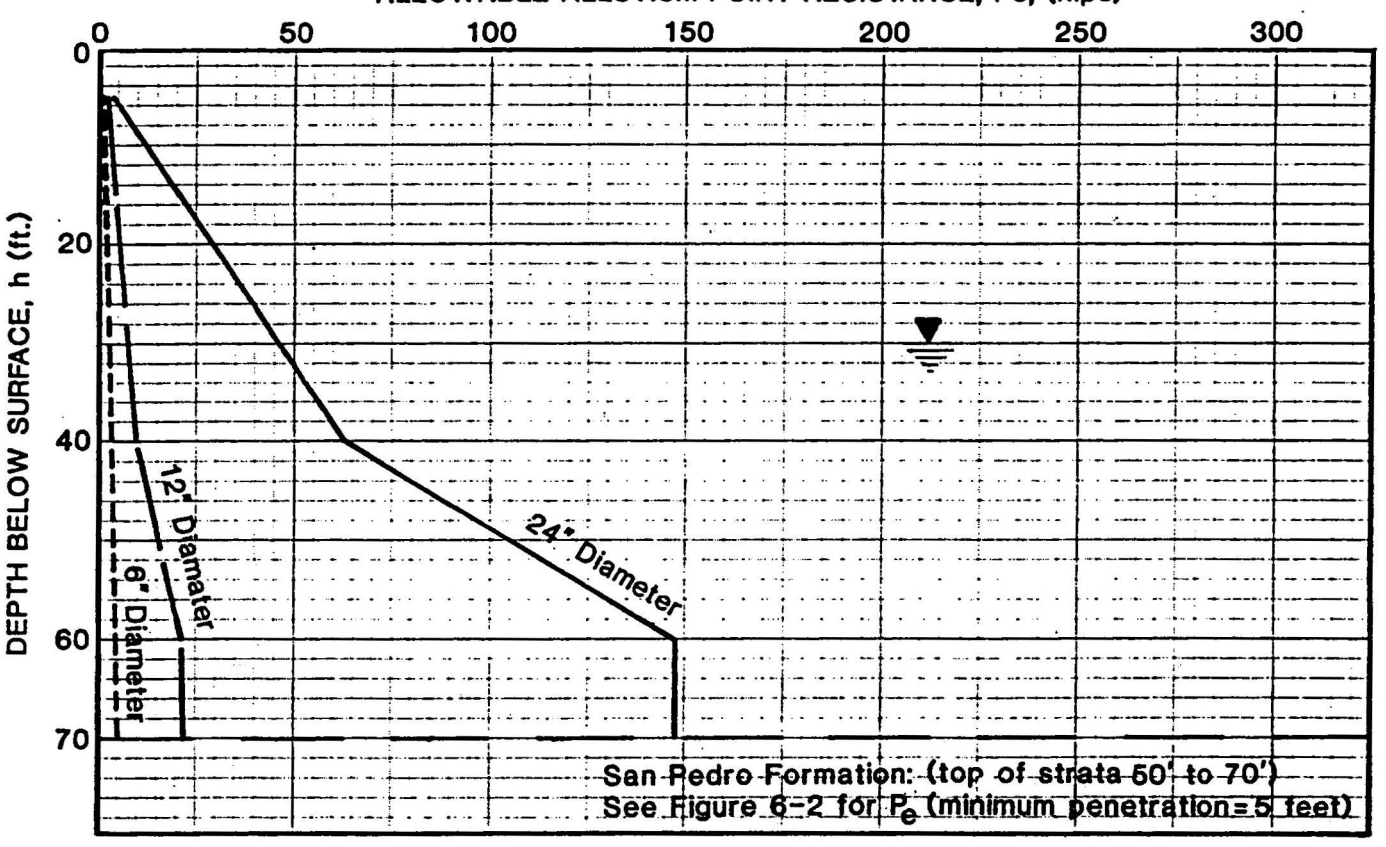

See Figure 6-2 for Determination of Total Capacity

UNDERPINNING - JACKED PILE DESIGN PARAMETERS (Pico/San Vicente)

METRO RAIL MID-CITY SEGMENT

Project No.
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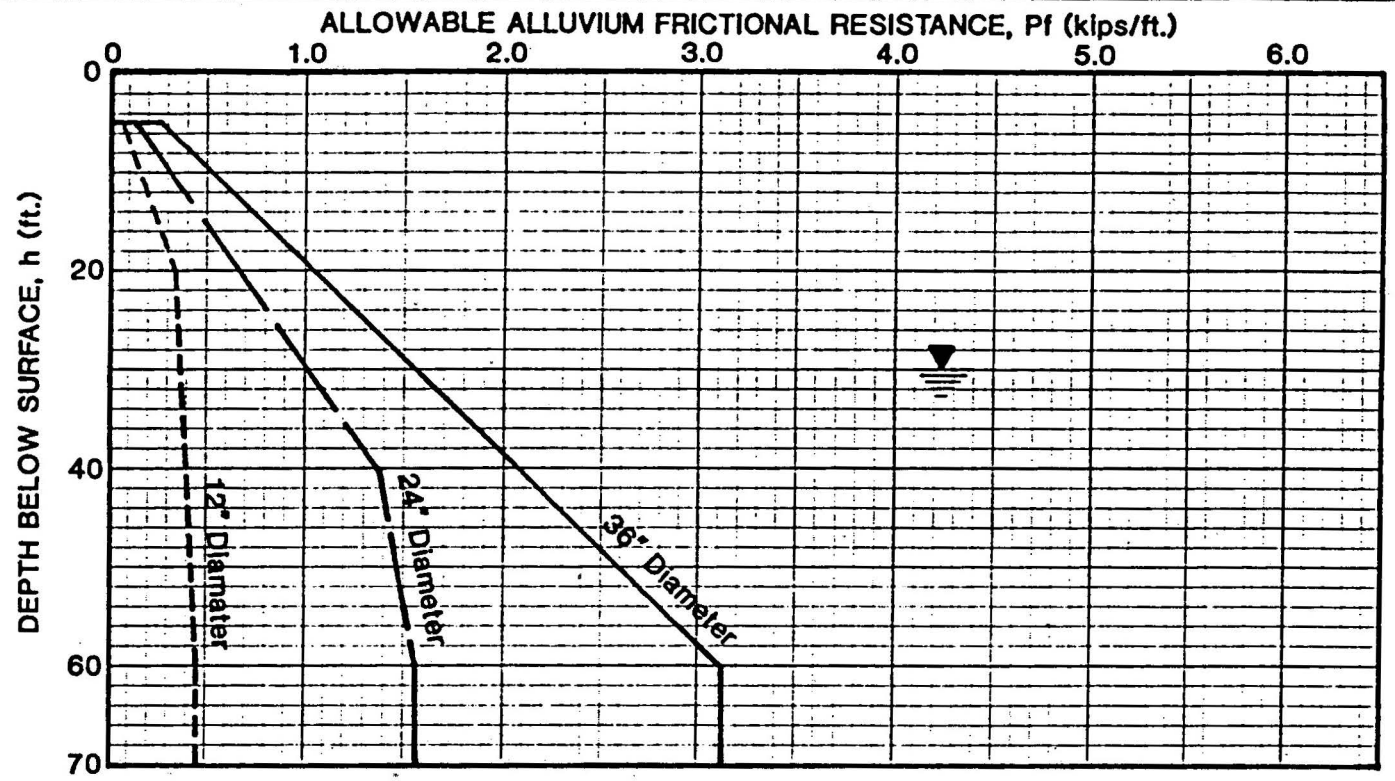
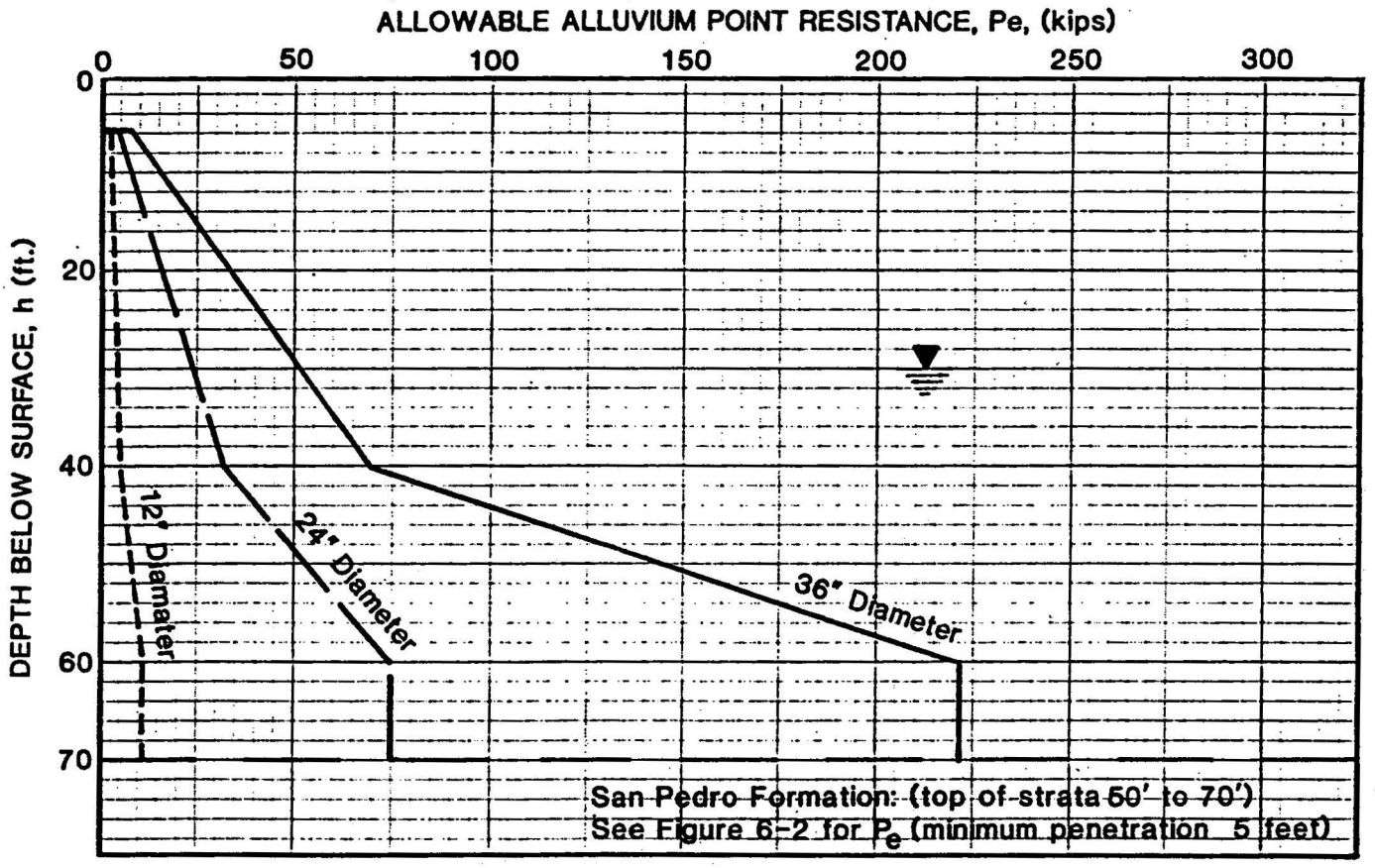
Figure No.
6-5





See Figure 6-2 for Determination of Total Capacity

UNDERPINNING - CAST-IN-PLACE PILE DESIGN PARAMETERS (Pico/San Vicente)

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

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Figure No.
6-6

procedures for determining the geometry of the support zones. No support should be allowed within any existing fill soils encountered or within the "no support" zone shown on Figure 6-2. Figures 6-3 and 6-4 present design parameters for underpinning based on the expected subsurface conditions at the Crenshaw/Olympic station. Figures 6-5 and 6-6 present underpinning design data for conditions at the Pico/San Vicente station.

If jetting or other methods which remove soil ahead of the pile are used, no shaft frictional resistance should be allowed. To ensure proper end bearing, jetting must not be used for the final 5 feet of penetration. Because the fine-grained subsurface soils are stiff and the granular subsurface soils are dense,no pile group reduction factor is necessary.

Total capacity of hand-dug, lagged piers should be limited to end bearing only and must extend below the "no support" line shown in Figure 6-2. All piers are assumed to be 36-inch square or larger in section. For design, an allowable bearing pressure of 7 ksf may be used for piers which bear on firm or stiff undisturbed alluvium and penetrate at least 10 feet below the ground surface. For piers which penetrate at least 5 feet into the San Pedro sand or weathered bedrock, an allowable bearing pressure of 20 ksf may be used. These values apply only if the bearing surface is observed to be adequate and approved by a qualified geotechnical engineer or engineering geologist.

Subsurface subsidence due to dewatering and lateral ground movements adjacent to the excavation are discussed in Sections 6.2.1 and 6.4.5, respectively. The capability of the existing structure and underpinning system to sustain these movements should be evaluated. If dewatering is planned, the effects of downdrag due to surface subsidence should be included in underpinning design. For computation of downdrag loads, the following procedure may be used:

1. The upper 3/4 of alluvium thickness (including soils within the "no load" zone) should be assumed to be the downdrag zone. The alluvium thickness may be estimated from Drawings 4 through 7 and <u>should not include</u> the San Pedro Sands.

2. No positive (upward) frictional resistance should be used in the downdrag zone, instead a negative (downward) frictional load equal to twice the allowable frictional resistance within the zone (as determined from Figures 6-3 through 6-6). should be added to the design load.

   The negative frictional load is based on full soil strength (safety factor = 1.0) while the positive allowable frictional resistance is based on a safety factor of 2.0.

<u>6.3.4 Underpinning Performance</u>: Underpinning does not guarantee that the structure will be totally free from either settlement or lateral movement. Some settlement may occur during the underpinning process. Additional vertical and/or

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lateral movement may occur during the construction of the main excavation, depending on the performance of both the shoring and the underpinning elements. Effects of subsidence may result in differential settlements between underpinning elements and non-underpinning elements.

6.3.5 Underpinning Instrumentation: Prior to construction, elevation reference points should be established on each foundation element to be underpinned. The points should be monitored on a regular basis consistent with the construction progress (readings may be required daily). Maximum allowable movements should be established for each element by the engineer prior to underpinning. If it appears that these limits may be exceeded, immediate measures should be taken such as restressing underpinning elements, adding more supports or changing installation procedures.

Where a group of three or more jacked piles is used to underpin a foundation element, load relaxation of previously installed piles can occur. Methods should be implemented to evaluate this problem and re-load piles if necessary.

6.4 Temporary Excavations

6.4.1 General: The required Crenshaw/Olympic and Pico/San Vicente station excavations will extend approximately to 70 and 85 feet, respectively, below the existing ground surface and about 50 feet below the groundwater level. A primary consideration in the selection of the shoring system should be the dewatering-caused differential settlements of underpinned structures, as discussed in Sections 6.1 and 6.2. These potential settlements could be mitigated by a conservatively designed shoring system which could minimize underpinning or by a "tight" shoring system which could eliminate the need for site dewatering, and because it is rigid enough, it could also minimize underpinning. There are several currently used shoring methods which include soldier piles and lagging, slurry-trench diaphragm wall construction ("tight shoring") and sheet piles. Bracing systems are generally either tieback anchors or internal bracing. We understand that the excavation system will be chosen and designed by the contractor in accordance with specified criteria and subject to review and acceptance by the Metro Rail Construction Manager.

The fine-grained alluvial soils at the site will generally be favorable for construction of shoring systems. However, caving may occur within the zones of granular alluvium and within the San Pedro Sands. In addition, gravel and cobble zones may be encountered, especially within the lower layers of San Pedro Sand.

Considering local construction practice, we feel that a soldier pile and lagging shoring system with tiebacks and/or internal bracing is the most probable shoring system to be used at this site by the contractor. The following discussions and recommendations are, therefore, directed to a soldier pile wall system. However, other shoring systems such as the slurry-trench diaphragm wall or sheet piles may be considered by the contractor, and further recommendations can be provided for their design, if required.

6.4.2 Soldier Pile Shoring Systems: A soldier pile and lagging shoring system consisting of soldier piles installed in predrilled holes is a common method of shoring deep excavations in the Los Angeles area. Both conventional and conservative soldier pile shoring systems may be used at these sites. The conservative wall should be designed for higher soil loads to reduce ground movements behind the wall.

Soldier piles have been installed in the Los Angeles area in soils similar to those encountered at the propose station sites. In granular soils, particularly below the groundwater table, caving can be a problem. The contractor should recognize that caving conditions will be encountered during construction of soldier piles or other drilled shaft elements. However, the volume and extent of caving cannot be predicted with certainty.

Granular soil layers within the alluvium at the site will require support between soldier piles to eliminate loss of ground, especially in the presence of adverse hydraulic gradients. Typically, wooden lagging is used although precast concrete or steel panels may also be used.

6.4.3 Shoring Design Criteria: This section provides design criteria for both conventional and conservative soldier pile shoring systems consisting of soldier piles and wooden lagging supported by tiebacks or internal bracing. The criteria are limited to soldier pile walls. The soldier piles are assumed to consist of steel W or H-sections installed in predrilled circular shafts. It is assumed that the drilled shaft will be filled with concrete. Thus, for computing the allowable soil loads, the piles were assumed to have circular concrete sections.

The Crenshaw/Olympic station shoring will penetrate the Fernando bedrock which was observed to be massive but highly weathered to the depths of our borings. It is our opinion that passive bedrock resistance will be affected by the weathering; therefore reduced values of passive resistance are recommended. Also, the portion of the vertical capacity of shoring piles within the weathered bedrock zone will be assumed to be the same as that portion of the capacity within the San Pedro sand.

Specific shoring design criteria include:

- Design Wall Pressure: Figure 6-7a presents conventional and conservative lateral earth pressures on temporary shoring for a braced wall condition. Figure 6-7b presents earth pressures for cantilevered shoring while Figures 6-7c and 6-7d present earth pressures for building and construction surcharges. We recommend that cantilevered shoring not be used for vertical cuts exceeding 15 feet in height. Figure 6-7e also includes the case of a partial slope cut. The full loading diagram above the bottom of excavation should be used to determine the design loads on tieback anchors and the required depth of embedment of the soldier piles. For computing design stresses in the soldier piles, the computed values can be

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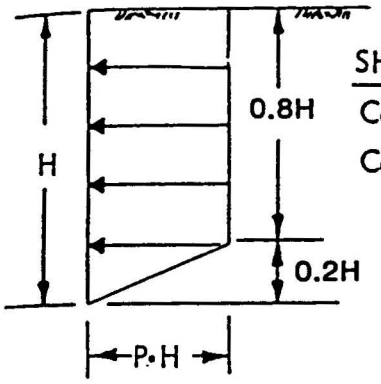
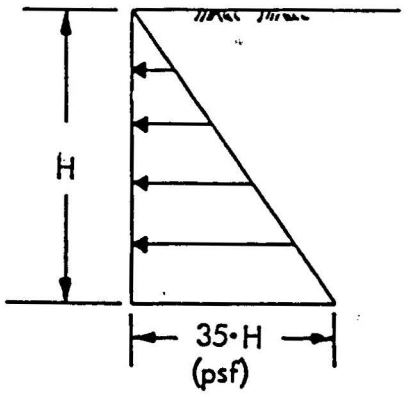
EARTH LOADING
BRACED SHORING



SHORING TYPE	P
Conventional	20
Conservative	25

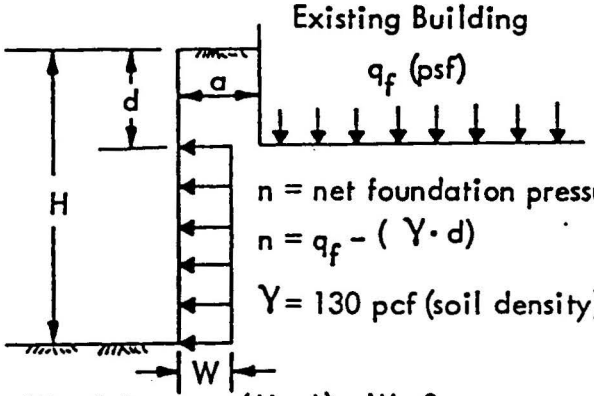
a

EARTH LOADING
CANTILEVERED SHORING



b

BUILDING SURCHARGE



n = net foundation pressure

$n = q_f - (\gamma \cdot d)$

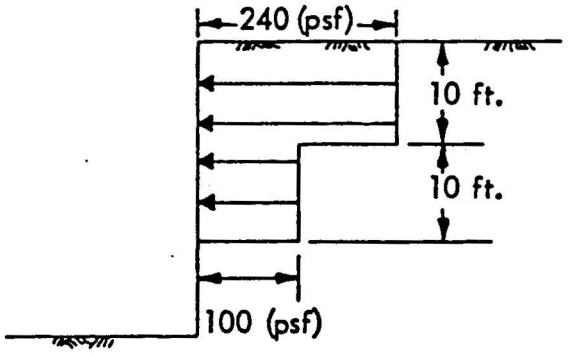
γ = 130 pcf (soil density)

IF $n \leq 0$ or $a \geq (H-d)$: $W=0$

IF $n > 0$: $W = 0.4n\left[1 - \frac{a}{(H-d)}\right]$ (psf)

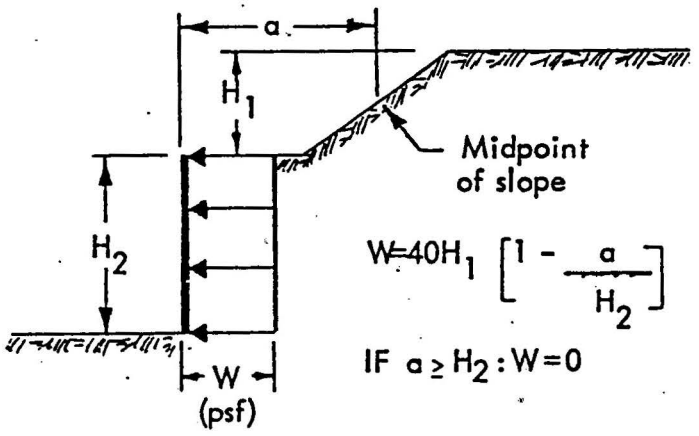
c

CONSTRUCTION SURCHARGE



d

SLOPE SURCHARGE



$W = 40H_1\left[1 - \frac{a}{H_2}\right]$

IF $a \geq H_2$: $W=0$

e

LATERAL LOADS ON TEMPORARY SHORING (WITH DEWATERING)

METRO RAIL MID-CITY SEGMENT

Project No.
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Converse Consultants West

Figure No.
6-7

multiplied by 0.8. For sizing lagging, the earth pressures can be reduced by a factor of 0.5.

- Depth of Pile Embedment: The embedment depth of soldier piles below the lowest anticipated excavation depth must be sufficient to satisfy both the lateral and vertical loads.

  The required depth of embedment to satisfy vertical loading should be computed based on the allowable vertical loads shown on Figure 6-8. It should be noted that all piles should penetrate at least 5 feet into the San Pedro bearing stratum or weathered bedrock. This figure shows vertical capacity which includes the full end-bearing. Proper cleanout of the pile excavations is assumed.

  The imposed lateral load on the pile should be computed based on the earth pressure diagrams of Figure 6-7 minus the support from tiebacks or internal bracing. The required depth of embedment to satisfy lateral loads should be computed based on the net allowable passive resistance (total passive resistance of the soldier pile minus the active earth pressure below the excavation). Due to arching effects, it is recommended that the effective pile diameter be assumed equal to 1.5 pile diameters or half of the pile spacing, whichever is less. Figure 6-9 indicates the recommended method to compute net passive resistance. Figure 6-9 should be used for piles penetrating San Pedro Sand and/or weathered bedrock.

- Pile Spacing and Lagging: The optimum pile spacing depends on many factors including soil type, soil loads, member sizes and costs. At the station sites the subsurface soils encountered consisted of alternated alluvial layers of fine-grained and granular soils overlying San Pedro Sand. The granular alluvial soils will be subject to ravelling and sloughing. Thus, it is recommended that the pile spacing be limited to about 6 feet and that continuous lagging be placed to minimize ravelling of soils and loss of ground between soldier piles. The contractor should limit the temporary unshored height of sandy soil to less than 3 feet to control ravelling problems, especially in the dewatered zone.

- Excavation Stability: As part of the shoring design, stability calculations should be performed to verify that the shoring/tieback system has an adequate safety factor against deep-seated failure.

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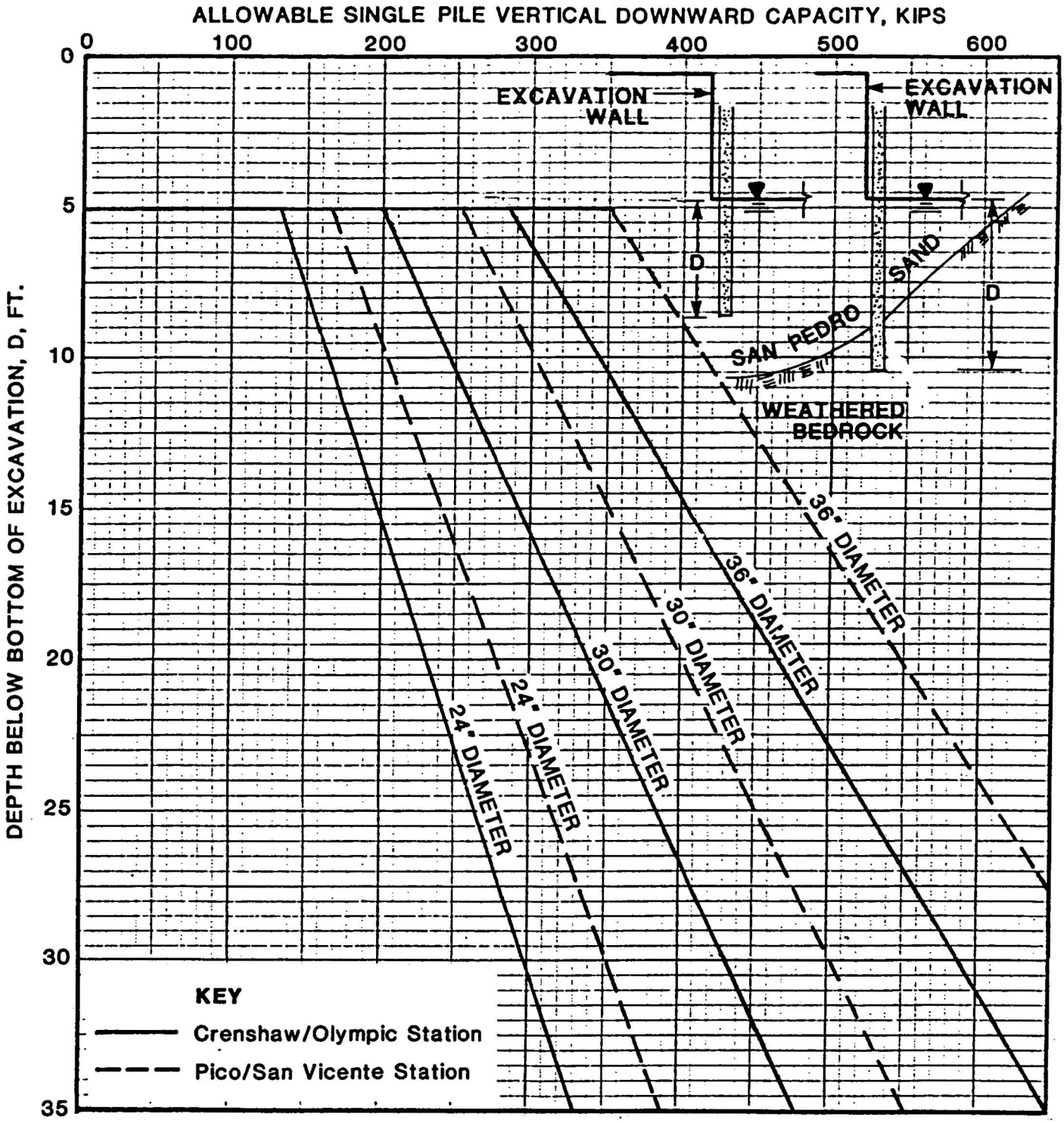

NOTES

1. All piles must penetrate at least 5 feet into the San Pedro Sand or Weathered Bedrock.
2. End-bearing and friction included in above curves

VERTICAL CAPACITY OF PILES FOR SHORING (SAN PEDRO OR WEATHERED BEDROCK)

METRO RAIL MID-CITY SEGMENT

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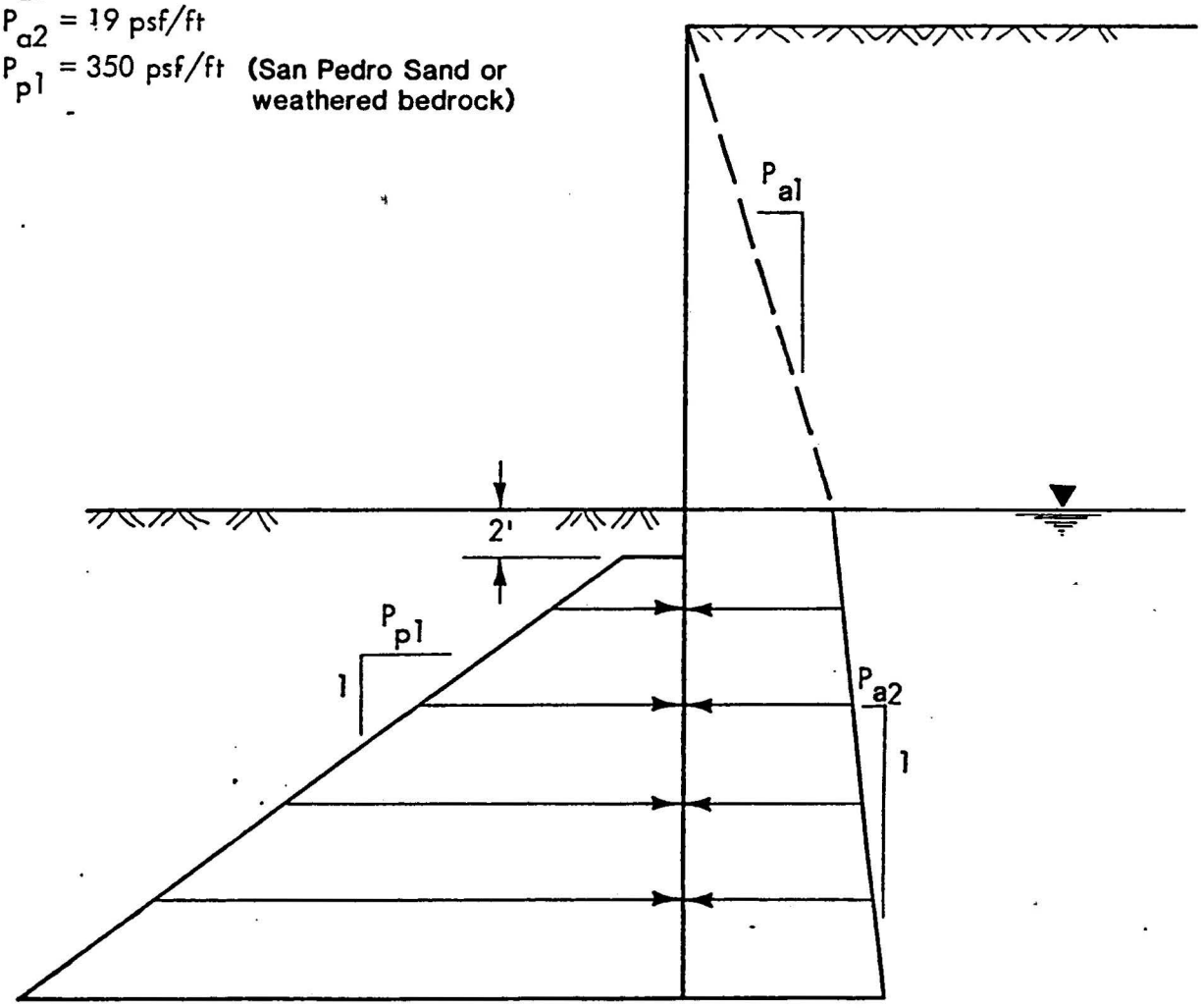
Figure No.
6-8

Recommended Unit Pressures

P_{a1} = 35 psf/ft

P_{a2} = 19 psf/ft

P_{p1} = 350 psf/ft (San Pedro Sand or weathered bedrock)



WHERE: P_p = Total allowable unit passive pressure

P_a = Unit active pressure

NOTES:

1) The site is assumed to be dewatered.
2) Available passive pressure = Total passive − Active
3) Available passive pressure can be assumed to act on 1.5 pile diameters or 1/2 the pile spacing, whichever is less.
4) Active pressure P_a2 is for evaluation of available passive pressure. Lateral shoring pressures are presented on Figure 6-7.

SOLDIER PILE PASSIVE RESISTANCE

METRO RAIL MID-CITY SEGMENT

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Figure No.
6-9

6.4.4 Internal Bracing and Tiebacks

6.4.4.1 General: Tiebacks and/or internal bracing may both be suitable to support the temporary shoring wall for the proposed excavation. Obtaining permission to install tiebacks under adjacent properties and encountering obstructions from adjacent below-grade structures (such as basements) can affect the feasibility of tiebacks. In this case, internal bracing may be more attractive to the contractor than tiebacks.

6.4.4.2 Performance: Based on available field data there does not appear to be a significant difference between the maximum ground movements of properly designed and carefully constructed tieback walls or internally braced walls. However, there is a difference in the distribution of the ground movements which is not expected to affect shoring system stability. Prestressing of both tiebacks and struts is essential to remove slack and minimize ground movements.

6.4.4.3 Internal Bracing: The contractor should not be allowed to extend the excavation an excessive distance below the lowest strut level prior to installing the next strut level. The maximum vertical distance depends on several specific details such as the design of the wall and the allowable ground movement. These details cannot be generalized. However, as a guideline, we recommend consideration of the following maximum allowable vertical distances between struts:

- Conventional Shoring System: 12 feet
- Conservative Shoring System: 8 feet

In addition, the contractor should not be allowed to extend the excavation more than 3 feet below a designated support level before placing the corresponding struts. The contractor may be allowed to excavate a trench within the excavation to facilitate construction operations provided the trench is at least 15 feet horizontally from the shoring and does not extend more than 6 feet below the designated support level.

To remove slack and limit ground movement, the struts should be preloaded. Preloading consists of jacking two auxiliary struts against opposite wales until no appreciable movement is noted. A permanent strut is then inserted between the auxiliary struts and wedged tightly before the jacks are released. Preloads to about 50% of the design load are possible. The shoring design, preload procedures, and monitoring/maintenance procedures must provide for the effects of temperature changes to maintain a stable shoring system.

6.4.4.4 Tieback Anchors: There are numerous types of tieback anchors available including large diameter straight shaft friction anchors, belled anchors, high pressure grouted anchors, high pressure regroutable anchors, and others. Generally, in the Los Angeles area, high capacity

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straight shaft or belled anchors have been used where construction conditions are favorable.

Tieback anchor capacity can be determined only in the field based on anchor load tests. For estimating purposes, we recommend that the estimated capacity of drilled straight shaft friction anchors be computed based on the following equation:

$$P = \pi DLq$$

Where:

P	=	allowable anchor design load in pounds
D	=	anchor diameter in feet
L	=	anchor length beyond no load zone in feet
q	=	soil adhesion in psf.

The design adhesion value (q) can be determined by:

$$q = 20d < 750 \text{ psf}$$

Where:

d	=	average depth (in feet) of the anchor beyond the no-load zone or theoretical failure wedge measured vertically from the ground surface.

Figure 6-10 illustrates the tieback anchor parameters.

Allowable anchor capacity/length relationships for tieback types other than straight shaft friction anchors cannot be generalized. Design parameters for anchors such as high pressure grouted anchors and high pressure regroutable anchors must be based on experience in the field and on the results of test anchors.

For design purposes, it should be assumed that the potential wedge of failure behind the shored excavation is determined by a plane drawn at 35° with the vertical through the bottom of the excavation. Only the frictional resistance developed beyond the no-load zone should be assumed effective in resisting lateral loads.

The anchors may be installed at angles generally between 20° and 50° below the horizontal. Based on specific site conditions, these limits could be expanded to avoid underground obstructions. Structural concrete should be placed in the lower portion of the anchor up to the limit of the

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APPENDIX A

BORING LOG SUMMARIES

BY

CONVERSE CONSULTANTS WEST

METRO RAIL MID-CITY SEGMENT
AUGUST 1992

PREPARED FOR

PARSONS, BRINCKERHOFF, QUADE & DOUGLAS, INC.

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MAJOR DIVISIONS			SYMBOLS		TYPICAL NAMES
COARSE GRAINED SOILS More than half is larger than No. 200 sieve	GRAVELS More than half coarse fraction is larger than No. 4 sieve	Clean gravels with little or no fines	GW		Well graded gravels, gravel-sand mixtures
			GP		Poorly graded gravels, gravel-sand mixtures
		Gravels with over 12% fines	GM		Silty gravels, poorly graded gravel-sand silt mixtures
			GC		Clayey gravels, poorly graded gravel-sand-clay mixtures
	SANDS More than half coarse fraction is smaller than No. 4 sieve	Clean sands with little or no fines	SW		Well graded sands, gravelly sands
			SP		Poorly graded sands, gravelly sands
		Sands with over 12% fines	SM		Silty sands, poorly graded sand-silt mixtures
			SC		Clayey sands, poorly graded sand-clay mixtures
FINE GRAINED SOILS > half is smaller than No. 200 sieve	SILTS AND CLAYS Liquid limit less than 50		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL		Organic clays and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50		MH		Inorganic silts, micaceous or diatomaceous fine, sandy or silty soils, elastic silts
			CH		Inorganic clays of high plasticity, fat clays
			OH		Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt		Peat and other highly organic soils

SAMPLE TYPE

STANDARD PENETRATION TEST, Split barrel sampler in accordance with ASTM D1586-84 Standard Test Method

DRIVE SAMPLE, 2.42-inch inside diameter driven with 140-lb. weight, 30-inch drop (ASTM D 3550-84)

BULK SAMPLE, loose cuttings from exploration

TEST TYPE

(Results shown in Appendix B)

	OTHER
CLASSIFICATION	
Plasticity	pi
Grain Size Analysis	ma
Sand Equivalent	SE
Specific Gravity	sg
Expansion Index	EI
Compaction Curve	max
STRENGTH	
Pocket Penetrometer	P
Direct Shear	ds
Unconfined Compression	uc
Triaxial Compression	tx
R-value	R
CONSOLIDATION	c
Collapse	col

EXPLORATION LOG KEY

Log of Boring No. MC-1

Date Drilled: 6/1/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 187 feet Depth to Water: Static water level 21.9' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		6-inch thick ASPHALT PAVEMENT						
		SILTY CLAY (CH); trace fine to coarse sand, plastic, dark brown						
5		SAND (SP); fine to medium sand, some silt, trace fine gravel, medium brown	C-1		10 13			
10		SAND (SW); fine to coarse sand, trace silt, light brown		SPT-2	5 6 6			
		SILTY SAND (SM); fine to medium sand, pockets of silt, medium brown	C-3		7 11			
15				SPT-4	7 8 8			
		SILT (ML); sandy, fine sand, trace coarse sand, micaceous, light gray	C-5		7 7	28	96	
20				SPT-6	7 8 10			
		▼ Static water level on 6/18/92, 7/14/92 at 21.9 below surface	C-7		8 10			

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-2

Log of Boring No. MC-1

Date Drilled: 6/1/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 187 feet Depth to Water: Static water level 21.9' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILTY SAND (SM); fine to medium sand, bluish gray		SPT-8	6 9 12			
		very fine to fine sand, some silt, micaceous, dark gray	C-9		8 12	27	98	
30				SPT-10	8 9 13			
		fine to coarse sand, trace coarse, 1/4"-thick lenses of silt, dark gray	C-11		12 12	19	111	
35				SPT-12	8 9 12			
			C-13		36 29			
40				SPT-14	10 14 18			
			C-15		15 18			
45		SILT (ML); trace clay and gravel, dark gray		SPT-16	4 5 6			
		SAND (SP); fine to medium, dark gray, SAN PERDO SAND, sampler wet	C-17		10 20			

Project No. 91-31-208-01 Drawing No. A-3

Converse Consultants West

Log of Boring No. MC-1

Date Drilled: 6/1/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 187 feet Depth to Water: Static water level 21.9' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued), SAN PEDRO SAND, very fine to fine sand, trace silt, wet		SPT-18	13 22 30			
			C-19		28 40			
55		Six inch lense of fine to coarse SAND		SPT-20	28 30 40			
			C-21			18	113	
60		with a more SILT (SP-SM)		SPT-22	10 11 20			Sands running into hollow stem auger, SPT sampling only
				SPT-23	8 20 20			
65		FERNANDO FORMATION SILTSTONE-CLAYSTONE, highly weathered, thinly bedded, dark gray						
				SPT-24	14 17 25			
70		End of boring at 70.5 feet Groundwater encountered at 47 feet during drilling Installed 4" dia. PVC Monitoring Well: 0-15' blank casing; 15'-65' slotted casing, 65-70 blank casing, Backfilled anular space with #30 sand from 9'-71';						

Log of Boring No. MC-1

Date Drilled: 6/1/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 187 feet Depth to Water: Static water level 21.9' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		Bentonite seal 2'-9'; concrete and traffic cover 0-2'						

Log of Boring No. MC-2

Date Drilled: 6/3/92 | Logged by: APM (MAA) | Checked by: MBS

Equipment: 6" Hollow Stem Auger | Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 203 feet | Depth to Water: Static water level 29.9' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		8-inch thick ASPHALT PAVEMENT						
		CLAY (CL); sandy, fine to medium, plastic, dark brown						
		SILTY SAND (SM); with some clay, fine to medium sand, trace fine to medium gravel, medium brown						
5		SILT (ML); sandy, fine to medium, little clay, light brown	B-1					
			C-1		12 22			
10				SPT-2	12 15 17			No OVA reading
		gray, compact	C-3		10 20			
15		SILTY SAND (SM); gray		SPT-4	7 8 12			No OVA reading
		SAND (SP-SM); fine to medium, with silt, trace gravel, gray	C-5		12 18			
20				SPT-6	12 13 14			No OVA reading
			C-7		16 24			

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-6

Log of Boring No. MC-2

Date Drilled: 6/3/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 203 feet Depth to Water: Static water level 29.9' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		8-inch thick ASPHALT PAVEMENT						
		CLAY (CL); sandy, fine to medium, plastic, dark brown						
		SILTY SAND (SM); with some clay, fine to medium sand, trace fine to medium gravel, medium brown						
5		SILT (ML); sandy, fine to medium, little clay, light brown	B-1					
			C-1		12 22			
10				SPT-2	12 15 17			No OVA reading
		gray, compact	C-3		10 20			
15		SILTY SAND (SM); gray		SPT-4	7 8 12			No OVA reading
		SAND (SP-SM); fine to medium, with silt, trace gravel, gray	C-5		12 18			
20				SPT-6	12 13 14			No OVA reading
			C-7		16 24			

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-7

Log of Boring No. MC-2

Date Drilled: 6/3/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 203 feet Depth to Water: Static water level 29.9' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP-SM); (continued) greenish gray		SPT-8	11 12 13			OVA 60-70 ppm Background 60 ppm
30		SILTY SAND (SM); fine to coarse, fine to medium gravel, light yellowish brown ▼ Static water level on 7/14/92 29 feet below surface	C-9	SPT-10	16 24 10 11 14			OVA 60 ppm Background 60 ppm
35		SAND (SP-SM); fine to medium, little to some silt, yellowish brown	C-11	SPT-12	16 20 15 25 37	20	110	OVA 60 ppm Background 60 ppm
40			C-13	SPT-14	17 24 10 13 14			OVA 60 ppm Background 60 ppm
45		SILT (ML); sandy, very fine to fine, dark gray	C-15	SPT-16	9 13 8 9 11	23	104	
			C-17		12 28			

Log of Boring No. MC-2

Date Drilled: 6/3/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 203 feet Depth to Water: Static water level 29.9' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); fine to medium, dark gray		SPT-18	6 22 24			OVA 70 ppm Background 60 ppm
			C-19		9 28			No recovery running sands OVA 60 ppm Background 60 ppm
55		SILT (ML); sandy, with some clay, very compact, greenish gray		SPT-20	10 17 22			
			C-21		19 16	19	112	
60				SPT-22	11 12 17			
			C-23		22 30			
65		same as above, well cemented		SPT-24	8 26 75			SPT refusal High Sampling Resistance OVA 110 ppm Background 100 ppm
			C-25		12 28			
70		SAND (SP); fine to medium sand, strong smell of oil, TAR sand, grayish black color, SAN PEDRO SAND		SPT-26	15 23 28			OVA 1500- 10,000 ppm Background 110 ppm
			C-27			13	107	High sampling resistance

Log of Boring No. MC-2

Date Drilled: 6/3/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 203 feet Depth to Water: Static water level 29.9' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued), SAN PEDRO SAND		SPT-28	25 48 80			SPT Refusal High Sampling Resistance OVA +10,000 Background 100 ppm
			C-29		20 40			
80				SPT-30	15 25 40			OVA +10,000 ppm
				SPT-32	10 14 30			Mo recovery running sands sands coming up hollow stem auger OVA +10,000 ppm
85								
		End of boring at 89 feet Static water level at 29.9 feet on 7-14-92 Installed 4" dia. Monitoring Well: 0-15' blank casing; 15'-85' slotted casing; 85'-90' blank casing Backfilled annular space with #30 sand from 9'-90'; Bentonite seal 2'-9'; concrete and traffic cover 0-2' P = Pocket Penetrometer OVA readings in ppm						

Log of Boring No. MC-3

Date Drilled: 6/10/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 190 feet Depth to Water: 27.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		2 1/2-inch thick ASPHALT PAVEMENT over 7-inch thick CONCRETE SLAB						Hand Augered to 8 feet
		SILTY SAND (SM); medium to coarse sand, light brown						OVA background = 2 ppm
5								
10		SILTY SAND (SM); fine to medium sand, trace clay, light gray to red brown	C-1	SPT-1	35 50 25 50			OVA 2 ppm Poor Recovery
15		contains crude horizontal layering. Layer expossed by color variations, orange brown stringers and lenses present	C-2	SPT-2	70 20 25 25 30			OVA 3 ppm Flowing Sands
		SAND (SW); coarse, light gray to red brown						
20		SILTY SAND (SM); medium to coarse sand, trace clay, scattered gravel present	C-3	SPT-3	13 40 25 35 50			Poor Recovery OVA 1 ppm
		SILT (ML); with little clay, trace coarse sand						
		SAND (SW); fine to medium, trace silt, laminated in yellow, gray and white						

Log of Boring No. MC-3

Date Drilled: 6/10/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 190 feet Depth to Water: 27.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		horizontal layers SAND (SW); (continued) contains scattered gravel, no layering observable; contains silty portions, white to yellow brown	C-4	SPT-4	35 50 17 25 35			OVA 1 ppm Sampler Wet at 27.5 feet
30		INTERBEDDED SILTY CLAYEY SAND (SC-SM) predominantly coarse sand	C-5	SPT-5	36 50 15 25 35	17	110	OVA 3 ppm
35		SILT (ML); with some clay, trace medium to coarse sand, dark green to blue green slightly decreased clay content	C-6	SPT-6	31 50 10 11 25			OVA 3 ppm
40			C-7		36 56			OVA 2 ppm
		SAND (SW); medium to coarse, scattered subrounded gravel light brown		SPT-7	11 22 30			
45			C-8		31 46			OVA 2 ppm
		SILT (ML); with little clay, trace fine to medium sand dark gray to gray green		SPT-8	21 35 50			

Log of Boring No. MC-3

Date Drilled: 6/10/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 190 feet Depth to Water: 27.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); (continued) decreasing clay content, decreasing medium sand, increasing fine sand	C-9	SPT-9	17 45 12 16 20	19		OVA 3 ppm
55		SILT (ML); sandy, fine sand, dark gray to gray green	C-10	SPT-10	20 44 21 24 34			OVA 30 ppm
		SILTY SAND (SM); fine sand, scattered coarse sand, dark green to gray green						
60		increasing medium sand, decreasing fine sand	C-11	SPT-11	43 50 30 50	24	102	OVA 30 ppm High Sampling Resistance SPT Refusal
65		SILT (ML); sandy, fine sand, trace clay, dark gray to gray green	C-12	SPT-12	18 50 26 52	21	103	OVA 4 ppm High Sampling Resistance SPT Refusal
		SILT (ML); trace fine sand, contains thin horizontal undulating laminate						
70		SILT (CL-ML); with some clay, trace fine to medium sand	C-13		35 50	31	92	OVA 35 ppm

Log of Boring No. MC-3

Date Drilled: 6/10/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 190 feet Depth to Water: 27.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		Hole drilled to 76 feet to try to loosen sampler and hammer, No SPT taken at 71 feet, No drive sample at 75 feet		SPT-13	16 56			High Sampling Resistance SPT Refusal
		SILTY SAND (SM); fine to medium, light gray, SAN PEDRO SAND						
		TAR SAND (SP); fine to medium sand, dark brown natural petroleum in void spaces tar present as dark brown globs within cleaner sand portions tar zones present as sub-horizontal layers from approximately 1/4" to 3" in thickness						OVA 450 ppm
80			C-14		16 50	17	112	High Sampling Resistance SPT Refusal
				SPT-14	25 50			OVA 500 ppm
85		SILTY SAND (SM); fine to medium, no tar staining in sample, gray	C-15		45 50			OVA 800 ppm
				SPT-15	27 50			High Sampling Resistance SPT Refusal
		Tar-rich zone voids completely filled with natural petroleum						
		SILTY SAND (SM); continued, thin tar lenses present, gray fine sand, increasing silt content, oily sheen present in sample						
90			C-16		40 47			OVA 1,500 ppm
				SPT-16	32 50			High Sampling Resistance SPT Refusal
95								
		FERNANDO FORMATION: SILTSTONE AND CLAYSTONE; gray, sandy		SPT-17	6 10 18			OVA 75 ppm
			C-18		16 50			SPT Refusal

Log of Boring No. MC-3

Date Drilled: 6/10/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 190 feet Depth to Water: 27.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		End of boring at 100 feet Groundwater encountered at 27.5 feet Natural tar sands encountered at 87.5 feet Hole sloughed to 57 feet when augers were pulled Boring backfilled with bentonite pellets and portland cement OVA readings in ppm						

Log of Boring No. MC-4

Date Drilled: 6/8/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 160 feet Depth to Water: Static water level 21.8' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); with little to some medium sand, trace fine roots, dark brown						
5			B-1					
		SILTY SAND (SM); trace clay, grayish brown	C-1		8 21			
10				SPT-2	6 7 9			
			C-3		6			
15		SAND (SW); fine to coarse, little silt, grayish brown		SPT-4	10 10 19			
			C-5		9 10	22	104	
20		SAND/SILTY SAND (SP/SM); fine to very fine with occasional thin sandy silt layers, gray, WET ▽ Static water level at 21.8 feet on 7/14/92		SPT-6	2 3 4			
			C-7		20 34			

Project No. 91-31-208-01 Drawing No. A-16

Converse Consultants West

Log of Boring No. MC-4

Date Drilled: 6/8/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 160 feet Depth to Water: Static water level 21.8' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued)		SPT-8	12 17 22			
		fine to medium, dark gray	C-9		20 28			
30		SAND (SP-SM); fine to very fine, with silt, dark gray		SPT-10	8 15 26			
			C-11		13 20			
35				SPT-12	12 20 36			
			C-13		11 13			
40		SILT (ML); sandy, very fine sand, trace mica, dark gray		SPT-14	11 13 17			
			C-15		18 26			
45		SAND (SP-SM); fine to medium, with silt and little mica, dark gray, SAN PEDRO SAND		SPT-16	25 50 100			High Sampling Resistance SPT Refusal
			C-17		29 38			

Log of Boring No. MC-4

Date Drilled: 6/8/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 160 feet Depth to Water: Static water level 21.8' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP-SM) (continued)		SPT-18	24 33 41			
			C-19		25 95			
55		trace silt, light gray		SPT-20	87 74 120			High Sampling Resistance SPT Refusal
			C-59		35 55			
60				SPT-22	11 12 17			
		SAND (SP-SM); fine to very fine, with silt, some mica, dark gray	C-23		25 55			
65				SPT-24	18 26 64			High Sampling Resistance SPT Refusal
			C-25		30 60			
70				SPT-26	11 13 15			
		FERNANDO FORMATION: SANDY SILTSTONE, gray						
			C-27		21 40			

Log of Boring No. MC-4

Date Drilled: 6/8/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 160 feet Depth to Water: Static water level 21.8' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		FERNANDO FORMATION: (continued)		SPT-28	12 25 28			
		End of boring at 76.5 feet Installed 4" dia. PVC Monitoring Well 0'-15' Blank casing 15'-75' Slotted casing 75'-80' Blank casing Backfilled annular space with #30 sand Bentonite seal from 2'-10' Concrete and traffic cover 0'-2'						

Log of Boring No. MC-5

Date Drilled: 6/30/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 159 feet Depth to Water: 19.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		4-inch thick CONCRETE						
		FILL: SILT (ML); sandy, with medium sand, dark brown						OVA background = 2 ppm
		CLAY (CL); some silt, contains white stringers, dark brown	C-1		8 8			OVA 3 ppm
5				SPT-1	3 4 8			
		CLAYEY SAND (SC); medium to coarse sand, green gray	C-2		7 10			OVA 30 ppm
10		SILT (ML); with trace coarse sand, mottled, light brown to red brown		SPT-2	4 5 8			
			C-3		7 10	32	92	OVA 300 ppm
15		light brown to light green gray		SPT-3	3 5 6			
		▼SAND (SP); medium to coarse sand, gasoline odor, free product on water	C-4		16 20			OVA 4,000 ppm Free product on water, strong gasoline odor
20				SPT-4	9 7 5			
		SILT (ML); trace medium sand, gray green						
		SAND (SP); medium to coarse, green	C-5		12 15			OVA 300 ppm

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-20

Log of Boring No. MC-5

Date Drilled: 6/30/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 159 feet Depth to Water: 19.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued)		SPT-5	3 7 15			
		SILT (ML); trace fine sand, with some clay						
		inreasing clay content	C-6		5 11	30	93	OVA 20 ppm
30				SPT-6	7 10 11			
			C-7		14 22	20	108	OVA 40 ppm
35		SAND (SW); fine, trace silt, light green		SPT-7	10 15 20			
			C-8		12 18			OVA 8 ppm
40		SILT (ML); trace fine sand, gray green		SPT-8	10 15 20			
			C-9		14 26			OVA > 10,000 ppm H_2S odor, gas
45		SAND (SW); fine to medium, trace silt binder, hydrogen sulfide odor, gas, SAN PEDRO SAND		SPT-9	25 35 50			
			C-10		14 45			OVA > 10,000 ppm H_2S odor

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-21

Log of Boring No. MC-5

Date Drilled: 6/30/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 159 feet Depth to Water: 19.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SW); (continued)		SPT-10	25 47 58			High Sampling Resistance SPT Refusal
			C-11		25 45			OVA 3,000 ppm
55				SPT-11				
			C-12		29 42			No recovery
60		fine to medium, light gray		SPT-12	27 36 57			H_2S odor
		some sand, medium to coarse gravel	C-13		36 70			OVA 9,500 ppm
65				SPT-13	3 12 48			
		6/30/92 Drilling stopped because of equipment failure on rig. Boring backfilled with bentonite pellets and concrete cap placed on top 7/16/92 redrill	C-14					OVA > 10,000 ppm 7/ 6/92 Drilled out boring and to 70' and started sampling
70		SILTY SAND (SM); fine sand, dark gray		SPT-14	7 21 10 32 43			
		FERNANDO FORMATION: SANDY	C-15		8 48			OVA > 10,000 ppm

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-22

Log of Boring No. MC-5

Date Drilled: 6/30/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 159 feet Depth to Water: 19.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILTSTONE, dark gray FERNANDO FORMATION: SANDY SILTSTONE (continued), dark gray		SPT-15	10 18 33			gas
		CLAYEY SILTSTONE; silt, little clay, dark gray	C-16		12 26			OVA > 10,000 ppm
80				SPT-16	8 13 17			
			C-17		7 25			OVA > 10,000 ppm
85				SPT-17	8 16 18			
		decreasing clay	C-18		17 24			OVA > 10,000 ppm
90				SPT-18	7 11 15			
			C-19		8 23			OVA > 10,000 ppm
95				SPT-19	8 14 22			
		increasing clay	C-20		10 20			OVA > 10,000 ppm

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-23

Log of Boring No. MC-5

Date Drilled: 6/30/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 159 feet Depth to Water: 19.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		CLAYEY SILTSTONE; (continued)		SPT-20	9 11 18			
		End of boring at 101.5 feet Backfilled boring with volclay chips Concreted top 1' of boring flush with sidewalk						

Project No. Drawing No.

Converse Consultants West

91-31-208-01 A-24

Log of Boring No. MC-6

Date Drilled: 6/5/92 6/29/92 | Logged by: GSB | Checked by: MBS

Equipment: 8" Hollow Stem Auger | Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet | Depth to Water: 17 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		4-inch thick CONCRETE						Hand Augered to 5' Background OVA=3 ppm
		FILL: CLAY (CL); trace medium sand, brick and concrete fragments in sample, dark brown						
5								
			C-1		9 17			
		CLAYEY SAND (SC); medium to coarse sand, trace silt, mottled, dark brown zones which appear petroleum rich						
10			C-2		16 19	24	99	OVA 15 ppm
		CLAY (CL); trace fine to medium sand, contains discontinuous orange brown oxidation staining		SPT-1	16 18 24			
		SILTY SAND (SM); medium to coarse sand, some silt, trace clay decreasing coarse sand, increasing fine to medium sand						
15			C-3		19 25			
		GRAVELLY SAND (SW); fine to coarse sand quartz sand, poorly sorted, grains angular to subrounded, no fines present, clean sand, petroleum odor, gray to white, wet		SPT-2	18 20 22			OVA 25 ppm
								Flowing sands
20			C-4		20 30	16	106	
				SPT-3	6 13 30			
		SILTY SAND (SM); fine to coarse sand, some silt, light gray to blue gray						Natural petroleum odor, gas

Log of Boring No. MC-6

Date Drilled: 6/5/92 6/29/92 | Logged by: GSB | Checked by: MBS

Equipment: 8" Hollow Stem Auger | Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet | Depth to Water: 17 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); with some clay, trace medium sand, some thin laminant, dark green to gray	C-5	SPT-4	17 25 16 18			OVA 150 ppm
		SAND (SW); medium to coarse, gravel, trace silt, light green to gray			19			OVA 80 ppm
30		SILT (ML); with some clay, trace medium sand, gray	C-6	SPT-5	15 25 6 12 30	18	112	OVA 150 ppm
		SILTY SAND (SM); fine sand, gray to blue gray						
35		contains reflective white quartz silt grains	C-7	SPT-6	16 30 16 30 30	24	102	OVA 15 ppm
		SILT (ML); trace clay, green gray to blue						
40			C-8	SPT-7	22 35 45 70			OVA 150 ppm Natural petroleum odor, gas SPT Refusal
		SILTY SAND (SM); fine to medium, little silt, SAN PEDRO SAND						
45			C-9		18 60	16	114	
		methane and hydrogen sulfide gas						Hollow stem drilling to 50' terminated due to hazardous emissions

Log of Boring No. MC-6

Date Drilled: 6/5/92 6/29/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 17 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		6/5/92: Drilling stopped because of hazardous gas emisions from top of augers. Boring backfilled with cement/bentonite/spoils mixture. 6/25/92: Drilling resumed with rotary wash drill rig. Drilling fluid to control gas emissions.	C-10					
55		SAND (SP); fine to medium, poorly graded, sugar sands, gray, SAN PEDRO SAND occasional silt layers	C-11	SPT-8	52 27 40 50			Redrilled with Rotary Wash High sampling resistance SPT Refusal
60			C-12	SPT-9	48 50 47 50			High Sampling Resistance SPT Refusal
65		trace small gravel, gray to blackish gray		SPT-10	40 50 9 39 28			No recovery
70		SILTY SAND (SM); fine to medium sand, gray to blackish gray	C-13	SPT-11	27 50 5 18 27			Upper portion of boring closing

Log of Boring No. MC-6

Date Drilled: 6/5/92 6/29/92 | Logged by: GSB | Checked by: MBS

Equipment: 8" Hollow Stem Auger | Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet | Depth to Water: 17 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	QVA/REMARKS
		SILTY SAND (SM); (continued) occasional gravel lenses		SPT-12	31 50 7 32 35			no recovery Rig chatter at 78'
80		FERNANDO FORMATION: SANDY SILTSTONE, dark gray to blackish gray color	C-14	SPT-13	12 15 5 11 14			
85		SILTSTONE/CLAYSTONE; trace shell fragments, olive gray, weathered		SPT-14	7 11 15			
90				SPT-15	9 12 17			
		End of boring at 91.5 feet Groundwater not observed with rotary wash drilling method Backfilled boring Pressure grouted through drilling rods to 88'. Injected mixture of 4-50lbs. bags of volclay grout blended with 100 gallons water. Grout observed at surface Backfilled top of boring with bentonite chips 6/26/92 Backfilled top of boring with 2.5 bags of enviroplug chips, tamped, concreted top of boring flush with sidewalk						

Log of Boring No. MC-7

Date Drilled: 6/26/92 Logged by: MBS Checked by: MBS

Equipment: 6" Rotary Wash Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 20.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		1/4-inch thick CONCRETE						Hand Augered to 8 feet
		CLAY (CL); sandy, brown to dark brown						
5		gradational contact						Rotary Wash Drilling, fluid filled boring
		SILTY SAND (SM); with clay, fine to medium, with silt and clay binder, brown	C-1		6 7			
				SPT-1	3 5 6			
10		gradational contact						
		SAND (SW-SM); with silt, predominantly fine to medium, some coarse and occasional gravel, gravels sub-angular, moderately clean, light brown	C-2		15 30			
				SPT-2	10 13 15			
15								
		▼ light brown to light olive gray, wet	C-3		14 19	13	116	
				SPT-3	6 7 5			
20		occasional gravel lenses						Slight to Moderate Rig Chatter

Project No. Drawing No.

Converse Consultants West

91-31-208-01 A-29

Log of Boring No. MC-7

Date Drilled: 6/26/92 | Logged by: MBS | Checked by: MBS

Equipment: 6" Rotary Wash | Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet | Depth to Water: 20.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); sandy, silt with fine to very fine sand, varies to silty sand (SM), light olive gray, some clay binder-varies	C-4	SPT-4	10 8 7 6 7			
30		**CLAY (CL)**; mixture of clay and silt, trace micaceous, olive gray	C-5	SPT-5	6 8 4 5 6			Moderate rig chatter
35			C-6	SPT-6	13 15 3 4 7			Disturbed Sample
40		trace organic inclusions grass/root fragments, increasing fine sand		SPT-7	7 10 11			
45		decreasing clay binder, increased fine sand	C-7	SPT-8	10 18 11 13 27			
		gradational contact						

Log of Boring No. MC-7

Date Drilled: 6/26/92 Logged by: MBS Checked by: MBS

Equipment: 6" Rotary Wash Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 20.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); fine to medium, poorly graded, moderately clean to clean, sample has a slight hydrogen sulfide odor, gray to light gray, SAN PEDRO SAND	C-8	SPT-9	39 50 23 36 44			
55		slight to moderate hydrogen sulfide odor, gray to dark gray	C-9	SPT-10	38 50 25 37 40			High Sampling Resistance
60		fine to medium sand		SPT-11	26 50			No recovery on ring sample High Sampling Resistance SPT Refusal
65		sample has a moderate to strong hydrogen sulfide odor, moderate to clean sands, gray to dark gray	C-10	SPT-12	38 50 9 29 39			
70		fine to coarse sand with gravels, dark gray to grayish black, sample has moderate hydrogen sulfide odor	C-11	SPT-13	28 50 9 26 30			High Sampling Resistance

Log of Boring No. MC-7

Date Drilled: 6/26/92 Logged by: MBS Checked by: MBS

Equipment: 6" Rotary Wash Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 20.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued) fine to medium, dark gray to grayish black	C-12	SPT-14	36 50 25 50			High Sampling Resistance SPT Refusal
80			C-13		21 50			High Sampling Resistance
		gravel layer or lense 82'-84'		SPT-15	35 23 15			82'-84' Drill Rig Chatter on Gravel Layer or lenses
85			C-14		15 21			
		FERNANDO FORMATION: SANDY SILTSTONE, dark gray		SPT-16	9 15 24			
90			C-15		15 27			
				SPT-17	18 31 35			
95		shell fragments, massive	C-16		15 30			
				SPT-18	9			

Log of Boring No. MC-7

Date Drilled: 6/26/92 Logged by: MBS Checked by: MBS

Equipment: 6" Rotary Wash Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 20.5 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILTSTONE; (continued), sandy		■	12 15			
		End of boring at 100.5 feet No groundwater observable with rotary wash drilling Backfilled boring pressure grouted hole through 95' of drill rod, injected 100 gallons of 4 sacks volclay grout mix, observed flow at top of hole, placed metal cover						

Log of Boring No. MC-8

Date Drilled: 5/28/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 156 feet Depth to Water: Static water level 18' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		10-inch thick ASPHALT PAVEMENT underlain by 3-inch thick GRAVEL BASE COURSE						
		CLAY (CL); plastic, trace fine sand and fine gravel, dark choco-brown						
5		little coarse sand, trace medium gravel, medium brown						
			C-1		14 16			
10				SPT-2	3 5 6			
		SILT (ML); sandy, very fine to fine, medium brown						
			C-3		12 10			
15		SILTY SAND (SM); fine to very fine, medium brown		SPT-4	4 6 7			
		SAND (SW); fine to coarse, occasional silt nodules, light brown grading to gray, wet Static water level at 18 feet on 7/14/92						
			C-5		13 15			
20				SPT-6	5 7 9			
			C-7		18 14			

Log of Boring No. MC-8

Date Drilled: 5/28/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 156 feet Depth to Water: Static water level 18' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILTY CLAYEY SAND (SC-SM); fine to medium, gray		SPT-8	3 4 5			
			C-9		7 13			
30		SANDY CLAY (CL) layers		SPT-10	8 10 12			
		SILT (ML); with some clay, trace fine sand, gray	C-11		7 10			
35				SPT-12	10 15 16			
		SILTY SAND (SM); very fine, gray	C-13		7 10	30	94	
40		SILT (ML); sandy, very fine, gray		SPT-14	10 13 15			
		CLAY (CL); with silt, trace medium sand, dark gray	C-15		13 15	36	87	
45				SPT-16	5 6 7			
			C-17		6 10			

Project No. Drawing No.

Converse Consultants West

91-31-208-01 A-35

Log of Boring No. MC-8

Date Drilled: 5/28/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 156 feet Depth to Water: Static water level 18' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP-SM); with silt, fine to medium, dark gray, slight petroleum smell		SPT-18	8 18 24			
			C-19		30 45	11	106	
55		strong petroleum smell		SPT-20	16 24 28			
			C-21		35 50			
60		fine sand, light gray		SPT-22	26 28 36			
			C-23		25 38			
65		little silt, trace fine gravel		SPT-24	25 50 75			High Sampling Resistance SPT Refusal
		SILTY SAND (SM); fine, dark gray						
			C-25		25 50			
70		little fine gravel, trace silt		SPT-26	12 18 24			
			C-27		45 50			High Sampling Resistance

Log of Boring No. MC-8

Date Drilled: 5/28/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 156 feet Depth to Water: Static water level 18' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILTY SAND (SM); fine, micaceous, dark gray		SPT-28	10 14 26			
		No recovery (dense GRAVELLY SAND (SP) ?)	C-29		14 32			
80		SILTY SAND (SM); wet, dark gray		SPT-30	12 14 18			
		End of boring at 81.5 feet Installed 4" dia. PVC Monitoring Well; 0-15' blank casing; 15'-75' slotted casing; 75'-80' blank casing Backfilled annular space with #30 sand from 9'-80' Bentonite chip seal from 2'-9' Concrete and traffic cover from 0-2'						

Log of Boring No. MC-9

Date Drilled: 6/29/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 50 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		2 1/2-inch thick ASPHALT PAVEMENT over 10-inch thick CONCRETE						
		FILL: SILTY SAND (SM); brown						
		SILTY CLAYEY SAND (SC-SM); with some clay, fine to coarse sand, mottled brown to light brown	C-1	SPT-1	8 8 2 2 2			Contains concrete fragments
5								
		CLAYEY SAND (SC); fine to medium, mottled green to black color	C-2	SPT-2	3 4 2 2 3			
10								
		TAR SAND (SP); fine to coarse, sand stained black by petroleum, abundant decomposing organic material in sampler tip	C-3	SPT-3	4 4 2 2 6			Strong petroleum odor present
15								
		INTERBEDDED SAND (SP) and SILT (ML); with some clay, medium to coarse, portions contain tar, dark green to black	C-4		5 14			
20		SAND (SW-SM); with silt, medium to coarse, poorly graded, light green, alternating coarse to very coarse layers, light brown, wet sampler and sample at 20'-perched water		SPT-4	6 5 6			Sand in SPT tip wet
			C-5		5 10	14	105	

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-38

Log of Boring No. MC-9

Date Drilled: 6/29/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 50 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	QUA/REMARKS
		SAND (SW-SM); (continued) scattered silty sand layers, wet sample		SPT-5	4 5 8			
			C-6		26 26			
30		SILT (ML); contains 1"-2"-thick fine sand, green to gray green		SPT-6	7 13 15			
			C-7		15 24	24	101	
35		▽SAND (SP); medium to coarse, trace fine, light brown gray, wet sample		SPT-7	11 13 15			Partial recovery flowing sands
		SILT (ML); sandy, some fine, gray						
		▽SAND (SW); fine, gray green	C-8		14 25			
40		SILT (ML); with some clay, green			14 20			
		SAND (SW); fine, gray green		SPT-8	27			
		SILT (ML); trace fine to medium sand, green gray	C-9		5 13	27	97	
45		SAND (SP); fine to medium, trace coarse, green gray		SPT-9	17 25 39			
			C-10		16 28			Sample wet Groundwater
		▼SILT (ML); scattered gravel, green gray						

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-39

Log of Boring No. MC-9

Date Drilled: 6/29/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 50 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SW); fine to medium, increasing coarse, 2"-3"-thick silt layers present, green gray, wet sample		SPT-10	12 22 25			Wet sands observed in sample rings
			C-11		9 16			
55		SILT (ML); little fine sand, green gray		SPT-11	10 22 33			
			C-12		10 15			
60		CLAY (CL); with some silt, trace fine sand, dark green to brown black		SPT-12	9 11 15			sampler wet
			C-13		13 21			
65				SPT-13	12 11 13			
			C-14		5 8			
70		contains abundant dark brown decomposing organic matter in a clayey silt matrix color becomes dark brown to red brown, abundant organic material, decomposing odor present		SPT-14	5 20 30			Slight hydrogen sulfide odor present
		SAND (SP); medium to coarse, gray to brown, SAN PEDRO SAND						
		SAND (SW); fine, trace medium to coarse	C-15		25 48			

Log of Boring No. MC-9

Date Drilled: 6/29/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 50 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SW); (continued) fine, trace medium to coarse, light gray		SPT-15	25 35 42			
		scattered coarse-grained lenses present	C-16		15 50			
80				SPT-16	5 11 23			moderate hydrogen sulfide odor in SPT sample
		gravelly and cobbly layer at 85 feet	C-17		37 75			Slight hydrogen sulfide odor
85				SPT-17	22 30 40			
		fine, trace silt, light gray	C-18		22 54			Slight hydrogen odor
90				SPT-18	5 22 35			
			C-19		45 54			No sample recovery at 95'
95				SPT-19	26 26 50			
			C-20					

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-41

Log of Boring No. MC-9

Date Drilled: 6/29/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 158 feet Depth to Water: 50 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		End of boring at 100 feet Groundwater encountered at 50', sloughed to 37' Boring backfilled with 12 bags of enviroplug medium bentonite pellets. Chips activated with clean water 3 feet of concrete provided in upper portion of boring to grade		SPT-20	15 37 49			No sample recovery at 100'

Log of Boring No. MC-10

Date Drilled: 6/9/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 175 feet Depth to Water: 60 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		3-inch thick ASPHALT PAVEMENT over 6 1/2-inch thick CONCRETE over 1-inch thick GRAVELLY SAND road base						Background OVA=2 ppm Hand Augered to 8 feet
		SILTY SAND (SM); fine to medium, with scattered coarse sand, little silt, slightly micaceous, brown to orange brown						
5								Drilling Begins
10		increasing silt, sand predominantly fine	C-1	SPT-1	11 50 15 18 20			OVA 4 ppm
15		decreasing silt, fine to medium sand, contains black micaceous minerals	C-2	SPT-2	35 35 19 26 34			OVA 3 ppm
20		fine sand, little silt, contains orange brown silty sand nodules, green gray	C-3		33 50			OVA 4 ppm
		SAND (SW); coarse sand lense, light gray		SPT-3	10 12 15			
		CLAY (CL); with some silt, contains white discontinuous stringers, trace medium sand, green gray to gray						

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-43

Log of Boring No. MC-10

Date Drilled: 6/9/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 175 feet Depth to Water: 60 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); with some clay, trace medium to coarse sand, green gray to gray	C-4	SPT-4	34 50 15 21 35			OVA 4 ppm
		increasing coarse sand content						
30		SILT (ML); sandy, medium to coarse, mottled light brown to brown in portions	C-5	SPT-5	31 48 15 20 30			OVA 3 ppm
35		increasing coarse sand	C-6		22 50			OVA 3 ppm
		SILTY SAND (SM); fine to coarse, predominantly coarse, some fine to medium, little silt, contains scattered subangular to subrounded gravel, green gray to gray		SPT-6	35 50			High sampling resistance SPT refusal
40		SAND (SW); predominantly coarse, trace silt, subrounded gravel (scattered), trace micaceous minerals present, green to gray	C-7	SPT-7	23 50 24 50			OVA 3 ppm Flowing sands High sampling resistance
45			C-8		45 50			OVA 4 ppm
		SILT (ML); with some clay, trace fine sand, green to gray		SPT-8	22 30 35			Perched water at 47 feet
		SAND (SW); fine to medium sand, trace silt, green to gray, wet						

Project No. 91-31-208-01

Drawing No. A-44

Converse Consultants West

Log of Boring No. MC-10

Date Drilled: 6/9/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 175 feet Depth to Water: 60 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); with some clay, trace medium sand	C-9		23 50			OVA 3 ppm
		SILTY SAND (SM); fine to medium, contains some quartz silt grains, gray to green		SPT-9	26 50			High sampling resistance SPT refusal
55		SILT (ML); abundant reflective quartz silt grains present, gray to green	C-10		35 50	29	95	
		SILT (ML); with some clay, trace medium sand, gray to green		SPT-10	18 25 35			
		SILT (ML); sandy, some medium to coarse sand, gray to green						
60		SILTY SAND (SM); fine to medium, little silt, gray to green	C-11		31 50	25	100	Sampler wet at 60'; groundwater OVA 4 ppm
		SILT (ML); sandy, little medium to coarse sand, green to gray		SPT-11	20 20 20			
65		trace clay	C-12		24 40			OVA 3 ppm
		SILTY SAND (SM); fine sand, green to gray		SPT-12	17 14 40			
		SILT (ML); green to gray						
70		SILTY SAND/SANDY SILT (SM/ML); fine, little silt, green to gray micaceous, contains reflective quartz silt grains, green to gray	C-13		46 45	26	96	OVA 4 ppm
				SPT-13	30 50			High Sampling Resistance SPT Refusal

Log of Boring No. MC-10

Date Drilled: 6/9/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 175 feet Depth to Water: 60 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILTY SAND/SANDY SILT (SM/ML); (continued) contains scattered coarse sand	C-14	SPT-14	65 25 33 40			OVA 5 ppm
		SILT (ML); sandy, little medium to coarse sand, trace clay, green to gray						
80		SILTY SAND (SM); fine to medium, scattered coarse sand present, green to gray	C-15	SPT-15	50 50			OVA 3 ppm High Sampling Resistance SPT Refusal
		SILT (ML); green to gray						
85		SILT (ML); with some clay, little medium to coarse sand, green to gray	C-16	SPT-16	20 50 35 50			OVA 200 ppm High Sampling Resistance
90		SILTY SAND (SM); medium sand, little silt, gray, SAN PEDRO SAND	C-17		50 50			Hydrogen Sulfide gas odor
		hydrogen sulfide odor, gas						
95			C-18		50 50			No sample recovered at 95'
			C-29		50 50			OVA=80

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-46

Log of Boring No. MC-10

Date Drilled: 6/9/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 175 feet Depth to Water: 60 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		End of broing at 100 feet Perched water zone at 47 feet Groundwater encountered at 60 feet Bacharach gas meter alarm sounded at 91 feet: 32% LEL, 43 ppm hydrogen sulfide, Oxygen depletion. Auger flooded with water. No additional readings. Hole advanced to 100'. Sampled bottom for Environmental and Geotechnical. Partial recovery in Geotechnical sample (no recovery at 95') Water sounder lowered into hole, water level at 80.5 feet, rising Sloughing in hole below 65-70 feet Hole closed at 65 feet Boring backfilled with 14 bags of bentonite pellets and hydrated as backfilling proceeded. Water added to pellets. Pellets placed to within 12" of street grade and hydrated. One sack of quickset concrete dyed black provided at surface						

Log of Boring No. MC-11

Date Drilled: 5/26/92 Logged by: ART (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 179 feet Depth to Water: Static water level 78.6' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); fine, little silt, trace fine roots, reddish brown						
5		SILTY CLAY (CL/ML); trace fine sand, grayish brown						
		SAND (SP); fine, little silt, brown						
		SILT (ML); with some clay, dark greenish-brown	C-1		17 30			
10		SAND (SP); fine to medium, grayish brown		SPT-2	12 12 14			
		SILT (ML); trace fine sand, grayish brown	C-3		7 18			
15				SPT-4	6 10 13			
			C-5		12 24			
20				SPT-6	8 10 13			
			C-7		8 21			

Project No. 91-31-208-01 Drawing No. A-48

Converse Consultants West

Log of Boring No. MC-11

Date Drilled: 5/26/92 Logged by: ART (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 179 feet Depth to Water: Static water level 78.6' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); (continued) 1/4" lens of fine sand, trace fine gravel		SPT-8	9 12 15			
			C-9					
30		very fine sandy silt, compact		SPT-10	14 21 12 15 18			
			C-11		10 20			
35				SPT-12	7 13 17			
			C-13		20 24			
40				SPT-14	9 10 12			
		CLAY (CL); with silt, compact, dark gray	C-15		13 20			
45				SPT-16	11 12 14			
			C-17		16 28			

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-49

Log of Boring No. MC-11

Date Drilled: 5/26/92 Logged by: ART (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 179 feet Depth to Water: Static water level 78.6' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); with some clay (continued)		SPT-18	10 11 15			
		SAND (SW); fine to coarse, well graded, little fine gravel, dark greenish brown	C-19		25 50			
55				SPT-20	20 30 30			
		SILTY SAND (SM); very fine to fine, micaceous, dark greenish gray	C-21		16 24			
60				SPT-22	15 18 18			
			C-23		17 30	31	93	
65				SPT-24	18 15 16			
		SAND (SP-SM); very fine to fine, with silt, dark gray	C-25		28 44	8	110	
70				SPT-26	17 14 32			
		SAND (SP); very fine to fine, micaceous, dark gray	C-27		24 30			

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-50

Log of Boring No. MC-11

Date Drilled: 5/26/92 Logged by: ART (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 179 feet Depth to Water: Static water level 78.6' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued)		SPT-28	9 16 25			
		▼SILTY CLAY (CL-ML); with sand, micaceous, dark gray 78.6' Static water level on 6/18/92, 7/14/92	C-29		22 27	21	108	
80				SPT-30	8 10 12			
			C-31		20 33			
85				SPT-32	13 15 17			
		SAND (SP); fine to medium, micaceous, dark gray	C-33		13 26			
90				SPT-34	13 16 18			
		SILT (ML); sandy, compact, gray	C-35		50 50			
95				SPT-36	25 32 38			
			C-37		25 40			

Log of Boring No. MC-11

Date Drilled: 5/26/92 Logged by: ART (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 179 feet Depth to Water: Static water level 78.6' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); sandy, (continued)		SPT-38	12 18 32			
		End of boring at 101.5 feet Installed 4" dia. PVC Monitoring Well; 0-25' blank casing; 15'-75' slotted casing; 25'-95' blank casing Backfilled annular space with #30 sand from 19'-100' Bentonite chip seal from 2'-9' Concrete and traffic cover from 0-2'						

Log of Boring No. MC-12

Date Drilled: 6/3/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 180 feet Depth to Water: 77 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		2-inch thick ASPHALT PAVEMENT over 4-inch thick CONCRETE SLAB						Hand Augered to 6' Background OVA 5 ppm
		SILTY SAND (SM); fine to medium, some small gray to greenish clayey portions, red brown						
5								Hollow Stem Drilling begins at 6'
		SAND (SP); fine, little to trace silt, clean sand, gray to light brown	C-1		18 22			OVA 5 ppm
10		SILTY SAND (SM); fine to coarse, trace clay, mottled, scattered white medium sand, dark micaceous minerals, some white quartz-rich coarse sand lenses	C-2	SPT-1	13 39 8 32 50			OVA 10 ppm
								OVA 10 ppm
15		SAND (SW); medium to coarse, some subrounded gravel, clean sand alternating orange brown and light brown layers, white orange brown to light brown, wet sample-perched water ▽	C-3	SPT-2	19 42 18 21 36			Sand is wet on SPT tip Flowing sands
20		contains 4-6-inch thick layers of light gray to green grey silty clay	C-4	SPT-3	30 70 20 20 56			OVA 8 ppm

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-53

Log of Boring No. MC-12

Date Drilled: 6/3/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 180 feet Depth to Water: 77 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SW); (continued) coarse sand, contains some subrounded to rounded gravel, gravel is predominantly quartz, yellow brown	C-5	SPT-4	44 56 30 50			OVA 9 ppm High Sampling Resistance SPT Refusal
30			C-6		35 70			OVA 10 ppm Geotech sample:
		6-inch thick fine sand layer, clean, well sorted		SPT-5	35 50 50			no recovery switched to split spoon and resampled SPT taken at 32'
35		fine to medium, well sorted, contains micaceous fractions, gray to light gray scattered coarse white quartz sand present	C-7	SPT-6	50 50 100 100			OVA 15 ppm High Sampling Resistance
40			C-8		100 100			
		SILTY SAND (SM); very fine sand, contains discontinuous sub horizontal thin black stringers or lenses, sands are laminated with alternating orange brown gray and dark gray layers		SPT-7	40 50 80			Hydrogen sulfide odor OVA 10 ppm High Sampling Resistance SPT Refusal
45		SILT (ML); with some clay, contains shiny polished clay surfaces, reflective quartz silt grains present, massive, no distinct layering within core sample, dark green to brown and black	C-9	SPT-8	30 75 18 34 50			OVA 10 ppm Slight organic odor

Project No. Drawing No.

Converse Consultants West

91-31-208-01 A-54

Log of Boring No. MC-12

Date Drilled: 6/3/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 180 feet Depth to Water: 77 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); trace fine sand and clay, contains reflective white quartz silt, well sorted sand, dark green to gray black and blue gray	C-10	SPT-9	35 100 21 36 70			OVA 15 ppm High Sampling Resistance SPT Refusal
55		SILTY SAND (SM); fine to medium, well sorted, dark green and blue gray	C-11	SPT-10	30 85 50 65 160			OVA 15 ppm High Sampling Resistance SPT Refusal
60		SAND (SW); medium to coarse, contains some subrounded gravel, no fine fraction present, dark green to blue gray	C-12	SPT-11	100 100 45 85			OVA 11 ppm High Sampling Resistance SPT Refusal
		SILTY SAND (SM); fine sand, well sorted, gray green						
65			C-13		50 105			OVA 11 ppm
		SILT (ML); trace medium sand, gray green		SPT-12	49 60			High Sampling Resistance SPT Refusal
		SILTY SAND (SM); sand is fine, gray green						
70		SILT (ML); trace clay, trace medium sand, green gray	C-14		60 70			OVA 10 ppm wet material at 71 feet
		SAND (SP); fine sand, some reflective quartz silt grains present, green gray, wet						

Project No. 91-31-208-01 Drawing No. A-55

Converse Consultants West

Log of Boring No. MC-12

Date Drilled: 6/3/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 180 feet Depth to Water: 77 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP) (continued)	C-15		24 80			OVA 20 ppm
				SPT-13	35 80			SPT Refusal
		▼ Groundwater at 77 feet						Groundwater at 77 feet
		SILTY SAND (SM); fine sand, contains abundant reflective quartz silt grains, green gray						Environmental sampling stoped at 75'
80		fine to medium, little silt, green gray	C-16		60 90	24		Materials and sampler wet
				SPT-14	35 50			High Sampling Resistance SPT Refusal
85		SILT (ML); trace medium sand, contains reflective quartz silt grains, green gray	C-17		20 35			
				SPT-15	40 60			
90			C-18		60 70	30	94	
				SPT-16	40 55			High Sampling Resistance SPT Refusal
95			C-29		45 70			
				SPT-17	42 58			High Sampling Resistance SPT Refusal
			C-20		18 36			

Log of Boring No. MC-12

Date Drilled: 6/3/92 Logged by: GSB Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 180 feet Depth to Water: 77 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		End of boring at 100 feet Groundwater encountered at 77 feet Environmental sampling to 75 feet Geotech sampling to 100 feet Boring backfilled with Enviroplug medium bentonite pellets, water added to boring approximately every 5 bags Placed black concrete at surface						

Log of Boring No. MC-13

Date Drilled: 6/5/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 165 feet Depth to Water: Static water level 65' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		10-inch thick **ASPHALT PAVEMENT** over 2-inch thick **BASE** course						
		SILT (ML); with some clay, greenish-gray						
		SILT (ML); very fine sand, dark brown						Background OVA 7 ppm
5								
			C-1		12 15			
10		very fine to fine sand, compact, with streaks of bright yellow orange iron oxide, brownish gray		SPT-2	6 10 15			OVA 7 ppm
		SILTY SAND (SM); fine to coarse, with iron oxide streaks, brownish gray	C-3		16 25			
15				SPT-4	19 12 17			OVA 7 ppm
		SAND (SP); fine to medium, little silt, trace fine to medium gravel, light brown	C-5		15 25			
20				SPT-6	8 13 16			OVA 8 ppm
			C-7		12 16			

Project No. 91-31-208-01 Drawing No. A-58

Converse Consultants West

Log of Boring No. MC-13

Date Drilled: 6/5/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 165 feet Depth to Water: Static water level 65' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); sandy, very fine sand, occasional thin layer of silt, greenish gray		SPT-8	8 12 17			OVA 7 ppm
			C-9		12 16			
30				SPT-10	9 15 23			OVA 10 ppm
		SAND (SP); fine to medium, trace silt, bluish gray						
		SILT (ML); sandy, fine to medium sand, trace medium gravel, gray	C-11		13 18			
35				SPT-12	11 16 20			OVA 10 ppm
			C-13		14 18			
40				SPT-14	13 17 22			OVA 7 ppm
		SAND (SP-SM); very fine to fine sand, with silt, dark gray	C-15		15 23			
45				SPT-16	9 14 17			OVA 10 ppm
			C-17		30 40			

Log of Boring No. MC-13

Date Drilled: 6/5/92 | Logged by: APM (MAA) | Checked by: MBS

Equipment: 6" Hollow Stem Auger | Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 165 feet | Depth to Water: Static water level 65' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP-SM) fine to medium sand, some silt		SPT-18	14 20 24			OVA 10 ppm
			C-19		35 50+			
55		alternating thin layer of fine sand and silt		SPT-20	15 20 28			OVA 12 ppm
		SILT (ML); with layers of very fine to fine sand, dark gray	C-21		20 30			
60				SPT-22	30 60 90			OVA 10 ppm High Sampling Resistance SPT Refusal
		SILTY SAND (SM); fine to medium, trace shells, dark gray	C-23		12 29	19	110	
65		▼ Static water level on 6/18/92, 7/14/92 at 65.3 feet		SPT-24	17 20 24			OVA 10 ppm
			C-25		16 26			
70				SPT-26	10 14 22			OVA 7 ppm
		SILTY SAND (SM); micaceous, some nodules of hard cemented silt, dark gray	C-27		18 33	21		

Log of Boring No. MC-13

Date Drilled: 6/5/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 165 feet Depth to Water: Static water level 65' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILTY SAND (SM); (continued)		SPT-28	14 15 20			OVA 7 ppm
80		SILT (ML); sandy, moderately cemented, occasional thin layers of fine sand, dark gray	C-29	SPT-30	11 18 7 10 19	33	91	
			C-31		17 50-5"			
85		SAND (SP); fine to medium, trace to little silt, dark gray, SAN PEDRO SAND		SPT-32	24 40 50			High Sampling Resistance
			C-33		40 50+			
90				SPT-34	32 45 65			High Sampling Resistance SPT Refusal
			C-35		33 42			
95				SPT-36	24 40 55			High Sampling Resistance SPT Refusal
			C-37		40 60			

Log of Boring No. MC-13

Date Drilled: 6/5/92 Logged by: APM (MAA) Checked by: MBS

Equipment: 6" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 165 feet Depth to Water: Static water level 65' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP) (continued)		SPT-38	30 65			High Sampling Resistance SPT Refusal
		End of boring at 101.5 feet Installed 4" dia. PVC Monitoring Well; 0-20' blank casing; 20'-95' slotted casing; 95'-100' blank casing Backfilled annular space with #30 sand from 19'-100' Bentonite chip seal from 2'-9' Concrete and traffic cover from 0-2' Moderate to strong hydrogen sulfide gas odor emissions observed at surface during monitoring well installation						

Log of Boring No. MC-14

Date Drilled: 7/8/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 143 feet Depth to Water: 31.2 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		5-inch thick ASPHALT PAVEMENT						
		FILL: CLAY (CL); sandy, wood fragments, dark brown						
5		silty, with trace sand, dark brown to black	C-1		Push			Background
				SPT-1	2 4 4			OVA 3-4 ppm
10		INTERBEDDED CLAY (CL) and SAND (SP); with some silt, dark brown	C-2		5 7			
				SPT-2	3 4 6			OVA 3-4 ppm
15			C-3		5 8			
		weakly vesicular (pin-hole voids)		SPT-3	3 5 5			OVA 5 ppm
20		CLAY (CL) with INTERBEDS OF SAND (SP); with some silt, dark brown to black	C-4		7 11			
				SPT-4	7 10 10			OVA 5.5 ppm

Log of Boring No. MC-14

Date Drilled: 7/8/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 143 feet Depth to Water: 31.2 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); medium, brown	C-5		11 15	6	107	
		few thin silty clay interbeds (2-inch thick)		SPT-5	11 19 22			OVA 19 ppm
30		medium to coarse, brown	C-6		24 50			
		▽ wet sample-perched water		SPT-6	16 12 12			OVA 8 ppm
35		SILT (ML); trace fine sand, interbedded with SAND (SP), blue green	C-7		16 26			Water appears perched on silt layer
				SPT-7	20 24 32			OVA 8 ppm
40			C-8		10 14			
				SPT-8	14 15 18			OVA 8 ppm
45		SAND (SP)/SILT (ML) INTERBEDS; silt layers are 1/16-inch thick to 1-inch thick with planar contacts, subhorizontal color varies from blue green to black	C-9		17 39			
				SPT-9	15 18 18			OVA 35-40 ppm

Log of Boring No. MC-14

Date Drilled: 7/8/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 143 feet Depth to Water: 31.2 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP)/SILT (ML); (continued)	C-10		18 34			
				SPT-10	25 36 48			OVA 7 ppm
		primarily sand (SP) but few silt (ML) interbeds						
55			C-11		39 64			
				SPT-11	25 30 40			OVA 6 ppm
60		SILT (ML) WITH SAND (SP) INTERBEDS; trace carbonized stem fragments, bedding is 1/16-inch to 5-inch thick with sharp but wavy contacts, blue green to gray	C-12		9 36			
				SPT-12	20 30 58			OVA 6 ppm High Sampling Resistance SPT Refusal
65			C-13		50 75			Weak Hydrogen sulfide odor, gas
		SAND (SP) with SILT (ML) INTERBEDS		SPT-13	23 34 50			OVA 850 ppm
70		SAND (SP); fine to medium, gray to black, SAN PEDRO SAND	C-14		23 35			Increasing Hydrogen sulfide odor, gas OVA 3,500 ppm
				SPT-14	12 26 35			SPT refusal

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-65

Log of Boring No. MC-14

Date Drilled: 7/8/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 143 feet Depth to Water: 31.2 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued)	C-15	SPT-15	32 62 30 54 63			High sampling resistance OVA 250 ppm SPT Refusal High sampling resistance
80		medium to coarse with trace fine gravel	C-16	SPT-16	13 32 27 70 100			SPT Refusal High sampling resistance OVA 100 ppm
85			C-17		30 100			
		INTERBEDDED SAND (SP) and SILTY SAND (SM); medium sand, massive to finely laminated (1/16"-1/2"), gray to black		SPT-17	37 42 65			SPT refusal High sampling resistance OVA 600 ppm
90			C-18		19 42			
		SAND (SP); fine, finely laminated, laminations are roughly horizontal, gray to black		SPT-18	17 30 42			OVA 400 ppm
95		weakly vesicular with increasing moisture content	C-19	SPT-19	18 32 15 28 58			SPT refusal High sampling resistance OVA 1,000 ppm

Log of Boring No. MC-14

Date Drilled: 7/8/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 143 feet Depth to Water: 31.2 feet

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); fine to medium, laminated, gray to black	C-20	SPT-20	20 32 25 40 72			SPT refusal High sampling resistance OVA 1,000 ppm
105			C-21	SPT-21	21 35 40 65 100			SPT refusal High sampling resistance OVA 500 ppm
110		trace coarse sand, fine gravel, gray to black	C-22	SPT-22	40 70 38 68 100			SPT refusal High sampling resistance OVA 5,000 ppm
		End of boring at 112.5 feet Groundwater encountered at 31.2 feet Strong hydrogen sulfide odor while pulling augers-gas Hole caved to 35 feet below ground surface Backfilled with bentonite chips and set concrete cap 7/8/92						

Log of Boring No. MC-15

Date Drilled: 7/9/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 139.5 feet Depth to Water: Static water level 64.1' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		6-inch thick ASPHALT PAVEMENT						
		FILL: CLAY (CL); with some silt, with small wood fragments, black						OVA Background 4-5 ppm
5			C-1		4 5			
				SPT-1	2 3 3			OVA 4 ppm
10			C-2		5 9			
		locally with thin sand interbeds, dark brown		SPT-2	3 4 5			OVA 3-4 ppm
15			C-3		6 8	27	95	
		CLAY (CL); interbedded sand, dark brown to black		SPT-3	3 4 4			OVA 4 ppm
20			C-4		7 13			
		SAND (SP); fine grained with trace clay binder, black to gray		SPT-4	7 7 9			OVA 4-5 ppm

Log of Boring No. MC-15

Date Drilled: 7/9/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 139.5 feet Depth to Water: Static water level 64.1' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILTY SAND (SM) INTERBEDDED with SAND (SP); locally trace clay binder, fine sand, blue gray	C-5	SPT-5	5 9 4 5 9	34	87	OVA 5 ppm
		CLAY (CL); sandy, interbedded with sand, blue green to black						
30			C-6		7 10			
		CLAY (CL); with some silt, trace fine sand, blue green to black		SPT-6	6 7 8			
35		SILTY/CLAYEY SAND (SC-SM) wet sample at 36.5'-perched water	C-7		7 10	25	99	
		SAND (SP); with trace clay binder, fine, blue green to black		SPT-7	6 7 12			OVA readings below were taken 7/10/92 OVA 4-5 ppm
40			C-8		13 17	21	107	OVA 4-5 ppm
				SPT-8	9 17 32			
45			C-9		10 13			
		silty clay interbeds		SPT-9	10 25 31			OVA 4-5 ppm
		silty sand interbeds						

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-69

Log of Boring No. MC-15

Date Drilled: 7/9/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 139.5 feet Depth to Water: Static water level 64.1' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued)	C-10		14 23	30	94	
		CLAY (CL); with some silt, trace fine sand, mottled, gray to tan		SPT-10	9 14 15			OVA 3-4 ppm
55		SILTY CLAY (CL-ML); trace dark brown organic fragments-stems, gray to tan	C-11	SPT-11	22 29 10 15 19			OVA 3-4 ppm
60		SAND (SP); fine to medium, gray to black, SAN PEDRO SAND	C-12	SPT-12	22 35 26 46 53			OVA 4-5 ppm
		▽ static water level at 64.1' on 7/14/92						
65			C-13	SPT-13	25 50 17 32 38			OVA 25 ppm
70		fine to medium, massive to finely laminated, beds have sharp but wavy contacts	C-14	SPT-14	22 34 23 30 57			OVA 3-4 ppm SPT refusal High sampling resistance

Log of Boring No. MC-15

Date Drilled: 7/9/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 139.5 feet Depth to Water: Static water level 64.1' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued) medium to coarse sand with fine gravel	C-15	SPT-15	22 63 24 48 60			OVA 10 ppm SPT refusal High sampling resistance
80			C-16	SPT-16	24 42 22 33 42			OVA 4 ppm
85		finely laminated, with black carbonized nodules, gray to black	C-17	SPT-17	30 100 18 29 42			OVA 5 ppm
90		locally with fine gravel, coarse sand layers	C-18	SPT-18	60 100 23 45 60			OVA 4-5 ppm SPT refusal High sampling resistance
95		fine sand	C-19	SPT-19	25 38 24 53 63			OVA 20 ppm SPT refusal High sampling resistance

Log of Boring No. MC-15

Date Drilled: 7/9/92 Logged by: DSS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 139.5 feet Depth to Water: Static water level 64.1' on 7/14/92

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP) (continued) fine with fine gravel and coarse sand layers, gray to black	C-20	SPT-20	19 30 34 83			OVA 6 ppm SPT refusal High sampling resistance
		End of boring at 102.5 feet Installed 2" dia. PVC monitoring well: 5' blank on bottom; 80' perf; 15' blank on top; Backfilled with #3 sand Sidewalls squeezing in and up bottom of auger during backfill Weak to moderate hydrogen sulfide odor while pulling augers PVC casing unscrewed approximately 50 feet below ground surface-lost the well. Backfilled top portion with sand, capped with 4 bags bentonite pellets and asphalt patched. 7/13/92-Reamed broken well to 102' depth Installed 2" dia. PVC monitoring well: 0-15' no perforated casing; 15'-95' machine slotted; 95'-100' non perforated casing; backfilled #3 sand 12' to 100'; Bentonite chips 1' to 12', traffic cover at surface, increased gas emmisions (methane and Hydrogen sulfide) during piezometer installation						

Log of Boring No. MC-16

Date Drilled: 6/29/92 Logged by: MBS Checked by: MBS

Equipment: 6" Rotary Wash Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 137.5 feet Depth to Water: not observed-rotary wash

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		6-inch thick ASPHALT PAVEMENT						
		FILL: SILT (ML); sandy, with clay, fragments of brick and concrete and tile, mottled, brown to dark brown						Hand augered to 8 feet
5								
		SILT (ML); with some clay, dark brown to grayish black						Rotary wash drilling
10			C-1		14 14			
		SAND (SP)/SILTY SAND (SM); fine to medium sand, some coarse sand, trace small gravel (subangular), olive gray to gray		SPT-1	4 3 3			
		CLAY (CL); with some silt, dark olive gray to grayish black						
15			C-2		6 7			
		SILT (ML)/SILTY SAND (SM); variable sand fraction, dark olive gray, no observed odor		SPT-2	5 3 4			
		easy drilling penetration-soft gradational contact						
20			C-3		14 32	9	103	perched water
		SAND (SP); fine to medium, poorly graded, clean to moderately clean sugar sands, light olive gray		SPT-3	12 13 13			No gas emmission observed from top of fluid filled boring

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-73

Log of Boring No. MC-16

Date Drilled: 6/29/92 Logged by: MBS Checked by: MBS

Equipment: 6" Rotary Wash Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 137.5 feet Depth to Water: not observed-rotary wash

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued)			5 9		.	sample fell out (sands)
		SANDY SILTY CLAY (CL-ML); with interbedded sand and silty sand layers, olive gray		SPT-4	6 9 6			
30		natural petroleum odor, thick musty odor	C-4		9 12			
		SAND (SP); fine to medium sand, moderately clean to clean, poorly graded, light olive gray		SPT-5	3 6 9			
		increased medium to coarse sand (SW), trace small gravel-gravel lenses						
35			C-5		17 20	23	100	No gas emmission observed from top of fluid filled boring
		interbedded SILTY CLAYEY SAND (SC-SM)		SPT-6	4 5 8			
40			C-6		11 14	21	108	
		SILTY SAND (SM); fine to medium, trace small gravel, some interbedded silt layers, olive gray		SPT-7	5 7 11			
45					7 10			
		SILT (ML); with some clay and with fine sand, trace micaceous, olive gray, grades to a silty sand (SM)		SPT-8	3 5 7			

Log of Boring No. MC-16

Date Drilled: 6/29/92 | Logged by: MBS | Checked by: MBS

Equipment: 6" Rotary Wash | Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 137.5 feet | Depth to Water: not observed-rotary wash

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued)			5 9			sample fell out (sands)
		SANDY SILTY CLAY (SC-SM); with interbedded sand and silty sand layers, olive gray		SPT-4	6 9 6			
30		natural petroleum odor, thick musty odor	C-4		9 12			
		SAND (SP); fine to medium sand, moderately clean to clean, poorly graded, light olive gray		SPT-5	3 6 9			
		increased medium to coarse sand (SW), trace small gravel-gravel lenses						
35			C-5		17 20	23	100	No gas emmission observed from top of fluid filled boring
		interbedded SILTY CLAYEY SAND (SC-SM)		SPT-6	4 5 8			
40			C-6		11 14	21	108	
		SILTY SAND (SM); fine to medium, trace small gravel, some interbedded silt layers, olive gray		SPT-7	5 7 11			
45					7 10			
		SILT (ML); silt with fine sand, trace micaceous, olive gray, grades to a silty sand (SM)		SPT-8	3 5 7			

Log of Boring No. MC-16

Date Drilled: 6/29/92 Logged by: MBS Checked by: MBS

Equipment: 6" Rotary Wash Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 137.5 feet Depth to Water: not observed-rotary wash

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SILT (ML); sandy (continued) trcae small brown organic inclusions-swamp grass fragments, occasional shell fragments	C-7	SPT-9	10 26 8 8 14	25	101	
55		interbedded silt (ML) and sand (SP) layers	C-8		50 56			Increased resistance to sampler penetration recovered sample has hydrogen sulfide odor
		SAND (SP); fine to medium, moderately clean to clean, poorly graded, recovered sample has moderate to strong hydrogen sulfide odor, light olive gray to gray, **SAN PEDRO SAND**		SPT-10	25 40 45			
60			C-9		40 40	15	103	
				SPT-11	30 50			High sampling resistance SPT refusal
		interbedded silt/sandy silt layers, sand mottled by brownish natural petroleum inclusions						
65			C-10		80 78			
		gravels and gravel lenses, gravels subangular to subrounded		SPT-12	50			Drive energy influenced by gravels High sampling resistance SPT refusal
70			C-11		100			High sampling resistance SPT refusal
				SPT-13	60 50			6/30/92 No gas emmission at top of fluid filled

Project No. 91-31-208-01 Drawing No. A-76

Converse Consultants West

Log of Boring No. MC-16

Date Drilled: 6/29/92 Logged by: MBS Checked by: MBS

Equipment: 6" Rotary Wash Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 137.5 feet Depth to Water: not observed-rotary wash

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued) fine sand, some dark to blackish brown organic peat inclusions, includes some vegetation remnants (swamp grass or roots), organic and petroleum odor	C-12	SPT-14	62 50 26 36 48			hole
80			C-13	SPT-15	27 62 30 50			High sampling resistance SPT refusal
85				SPT-16	68 52 53 50			High sampling resistance SPT refusal
90		fine to medium sand, poorly graded, sugar sand, clean and moderately clean, trace organic, peaty, inclusions	C-14	SPT-17	100 50			High sampling resistance SPT refusal
95				SPT-18	100 60			High sampling resistance SPT refusal

Log of Boring No. MC-16

Date Drilled: 6/29/92 Logged by: MBS Checked by: MBS

Equipment: 6" Rotary Wash Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 137.5 feet Depth to Water: not observed-rotary wash

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued)	C-15		100			High sampling resistance
				SPT-19	60			SPT refusal
		End of boring at 102 feet No groundwater observations made with rotary wash drilling method Backfilled boring pressure mixture of 4-50lbs. bags, bags of volclay blended with 100, observed volclay at surface, pulled rods 7/1/92-Placed one bag of medium enviroplug bentonite chips, tamped, placed rapid set concrete mix, plug to surface, plug died black to match asphalt						

Log of Boring No. MC-21

Date Drilled: 5/29/92 Logged by: MBS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 134 feet Depth to Water: not observed

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		CLAY (CL); with some silt, grass, roots, parkway planter, dark brown						
		CLAY (CL/CH); some silt, musty organic odor, olive gray						
5		trace sand, interbedded (CH) clay layers	B-1		15 10			
10			C-1		10 19			
		interbedded olive gray and blackish gray clay layers, musty organic odor	C-2		10 15			
				SPT-1	12 12 17			
15			C-3		25 25			
		gradational contact						
		SAND (SP); fine to medium, trace silty sand, gray to olive gray		SPT-2	30 37 40			
20		CLAY (CL); with some silt, mixture of clay with silt, olive gray, moderate hydrogen sulfide odor, interbedded (SP) sand layers	C-4		25 40			Bacharach gas meter 1 ppm H_2S
				SPT-3	30 37 45			

Project No. 91-31-208-01 Drawing No. A-79

Converse Consultants West

Log of Boring No. MC-21

Date Drilled: 5/29/92 Logged by: MBS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 134 feet Depth to Water: not observed

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES DRIVE	SAMPLES SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		CLAY (CL); (continued)	C-5	SPT-4	13 20 30 37 41			
30		hydrogen sulfide odor, predominantly silty clay, olive gray with interbedded (SP) sand layers, trace organic inclusion (wood/swamp grass) with dark brown	C-6	SPT-5	20 34 7 20 35			
35		INTERBEDDED SILTY CLAY (CL-ML) and SAND (SP) LAYERS; 100% LEL combustable gas-stopped drilling-strong odors-alarm sounded-drillers feeling sick-allowed hole to vent, gas turbulance observed at top of flight augers, waited 30 minutes-gas flow continued, filled augers with water to reduce flow Gravelly sand layer-strong hydrogen sulfide odor from sample gradational contact	C-7	SPT-6	20 30 15 25 40			Increasing gas odor and emissions Continually flooding augers with water to control flow SPT refusal
40			C-8	SPT-7	50 50 50			
45		SAND (SP); fine to medium, gray to olive gray, strong hydrogen sulfide odor, occasional silty clay layers	C-9	SPT-8	70 100 75			

Converse Consultants West

Project No. 91-31-208-01

Drawing No. A-80

Log of Boring No. MC-21

Date Drilled: 5/29/92 Logged by: MBS Checked by: MBS

Equipment: 8" Hollow Stem Auger Driving Weight and Drop: 140 lb / 30 in

Ground Surface Elevation: 134 feet Depth to Water: not observed

DEPTH (ft)	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS This log is part of the report prepared by Converse for this project and should be read together with the report. This summary applies only at the location of the boring and may differ at other locations and may change 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 is a simplification of actual conditions encountered.	SAMPLES: DRIVE	SAMPLES: SPT	BLOWS/6"	MOISTURE (%)	DRY UNIT WT. (pcf)	OVA/REMARKS
		SAND (SP); (continued) sample wet-water zone ▽	C-10	SPT-9	70 100 50			High sampling resistance SPT refusal Unable to control gas flow with flooded augers
55		Terminated boring at 55 feet Dangerous and hazardous gas emissions from top of augers Bacharach Gas Meter readings indicated: 245ppm Hydrogen Sulfide 100% LEL level oxygen depletion Field personnel becoming sick from gas-suited up with level B protection to close boring Constant gas emissions observed at top of hollow stem augers Tremied 26-(50lb) bags of enviroplug through hollow stem augers as they were pulled. Activated enviroplug with clean water. Filled boring to 3 to 4 feet below surface Placed cement slurry plug to 0.5' below surface Plug remainder of hole with soil Cleaned up site						

GEOLOGIC UNITS

QUATERNARY	HOLOCENE	A_1	YOUNG ALLUVIUM (Granular): Includes clean sands, silty sands, gravelly sands, sandy gravels, and locally contains cobbles and boulders. Primarily dense, but ranges from loose to very dense.
		A_2	YOUNG ALLUVIUM (Fine-grained): Includes clays, clayey silts, sandy silts, sandy clays, clayey sands. Primarily stiff, but ranges from firm to hard.
	PLEISTOCENE	A_3	OLD ALLUVIUM (Granular): Includes clean sands, silty sands, gravelly sands and sandy gravels. Primarily dense, but ranges from medium dense to very dense.
		A_4	OLD ALLUVIUM (Fine-grained): Includes clays, clayey silts, sandy silts, sandy clays, and clayey sands. Primarily stiff, but ranges from firm to hard.
		SP	SAN PEDRO SAND: Predominantly clean, cohesionless, fine- to medium-grained sands, but includes layers of silts, silty sands, and fine gravels. Primarily dense but ranges from medium dense to very dense. Locally impregnated with oil or tar.
TERTIARY	PLIOCENE	C	FERNANDO FORMATION: Claystone, siltstone, and sandstone: thinly to thickly bedded. Primarily low hardness, weak to moderately strong. Locally contains very hard, thin cemented beds and cemented nodules.

SYMBOLS



Geologic contact: approximately located, queried where inferred.

Perched groundwater



Groundwater level: approximately located: queried where inferred



Boring - CEG (1981)
Boring- CCI/ESA/GRC (1983)



Boring - Nuclear Regulatory Commission (1980)



Boring - Woodward-Clyde (1977)



Boring Kaiser Engineers (1962)



Boring - CCW (1992)

Drawing notes are shown on drawing No.1.

GEOLOGIC EXPLANATION

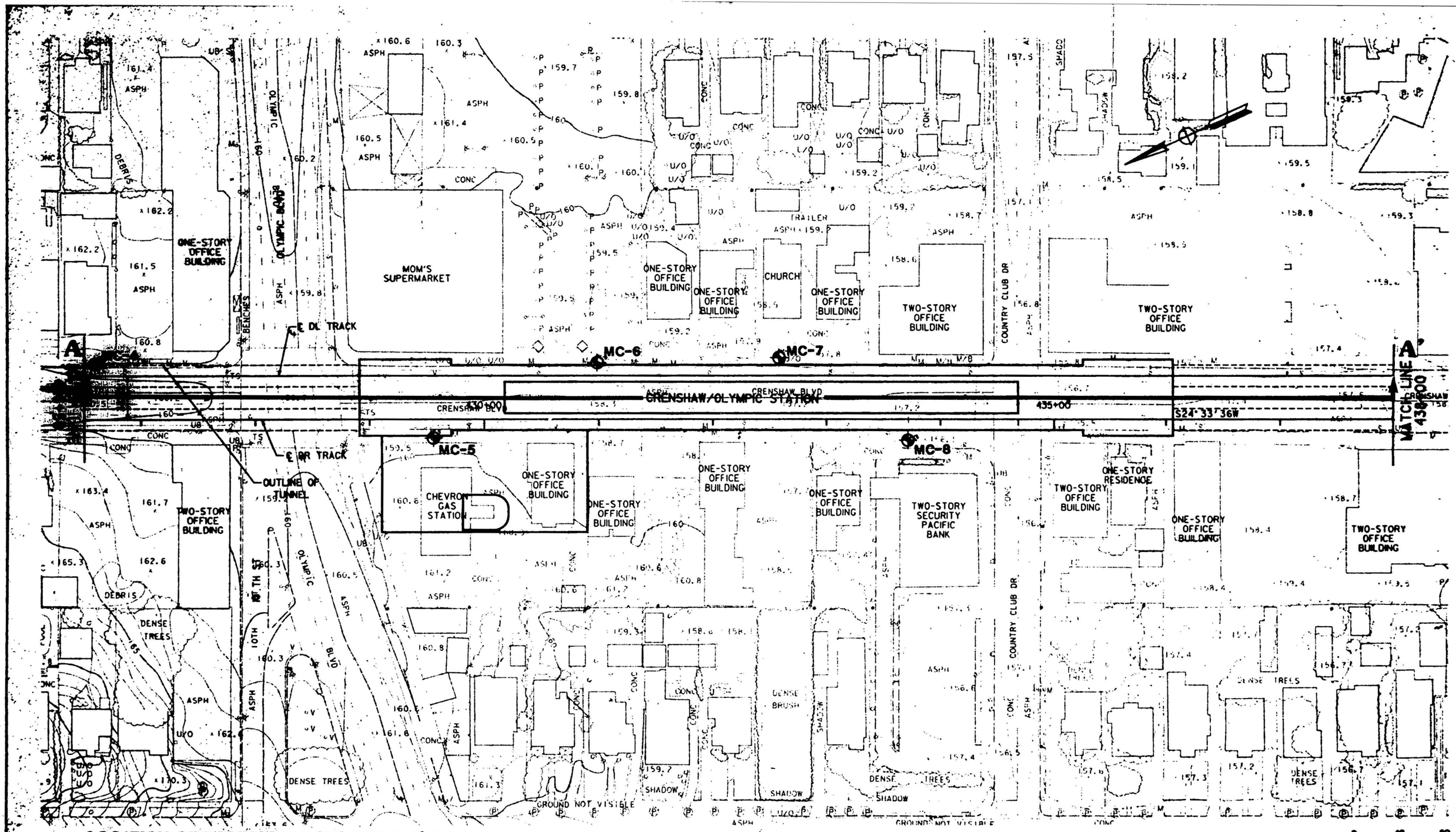
METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Converse Consultants West

Drawing 1A

Approved for publication by



LOCATION OF BORINGS and SECTION A-A' AT CRENSHAW/OLYMPIC STATION

NOTE: FOR EXPLANATION OF GEOLOGIC UNITS, SYMBOLS, AND NOTES SEE DRAWINGS 1A & 1.

0 40 80

PROPOSED CRENSHAW/OLYMPIC STATION METRO RAIL MID-CITY SEGMENT	Scale: as shown	Project No. 91-31-208-01	DESIGNED BY
	Date: 8/14/92		DRAWN BY
	Prepared By: DSS	Drawing No. 4	CHECKED BY
Converse Consultants West	Checked By: MBS		APPROVED BY
	Approved By: HAS		DATE

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
METRO RED LINE

LACTC

Parsons Brinckerhoff

SUBMITTED: APPROVED:

MID-CITY SEGMENT

PLAN

426+50 TO 437+00

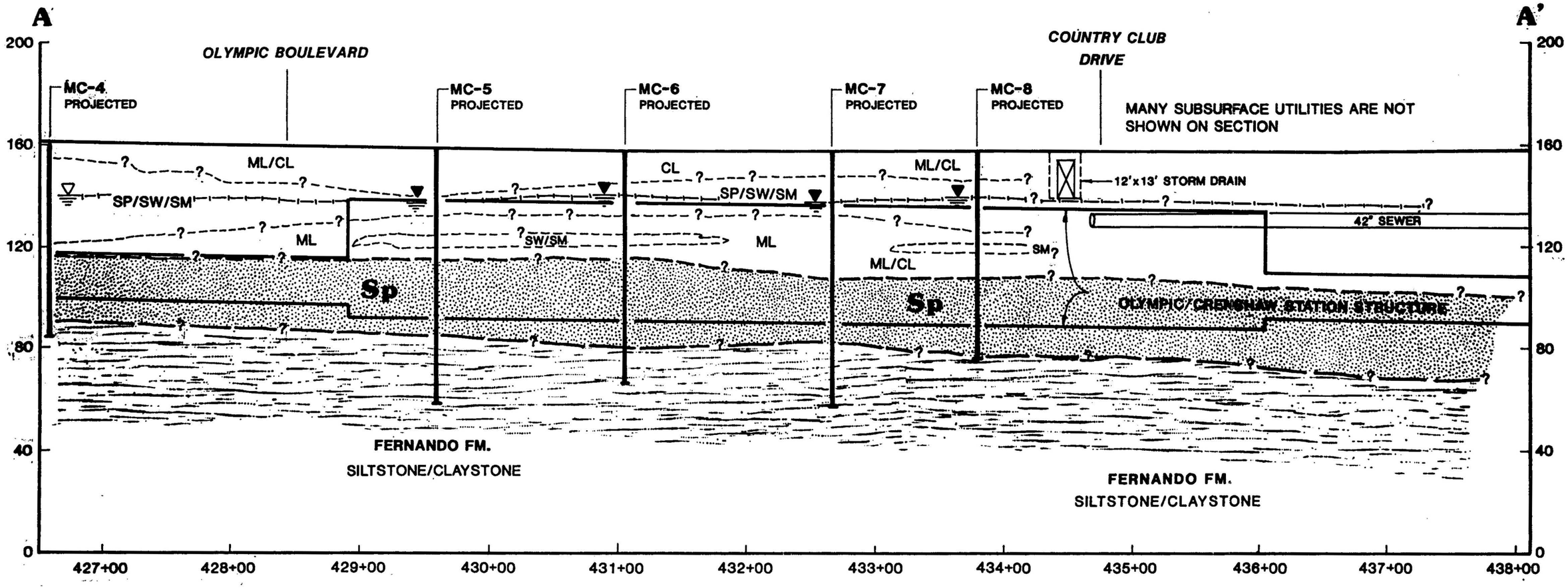
CONTRACT NO. 0400

DRAWING NO.

REV. SHEET NO.

SCALE: 1"=40'

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3



NOTE: FOR EXPLANATION OF GEOLOGIC UNITS, SYMBOLS, AND NOTES SEE DRAWINGS 1A & 1.

VERTICAL 0 20 40 80
HORIZONTAL SCALE IN FEET 0 40 80 160

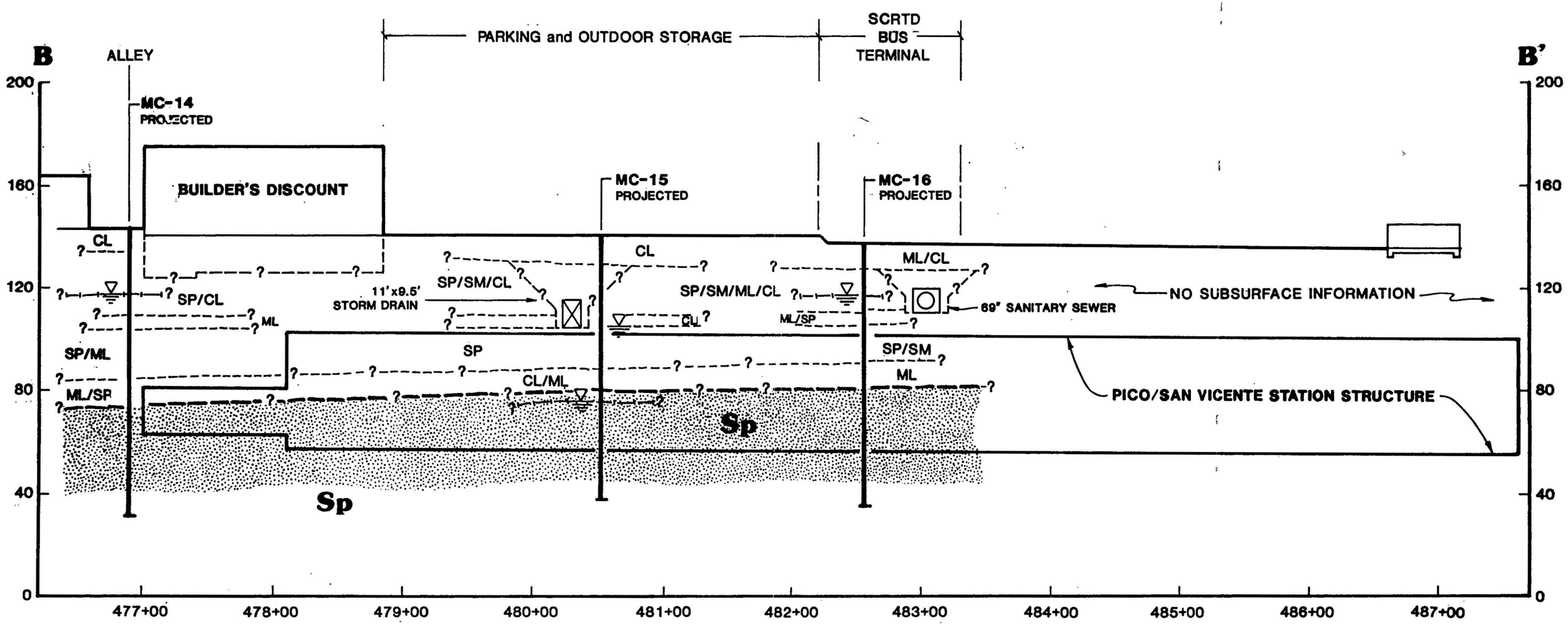
GEOLOGIC PROFILE AT OLYMPIC/CRENSHAW STATION

PROPOSED CRENSHAW/OLYMPIC STATION
METRO RAIL MID-CITY SEGMENT

Converse Consultants West

Scale	as shown
Date	8/14/92
Prepared By	DSS
Checked By	DS
Approved By	MBS
Project No.	91-31-208-01
Drawing No.	5

MODERN PASADENA BLUEPRINT / 99934



NOTE: FOR EXPLANATION OF GEOLOGIC UNITS, SYMBOLS, AND NOTES SEE DRAWINGS 1A & 1.

VERTICAL 0 20 40 80
SCALE IN FEET
HORIZONTAL 0 40 80 160

GEOLOGIC SECTION B-B' AT PICO/SAN VICENTE STATION

PROPOSED PICO/SAN VICENTE STATION
METRO RAIL MID-CITY SEGMENT

Converse Consultants West

Scale	as shown
Date	8/14/92
Prepared By	DSS
Checked By	DS
Approved By	MBS
Project No.	91-31-208-01
Drawing No.	7

MODERN PASADENA BLUEPRINT / 99934

APPENDIX A

BORING LOGS SUMMARIES
BY
CONVERSE CONSULTANTS, INC.
EARTH SCIENCES ASSOCIATES
GEO/RESOURCE CONSULTANTS

METRO RAIL PROJECT DESIGN UNITS A220 AND A240
MARCH AND APRIL 1984

PREPARED FOR

METRO RAIL TRANSIT CONSULTANTS

Printed On Recycled Paper

THIS BORING LOG IS BASED ON FIELD CLASSIFICATION AND VISUAL SOIL DESCRIPTION, BUT IS MODIFIED TO INCLUDE RESULTS OF LABORATORY CLASSIFICATION TESTS WHERE AVAILABLE. THIS LOG IS APPLICABLE ONLY AT THIS LOCATION AND TIME. CONDITIONS MAY DIFFER AT OTHER LOCATIONS OR TIME.

Converse Consultants, Inc.
Earth Sciences Associates
Geo/Resource Consultants

BORING LOG 15

Proj: DESIGN UNIT A-220 Date Drilled 1-26-81/1-28-81 Ground Elev. 200'

Drill Rig FAILING 1500 Logged By S. Testa Total Depth 200.0'

Hole Diameter 5.0" Hammer Weight & Fall 140 lb @ 30"

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
0		0.0-0.2 ASPHALT			AD	started drilling at 11 a.m., augered down to 6.0'
	CL	ALLUVIUM 0.2-7.0 SANDY CLAY: dark yellowish brown; some medium to coarse sand; moist; stiff				
2						
4						
6					RD	
	SC					
8						
10		7.0-15.0 CLAYEY SAND: dark yellowish brown, fine grained sand, some fines, trace of tar, mottled, moist, dense	J-1	8 15 21	SS	SPT at 10.0' 1.1/1.5 recovery, pocket penetrometer 3.5 tsf (broke apart) 2-9-81
12					RD	
14						
	SP	15.0-15.5 TAR SAND: black, fine to medium subangular to subrounded sand	J-2	7 8 21	SS	SPT at 15.0' 1.5/1.5 recovery
16	CL	15.5-20.0 SANDY CLAY: dark yellowish brown mostly fines, with a little fine to medium sand, mottled, moist, stiff			RD	
18						
20						

Project DESIGN UNIT A-220 Date Drilled 1-26-81 Hole No. 15

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
20	CL	20.0-21.3 SANDY CLAY: dark greenish gray, with some fine sand, mottled, moist, hard		25	DR	(continued)
			C-1	26		sample at 20.0',
				29		1.5/1.5 recovery
	SP		J-3			pocket penetrometer
22		21.3-28.0 SAND: dark greenish gray, trace of fines, fine to medium sand, trace of fine gravel, moist, medium dense, poorly graded		3	SS	3.75 (broke apart)
				4		2-9-81
				7		SPT at 21.5'
					RD	.4/1.5 recovery
24						
		25.0-26.0 continued, moist, dense				SPT at 25.0', 1.0/1.5
			J-4	6	SS	recovery
26				23		
				24		
					RD	
28	CL					
30		28.0-30.8 SANDY CLAY: greenish black with some fine sand, moist		6	SS	SPT at 30.0', 1.5/
			J-5	11		1.5 recovery pocket
	SP	30.8-42.0 SAND: greenish black, fine to coarse sand, trace of fine gravel, trace of fines, moist, medium dense, poorly graded		17		penetrometer 3.5 tsf
32					RD	(broke apart) 2-9-81
34						
		dark greenish gray, mostly fine to coarse sand, trace of fines, very dense		25	SS	SPT at 35.0', 1.5/
			J-6	33		1.5 recovery.
36				25		
					RD	
38						
40		continued, moist, very dense		24	DR	sample from 40.0' to
				39		41.5', 1.5/1.5 recovery
			C-2	50		
				15	SS	
42	CL	42.0-53.0 CLAY: greenish black, fine sand, moist, very stiff	J-7	16		SPT at 41.5, 1.5/1.5
				21		recovery, pocket pene-
						trometer > 4.5, 2-9-81
44					RD	

Project DESIGN UNIT A-220 Date Drilled 1-26-81 Hole No. 15

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
44	CL	42.0-49.0 CLAY:(continued)			RD	(continued)
						SPT at 45.0', 1.5/1.5 recovery
		greenish black, trace of fine sand, moist, vert stiff		12		
46			J-8	15		
				21		
					RD	
48						
	CL					
50		49.0-53.0 SANDY CLAY: dark greenish gray with some trace of fine sand, gravel, moist, very stiff		16	SS	SPT at 50.0',1.5/1.5 recovery, pocket penetrometer > 4.5, 2-9-81
				23		
			J-9	26		
52					RD	
	SC					
54						
		53.0'-58.0' CLAYEY SAND: dark greenish gray, fine to coarse sand with some fines, moist, very dense grades coarser with depth		16	SS	SPT at 55.0', 1.5/1.5 recovery
				16		
56			J-10	21		
					RD	
58	CL					
						sample from 60.0' to 61.0', 1.0/1.0 recovery, pocket penetrometer 4.5 (broke apart) 2-9-81
60		58.0'-64.0' SANDY CLAY: dark greenish gray, some fine to coarse sand, moist, very stiff, thinly imbedded		30	DR	
			C-3	62		
				11	SS	
62			J-11	13		
				22		
					RD	
64	SC / CL	64.0'-69.5' SANDY CLAY AND CLAYEY SAND: thinly laminated dark greenish gray, moist		11	SS	SPT at 65.0', 1.0/1.5 recovery, pocket penetrometer > 4.5, 2-9-81
			J-12	21		
66				25		
		SANDY CLAY: fine to coarse sand			RD	
		CLAYEY SAND: fine to coarse				

Project DESIGN UNIT A-220 Date Drilled 1-26-81/1-27-81 Hole No. 15

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
68	SC / CL	64.0-69.5 SANDY CLAY AND CLAYEY SAND: (continued)			RD	(continued)
		SAN PEDRO FORMATION				
70	SP	69.5-90.0 SAND: dark greenish gray fine sand, little fines, very moist, very dense		22	SS	SPT at 70.0', 1.5/1.5 recovery
			J-13	30		
				32		
72					RD	
74		continued fine sand				SPT at 75.00, 1.0/1.5 recovery
			J-14	15	SS	
76				10		
				21		
78					RD	
80				50	DR	sample at 80.0', no recovery, SPT at 80.5', .1/.5 recovery, halted drilling at 81.0' at 5:00 PM. resumed drilling at 7:00 AM, 1-27-81
				50	SS	
					RD	
82						
84		continued				SPT at 85.0', .1/.4 recovery
				50/4"	SS	
86					RD	
88		shell fragments from cuttings				minor rod chatter below 80.6', considerable rod chatter from 88.0 to 88.5', minor from 88.5' to 90.0', continuous pitcher barrel sampling from 90.0'
		PUENTE FORMATION				
90		90.0-200.0 CLAYSTONE: thinly laminated, primarily olive gray claystone with fine grained light gray sandstone laminae, micaceous, fossiliferous	Box # 1		PB	
	20°					
92						

Project DESIGN UNIT A-220 Date Drilled 1-27-81 Hole No. 15

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
92		90.0-200.0 CLAYSTONE:			PB	(continued)
		92.5-97.5 thinly laminated olive gray				200 psi
	5-30°	claystone, light gray sandstone,				
94		and dark yellowish brown silt-				
		stone (occasionally well cement-				
		ed).				
	0-15°					200 psi
96						
			Box			
		97.5-100.0 primarily claystone with fine	# 1			200 psi
98	0-10°	sandstone				
		Physical Condition: massive				
		soft to friable hardness, plastic				
	0-10°	to weak strength, fresh.				200 psi
100		claystone and fine sandstone				
102		claystone and fine sandstone, no				200 psi
		discernable bedding apparent				
104		Physical Condition: continued;				
		tends to fracture along bedding				200 psi
		planes, notably sandstone				pocket penetrometer
			Box			>4.5 2-9-81
106			# 2			
						200 psi
	10-15°					
108						
110		alternating laminations of clay-				250 psi
		stone, sandstone and siltstone				
112	45°					250 psi
	5-15°					
		continued, siltstone is fossili-				
114		ferous				
			Box			
			#3			
116						

Project DESIGN UNIT A-220 Date Drilled 1-27-81 Hole No. 15

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
116	10-15°	90.0-200.0 CLAYSTONE: (continued) alternating thin to medium laminations, primarily claystone with subordinate fine sandstone and siltstone, cross-bedding evident in sandstone laminae, mottled from 116.8-117.0			PB	(continued) pocket penetrometer >4.5 2-9-81
118			Box # 3			200 psi, gas check 0.0% LEL, 11 a.m.
120		primarily claystone with fine sandstone laminae from 117.5				200 psi
122	0-10°					200 psi
124						
	20-30°	alternating claystone, sandstone and siltstone from 125.0', cross bedding apparent				250 psi
126						
			Box # 4			250 psi pocket penetrometer >4.5 2-9-81
128						
130		primarily claystone, fine sandstone				200 psi
132		continued Physical Condition: massive, soft to friable hardness, plastic to weak strength, fresh, tends to fracture along bedding planes notably sandstone				pocket penetrometer >4.5 2-9-81 200 psi
134						
		alternating thin to medium laminations of claystone, subordinate sandstone and siltstone from 135.7	Box # 5			
136						
138	15-20°	continued				

Project DESIGN UNIT A-220 Date Drilled 1-27-81 Hole No. 15

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
140		90.0-200.0 CLAYSTONE: (continued) Physical Condition: massive, soft to friable hardness, plastic to weak strength, fresh; tends to fracture along bedding planes, clay filled 60° fracture at 142.0, primarily claystone with thin to medium fine sandstone laminae	Box # 6		PB	(continued) 250 psi
142	60°					200 psi
	10-15°					
144						200 psi pocket penetrometer >4.5 2-9-81
	5-10°					
146						
	10-15°					200 psi
148						
150	0-15°	thin laminae of claystone, siltstone and fine sandstone				250 psi
152			Box # 7			pocket penetrometer >4.5 tsf 2-9-81 250 psi
154		continued				250 psi
156						250 psi
158						
160		primarily claystone, fine sandstone				200 psi
162			Box # 8			200 psi

Project DESIGN UNIT A-220 Date Drilled 1-27-81/1-28-81 Hole No. 15

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
164		90.0-200.0 CLAYSTONE: (continued) Physical Condition: massive, soft to friable hardness, plastic to weak strength, fresh, tends to fracture along bedding planes, notably sandstone			PB	(continued) 200 psi
166			Box # 8			pocket penetrometer >4.5 2-9-81 250 psi
168	10-15°	primarily claystone to 169.0, alternating claystone with subordinate sandstone and siltstone				
170						200 psi
172	15-25°	alternating thin to medium laminae of claystone, fine sandstone and siltstone	Box # 9			pocket penetrometer >4.5 2-9-81 250 psi
174						stopped drilling at 5 at a depth of 175.0'
176	15-25°					1-28-81 resumed drilling at 7 a.m., light rain 250 psi
178	25°	primarily claystone with sandstone laminae				
180	20°					250 psi
182		fossiliferous	Box #10			pocket penetrometer >4.5 2-9-81
184						
186						
	15-20°		Box #11			

Project DESIGN UNIT A-220 Date Drilled 1-28-81 Hole No. 15

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
188		90.0-200.0 CLAYSTONE: (continued) Physical Condition: as previously described				(continued)
190		primarily olive gray, claystone with thin to medium fine sandstone				200 psi
192			Box #11			pocket penetrometer >4.5 2-9-81 200 psi
194						200 psi
196						
198			Box #12			200 psi gas check 0.0% LEL, 11:50 pocket penetrometer >4.5 2-9-81 Terminated hole at
200		B.H. 200.0' Hole Terminated				11:45 at a depth of 200.0' 1-29-81 (heavy rain) water pressure test taken at the following intervals 100-120', 72-90'(10am to 11am, reamed hole to 7" then installed 100.0' of 4" PVC and grouted
202						
204						
206						
208						
210						

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Converse Consultants, Inc.
Earth Sciences Associates
Geo/Resource Consultants

BORING LOG 15-A

Proj: DESIGN UNIT A-220 Date Drilled 11-8-83 Ground Elev. 199'

Drill Rig MAN-SIZE AUGER Logged By J. Stellar Total Depth 60'

Hole Diameter 33" Hammer Weight & Fall N.A.

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
0		ASPHALTIC CONCRETE PAVEMENT 0.0-1.0				Hole stood well in general, 3'-4' of caving @ 17'-22' and probable caving 55'-60' Hole caved at 40 to 45" after drilling
	ML	FILL 1.0-2.0 CLAYEY SILT: dark brown, moist, stiff, minor coarse sand				
2	ML	ALLUVIUM 2.0-7.0 SANDY SILT: medium brown, moist, stiff				
4						
6						
	SP	7.0-9.0 SAND: medium brown, very moist, medium dense, medium to coarse grained				
8						
	ML	9.0-17.0 SILT: medium brown, moist, stiff, with layers of coarse sandy silt				
10						
12						
14						water level @ 15' after 2 hours water level @ 16' after 1½ hours
16						
	SP	17.0-23.0 SAND: light brown, wet, medium dense, coarse grained, saturated, very minor gravel to ½"				3 to 4' of caving at 17'-22', seepage at 10-15± g.p.m.
18						

Project DESIGN UNIT A - 220 Date Drilled 11-8-83 Hole No. 15A

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
20	SP	17.0-23.0 SAND: (continued)				
22		gravel to 3' @ 22.5'				
	ML	23.0-35.0 SILT: medium brown v. moist, stiff, with layers of sandy silt				
24						
26		becomes reddish brown and v. stiff				
28						
30						
32		becomes medium brown				bag sample @ 33'
34						
	ML	35.0-42.0 CLAYEY SILT: blue gray, very moist stiff, with layers of sandy silt				
36						
38						
40						
42	SP/SM	42.0-44.6 SAND: blue, wet, dense with layers of silty sand and silt				

Project DESIGN UNIT A - 220 Date Drilled 11-8-83 Hole No. 15A

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
44	SM	42.0- SAND: (continued)				
	ML	44.6				
		44.6- CLAYEY SILT: blue, very moist, stiff with layers of silt and sandy silt				
46						
48		becomes v. stiff				bag sample @ 49'
50						
52						
54						Bag sample @ 55' unable to remove sand cuttings below 56' - saturated clean sand falling from bucket probable caving 55'-60' based on drilling behavior
	SP	SAND PEDRO FORMATION				
56		55.0- SAND: blue, wet, dense, with minor layers of sandy silt and silt				
58		clean sand				
60		B.H. 60.0'. Water at 27' during drilling operation. H20 @ 16' after 1½ hours. Hole caved back to 45' after 1½hrs. Water level at 15' after 2 hours. Hole caved back to 40' after 2 hours.				
62						
64						
66						

THIS BORING LOG IS BASED ON FIELD CLASSIFICATION AND VISUAL SOIL DESCRIPTION, BUT IS MODIFIED TO INCLUDE RESULTS OF LABORATORY CLASSIFICATION TESTS WHERE AVAILABLE. THIS LOG IS APPLICABLE ONLY AT THIS LOCATION AND TIME. CONDITIONS MAY DIFFER AT OTHER LOCATIONS OR TIME.

Converse Consultants, Inc.
Earth Sciences Associates
Geo/Resource Consultants

BORING LOG 15-1

Proj: DESIGN UNIT A-220 Date Drilled 9-22-23-83 Ground Elev. 196'

Drill Rig Failing 1500 Logged By L. Schoerlein Total Depth 84.8

Hole Diameter 4 7/8" Hammer Weight & Fall 140 lb @ 30"

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
0		0.0-0.2 ASPHALT 0.2-1.0 CONCRETE			GB	start drilling 2:45
	CL	FILL		4	DR	1.0/1.0
2		1.0-2.5 SILTY CLAY: dark greenish grey to dark yellowish brown; stiff; moist	C-1	9		
					AD	
	SM ML	OLD ALLUVIUM 2.5-7.5 SILTY SAND/SANDY SILT: brown; dense; moist	J-1	11 14 26	SS	1.5/1.5
4					RD	set tub and cased to 6.5'
6			C-2	12 21	DR	1.0/1.0
					RD	
8	SP	7.5-15.5 SAND: yellowish grey; mostly fine sand, silt; dense to v. dense; dry to moist; occasional zones of silt	J-2	16 16 25	SS	1.0/1.5
10					RD	
			C-3	17 48	DR	1.0/1.0
12					RD	
			J-3	25 38 40	SS	1.0/1.5
14		increased silt			RD	
16	SC	15.5-24.0 CLAYEY SAND W/CLAYEY SILT: yellowish grey; mostly fine to medium sand; dense; moist	C-4	14 14	DR	1.0/1.0
					RD	
18			J-4	17 28 34	SS	
20					RD	Sheet 1 of 4

Project DESIGN UNIT A-220 Date Drilled 9-22-23-83 Hole No. 15-1

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
20	SC	15.5-24.0 CLAYEY SAND: continued			RD	
		contains occasional silty zones and sand lenses,		24	DR	1.0/1.0
22		grades to sandy clay	C-5	22		
					RD	
			J-5	8	SS	1.5/1.5
				11		
24				16		
	CL	24.0-27.5 SILTY CLAY: light olive grey; stiff; moist			RD	
26		thin sandy clay lens 3"		16	DR	1.0/1.0 pocket pen 3.5 tsf
			C-6	21		
					RD	
	CL	27.5-45.8 CLAY: dark greenish grey; v. stiff to hard; moist; sample J-6 - 3" lenses of silty clay and sandy clay	J-6	14	SS	1.5/1.5
28				30		
				39		
30					RD	
				25	DR	1.0/1.0
	CH	hard	C-7	58		pocket pen > 4.5 tsf
32					RD	
			J-7	16	SS	
				27		
34				29		
					RD	
36					PB	
	CL	grading to SILTY CLAY, v. stiff	PB-1			2.5/2.5
38						
	ML	grading to SILT	J-8	12	SS	1.5/1.5
				25		
40				39		
					RD	
				19	DR	1.0/1.0
	SM	grading to SILTY SAND	C-8	61		pocket pen > 4.5 tsf
42					RD	
	CL	grading to SILTY CLAY	J-9	6	SS	1.5/1.5
				13		

Project DESIGN UNIT A-220 Date Drilled 9-22-23-83 Hole No. 15-1

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
44	CL	27.5-45.8 CLAY: continued		22		
					RD	
46	CL	45.8-55.6 SANDY CLAY: dark greenish grey; little fine sand; hard, moist; contains occasional lenses of sand clay	C-9	49 50-	DR 4"	0.8/0.8
					RD	
48			J-10	17 30 30	SS	1.5/1.5
						6:30 9/22/83
50					RD	6:30 9/23/83
			C-10	30 50-	DR 4.5"	0.9/0.9
52					RD	
			J-11	20 41 50-	SS 5"	1.4/1.4
54		clayey sand grading to sandy silt grading to silty sand grading to:			RD	
		SAN PEDRO FORMATION				
56	SP	55.6-67.5 SAND: dark greenish grey; fine sand; very dense; saturated	C-11	60 50-	DR 3"	0.8/0.8
					RD	
58			J-12	25 50-	SS 5"	0.5/0.9
					RD	
60						
			C-12	70 50-2	DR .5"	0.6/0.7
62					RD	
			J-13	36 56	SS	0.8/1.0
64					RD	
66			C-13	100 30-	DR 1/2"	0.5/0.5
					RD	
68	SW/GP	67.5-73.0 GRAVELLY SAND:				

Project DESIGN UNIT A-220 Date Drilled 9-22-23-83 Hole No. 15-1

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
68	SW / GP	67.5-73.0 GRAVELLY SAND/SANDY GRAVEL: cont greenish grey; mostly fine to coarse sand; fine to coarse gravel; v. dense; saturated	C-14	50-4"	SS RD	0.3/0.3
70						
72				110-3"	DR RD	0.0/0.2
	SM	73.0-76.5 SILTY SAND: dark greenish grey; mostly fine sand; some non-plastic silt; v. dense; saturated; sulfur odor	J-15	68 50-3"	SS RD	0.5/0.7
74		75.5-76.5 gravelly				
76		PUENTE FORMATION		30	DR	0.9/0.9
		76.5-84.8 INTERBEDDED SILTSTONE, CLAYSTONE AND FINE SAND: olive grey and dark greenish; sand lenses; thinly to thickly bedded	C-14	50-5"	RD	
78		Physical Condition: fractured to massive; friable hardness and strength; little weathered to fresh	C-15	39 50-3"	DR RD	0.7/0.7
80						
82						
84			C-16	34 50-3.5"	DR	0.7/0.8
		B.H. 84.8 Terminated hole, installed piezometer bottom 20' slotted				complete drilling 10:15
86						
88						
90						
92						

THIS BORING LOG IS BASED ON FIELD CLASSIFICATION AND VISUAL SOIL DESCRIPTION, BUT IS MODIFIED TO INCLUDE RESULTS OF LABORATORY CLASSIFICATION TESTS WHERE AVAILABLE. THIS LOG IS APPLICABLE ONLY AT THIS LOCATION AND TIME. CONDITIONS MAY DIFFER AT OTHER LOCATIONS OR TIME.

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BORING LOG 15-2

Proj: DESIGN UNIT A-220 Date Drilled 9-21-22-83 Ground Elev. 199'

Drill Rig Failing 1500 Logged By L. Schoeberlein Total Depth 86.7'

Hole Diameter 4 7/8" Hammer Weight & Fall 140 lb @ 30"

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
0		0.0-0.7 CONCRETE			GB	start drilling 5 pm
2	SM / CL	FILL 0.7-8.5 INTERBEDDED SILTY SAND, SANDY CLAY, & SILTY CLAY: mottled yellowish grey to light brown; lenses 2" to 1' thick, stiff or dense; dry to moist	C-1	12 18	DR 6"	0.7/0.7
					AD	
4			J-1	11 20 25	SS	1.5/1.5
6					RD	set tub & cased to 6.5'
8			C-2	7 16	DR	1.0/1.0
					RD	
10	CL	OLD ALLUVIUM 8.5-21.0 SILTY CLAY: medium brown; v. stiff; moist	J-2	9 15 27	SS	1.5/1.5
					RD	
12	CH	mottled dark greenish grey and medium brown	C-3	18 29	DR	1.0/1.0
					RD	
14			J-3	9 15 20	SS	1.5/1.5
16					RD	
18			C-4	13 24	DR	1.0/1.0 pocket pen > 4.5 tsf
					RD	
20		contains 6" sandy clay lens	J-4	10 17	SS	1.0/1.5

Project DESIGN UNIT A-220 Date Drilled 9-21-22-83 Hole No. 15-2

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
20	CL	8.5-21.0 SILTY CLAY: continued		24		
					RD	
	CL	21.0-31.0 SANDY CLAY: yellowish brown; trace fine sand; stiff; moist				
22				12	DR	1.0/1.0
			C-5	50-	5.5	" pocket pen 2.5 tsf
					RD	
24		sand content decreasing		9	SS	1.5/1.5
			J-5	12		
				20		
					RD	
26				14	DR	1.0/1.0
			C-6	26		pocket pen 4.25 tsf
28					RD	
				7	SS	1.5/1.5
			J-6	17		
30				23		
					RD	
	CL	31.0-46.5 CLAY: mottled greenish grey and yellowish brown, grading to dark greenish grey at 37.5'; v. stiff moist		18	DR	1.0/1.0
32			C-7	26		
					RD	
34				14	SS	1.5/1.5
		becomes silty and contains some sand lenses	J-7	20		
				25		
					RD	
36				27	DR	1.0/1.0
			C-8	45		7:30 9/21/83
38					RD	6:30 9/22/83
				15	SS	1.5/1.5
			J-8	27		
40				42		
					RD	
42					PB	
			PB-1			2.5/2.5

Project DESIGN UNIT A-220 Date Drilled 9-21-22-83 Hole No. 15-2

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
44	CL	31.0-46.5 CLAY: continued grading to silty			RD	
			J-9	11	SS	1.5/1.5
				23		
46				44		
					RD	
	SM	46.5-48.5 SILTY SAND: dark greenish grey; mostly fine sand, silt; v. stiff; moist		30	DR	0.8/0.8
			C-9	50-	4"	
48					RD	
	CL	48.5-65.0 SANDY CLAY: dark greenish grey; some fine sand; v. stiff; moist		9	SS	1.5/1.5
			J-10	18		
50				23		
					RD	
52				23	DR	1.0/1.0
			C-10	49		
					RD	
54		silt, clayey silt, clayey sand and silty sand interbeds to 8" thick		9	SS	1.5/1.5
			J-11	22		
				33		
56					RD	
				25	DR	1.0/1.0
			C-11	37		pocket pen > 4.5
58					RD	
			J-12	9	SS	1.5/1.5
				15		
60				22		
					RD	
62				23	DR	1.0/1.0
			C-12	42		
					RD	
64		63.5-65.0 clayey sand lense		17	SS	1.0/1.5
			J-13	42		
				56		
	SP	SAN PEDRO FORMATION			RD	
66		65.0-75.0 SAND: dark greenish grey; mostly fine sand, silt; v. dense; saturated				
				67	DR	sample fell out
68				50-	1" DR	

Project DESIGN UNIT A-220 Date Drilled 9-21-22-83 Hole No. 15-2

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
68	SP	65.0-75.0 SAND: continued			RD	
			J-14	17 24 36	SS	1.5/1.5
70					RD	
72			C-13	80 80-	DR 3"	0.7/0.7 best San Pedro sample
					RD	
74			J-15	22 51	SS	0.8/1.0
	SW	75.0-85.0 GRAVELLY SAND: dark greenish grey; mostly fine to coarse sand fine to coarse gravel; v. dense; saturated			RD	rig chatter
76			C-19	110 86-	DR 4.5"	
78					RD	
						skip sample, too gravelly
80						
		very fine silty sand lens	J-16	32 50-	SS 2"	0.4/0.7
82					RD	
84				184	DR	0.0/0.5
					RD	
		PUENTE FORMATION				
86		85.0-86.7 INTERBEDDED SILTSTONE & CLAYSTONE: olive grey and dark greenish grey; thinly to thickly bedded Physical Condition: little fractured to massive; friable hardness and strength; fresh to little weathered	C-15	42 50-	DR 3"	gravels @ top fall in. 0.6/0.7, pocket pen >4.5 tsf
88						complete drilling 12:15
		B.H. 86.7 Terminated hole, tremied grout to surface				
90						
92						

Sheet 4 of 4

THIS BORING LOG IS BASED ON FIELD CLASSIFICATION AND VISUAL SOIL DESCRIPTION, BUT IS MODIFIED TO INCLUDE RESULTS OF LABORATORY CLASSIFICATION TESTS WHERE AVAILABLE. THIS LOG IS APPLICABLE ONLY AT THIS LOCATION AND TIME. CONDITIONS MAY DIFFER AT OTHER LOCATIONS OR TIME.

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BORING LOG 15-3

Proj: DESIGN UNIT A-220 Date Drilled 9-28-83 Ground Elev. 199'

Drill Rig Failing 1500 Logged By L. Schoeberlein Total Depth 160.9

Hole Diameter 4 7/8" Hammer Weight & Fall NA

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
0		0.0-0.8 CONCRETE			GB	start day 7:00 am start drilling 7:30 am
	CL	FILL 0.8-1.8 GRAVELLY SANDY CLAY: mottled grey and browns; soft		4	DR	1.0/1.0
			C-1	11		
2	SM	OLD ALLUVIUM 1.8-6.0 SILTY SAND: yellowish brown; mostly fine sand; medium dense; moist			GB	
			J-1	3 5 8	SS	0.8/1.5
4					RD	set tub & cased to 4.5'
		grading to				
6	CL	6.0-20.5 SILTY CLAY: yellowish brown mottled with mod. brown; stiff; moist; interbedded sand lenses		7	DR	1.0/1.0
			C-2	10		pocket pen> 4.5 tsf
					RD	
8			J-2	3 8 12	SS	1.3/1.5
					RD	
10				5	DR	1.0/1.0
			C-3	10		pocket pen 3.5 tsf
12					RD	
			J-3	6 10 15	SS	1.3/1.5
14					RD	
				12	DR	0.9/1.0
16			C-4	18		pocket pen > 4.5 tsf
					RD	
18			J-4	7 14 22	SS	1.3/1.5
					RD	
20						Sheet 1 of 7

Project DESIGN UNIT A-220 Date Drilled 9-28-83 Hole No. 15-3

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
20	CL	6.0-20.5 SILTY CLAY: continued			RD	
	CL	20.5-38.0 SANDY CLAY: yellowish brown; some fine sand; dense; moist		13	DR	0.9/1.0
22			C-5	22		
					RD	
	SC	grading to CLAYEY SAND: moderately plastic fines; med. dense; moist;~ 2' thick	J-5	11 12 12	SS	1.0/1.5
24					RD	
26	CL	grading back to SANDY CLAY		10	DR	1.0/1.0
			C-6	23		
					RD	
28		interbedded sand and clay	J-6	10 16 23	SS	1.5/1.5
30					RD	
		grading to dark greenish grey; interbedded silty clay with clayey sand~ 6" thick		18	DR	1.0/1.0
			C-7	50-	5"	
32					RD	
			J-7	11 12 20	SS	1.3/1.5
34					RD	
36				25	DR	0.7/0.8
			C-8	50-	4"	
					RD	
38		increased silty clay				
	CL	38.0-42.5 CLAY: dark greenish grey; v. stiff to hard; moist	J-8	13 30 53	SS	1.5/1.5
40					RD	
				48	DR	0.6/0.6
			C-9	50-	2"	
42					RD	
		grading to				
	CL	42.5-44.5 SANDY CLAY: very stiff to hard	J-9	11 26	SS	1.5/1.5

Project DESIGN UNIT A-220 Date Drilled 9-28-83 Hole No. 15-3

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
44	CL			30	SS	
	CL	44.5-47.5 SILTY CLAY: very stiff to hard			RD	
46				32	DR	1.0/1.0
			C-10	50		
		grading to			RD	
48	ML	47.5-52.0 CLAYEY SILT: dark greenish grey; stiff; wet		10	SS	1.5/1.5
			J-10	28		
				31		
50					RD	
					PB	
		grading to				
52	CL	52.0-65.5 SANDY CLAY: dark greenish grey; v. stiff; moist	PB-1			2.5/2.5
				9	SS	1.3/1.5
			J-11	18		
54				29		
					RD	
56				51	DR	1.0/1.0
		contains thin interbeds of sand, clayey sand, silty sand and silty clay, 2"-8" thick	C-11	47		
					RD	
58				17	SS	1.0/1.5
			J-12	40		
				43		
60					RD	
		increased sand content				
				30	DR	1.0/1.0
			C-12	50-	5.5"	
62					RD	
				7	SS	0.0/1.5
				13		
64				16		
					RD	
		grading to				
66	SM	65.5-67.5 SILTY SAND: dark greenish grey; plastic fines; dense; moist				
			C-13	31	DR	0.9/0.9
				50	5"	
					RD	
68	SP	SAN PEDRO SAND				

Project DESIGN UNIT A-220 Date Drilled 9-28-83 Hole No. 15-3

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
68	SP	67.5-80.5 SAND: continued dark greenish grey; trace of silt; v. dense; saturated	J-13	23 51	SS	0.7/1.0
					RD	
70						
				60	DR	0.5/0.7
			C-14	50-	3"	
72					RD	
				50	SS	0.6/0.9
			J-14	50-	5"	
74					RD	
				57	DR	0.6/0.7
76			C-15	50-	2½"	
					RD	
				32	SS	0.5/0.9
78			J-15	50-	5.5"	
					RD	
80						
	GP	80.5-86.5 SANDY GRAVEL: dark greenish grey; mostly fine to medium gravel; angular; occasional coarse gravel and cobbles; v. dense; saturated	C-16	125-	5.5" RD	rig chatter DR 0.4/0.4 disturbed sample
82						
		fine sand lens, contains shells		32	SS	0.6/0.9
84			J-16	50-	4.5"	
					RD	
86						
		PUENTE FORMATION 86.5-160.9 INTERBEDDED SILTSTONE & CLAYSTONE: olive grey and greenish black; thinly interbedded 1/2" to 3"; occasional well cemented zones in primarily uncemented material.		46	DR	0.7/0.8
88			C-17	60-	3"	
					RD	
90						
92						

Project DESIGN UNIT A-220 Date Drilled 19-28-83 Hole No. 15-3

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
92		86.5-160.9 INTERBEDDED SILTSTONE & CLAYSTONE: continued Physical Condition: little fractured to massive; friable strength and hardness; little weathered to fresh			RD	
94						
96						
98						
100						rig chatter probable cemented zone 1-2" thick
102						
104						
106						
108						
110		occasional 1/16" thick sand lenses	C-18	40 52-	DR 3"	0.7/0.7 rig chatter
112						
114						
116						

Project DESIGN UNIT A-220 Date Drilled 9-28-83 Hole No. 15-3

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
116		86.5-160.9 INTERBEDDED SILTSTONE & CLAYSTONE: continued			RD	
118						
120						
122						
124						
126						
128						
130				39	DR	0.8/0.8
			C-19	50-	4" RD	
132						
134						
136						
138						

Project DESIGN UNIT A-220 Date Drilled 9-28-83 Hole No. 15-3

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	SPT (6")	DRILL MODE	REMARKS
140		86.5-160.9 INTERBEDDED SILTSTONE & CLAYSTONE: continued			RD	
142						
144						
				65	DR	0.7/0.7
			C-20	50-	3"	
146					RD	
148						
150						
152						
154						
156						
158						
		35° dip fractures more readily along fine sand partings				
160				41	DR	0.8/0.9
			C-21	50-	4.5"	
162		B.H. 160.9 Terminated hole at extended depth to install piezometer to read bedrock H20 levels. Bottom 20' slotted, seal from ~80 to 120'; pea gravel backfill from 120-160'				completed drilling 6:45
164						

Sheet 7 of 7

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BORING LOG 16

Proj: DESIGN UNIT A-240 Date Drilled 1-20-27-81 Ground Elev. 211'

Drill Rig Failing 1500 Logged By Gallinatti Total Depth 199.2'

Hole Diameter 4 7/8" Hammer Weight & Fall 140 lb. 30"

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
0		0.0-0.5 CEMENT			AD	Begin drilling 11:30 1/20/81
	SM	OLD ALLUVIUM 0.5-9.0 SILTY SAND: light olive brown; poorly graded fine sand, moist; subangular; loose;				
2						
4						install 5' of 5" surface casing
					RD	
6						
8						
	CL	9.0-12.0 SANDY CLAY: moderate yellowish brown; fine to medium sand; very stiff; moist				
10			J-1	22 50	SS	0.9/0.9 recovery
					RD	install 5' more of surface casing
12	CH	12.0-20.0 CLAY: dusky yellow; firm; moist				
14						
			J-2	8 11 21	SS	1.5/1.5 recovery
16					PB	
			S-1			
18						2.8/2.8 recovery
			Box			

Project DESIGN UNIT A-240 Date Drilled 1-20-27-81 Hole No. 16

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
20	SM	20.0-29.5 SILTY SAND: pale yellowish brown mostly medium sand; little fines loose to medium dense; moist	Box 4		PB	2.8/2.9 recovery
		21.0-22.0 fine sand				
22						2.7/2.8 recovery
		23.0-24.0 fine sand				
24						
						2.0/2.8 recovery
26						
28						2.1/2.8 recovery pocket penetrometer 1.5/3.25 2/9/81
30	SM	29.5-32.0 SILTY SAND: medium blueish gray; fine sand with little fines; loose; moist to wet	Box 2			2.7/2.8 recovery
32	CL	32.0-45.4 CLAY: dark greenish gray; stiff; moist				pocket penetrometer 1.0 2/9/81
						2.8/2,8 recovery
34			S-2			
36			Box 2 (cont)			2.7/2.8 recovery
		37.2-37.8 Clayey Sand: medium sand				
38						
		39.0-42.0 some inclusions of cemented material				2.8/2.8 recovery
40						
42						2.8/2.8 recovery pocket penetrometer >4.5 2/9/81
			Box 3			
44						

Project DESIGN UNIT A-240 Date Drilled 1-20-27-81 Hole No. 16

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
44	CL	32,0-45.4 CLAY: (continued)	Box 3		PB	2.8/2.8 recovery
	SM	45.4-51.0 SILTY SAND: dark greenish gray; poorly graded fine sand; little fines; medium dense to loose; moist				
48						2.4/2.8 recovery pocket penetrometer 2.25 2/9/81
50						2.8/2.8 recovery
	CL / SC	51.0-56.2 CLAY AND CLAYEY SAND: dark greenish gray; CLAYEY SAND lenses are medium to coarse sand	S-3			
52						
			Box 3 (cont)			2.5/2.8 recovery
54						
56			Box 4			2.1/2.8 recovery
	CL	56.2-60.0 CLAY: dark greenish gray; with trace of medium, angular sand; stiff; moist				
58						1.7/2.8 recovery
60		SAN PEDRO FORMATION				
	SM	60.0-85.0 SILTY SAND: dark greenish gray; fine sand with little fines; loose; wet				1.8/2.8 recovery
62						
64						pocket penetrometer 3.5 2/9/81
						65' water table
66						0.6/2.8 recovery
68						

Project DESIGN UNIT A-240 Date Drilled 1-20-81 Hole No. 16

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
68	SM	60.0-85.0 SILTY SAND: (continued)			PB	No Recovery - saturated sands
70			S-4			1.5/2.8 recovery
72			S-5			.9/2.8 recovery
74		75'-77' medium to coarse sand				
76			Box 4 (cont)			1.8/2.8 recovery
78						No Recovery
80		81'-85' gravelly sand: probably basal conglomerate			RD	81.3'-stop drilling 1/20/81 begin rotary drilling 1/21/81
82						
84						
		FERNANDO FORMATION				
86		85.0-96.4 SILTSTONE: moderate brown; moist	Box 4 (cont)		PB	1.1/2.8 recovery
88		Physical Condition: massive; low hardness; friable; fresh				2.8/2.8 recovery
90			Box 5			
92	40°	91'-96.4' some thin sandy siltstone lenses				

Project DESIGN UNIT A-240 Date Drilled 1-21-81 Hole No. 16

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
92		FERNANDO FORMATION 85.0-96.4 SILTSTONE: (continued)	Box 5		PB	2.8/2.8 recovery
94	40°					2.5/2.8 recovery pocket penetrometer >4.5 2/9/81
96						
		96.4-105.0 SILTSTONE with interbedded CLAYSTONE and SILTY SAND: dark moderate brown and greyish brown				2.8/2.8 recovery
98	30°		Box 6			
100		Physical Conditions: massive; low hardness; friable; fresh	S-6			2.8/2.8 recovery
102	30°		Box 6 (cont)			2.8/2.8 recovery
104						
		105.0-135.0 SILTSTONE: dark moderate brown; moist				
106		Physical Condition: massive; low hardness; friable; fresh				2.7/2.8 recovery
108						pocket penetrometer >4.5 2/9/81 2.8/2.8 recovery
110						
		111'-114' some very thin silty sandstone layers and claystone layers	Box 7			2.8/2.8 recovery
112	35°	(0.05' - 0.1 Thick)				
114						2.8/2.8 recovery
116						

Project DESIGN UNIT A-240 Date Drilled 1-21-81 Hole No. 16

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
116		FERNANDO FORMATION 105.0-135.0 SILTSTONE: (continued)	Box 7		PB	
			S-7			2.8/2.8 recovery
118						
			Box 7 (cont.)			pocket penetrometer >4.5 2/9/81
120						2.8/2.8 recovery
		120.1-120.3: SILTY SANDSTONE: light brown; mostly fine sand with some fines				
122						2.8/2.8 recovery
		123.0-135: occasional very thin SILTY SANDSTONE layers	Box 8			
124						2.8/2.8 recovery
126						
	40°		S-8			2.0/2.8 - bent tube requires pipe cutter before extruding
128						
130						
	35°	becoming more competent with depth	Box 8 (cont.)			1.5/2.5 recovery (cemented material)
132				RD		RD to 133'
				PB		2.2/2.3 recovery
			S-9			134' - Gas Test no gas
134						
		135.0-169.5 SILTSTONE: as above, although gradually more competent Physical Condition: massive, low hardness, friable, fresh	Box 8 (cont.)			2.6/2.7 recovery pocket penetrometer >4.5 2/9/81
136						
138						2.0/2.1 recovery
	35°					
140			Box 9			

Project DESIGN UNIT A-240 Date Drilled 1-20-27-81 Hole No. 16

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
140		135.0-169.5 SILTSTONE: (cont.)	Box 9		PB	2.0/2.0 recovery
142		SILTY SANDSTONE layers				1.9/2.0 recovery
144						pocket penetrometer <4.5 2/9/81. 2.0/2.0 recovery
146			S-10			2.5/2.5 recovery
148		Physical Condition: massive, low hardness, friable to weak, fresh	Box 9 (cont.)			2.3/2.8 recovery
150		149.7 very thin volcanic ash layer				1.9/2.0 recovery
152						
154			Box 10			2.8/2.8 recovery
156						2.7/2.8 recovery
158		157.2 very thin layer of SANDY SILTSTONE 30°				pocket penetrometer <4.5 2/9/81
160						2.3/2.8 recovery
162			S-11			2.2/2.2 recovery
164						164' - stop 1/21/81 - begin 1/26 - clean out hole to 164'

Project DESIGN UNIT A-240 Date Drilled 1-20-27-81 Hole No. 16

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
164		135.0-169.5 SILTSTONE: (cont.)	Box 10		PB	2.7/2.8 recovery pocket penetrometer >4.5 2/9/81
			Box 11			
166						2.1/2.8 recovery
168		169.5-189.0 SILTSTONE with interbedded CLAYSTONE and SILTY SANDSTONE: very thinly bedded; claystone is greyish brown; silty sandstone is light blueish grey with mostly fine sand and little fines				2.8/2.8 recovery
170						
	40°					
172		Physical Condition: massive, low hardness, friable, fresh				2.3/2.8 recovery
	45°					
174			Box 12			2.2/2.2 recovery
			S-12			
176						
178			S-13			2.8/2.8 recovery
180		180.0-181.5 SILTSTONE: (not interbedded)	Box 12 cont.			2.8/2.8 recovery pocket penetrometer >4.5 2/9/81
182						2.4/2.8 recovery
	40°					
184						
	30°					
186						2.3/2.8 recovery
188						

Project DESIGN UNIT A-240 Date Drilled 1-20-27-81 Hole No. 16

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
188		169.5-189.0 SILTSTONE with interbedded CLAYSTONE and SILTY SANDSTONE:	Box 12		PB	1.9/2.2 recovery
190		189.0-199.2 SILTSTONE: dark moderate brown; moist Physical Condition: massive; low hardness, friable, fresh	Box 13			2.8/2.8 recovery
192						
194			S-14			1.2/2.8 recovery
196		196.0-199.0 some SANDSTONE AND CLAYSTONE interbeds	Box 13 cont.			2.8/2.8 recovery pocket penetrometer >4.5 2/9/81
198		30°				
		Bottom of hole				199.2' Terminate hole: 4:00 1/26/81 run electric logs 1/26/81. 1/27/81 - install piezometers; 2" PVC from 200' to surface w/cloth covered perforations from 160' to 195'. Gravel pack to 87'. Bentonite plug from ~75' to 87'. 1" PVC piezometer from 80' to surface w/perforations from 40' to 75' Gravel pack to 5'. Bentonite surface plug & surface cap. Clean-up site and move off 12:00 1/27/81 water sampled 2" & 1" 2/18/81
200						
202						
204						
206						
208						
210						
212						

THIS BORING LOG IS BASED ON FIELD CLASSIFICATION AND VISUAL SOIL DESCRIPTION, BUT IS MODIFIED TO INCLUDE RESULTS OF LABORATORY CLASSIFICATION TESTS WHERE AVAILABLE. THIS LOG IS APPLICABLE ONLY AT THIS LOCATION AND TIME. CONDITIONS MAY DIFFER AT OTHER LOCATIONS OR TIME.

Converse Consultants, Inc.
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BORING LOG 16A

Proj: DESIGN UNIT A-240 Date Drilled 2-22-83 Ground Elev. 212.0'

Drill Rig B. Auger Logged By Dan Gillette Total Depth 72.0'

Hole Diameter 36" Hammer Weight & Fall NA

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
0	SC	YOUNG ALLUVIUM 0.0-10.0 CLAYEY SAND: grayish orange; medium sand; moist; medium dense	NO SAMPLES REQUIRED OBSERVATION HOLE			0.0-33.0 hole stands well
2						
4						
		5.0-6.0 Sand lens				
6						
8						
10	CL	OLD ALLUVIUM 10.0-21.0 SANDY CLAY: pale yellowish brown; with fine sand; moist; stiff				
12						
14						
16						
18						
		20.0 light brown streaks				

Project DESIGN UNIT A-240 Date Drilled 2-22-83 Hole No. 16A

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
20	CL	10.0-21.0 SANDY CLAY: (cont.)				
	SW	21.0-31.0 SAND: moderate brown; contains mostly fine sand; moist to very moist; medium dense				
22						
24						Ground Water Data - recovery 10:15 - 51.5' 10:35 - 50.0' 11:45 - 46.6' 12:40 - 44.5' 145 min. 260 gal. $Q=\frac{260}{145}$= 1.8gpm
26						
28						
		29.0 medium gray streaks				
30						
	SM/ ML	31.0-35.0 SANDY SILT: dark gray; silt and fine sand; firm; very moist to wet; has strong sulfur odor				30-33' hole ravels slightly due to seep at 32.0' 33-42' hole stands well
32						
34						
	CH	35.0-42.0 SANDY CLAY: dark gray; some medium and coarse sand; firm; moist				
36						
38				▼	WL	39.0 water level
40						
42	SP/ SM	SAN PEDRO FORMATION 42.0-51.0 SILTY SAND: med. dark grey; fine sand; dense; moist				

Project DESIGN UNIT A-240 Date Drilled 2-22-83 Hole No. 16A

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
44	SP/SM	42.0-51.0 SILTY SAND: (cont.) 43.5-45.0 little fine gravel				
46						
48						
50						
52	CL	51.0-53.0 SANDY CLAY: dusky blue green; little medium sand; firm; moist				
54	SC	53.0-72.0 CLAYEY SAND: medium dark grey; dense; medium sand; very moist;				
56						
58						
60						
62						
64						
66						
68						

Project DESIGN UNIT A-240 Date Drilled 2-22-83 Hole No. 16A

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
68	SC	53.0-72.0 CLAYEY SAND: (cont.)				
70						
72		End Boring 72.0'				SPECIAL HOLE CLOSURE Note: stopped drilling due to excessive bellin backfill - placed pea gravel to 30' then slurry to 1' then concrete cap to side-walk grade
74						
76						
78						
80						
82						
84						
86						
88						
90						
92						

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BORING LOG 16-5

Proj: DESIGN UNIT A-240 Date Drilled 10-3-4-83 Ground Elev. 211.5'

Drill Rig Failing 1500 Logged By L. Schoeberlein Total Depth 99.7'

Hole Diameter 4 7/8" Hammer Weight & Fall 140 lb @ 30"

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
0	AC	0.9-0.2 ASPHALT			GB	start drilling 2:15
	CL	FILL 0.2-1.5 SANDY CLAY: brown, stiff; moist				
2	CL	ALLUVIUM 1.5-10.0 SANDY CLAY: greyish green; some fine sand; stiff to hard; moist		7	DR	1.0/1.0 recovery
			C-1	11		
4					AD	
6		thinly bedded clayey sand	SH-1		SH	2.5/2.5 recovery
	(SC					
8			J-1	16 17 20	SS	1.5/1.5 recovery
10					AD	
	CL	10.0-11.5 SILTY CLAY: light olive brown; fines, trace fine sand; hard; moist				
12	CL	11.5-21.0 SANDY CLAY: mottled light olive brown with greyish green; little fine sand; hard; moist		13	DR	1.0/1.0 recovery
			C-2	37		set tube & cased to 13', mixed mud
14					RD	
16	SP	sand lens	PB-1		PB	2.1/2.5 recovery
	CL					
18	(SC	18.0- CLAYEY SAND	J-2	7 17 23	SS	1.5/1.5 recovery
					RD	

Project DESIGN UNIT A-240 Date Drilled 10-3-4-83 Hole No. 16-5

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
20	CL	11.5-21.0 SANDY CLAY: cont.			RD	
	SC	21.0-25.0 CLAYEY SAND: light olive grey; dense; moist				
22				22	DR	1.0/1.0 recovery
			C-3	39		
					RD	
24						
	SP	25.0-27.0 SAND: light olive grey; fine to medium sand, trace of silt; medium dense; wet	PB-2		PB	2.2/2.5 recovery
26						
	ML	27.0-29.0 CLAYEY SILT: dusky yellow; very stiff; moist				
28			J-3	4	SS	1.5/1.5 recovery
				9		
				14		
	CL	29.0-31.5 SILTY CLAY: dusky yellow; very stiff; moist			RD	
30						
	ML	31.5-35.0 SANDY SILT: dusky yellow; occasional silty sand lenses; stiff; moist				
32				18	DR	1.0/1.0 recovery
			C-4	19		
	(SM)				RD	
34						
	CL/ SM/ ML	35.0-52.0 SANDY CLAY/SILTY SAND/SILT: dark greenish grey; thin to medium layers; dense; moist; contains cemented nodules	PB-3		PB	2.7/2.7 recovery
36						
38			J-4	17	SS	1.5/1.5 recovery
				26		
				50		
40					RD	
42				36	DR	0.9/0.9 recovery
			C-5	50-5	"	
		43.0- SANDY CLAY			RD	
44						

Project DESIGN UNIT A-240 Date Drilled 10-3-4-83 Hole No. 16-5

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
44	CL/SM/ML	35.0-52.0 SANDY CLAY/SILTY SAND/SILT: cont.			RD	
					PB	bent tube
46						
			J-5	12 27 39	SS	1.5/1.5 recovery 5:30 10/3/83
48					RD	7:00 10/4/83
50						
			PB-4		PB	2.1/2.5 recovery
52	SM	52.0-58.5 SILTY SAND: dark greenish grey; fine sand; dense; moist				
					RD	
54						
			PB-5		PB	2.5/2.5 recovery
56						
58			J-6	12 20 25	SS	1.5/1.5 recovery
	CL	58.5-60.5 SANDY CLAY: dark greenish grey; little fine sand; hard; moist; contains cemented nodules			RD	
60						
	SM	60.5-64.5 SILTY SAND: dark greenish grey; fine sand, dense; moist				
62				40	DR	1.0/1.0 recovery
			C-6	56		
					RD	
64						
	SP/SM	SAN PEDRO FORMATION 64.5-86.5 SAND/SILTY SAND: dark greenish grey; fine sand; trace of silt; very dense; wet				
66					PB	1.6/2.5 recovery
			PB-6			
68						

Project DESIGN UNIT A-240 Date Drilled 10-3-4-83 Hole No. 16-5

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
68	SP/SM	64.5-86.5 SAND/SILTY SAND: cont.	J-7	29 50-4	SS 5"	0.7/0.9 recovery
70					RD	
72			C-7	48 50-4	DR 5"	0.7/0.9 recovery
74					RD	
76			PB-7		PB	1.9/2.0 recovery
78			J-8	50-4	" SS	0.3/0.3 recovery
80	GP	79.0-86.5 gravelly sand grading to sandy gravel with some fine sand lenses			RD	
82			C-8	106	DR RD	0.3/0.5 recovery
84						
86						
88		PUENTE FORMATION 86.5-99.7 INTERBEDDED SILTSTONE and CLAYSTONE: olive grey and dark greenish grey; thinly to thickly interbedded;	PB-8		PB	2.0/2.5 recovery
90		Physical Condition: little fractured to massive; friable hardness and strength; little weathered to fresh			RD	
92						

Project DESIGN UNIT A-240 Date Drilled 10-3-4-03 Hole No. 16-5

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
92		86.5-99.7 INTERBEDDED SILTSTONE and CLAYSTONE: cont.	C-9	41 50-3"	DR RD	0.7/0.7 recovery
94						
96						
98			PB-9		PB	2.5/2.5 recovery
100		B.H. 99.7 Terminated hole; flushed hole and installed piezometer to bottom, ~ 80-100' slotted; pea gravel backfill to surface				Completed drilling 12:15
102						
104						
106						
108						
110						
112						
114						
116						

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BORING LOG 16-6

Proj: DESIGN UNIT A-240 Date Drilled 10-23-24-83 Ground Elev. 204'

Drill Rig Failing 1500 Logged By L. Schoeberlein Total Depth 95.7'

Hole Diameter 4 7/8" Hammer Weight & Fall 140 lb @ 30"

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
0	CONC	0.0-0.8 CONCRETE			GB	started drilling 9:30
	GP	0.8-1.5 BASE ROCK				
2	CL	OLD ALLUVIUM 1.5-3.5 SANDY CLAY: dark greenish grey; trace of fine sand; very stiff; moist		9	DR	0.8/1.0 recovery
			C-1	16		pocket pen 4.25 tsf
					AD	
4	CL	3.5-11.0 CLAY: dark greenish grey; hard; moist		7	SS	1.5/1.5 recovery
			J-1	13		
				20		
6					RD	set tub & cased to 6.5'
				8	DR	1.0/1.0 recovery
		contains white cemented nodules	C-2	9		pocket pen 4.25 tsf
8					RD	
				6	SS	0.1/1.5 recovery
				11		
10				15		
					RD	
	CL	11.0-15.0 SILTY CLAY: dusky yellow; stiff; moist; mottled with ferrous staining		11	DR	1.0/1.0 recovery
12			C-3	8		pocket pen 3.5 tsf
					RD	
14				3	SS	1.4/1.5 recovery
			J-2	5		
				15		
	SP	15.0-23.5 SAND: dusky yellow; trace of fines; very dense; moist; occasional lenses of medium sand			RD	
16				23	DR	1.0/1.0 recovery
			C-4	36		
18	(SM)	18.0- SILTY SAND			RD	
		intense ferrous mottling		17	SS	1.5/1.5 recovery
			1-2	41		

Project DESIGN UNIT A-240 Date Drilled 10-23-24-83 Hole No. 16-6

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
20	SP	15.0-23.5 SAND: cont.		42	SS	
					RD	
22	(ML)	thin clayey silt lens		15	DR	0.9/1.0 recovery
			C-5	36		
					RD	
24	CL	23.5-43.5 SILTY CLAY: dark greenish grey; hard; moist		8	SS	1.5/1.5 recovery
			J-4	18		
				30		
					RD	
26						
				21	DR	1.0/1.0 recovery
			C-6	50-5.5"		pocket pen 2.75 tsf
28	(SC)	clayey sand lens			RD	
				11	SS	1.5/1.5 recovery
			J-5	20		
30				31		
					RD	
32				34	DR	0.8/0.9 recovery
		becoming weakly cemented throughout with cemented nodules	C-7	50-5"		pocket pen > 4.5 tsf
					RD	
34				16	SS	1.5/1.5 recovery
	(SC)	no cementation, no nodules; contains some thin clayey sand lenses	J-6	34		
				50-5"		
36					RD	
		occasional cemented nodules, increased silt, sandy clay lens		36	DR	1.0/1.0 recovery
			C-8	43		pocket pen > 4.5 tsf
38					RD	
		interbedded silty sand, silty clay and silt		9	SS	1.1/1.5 recovery
			J-7	24		
40				28		
					RD	
42		weakly cemented in places		24	DR	0.9/1.0 recovery
			C-9	59		
	(SM)	43.0- SILTY SAND lense			RD	
44	CL	43.5-46.5 SANDY CLAY:				

Project DESIGN UNIT A-240 Date Drilled 10-23-24-83 Hole No. 16-6

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
44	CL	43.5-46.5 SANDY CLAY: cont. dark greenish grey; little fine sand; hard; moist; occasional clayey sand lenses	J-8	19 24 30	SS	1.5/1.5 recovery
	SC				RD	
46	SM/SP	46.5-49.6 SILTY SAND: dark greenish grey; little silt; very dense; moist; sulfur odor		58	DR	0.9/1.0 recovery
			C-10	50-3"		
48					RD	
			J-9	21 29 38	SS	1.5/1.5 recovery
50	CL	49.6-54.0 SILTY CLAY: dark greenish grey; trace of sand; hard; moist; contains occasional small cemented nodules			RD	
52				31	DR	0.9/1.0 recovery pocket pen > 4.5 tsf
			C-11	46		
					RD	
54	ML	54.0-56.0 SANDY SILT: dark greenish grey; increasing sand content with depth; dense; moist	J-10	5 13 24	SS	1.5/1.5 recovery
					RD	
56	SM	56.0-57.4 SILTY SAND: dark greenish grey; increasing sand content with depth; very dense; wet		42	DR	0.7/0.7 recovery
	SP/SM	SAN PEDRO FORMATION	C-12	50-3	"	
58		57.4-67.0 SAND/SILTY SAND: dark greenish grey; fine sand, trace silt; very dense; wet			RD	
				22 50	SS	0.1/1.0 recovery
60					RD	
62				71	DR	0.4/0.7 recovery
			C-13	50-2	5"	disturbed
					RD	
64				31 53	SS	0.1/1.0 recovery
					RD	
66						
	SW	67.0-71.0 GRAVELLY SAND: dark greenish grey		120	DR	0.0/0.5 recovery

Project DESIGN UNIT A-240 Date Drilled 10-23-24-83 Hole No. 16-6

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
68	SW	67.0-71.0 GRAVELLY SAND: cont. mostly fine to coarse sand with little fine gravel; very dense; wet			RD	
			J-11	91-5.5"	SS	0.4/0.5 recovery
70						
	SP/SM	71.0-76.0 SAND/SILTY SAND: dark greenish grey; fine sand; trace of silt; very dense; wet				
72			C-14	86	DR	0.3/0.5 recovery
					RD	disturbed
		becoming fine grained		25	SS	0.9/0.9 recovery
74			J-12	50-4.5"		
					RD	
		gravelly sand lens				rig chatter
76		PUENTE FORMATION				
		76.0-95.7 INTERBEDDED SILTSTONE and CLAYSTONE: dark greenish grey and olive grey; thinly to thickly bedded; uncemented		30	DR	0.6/0.9 recovery
78			C-15	50-4.5"		
					RD	
		Physical Condition: little fractured to massive; friable hardness and strength; little weathered to fresh				
80						
82				46	DR	
		some sandstone beds	C-16	50-4	"	4:30 10/23/83
					RD	7:00 10/24/83
84						
86						
		contains some irregular inclusions of variable color		39	DR	0.6/0.7 recovery
			C-17	50-2	5"	
88					RD	
90						
				53	DR	0.7/0.8 recovery
92			C-18	50-4	" RD	

Project DESIGN UNIT A-240 Date Drilled 10-23-24-83 Hole No. 16-6

DEPTH	USCS	MATERIAL CLASSIFICATION	SAMPLE	BLOWS (6")	DRILL MODE	REMARKS
92		76.0-95.7 INTERBEDDED SILTSTONE and CLAYSTONE: cont.			RD	
94			C-19	80 50-2.5"	DR	
96		B.H. 95.7 Terminated hole; installed piezometer to bottom, ~ 75-95' slotted.				complete drilling and flushing 8:45
98						
100						
102						
104						
106						
108						
110						
112						
114						

APPENDIX A

TEST BORINGS LOGS
BY
KAISER ENGINEERS
JUNE 1962

PREPARED FOR

THE LOS ANGELES METROPOLITAN TRANSIT AUTHORITY

REFERENCE: VOLUME IV - BOOK 3

Printed On Recycled Paper

LOG OF DRILLHOLE

HOLE NO. WC-59 DATE 3/23/62 PAGE NO. 1 OF 4 PAGES

LOCATION Wilshire & Norton Ave. JOB NO. 6148-5

COLLAR ELEV. 200.2 INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		0.0 - 0.6 Asphalt-Concrete
		0.6 - 5.0 (SC)
		Sandy-clay with small amount of silt mixture, light brown gravish color, damp, inorganic, low to medium plasticity
		5.0 - 6.5 (SM) WC-59-1
		Silty sand, gray color, medium dense, inorganic
		III Disturbed
		II Disturbed
		I Disturbed
		6.5 - 10.0 (GM)
		Gravel-sand-silt mixture, sand is coarse-grained with about 15% silt, damp, inorganic, gray color
		10.0 - 11.5 (GM) WC-59-2
		As above
		III Empty
		II Empty
		I Disturbed
		11.5 - 15.0 (SM)
		Silty, fine sand, clayey, small amount of coarse sand and gravel mixture, damp, dense, inorganic, slight plasticity
		15.0 - 16.5 (SM) WC-59-3
		Silty, fine sand as above
		III
		II
		I

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS
0.0	0.6	0.6			Tri-Cone
0.6	63.0	62.6			Auger

CASING NOTES

FROM	TO	SIZE	REMARKS
			No casing

SAMPLING NOTES

TYPE SAMPLER Split-Tube

SIZE 2" WT. OF HAMMER 140 lb DROP 30"

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
1	5.0	6.5	1.5		4	13	23	
2	10.0	11.5	1.5		10	18	27	
3	15.0	16.5	1.5		7	14	22	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	25'
DEPTH TO WATER	22'
TIME OF OBSERV.	11:15 PM 3/23/62

LOG OF DRILLHOLE

HOLE NO. WC-59 DATE 3/23/62 PAGE NO. 2 OF 4 PAGES

LOCATION Wilshire & Norton Ave. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		16.5 - 20.0 (SM)
		Silty, fine sand as above
		20.0 - 21.5 (SM) WC-59-4
		III
		II
		I
		21.5 - 25.0 (SM,ML)
		Silty, fine sand becoming
		clayey fine silt, gray color
		dense, damp, inorganic,
		slight plasticity
		25.0 - 26.5 (ML) WC-59-5
		III
		II
		I
		26.5 - 30.0 (ML)
		Clayey, fine silt, damp,
		gray color, dense, inorganic
		slight plasticity
		30.0 - 31.5 (ML) WC-59-6
		III
		II
		I
		31.5 - 35.0 (ML, SM)
		Clayey fine silt as above
		becoming silty, fine sand
		at 35.0', damp, dense, in-
		organic, low to slight
		plasticity

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
4	20.0	21.5	1.5		6	15	28	
5	25.0	26.5	1.5		4	12	25	
6	30.0	31.5	1.5		11	30	49	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	
TIME OF OBSERV.	

LOG OF DRILLHOLE

HOLE NO. WC-59 DATE 3/23/62 PAGE NO. 3 OF 4 PAGES

LOCATION Wilshire & Norton Ave. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		35.0 - 36.5 (SM) WC-59-7
		Silty, fine sand, damp,
		inorganic, low plasticity
		III
		II
		I
		36.5 - 40.0 (SM)
		Silty, fine sand, damp,
		dense, inorganic, becoming
		medium grained sand at 40.0
		40.0 - 41.0 (SM) WC-59-8
		Silty sand, sand is medium
		grained, grav color, dense,
		inorganic
		III Empty
		II
		I
		41.0 - 45.0 (ML)
		Clayey, fine silt, grav
		color, damp, dense, in-
		organic, low to slight
		plasticity
		45.0 - 46.5 (ML) WC-59-9
		Same as above
		III
		II
		I
		46.5 - 50.0 (GM)
		Gravel-sand-silt mixture,
		gravel is coarse, dense,
		damp, inorganic

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
7	35.0	36.5	1.5		10	21	36	
8	40.0	41.0	1.0		15	50		
9	45.0	46.5	1.5		9	20	37	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	
TIME OF OBSERV.	

LOG OF DRILLHOLE

HOLE NO. WC-59 DATE 3/23/62 PAGE NO. 4 OF 4 PAGES

LOCATION Wilshire & Norton Ave. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		50.0 - 51.5 (GM) WC-59-10
		III
		II
		I
		51.5 - 55.0 (SP)
		Sand, coarse grained, wet,
		poorly graded, gray color,
		inorganic, non-plastic
		55.0 - 56.5 (SP) WC-59-11
		Same as above
		III Empty
		II Empty
		I Empty
		56.5 - 60.0 (SP)
		Sand as above, very wet
		60.0 - 61.5 No sample
		56.5 - 63.0 (SP)
		Sand, coarse grained, very
		wet, inorganic, gray color,
		non-plastic
		63.0 - 64.5 (SP) WC-59-13
		Same as above
		III
		II
		I
		Note: Hole caved in at 55.0'.

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
10	50.0	51.5	1.5		15	31	86	
11	55.0	56.5	1.5		3	5	8	
12	60.0	61.5	1.5		No sample			
13	63.0	64.5	1.5		12	24	52	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	
TIME OF OBSERV.	

LOG OF DRILLHOLE

HOLE NO. WC-60 DATE 3/22/63 PAGE NO. 1 OF 4 PAGES

LOCATION Wilshire & Van Ness Ave. JOB NO. 6148-5

COLLAR ELEV. 191.1 INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		0.0 - 0.6 Asphalt - Concrete
		0.6 - 5.0 (SC)
		Sandy clay, brown color, very small amount of silt, slightly damp, inorganic
		5.0 - 6.5 (SC) WC-60-1
		Sandy clay as above
		III Disturbed
		II Disturbed
		I Discarded
		6.5 - 10.0 (SC, GM)
		Sandy clay as above becoming gravel-sand-silt mixture, damp, sand is coarse grained, maximum size of gravel is 1/4", well-graded, inorganic loose
		10.0 - 11.5 (GM) WC-60-2
		Gravel-sand-silt mixture
		III
		II
		I
		11.5 - 1.50 (SW)
		Sand-gravel mixture becoming clayey-sand (SC) with some gravel, sand is coarse, damp, inorganic at 16.5'
		15.0 - 16.5 (SW, SC) WC-60-3
		Sand-gravel mixture becoming clayey-sand at 16.5', small amount of gravel
		III Empty
		II Empty
		I Empty

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS
.0	0.6	0.6			Tri-Cone
).6	55.0	54.6			Auger

CASING NOTES

FROM	TO	SIZE	REMARKS
			No casing

SAMPLING NOTES

TYPE SAMPLER Split-Tube

SIZE 2" WT. OF HAMMER 140 lb DROP 30"

SMPL NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
1	5.0	6.5	1.5		4	7	20	
2	10.0	11.5	1.5		3	10	28	
3	15.0	16.5	1.5		4	13	23	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	15
DEPTH TO WATER	12
TIME OF OBSERV.	10:45 PM 3/22/63

LOG OF DRILLHOLE

HOLE NO. WC-60 DATE 3/22/62 PAGE NO. 2 OF 4 PAGES

LOCATION Wilshire & Van Ness Ave. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		16.5 - 20.0 (ML)
		Clayey silt, light brown color, damp, inorganic, medium dense, slight plasticity
		20.0 - 21.5 (ML) WC-60-4
		Same as above
		III
		II
		I
		21.5 - 25.0 (SM)
		Silty sand, clayey, sand is coarse grained, damp, inorganic, medium dense, slight plasticity
		25.0 - 26.5 No sample
		26.5 - 30.0 (SM)
		Silty sand, gray color, about 30% silt, sand is coarse grained, wet, inorganic, non-plastic
		30.0 - 31.5 (SM) WC-60-6
		Silty sand, coarse grained
		III
		II
		I
		31.5 - 35.0 (SW)
		Gravelly-sand, wet, inorganic, becoming silty, fine sand with clay mixture at 35.0:

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
4	20.0	21.5	1.5		6	15	29	
5	25.0	26.5	1.5		5	13	25	
6	30.0	31.5	1.5		6	25	44	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	
TIME OF OBSERV.	

LOG OF DRILLHOLE

HOLE NO. WC-60 DATE 3/22/62 PAGE NO. 3 OF 4 PAGES

LOCATION Wilshire & Van Ness Ave. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		35.0 - 36.5 (SM) WC-60-7
		Silty fine sand, clayey, dark gray color, medium dense
		III
		II
		I
		36.5 - 40.0 (SM)
		Silty, fine sand with small amount of coarse grained sand, medium dense, inorganic, slight plasticity
		40.0 - 41.5 (SM) WC-60-8
		Silty, sand, sand is coarse grained, dense, earthy odor
		III
		II
		I
		41.5 - 45.0 (SM)
		Silty, fine sand, dark gray color, micaceous, inorganic, slight plasticity
		45.0 - 46.5 (SM) WC-60-9
		Same as above
		III
		II
		I
		46.5 - 50.0 (SM)
		Silty sand, sand is medium grained, some coarse grained sand mixture, very wet, inorganic, non-plastic, gray color

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
7	35.0	36.5	1.5		7	16	26	
8	40.0	41.5	1.5		5	18	32	
9	45.0	46.5	1.5		6	18	37	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	
TIME OF OBSERV.	

LOG OF DRILLHOLE

HOLE NO. WC-60 DATE 3/22/62 PAGE NO. 4 OF 4 PAGES

LOCATION Wilshire & Van Ness Ave. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		50.0 - 51.5 (SM) WC-60-10
		Same as above
		III Wet
		II Wet
		I Wet
		51.4 - 55.0 (SM)
		Sand with silt mixture, sand is coarse grained becoming poorly graded medium sand at 55.0', wet, gray color, inorganic
		55.0 - 56.5 (SM, SL) WC-60-11
		Sand-silt mixture - poorly graded sand
		III
		II
		I
		Note: Hole caved in at 47'.

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
10	50.0	51.5	1.5		13	51	100	
11	55.0	56.5	1.5		13	45	101	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	
TIME OF OBSERV.	

LOG OF DRILLHOLE

HOLE NO. WC-61 DATE 3-21-62 PAGE NO. 1 OF 4 PAGES

LOCATION Wilshire & Gramercy Pl. JOB NO. 6148-5

COLLAR ELEV. 191.6 INSPECTOR R. Singh

GEOLOGIC NOTES

Depth	Classification and Physical Character
0 - 0.4	Concrete
0.4 - 5.0	(SM) Silty sand, Light brown color, sand is coarse grained to medium, damp, inorganic, dense, slight plasticity
5.0 - 6.5	(SM) WC-61-1 Silty sand as above III Disturbed II Disturbed I Disturbed
6.5 - 10.0	(SM) Silty sand, light brown color as above becoming gray silty sand, clayey, dense, inorganic, low plasticity
10.0 - 11.5	(SM) WC-61-2 Silty sand, clayey III II I
11.5 - 15.0	(SM) Silty sand, clayey, gray color, dense, inorganic, low plasticity
15.0 - 16.5	(SM) WC-61-3 Same as above III II I

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS
0	0.4	0.4			Tri-Cone
0.4	53.0	52.8			Auger

CASING NOTES

FROM	TO	SIZE	REMARKS
			No Casing

SAMPLING NOTES

TYPE SAMPLER Split Tube

SIZE 2" WT. OF HAMMER 140 lb DROP 30"

SMPL NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
1	5.0	6.5	1.5		6	15	30	
2	10.0	11.5	1.5		10	20	32	
3	15.0	16.5	1.5		5	11	25	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

LOG OF DRILLHOLE

HOLE NO. WC-61 DATE 3-21-62 PAGE NO. 2 OF 4 PAGES

LOCATION Wilshire & Gramercy Pl. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		16.5 - 20.0 (ML) Clayey silt with small amount of sand mixture, gray color, damp, inorganic, dense, low plasticity
		20.0 - 21.5 (ML) WC-61-4 Clayey silt with sand mixture
		III
		II
		I
		21.5 - 25.0 (ML) Clayey silt as above
		25.0 - 26.5 (ML) WC-61-5 Clayey silt as above
		III
		II
		I
		26.5 - 30.0 (ML-SM) Clayey silt becoming more silty sand, damp, micaceous, inorganic, dense, low to slight plasticity
		30.0 - 31.5 (SM) WC-61-6 Silty, fine sand, damp, gray color, micaceous
		III
		II
		I
		Note: Second observation made at 3:30 A.M. Water level at 15',

BORING NOTES

Drilling Method _____

Hole Size _____

Angle _____ Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER Split -tube

SIZE 2" WT. OF HAMMER 140 lt DROP 30"

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
4	20.0	21.5	1.5		6	16	32	
5	25.0	26.5	1.5		6	14	27	
6	30.0	31.5	1.5		7	16	33	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	25'
DEPTH to WATER	20'

LOG OF DRILLHOLE

HOLE NO. WC-61 DATE 3-21-62 PAGE NO. 3 OF 4 PAGES

LOCATION Wilshire & Gramercy Pl. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		31.5 - 35.0 (SM) Silty, fine sand,
		Clayey becoming coarse
		grained to medium sand,
		gravelly, damp, inorganic,
		dense
		35.0 - 36.5 (SM) WC-61-7
		III NF
		II NF
		I
		36.5 - 40.0 (SM) Silty sand, damp,
		gray color, medium grained
		sand, inorganic
		40.0 - 41.5 WC-61-8
		No sample - hole caving
		in at this depth
		III No sample
		II No sample
		I No sample
		41.5 - 45.0 (SM) Silty sand, as
		above
		45.0 - 46.5 WC-61-9
		No sample, water increas-
		ing in hole
		46.5 - 50.0 (SM) Silty sand, sand is
		coarse to medium grained
		50.0 - 51.5 (SM) WC-61-10-
		Silty sand, little fines,
		sand is coarse grained,
		very damp, inorganic,
		gray color
		III Empty
		II Wet

BORING NOTES

Drilling Method _____

Hole Size _____

Angle _____ Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER Split-tube

SIZE 2" WT. OF HAMMER 140 lb DROP 30"

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
7	35.0	36.5	1.5		5	13	23	
8	40.0	41.5	1.5		2	4	7	NS
9	45.0	46.5	1.5		9	24	43	NS
10	50.0	51.5	1.5		4	11	30	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

LOG OF DRILLHOLE

HOLE NO. WC-61 DATE 3-21-62 PAGE NO. 4 OF 4 PAGES

LOCATION Wilshire & Gramercy Pl. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		51.5 - 53.0 (SM) Silty sand as above
		53.0 - 54.5 (SM) WC-61-11
		No samole, hole caving in
		due to rapid flow of water

BORING NOTES

Drilling Method _____

Hole Size _____

Angle _____ Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
11	53	54.5	1.5		17	30	58	NS

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

LOG OF DRILLHOLE

HOLE NO. WC-62 DATE 3-19-62 PAGE NO. 1 OF 4 PAGES

LOCATION Wilshire & Andrews Pl. JOB NO. 6148-5

COLLAR ELEV. 196.2 INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		0 - 1.0 Asphalt - Concrete
		1.0 - 5.0 (SM) Silty sand, brown color, small amount of clay, damp, medium dense, low consistency, inorganic
		5.0 - 6.5 (SM) WC-62-1 Silty sand, light brown color, damp, inorganic, low consistency, some coarse gravel
		III Disturbed
		II Disturbed
		I Disturbed
		6.5 - 10.0 (SM) Silty sand, brown color, more clayey than above, medium dense, low consistency, inorganic
		10.0 - 11.5 (ML) WC-62-2 Clayey silt, damp
		III NF Disturbed
		II Disturbed
		I Disturbed
		11.5 - 15.0 (ML) Clayey silt, brown color, damp, dense, inorganic, some coarse grained gravel.
		15.0 - 16.5 (ML) WC-62-3 Clayey silt, brown color damp, dense, inorganic, some coarse grained gravel
		III
		II
		I

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS
0	1.0	1.0			Tri-Cone
1.0	50.0	44.0			Auger

CASING NOTES

FROM	TO	SIZE	REMARKS
			No Casing

SAMPLING NOTES

TYPE SAMPLER Split-Tube

SIZE 2" WT. OF HAMMER 140lb DROP 30"

SMPL NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
1	5.0	6.5	1.5		9	20	32	
2	10.0	11.5	1.5		5	11	18	
3	15.0	16.5	1.5		3	12	24	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	20.0
DEPTH to WATER	16.0

LOG OF DRILLHOLE

HOLE NO. WC-62 DATE 3-19-62 PAGE NO. 2 OF 4 PAGES

LOCATION Wilshire & St. Anrews Pl. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		16.5 - 20.0 (ML-GM) Clayey silt, gravelly sand - silt mixture, damp, brown color, sand is coarse at 20.0; inorganic
		20.0 - 21.5 (GM-ML) WC-62-4 Gravelly - sand- silt becoming clayey silt at about 20.5'
		III
		II
		I
		21.5 - 25.0 (ML) Clayey silt, brown, some coarse sand and little gravel mixture, damp, inorganic
		25.0 - 26.5 (SM) WC-62-5 Silty sand with coarse gravel mixture, gravel is about 20%
		III
		II
		I
		26.5 - 30.0 (ML) Clayey silt, gray color Micaceous, damp, dense, inorganic, low consistency
		30.0 - 31.5 (ML) WC-62-6 Same as above
		III
		II
		I

BORING NOTES

Drilling Method _____

Hole Size _____

Angle _____ Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
4	20.0	21.5	1.5		6	15	24	
5	25.0	26.5	1.5		6	15	26	
6	30.0	31.5	1.5		5	14	24	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

LOG OF DRILLHOLE

HOLE NO. WC-62 DATE 3-19-62 PAGE NO. 3 OF 4 PAGES

LOCATION Wilshire & St. Andrews Pl JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		31.5 - 35.0 (ML) Clayey silt with small amount of coarse-grained sand, damp, gray color, inorganic, slight consistency.
		35.0 - 36.5 (ML) WC-62-7 Clayey silt, gray color, medium dense, inorganic. III II I
		36.5 - 40.0 (ML) Clayey silt with sand mixture becoming silt-sand-gravel mixture at 40.0', damp, gray color, inorganic, medium dense.
		40.0 - 41.5 (GM WC-62-8 Gravel-sand-silt mixture, 10% gravel coarse grained, well graded. III II I
		41.5 - 45.0 (GM) Gravel-sand-silt mixture with gravel about 10%, coarse-grained with medium sand, damp, medium dense, non-plastic
		45.0 - 46.5 (GM) WC-62-9 Same as above III II I

BORING NOTES

Drilling Method _____

Hole Size _____

Angle _____ Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
7	35.0	36.5	1.5		3	13	19	
8	40.0	41.5	1.5		5	21	46	
9	45.0	46.5	1.5		10	28	64	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

LOG OF DRILLHOLE

HOLE NO. WC-62 DATE 3-19-62 PAGE NO. 4 OF 4 PAGES

LOCATION Wilshire & St. Andrews Pl. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		46.5 - 50.0 (SM) Silty sand with small amount of gravel, coarse, damp, inorganic, medium dense.
		50.0 - 51.5 (SM) WC-62-10 Same as above
		III
		II
		I

BORING NOTES

Drilling Method _____

Hole Size _____

Angle _____ Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
10	50.0	51.5	1.5		6	15	23	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

LOG OF DRILLHOLE

HOLE NO. WC-63 DATE 3/16/62 PAGE NO. 1 OF 3 PAGES

LOCATION Wilshire & Manhattan Pl. JOB NO. 6148-5

COLLAR ELEV. 197.4 INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		0.0 - 0.4 Concrete
		0.4 - 5.0 (GM, SM) Silty sand, light gray color silt is about 10%, some coarse gravel mixture, medium dense, inorganic. low plasticity
		5.0 - 6.5 (SM) WC-63-1 Silty sand, as above III Disturbed II Disturbed I Disturbed
		6.5 - 10.0 (GM) Gravel-sand-silt mixtures, sand is coarse & gravelly, gray color, dry, inorganic
		10.0 - 11.5 (SM) WC-63-2 Silty sand with little gravel mixture, gravel is coarse III Disturbed II Disturbed I Disturbed
		11.5 - 15.0 (SM, ML) Silty sand becoming more clayey silt, gray color, very fine silt, slight plasticity, inorganic, coarse sand at 16.0
		Note: Water appears to be dripping

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS
0.0	0.4	0.4			Tri-Cone
0.4	41.0	36.6			Auger

CASING NOTES

FROM	TO	SIZE	REMARKS
			No casing

SAMPLING NOTES

TYPE SAMPLER Split-Tube

SIZE 2" WT. OF HAMMER 140 lb DROP 30"

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
1	5.0	6.5	1.5		14	34	55	
2	10.0	11.5	1.5		9	21	28	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	15.0'

LOG OF DRILLHOLE

HOLE NO. WC-63 DATE 3/16/32 PAGE NO. 2 OF 3 PAGES

LOCATION Wilshire & Manhattan Pl. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		15.0 - 16.5 (SM) WC-63-3
		Silty sand, sand is coarse, light brown-yellow color, damp, petroliferous traces in tube I
		III Empty
		II Empty
		I Empty
		16.5 - 20.0 (SM)
		Silty sand, medium-grained sand with little amount of clay, yellowish-gray color, damp, inorganic
		20.0 - 21.5 (SM) WC-63-4
		Silty sand, wet, medium grained, inorganic
		III Disturbed
		II Disturbed
		I Disturbed
		21.5 - 25.0 (SM, ML)
		Silty sand-clayey fine sand, damp, inorganic, gray color, micaceous, slight plasticity
		25.0 - 26.5 (ML) WC-63-5
		Silty fine sand, gray color, damp, inorganic
		III
		II
		I

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
3	15.0	16.5	1.5		22	39	79	
4	20.0	21.5	1.5		7	15	24	
5	25.0	26.5	1.5		9	21	44	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

LOG OF DRILLHOLE

HOLE NO. WC-63 DATE 3/16/62 PAGE NO. 3 OF 3 PAGES

LOCATION Wilshire & Manhattan Pl. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		26.5 - 30.0 (ML)
		Silty fine sand, no gravel, gray color, micaceous, inorganic, damp, slight plasticity
		30.0 - 31.5 (ML) WC-63-6
		Same as above
		III NP
		II
		I
		31.5 - 35.0 (ML) Same as above
		35.0 - 36.5 (ML) WC-63-7
		Same as above
		III
		II
		I ML(Formation)
		36.5 - 41.0 (ML) Same as above
		41.0 - 42.5 (ML) WC-63-8
		Same as above
		III
		II
		I

BORING NOTES

Drilling Method _____

Hole Size _____

Angle _____ Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
6	30.0	31.5	1.5		9	24	42	
7	35.0	36.5	1.5		24	54	101	
8	41.0	42.5	1.5		12	25	46	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

LOG OF DRILLHOLE

HOLE NO. WC-64 DATE 3/20/62 PAGE NO. 1 OF 3 PAGES

LOCATION Wilshire & Oxford Ave. JOB NO. 6148-5

COLLAR ELEV. 198.4 INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		0.0 - 1.0 Asphalt-Concrete
		1.0 - 5.0 (SC)
		Clayey sand, small amount of silt, light brown-gravish color, slightly damp, non-plastic, inorganic, loose
		5.0 - 6.5 (SC) WC-64-1
		Clayey sand - more silty
		III Disturbed
		II Disturbed
		I Disturbed
		6.5 - 10.0 (SM)
		Silty sand, clayey, brown-gravish color, inorganic, medium dense, low plasticity
		10.0 - 11.5 (SM) WC-64-2
		Silty sand, clayey, as above
		III Disturbed, loose
		II Disturbed, loose
		I Disturbed, loose
		11.5 - 15.0 (SC)
		Clayey sand with small amount of silt, damc, mediu dense, inorganic, light brown-gravish color, low plasticity
		15.0 - 16.5 (SC) WC-64-3
		Same as above
		III Disturbed
		II Disturbed
		I Disturbed

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS
			No casing

SAMPLING NOTES

TYPE SAMPLER Split-Tube

SIZE 2" WT. OF HAMMER 140 lb DROP 30"

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
1	5.0	6.5	1.5		1	2	4	
2	10.0	11.5	1.5		6	16	33	
3	15.0	16.5	1.5		10	27	45	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	25.0
DEPTH TO WATER	20.0

LOG OF DRILLHOLE

HOLE NO. WC-64 DATE 3/20/62 PAGE NO. 2 OF 3 PAGES

LOCATION Wilshire & Oxford Ave. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		16.5 - 20.0 (SM)
		Silty sand, dense, light brown color, clayey, inorganic, some coarse gravel mixture, low plasticity
		20.0 - 21.5 (SM) WC-64-4
		Silty sand, dense
		III
		II
		I
		21.5 - 25.0 (SM)
		Silty sand, some medium grained sand about 20%, light brown color, dense, low plasticity
		25.0 - 26.5 (SM) WC-64-5
		III
		II
		I
		26.5 - 30.0 (SM)
		Silty sand, clayey, dense, damp, inorganic, slight plasticity
		30.0 - 31.5 (SM) WC-64-6
		Silty sand becoming coarse gray wet sand at about 31.0
		III
		II
		I

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
4	20.0	21.5	1.5		6	15	31	
5	25.0	26.5	1.5		6	17	32	
6	30.0	31.5	1.5		3	10	24	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

LOG OF DRILLHOLE

HOLE NO. WC-64 DATE 3/20/62 PAGE NO. 3 OF 3 PAGES

LOCATION Wilshire & Oxford Ave. JOB NO. 6148-5

COLLAR ELEV. _____ INSPECTOR R. Singh

GEOLOGIC NOTES

Depth		Classification and Physical Character
		31.5 - 35.0 (SW)
		Gravelly sand, sand is coarse grained and about 60%, small amount of silt, very damp, gray color, inorganic, non plastic
		35.0 - 36.5 (SW) WC-64-7
		Same as above becoming clayey silt (ML), gray color at 36.5'
		III
		II
		I
		36.5 - 40.0 (ML)
		Clayey silt, damp, dense, gray color, micaceous, inorganic, low plasticity
		40.0 - 41.5 (ML) WC-64-8
		III
		II
		I
		41.5 - 47.0 (ML)
		Clayey silt, damp, dense, gray color, micaceous, low-slight plasticity
		47.0 - 48.5 (ML) WC-64-9
		Same as above but more damp
		III
		II
		I

BORING NOTES

Drilling Method Auger

Hole Size 5"

Angle Vertical Bearing _____

FROM	TO	INTERV.	RECOV.	% RECOV.	REMARKS

CASING NOTES

FROM	TO	SIZE	REMARKS

SAMPLING NOTES

TYPE SAMPLER _____

SIZE _____ WT. OF HAMMER _____ DROP _____

SMPL. NO.	FROM	TO	INTERV.	RECOV.	BLOWS 6"	12"	18"	24"
7	35.0	36.5	1.5		10	23	40	
8	40.0	41.5	1.5		9	23	40	
9	47.0	48.5	1.5		12	25	47	

GROUND WATER OBSERVATIONS

DEPTH OF HOLE	
DEPTH OF WATER	

APPENDIX B

GEOTECHNICAL LABORATORY TEST PROGRAM

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APPENDIX B

GEOTECHNICAL LABORATORY TEST PROGRAM

Geotechnical laboratory tests were conducted in the Converse Consultants West (Converse) geotechnical laboratory on selected soil samples for the purpose of evaluating the physical properties and engineering characteristics of the sampled materials. Test results are presented on the exploration logs and in this appendix. A summary of the various laboratory tests conducted is presented below.

In-Situ Moisture Content and Dry Density

Data obtained from these tests, performed on relatively undisturbed ring samples obtained from the field, were used to aid in the classification and correlation of the earth materials and to provide qualitative information regarding soil strength and compressibility. The percent of moisture as a function of dry weight, and the encountered dry density in units of pounds per cubic foot (pcf) are provided in the right-hand columns on the exploration logs. Moisture content tests were performed in accordance with ASTM D 2216-80 Test method.

Mechanical Grain-Size Analysis

Grain-size analyses were performed on subsurface soil samples to assist in soil classification ant to determine the distribution of soil particles. The test were performed in general accordance with the ASTM D 422-72 Standard Test Method. Results are plotted on Drawings B-1 through B-6, "Grain Size Distribution Chart".

Hydrometer analyses were performed on eleven samples in accordance with ASTM Standard D 422-72. The hydrometer test results are graphically presented in conjunction with corresponding mechanical grain-size analyses.

Permeability Tests

Permeability coefficients were determined according to ASTM D 2434-68. The samples were saturated first; then, a constant head hydraulic gradient was applied. The flow of water was monitored from the bottom to the top of the samples. The test results are presented in Table B-1.

Direct Shear Tests

Direct shear test were performed on relatively undisturbed ring specimens. Specimens were soaked prior to shearing. Individual specimens were prepared and different vertical normal stresses were applied. Specimens were sheared at a constant rate of strain. Based upon the range of normal loads applied, the shear strength envelope was determined. Results of the tests are presented on Drawings B-7 through B-11, "Direct Shear Test".

91-31-333-01

Consolidation Tests

Consolidation test were performed on relatively undisturbed ring samples to evaluate settlement and collapsibility/swelling characteristics of subsurface soils. These tests involved loading specimens into the test apparatus which contained porous stones to accommodate vertical drainage during testing. Normal vertical axial loads were applied to the sample through the porous stones, and resulting vertical compression was recorded at various time periods. The load was increased after the sample reached a reasonable state of equilibrium. Normal loads were applied at a constant load-increment ratio, successive loads being generally twice the preceding load.

One sample was tested at field moisture content, and submerged for further loading. Another sample was submerged prior to loading. Test results are shown on Drawings B-12 and B-13, "Consolidation Tests".

Sample Storage

Samples presently stored in the Converse Pasadena geotechnical laboratory will be discarded 90 days after the date of this report, unless this office receives a specific request to retain the samples for a longer period.

TABLE B-1

GEOTECHNICAL LABORATORY TEST RESULTS

PERMEABILITY TEST RESULTS

Boring No.	Sample No.	Sample Depth (feet)	Coefficient of Permeability (cm/sec)	Soil Type
MC-3	C-12	66	1.40×10^{-4}	Silt/Silty Sand
MC-4	C-17	50	1.24×10^{-3}	Sand/Silty Sand (San Pedro Sand)
MC-8	C-19	55	1.21×10^{-4}	Sand/Silty Sand (San Pedro Sand)
MC-10	C-13	71	1.66×10^{-4}	Silty Sand/Sand Silt
MC-13	C-23	65	2.23×10^{-4}	Silty Sand

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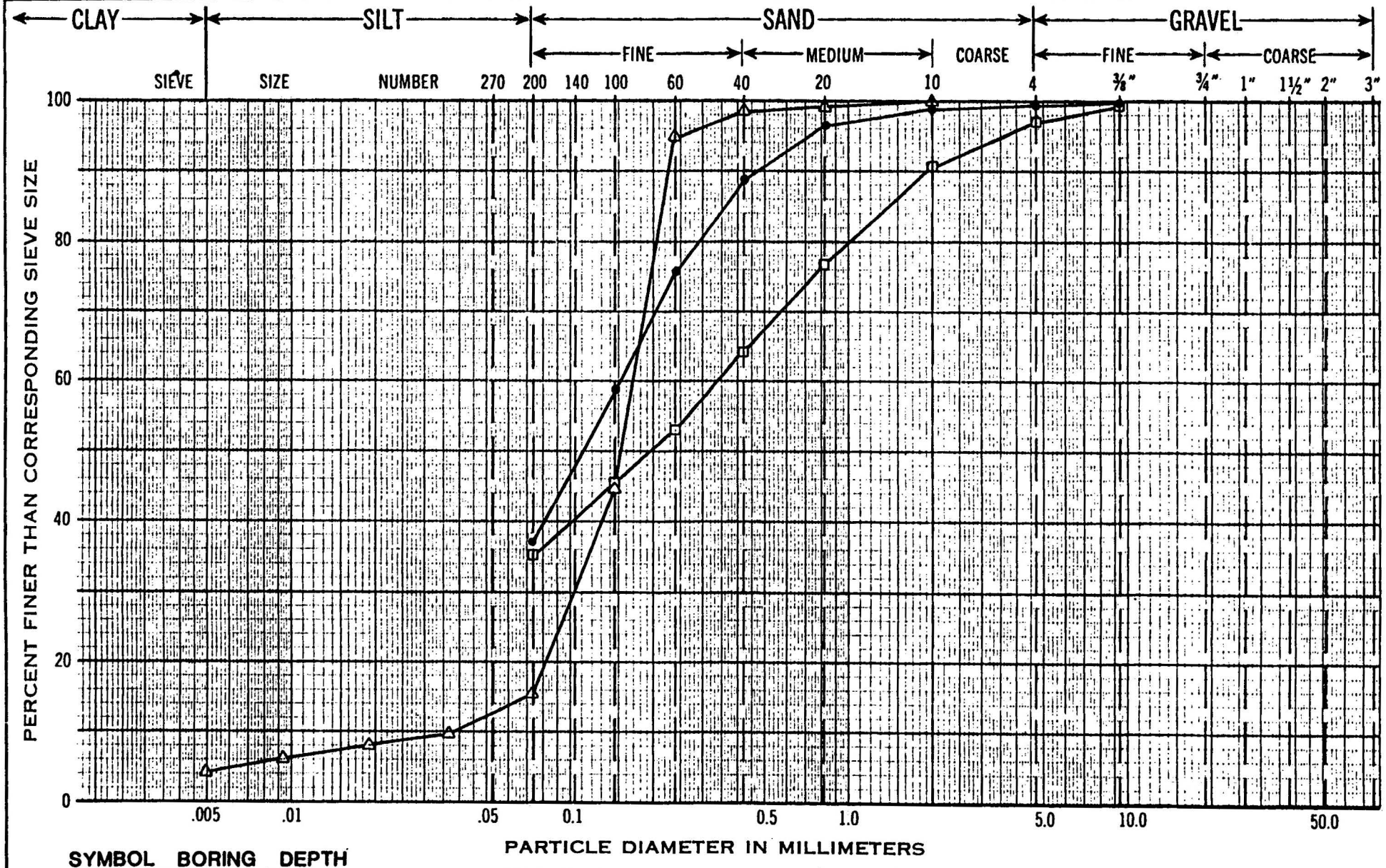


SYMBOL	BORING	DEPTH
●	MC1	30′
□	MC1	35′
△	MC1	50′

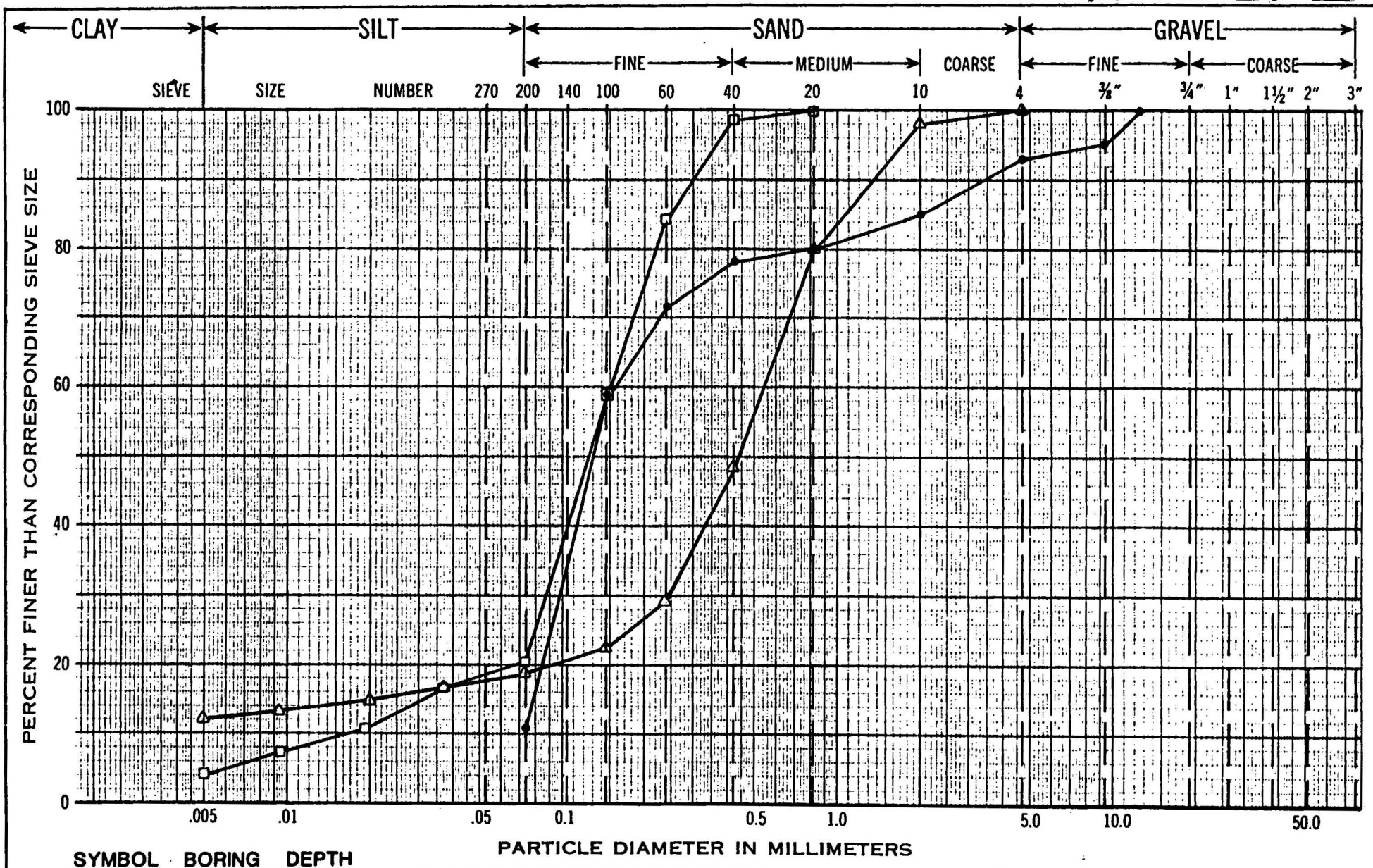
GRAIN-SIZE DISTRIBUTION CHART

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Drawing No.
B-1

Converse Consultants West



SYMBOL	BORING	DEPTH
●	MC1	60′
□	MC2	50′
△	MC3	30′

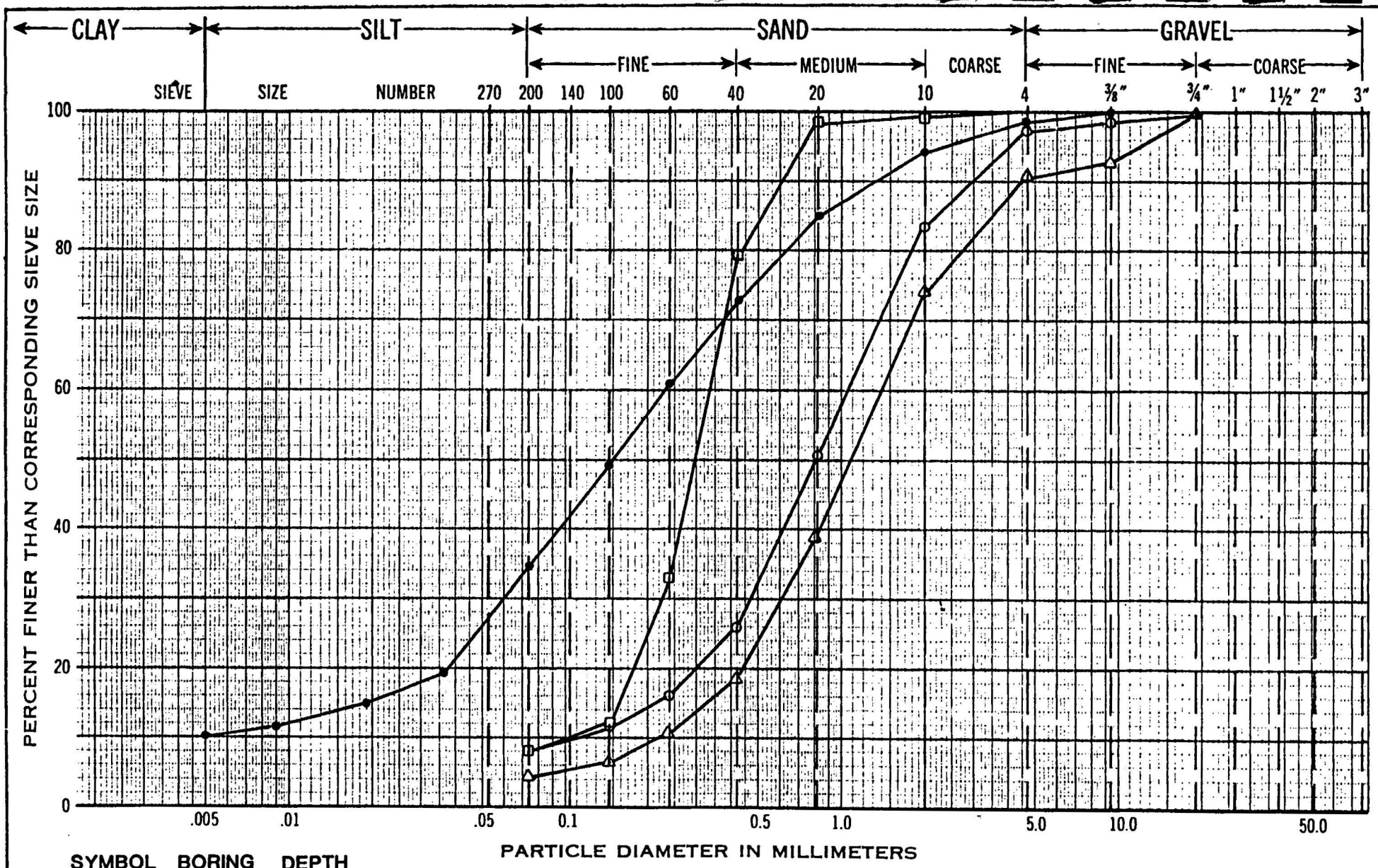
GRAIN-SIZE DISTRIBUTION CHART

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Converse Consultants West

Drawing No.
B-2



SYMBOL	BORING	DEPTH
●	MC4	19′
□	MC4	49′
△	MC6	20′
○	MC7	21′

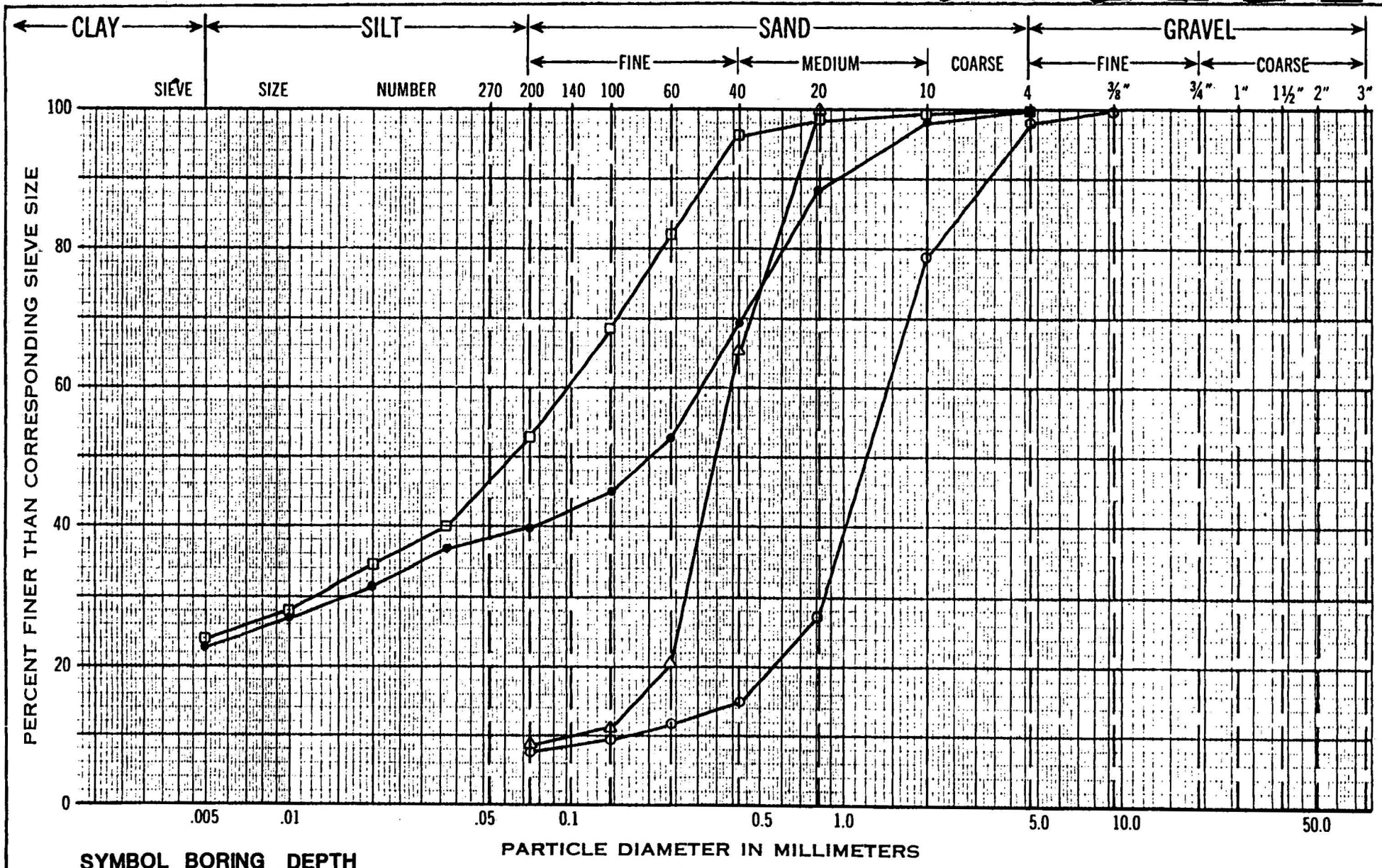
GRAIN-SIZE DISTRIBUTION CHART

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Drawing No.
B-3

Converse Consultants West



SYMBOL	BORING	DEPTH
●	MC8	25′
□	MC8	30′
△	MC8	54′
○	MC9	24′

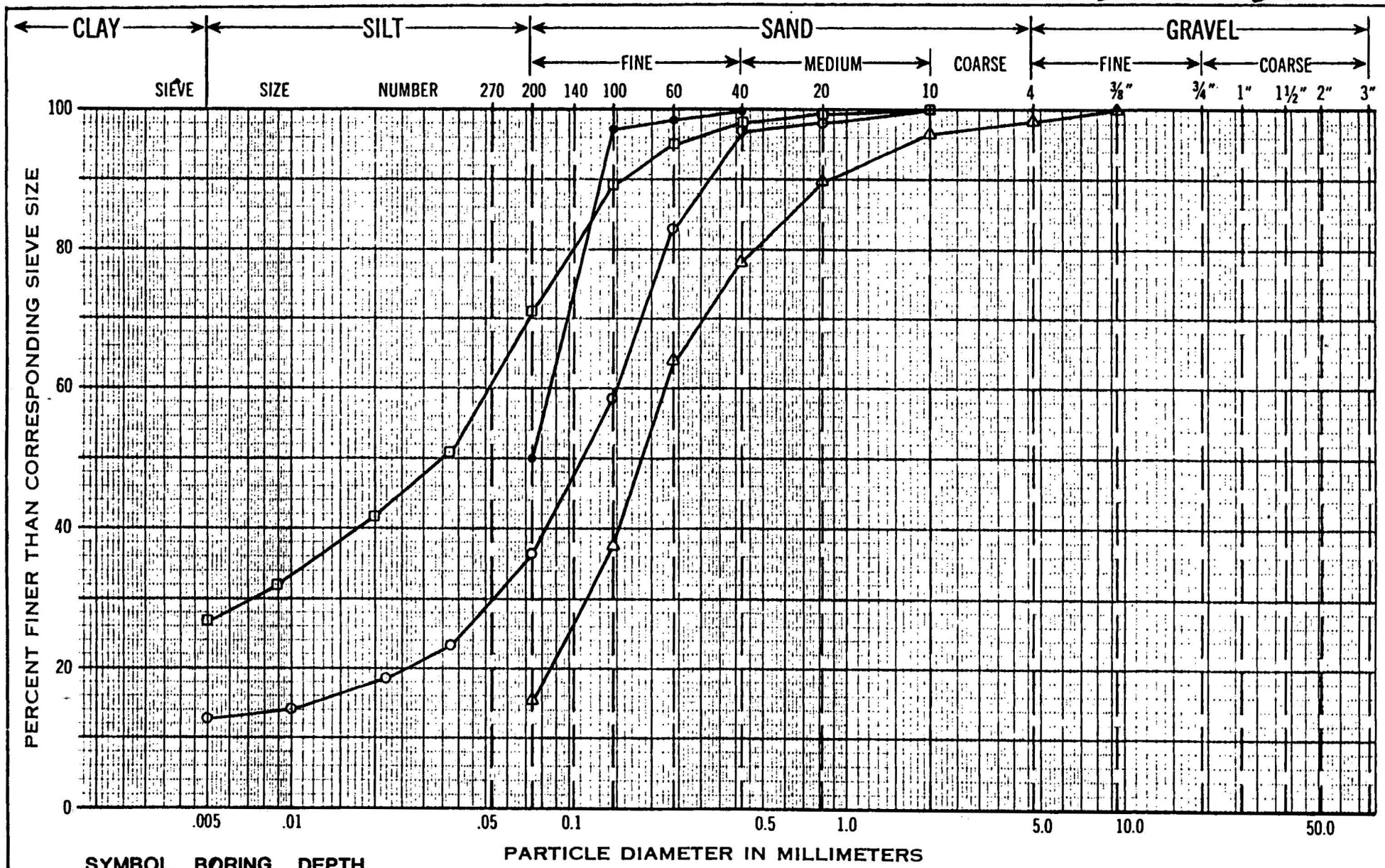
GRAIN-SIZE DISTRIBUTION CHART

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Converse Consultants West

Drawing No.
B-4



SYMBOL	BORING	DEPTH
●	MC10	70′
□	MC11	80′
△	MC13	64′
○	MC15	36′

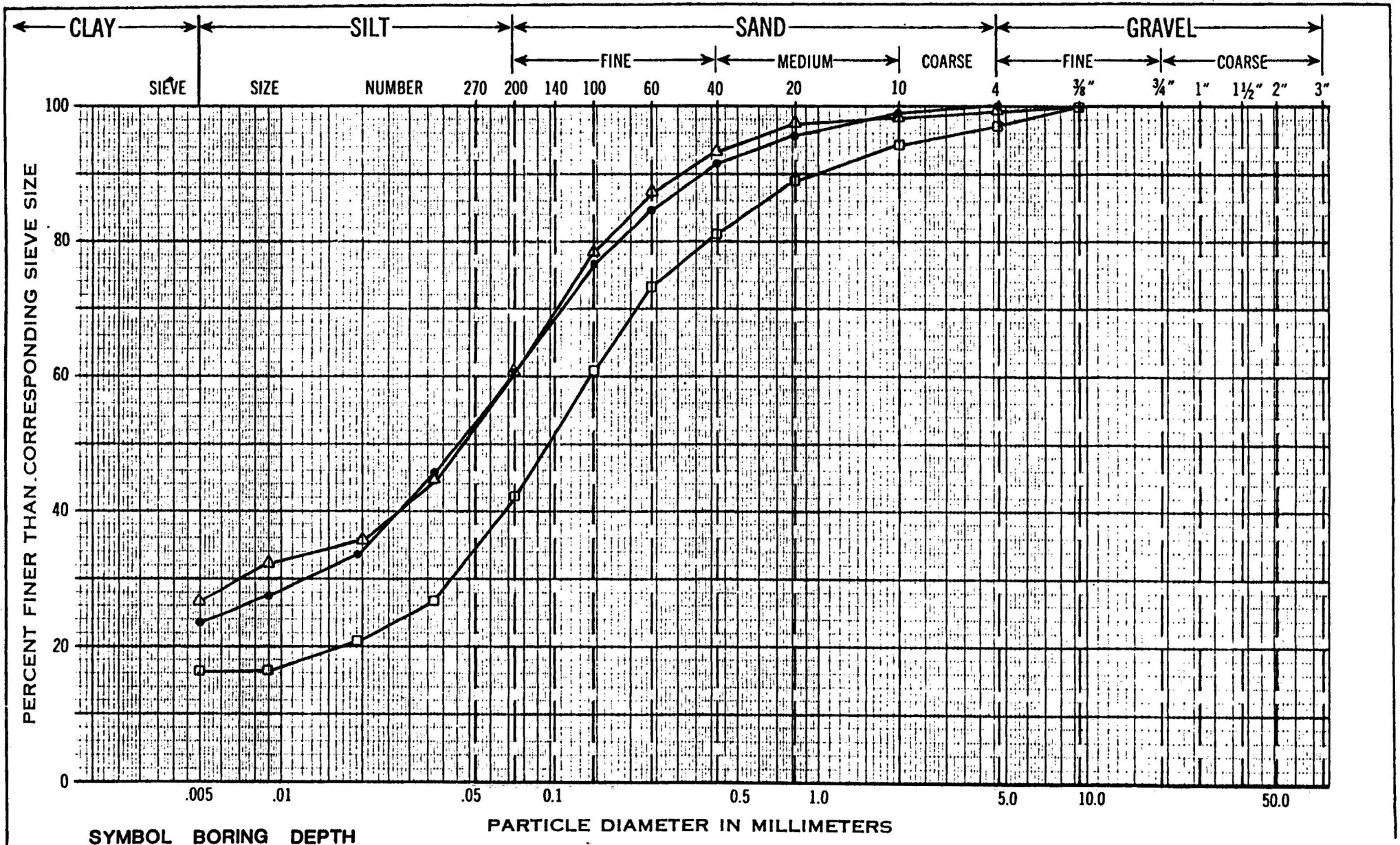
GRAIN-SIZE DISTRIBUTION CHART

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Drawing No.
B-5

Converse Consultants West



SYMBOL	BORING	DEPTH
●	MC16	26′
□	MC16	36′
△	MC16	41′

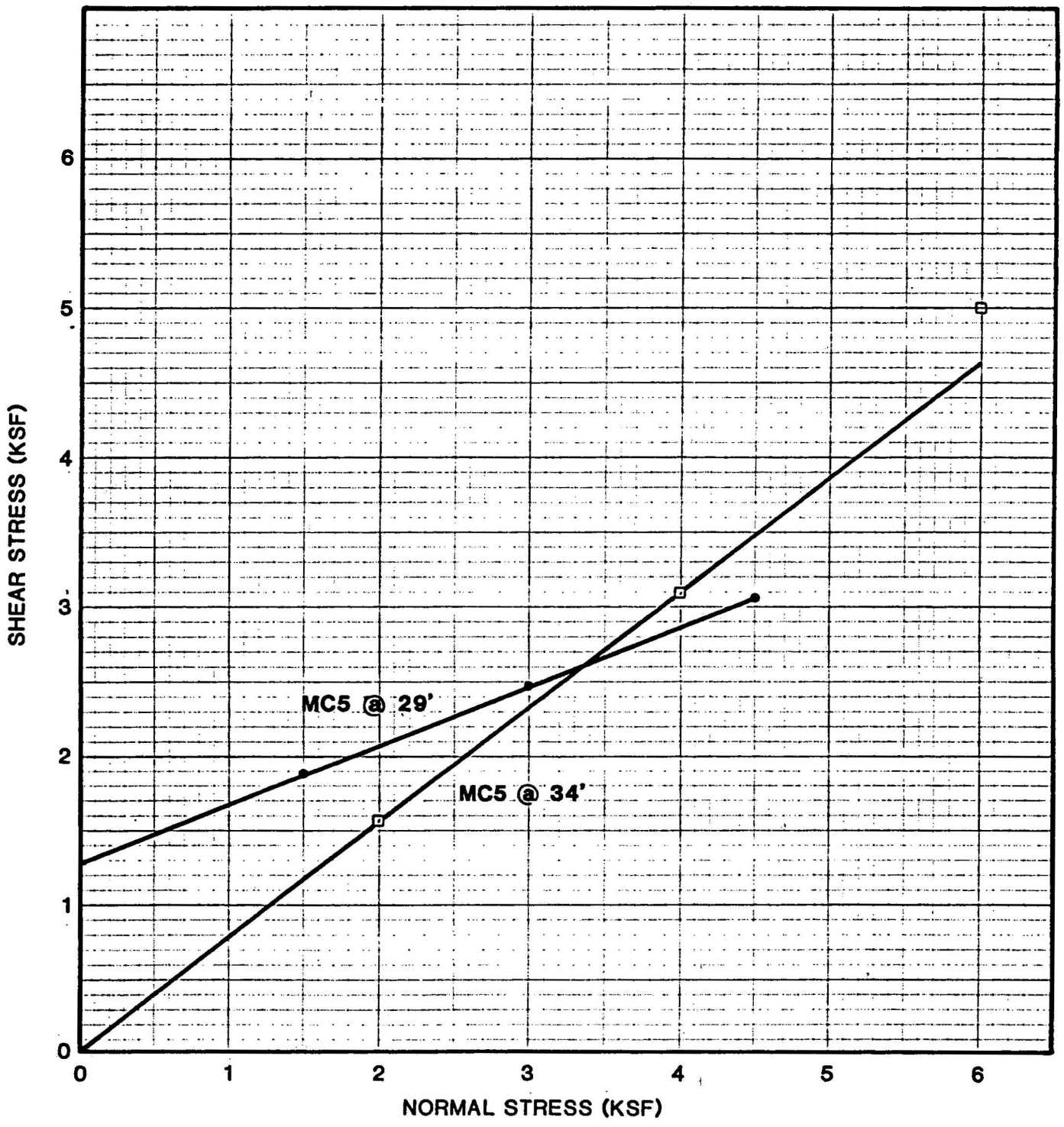
GRAIN-SIZE DISTRIBUTION CHART

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Converse Consultants West

Drawing No.
B-6



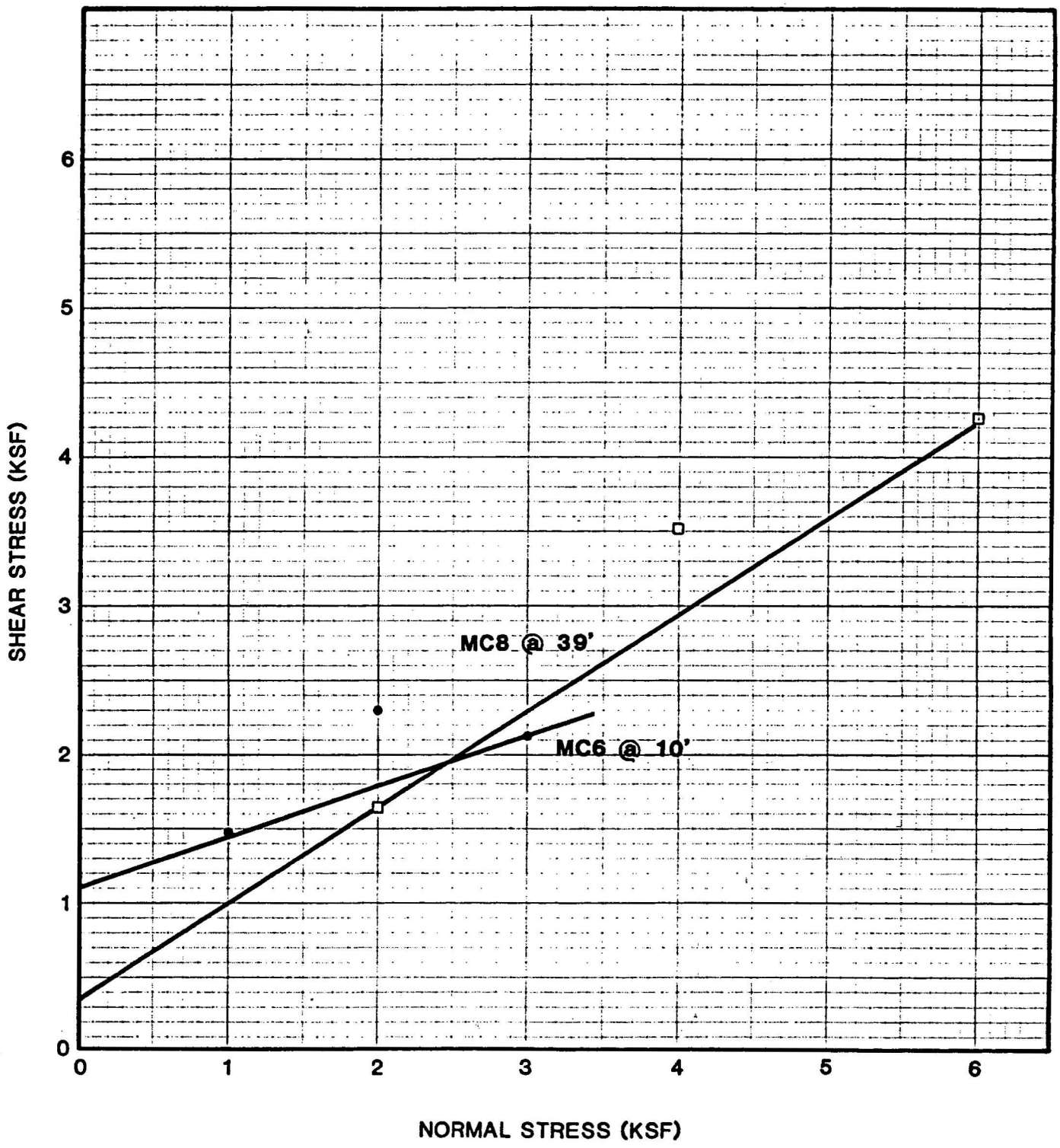
DIRECT SHEAR TEST

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Drawing No.
B-7

Converse Consultants West



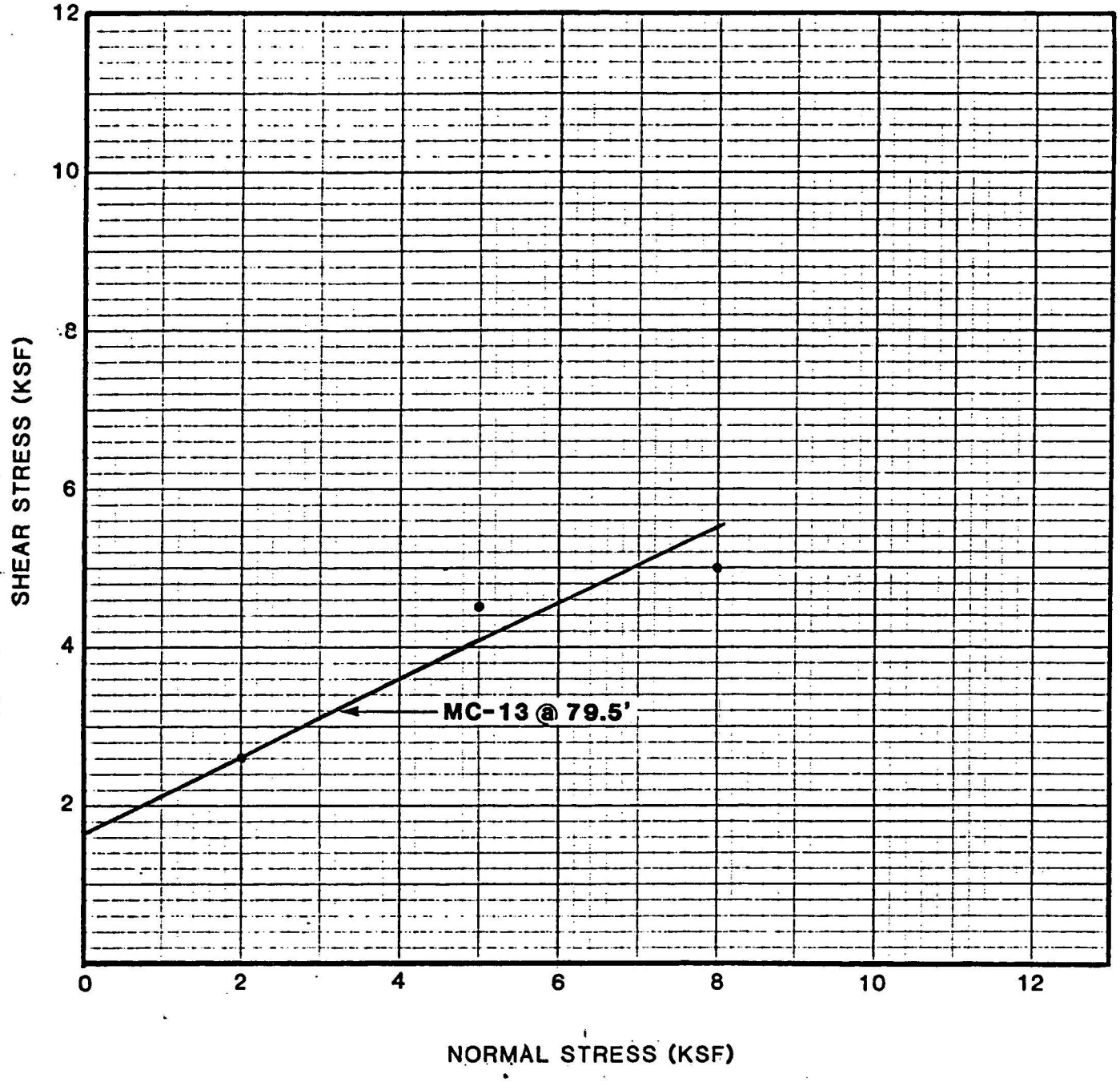
DIRECT SHEAR TEST

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Converse Consultants West

Drawing No.
B-8



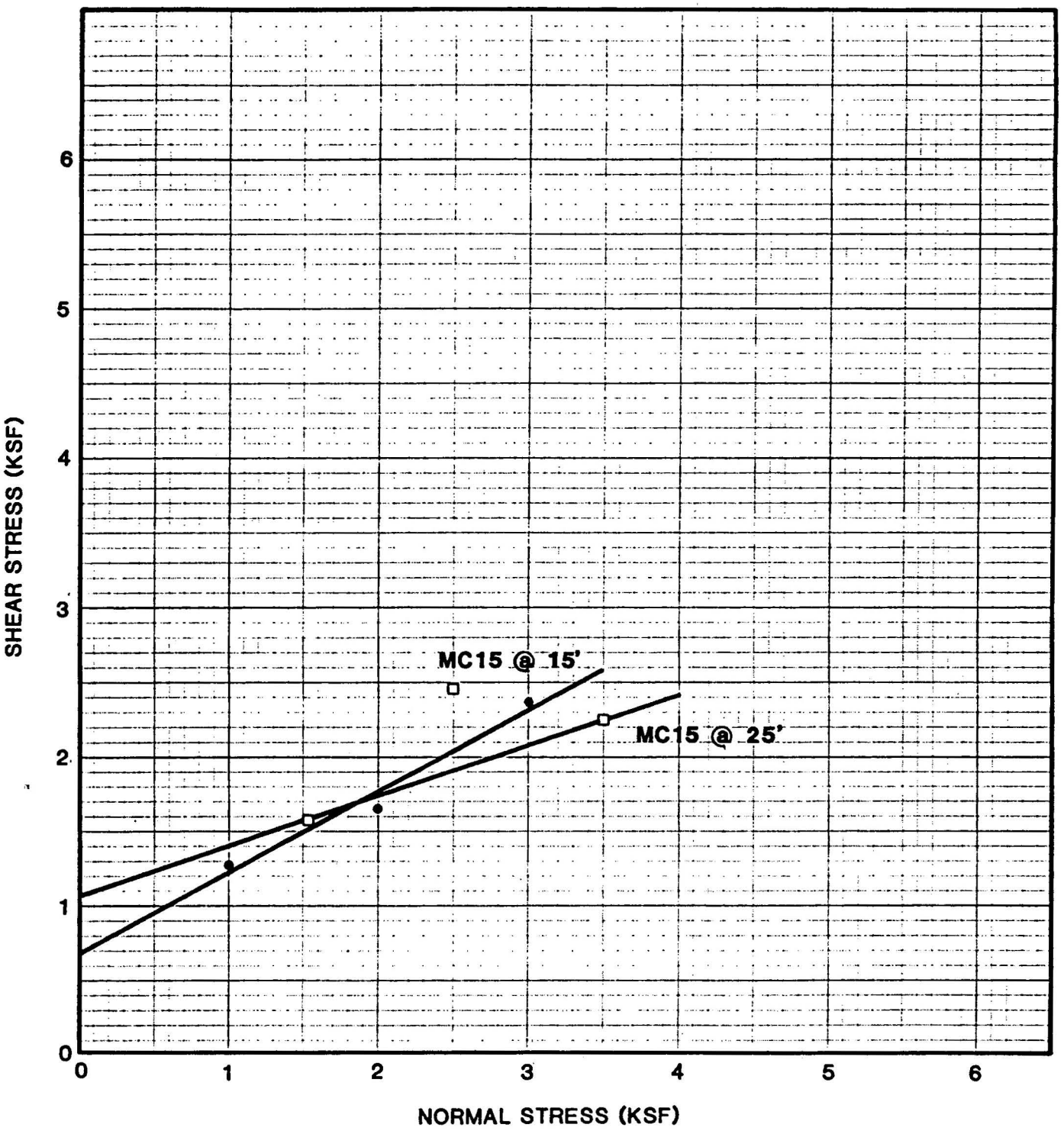
DIRECT SHEAR TEST

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Converse Consultants West

Drawing No.
B-9



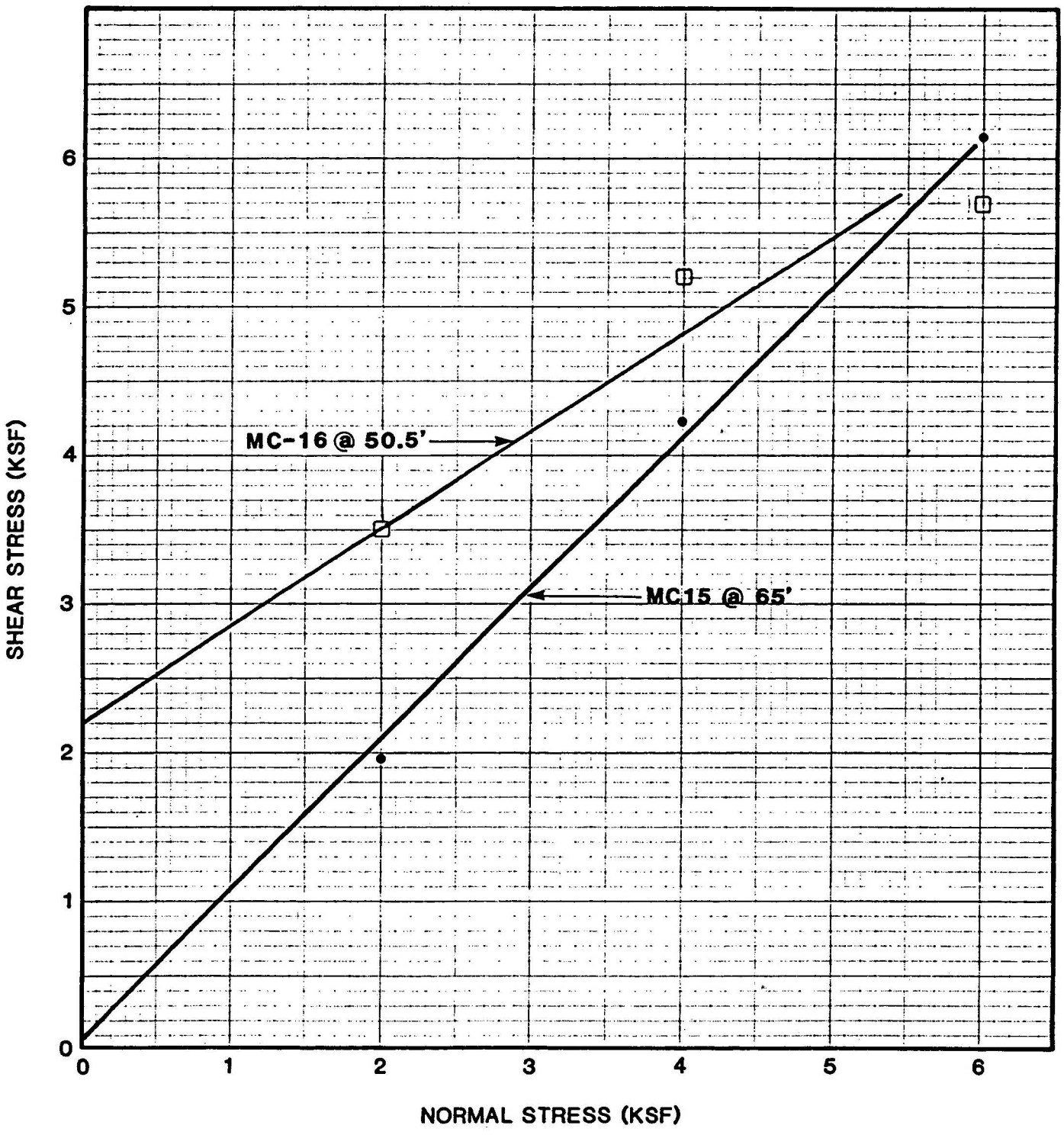
DIRECT SHEAR TEST

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Converse Consultants West

Drawing No.
B-10



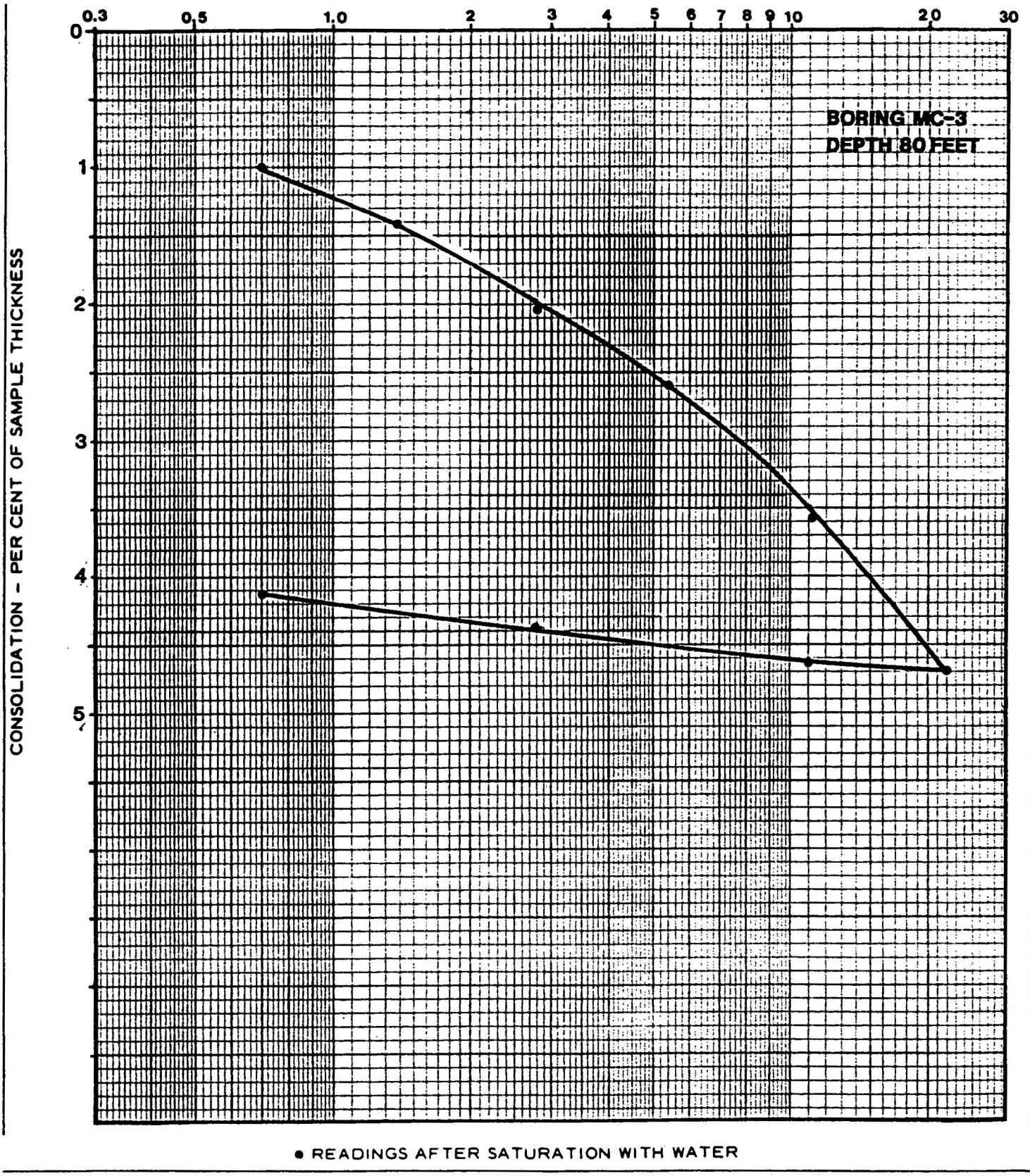
DIRECT SHEAR TEST

METRO RAIL MID-CITY SEGMENT

Project No.
91-31-208-01

Converse Consultants West

Drawing No.
B-11



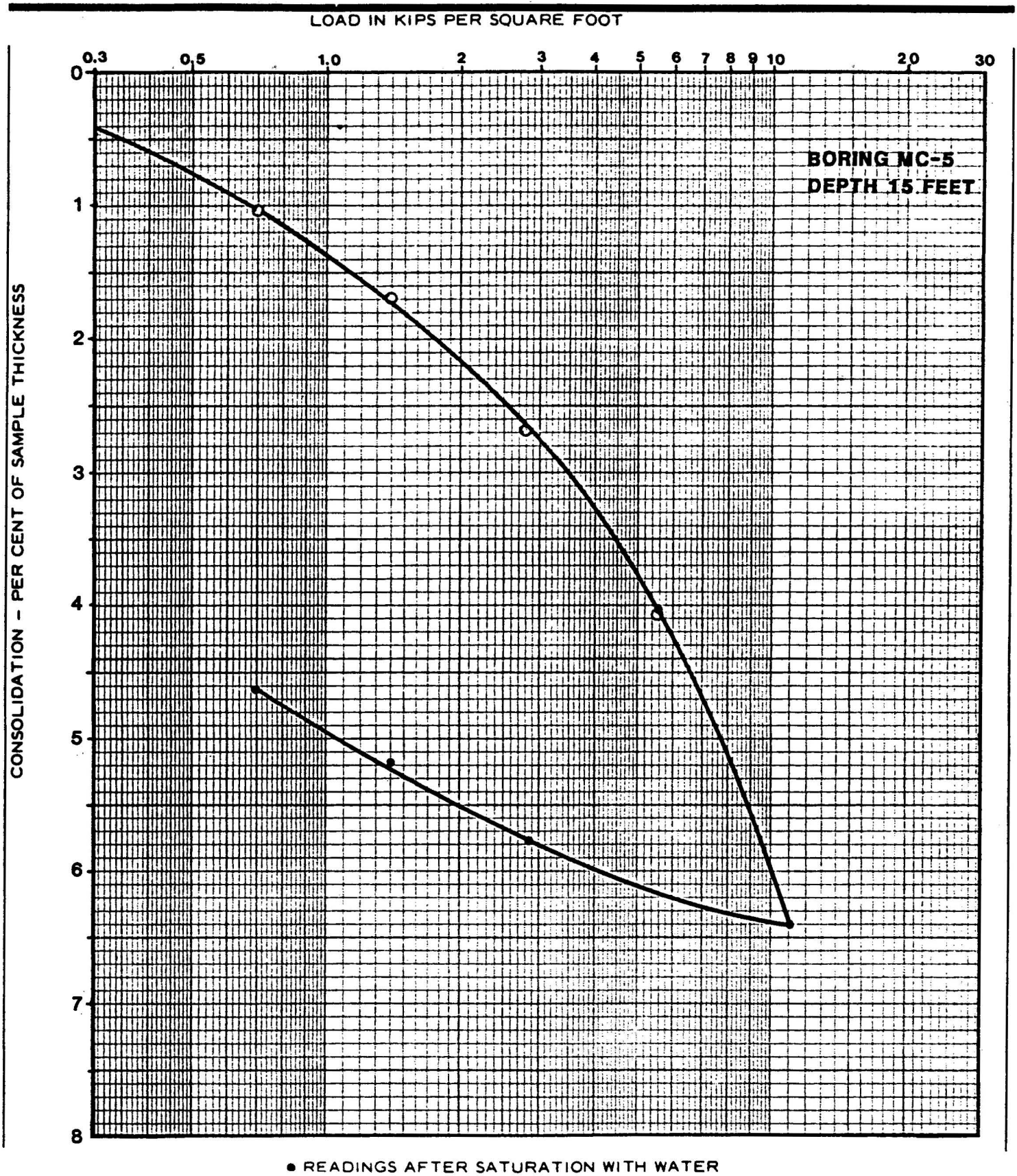
CONSOLIDATION TESTS

METRO RAIL MID-CITY SEGMENT

Project No
91-31-208-01

Converse Consultants West

Drawing No
B-12



CONSOLIDATION TESTS

METRO RAIL MID-CITY SEGMENT

Project No
91-31-208-01

Converse Consultants West

Drawing No
B-13

APPENDIX D

EARTHWORK SPECIFICATIONS

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APPENDIX D

EARTHWORK SPECIFICATIONS

The following guidelines are recommended for earthwork associated with site development. Recommendations for dewatering and major temporary excavations are presented in the text Sections 6.2 and 6.4, respectively.

- Site Preparation (surface structures): Existing vegetation, debris and soft or loose soils should be stripped from the areas that are to be graded. Soils containing more than 1% by weight of organics may be re-used in planter areas, but should not be used for fill beneath building and paved areas. Organic debris, trash, and rubble should be removed from the site. Subsoil conditions on the site may vary from those encountered in the borings. Therefore, the geotechnical engineer should observe the prepared graded area prior to placement of fill.

- Minor Construction Excavations: Temporary dry excavations for foundations or utilities may be made vertically to depths up to 5 feet. For deeper dry excavations in existing fill or natural materials up to 15 feet, excavations should be sloped no steeper than 1;1 (horizontal to vertical). Recommendations for major shored excavations are presented in Section 6.4.

- Structural Fill and Backfill: Where required for support of near surface foundations or where subterranean walls and/or footings require backfilling, excavated onsite granular soils or imported granular soils are suitable for use as structural fill. Loose soil, formwork and debris should be removed prior to backfilling the walls. Onsite soils or imported granular soils should be placed and compacted in accordance with "Recommended Specifications for Fill Compaction". In deep fill areas or fill areas for support of settlement-sensitive structures, compaction requirements should be increased from the normal 90% to 95% or 100% of the maximum dry density to reduce future fill settlement.

  Where space limitations do not allow for conventional backfill compaction operations, special backfill materials and procedures may be required. Sand-cement slurry, pea gravel or other selected backfill can be used in limited space areas. Sand-cement slurry should contain at least 1-1/2 sacks cement per cubic yard. Pea gravel should be placed in a moist condition or should be wetted at the time of placement. Densification should be accomplished by vibratory equipment; e.g., hand-operated mechanical compactor, backhoe mounted hydraulic compactor, or concrete vibrator. Lift thickness should be consistent with the type of compactor used. However, lifts should never exceed 5 feet. A geotechnical engineer experienced in the placement of pea gravel should observe the placement and densification procedures to render an opinion as to the adequate densification of the pea gravel.

  If granular backfill or pea gravel is placed in an area of surface drainage, the backfill should be capped with at least 18 inches of relatively impervious type soil; i.e., silt-clay soils.

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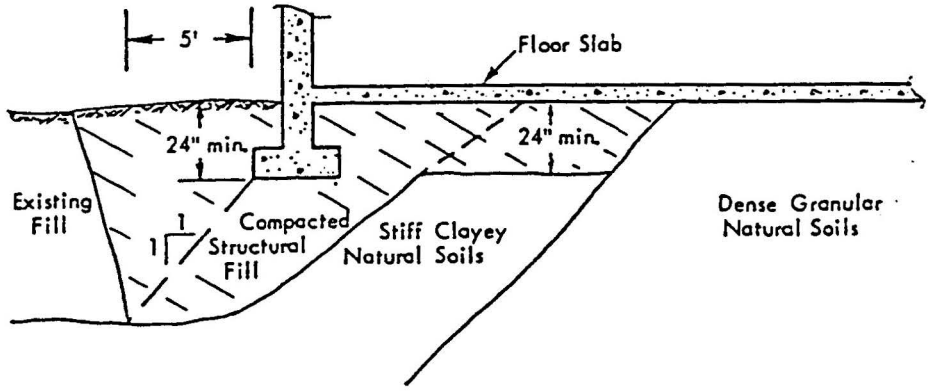
- Foundation Preparation: Where foundations for near surface appurtenant structures are underlain by existing fill soils, the existing fill should be excavated and replaced with a zone of properly compacted structural fill. The zone of structural fill should extend to undisturbed dense or stiff natural soils. Horizontal limits of the structural fill zone should extend out from the footing edge a distance equal to 5 feet or 1/2 the depth of the zone beneath the footing (a 1:1 ratio), whichever is larger. The structural fill should be placed and compacted as recommended under "Structural Fill and Backfill".

FOUNDATION/SUBGRADE PREPARATION



- Subgrade Preparation: Concrete slabs-on-grade at the subterranean levels may be supported directly on undisturbed dense materials. The subgrade should be proof rolled to detect soft or disturbed areas, and such areas should be excavated and replaced with structural fill. If existing fill soils are encountered in near surface subgrade areas, these materials should be excavated and replaced with properly compacted granular fill. Where clayey natural soils (near existing grade) are exposed in the subgrade, these soils should be excavated to a depth of 24 inches below the subgrade level and replaced with properly compacted granular fill. Where dense natural granular soils are exposed at slab subgrade, the slab may be supported directly on these soils. All structural fill for support of slabs or mats should be placed and compacted as recommended under "Structural Fill and Backfill".

- Site Drainage: Buried utility conduits should be bedded and backfilled around the conduit in accordance with the project specifications. Where conduit underlies concrete slabs-on-grade and pavement, the remaining trench backfill above the pipe should be placed and compacted in accordance with "Structural Fill and Backfill".

- Utility Trenches: Buried utility conduits should be bedded and backfilled around the conduit in accordance with the project specifications. Where conduit underlies concrete slabs-on-grade and pavement, the remaining trench backfill above the

pipe should be placed and compacted in accordance with "Structural Fill and Backfill".

- Recommended Specifications for Fill Compaction: The following specifications are recommended to provide a basis for quality control during the placement of compacted fill.

  1. All areas that are to receive compacted fill shall be observed by the soils engineer prior to placement of fill.

  2. Soil surfaces that will receive compacted fill shall be scarified to a depth of at least 6 inches. The scarified soil shall be moisture-conditioned to obtain soil moisture near optimum moisture content. The scarified soil shall be compacted to a minimum relative compaction of 90%. Relative compaction is defined as the ratio of the inplace soil density to the maximum dry density as determined by the ASTM D 1557-91 compaction test method.

  3. Fill shall be placed in controlled layers the thickness of which is compatible with the type of compaction equipment used. The thickness of the compacted fill layer shall not exceed the maximum allowable thickness of 8 inches. Each layer shall be compacted to a minimum relative compaction of 90%. The field density of the compacted soils shall be determined by the ASTM D 1556-82 test method or equivalent.

  4. Fill soils shall consist of excavated onsite soils essentially cleaned of organic and deleterious material or imported soils approved by the soils engineer. All imported soil shall be granular and non-expansive or of low expansion potential (plasticity index less than 15%). The soils engineer shall evaluate and/or test the import materials for its conformance with the specifications prior to its delivery to the site. The contractor shall notify the soils engineer 72 hours prior to importing the fill to the site. Rocks larger than 6 inches in diameter shall not be used unless they are broken down.

  5. The soils engineer shall observe the placement of compacted fill and conduct inplace field density tests on the compacted fill to check for adequate moisture content and the required relative compaction. Where less than 90 relative compaction is indicated, additional compactive effort shall be applied and the soil moisture-conditioned as necessary until 90% relative compaction is attained. The contractor shall provide level testing pads for the soils engineer to conduct the field density tests on.

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APPENDIX C

CHEMICAL ANALYSIS OF SOIL AND GROUNDWATER

Printed On Recycled Paper

Converse Envirolab
169 North Halstead Street, Pasadena, California 91107-3127

Telephone (818) 351-2330
FAX (818) 568-9165

Jul. 21, 1992

PROJECT/CLIENT : METRO RAIL/MID CITY PROJECT NO. : 91-31-208-01
PROJECT ENG/MGR: Mark Schluter ENVIROLAB NO. : 92-71-07-133

Subject : Analysis of Samples

On Jul. 09, 1992, 2 soil sample(s) was/were delivered to the laboratory for analysis. The soil sample(s) was/were analyzed using the following methods:

418.1

The results which were obtained are listed in the attached table(s).

George Colovos, Ph.D.
Laboratory Director

Converse Envirolab
169 North Halstead Street, Pasadena, California 91107-3127

Telephone (818) 351-2330
FAX (818) 568-9165

Envirolab No.	: 92-71-07-133	Date Sampled	: Jun 03, 1992
Project No.	: 91-31-208-01	Date Received	: Jul 09, 1992
Project/Client	: METRO RAIL/MID CITY	Report Date	: Jul 21, 1992
Project Eng/Mgr:	Mark Schluter		

Analysis Method: 418.1

Sample ID:	133-01	133-02	DL
Client Sample ID	MC-2,R25	MC-9,C-3	
Batch Number	Q199R021	Q199R021	
Date Analyzed	07/17/92	07/17/92	
Petrol Hydrocarbons	48000.0	30000.0	10.0

REMARKS:
133-01: DLX200
133-02: DLX200

Units: mg/kg
DL : Detection Limits
N.D. : Not Detected
Trace: Detected, but less than DL

Reviewed by:

Approved by:

George Colovos, Ph.D
Laboratory Director

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Converse Envirolab
169 North Halstead Street, Pasadena, California 91107-3127

Telephone (818) 351-2330
FAX (818) 568-9165

IRS #95-4115025

INVOICE
EL-2159

To: Converse Consultants-Pas.
3393 E. Foothill Blvd.
Pasadena, CA 91107

Billing Code : 90-71-101
Invoice date: 07/21/92

Please return copy of invoice with payment.

Envirolab No. :92-71-07-133

Project No. :91-31-208-01
Project Name :METRO RAIL/MID CITY
Project Eng/Mgr :Mark Schluter

Date Sampled : 06/03/92
Date Received : 07/09/92
Purchase Order :

Invoice for Services

Test	# of Samples	Unit Cost	Rush Fees	Cost
418.1	2	$65.00	$.00	$130.00

Total Due This Invoice $130.00

DRAFT

Invoices are due when rendered. A service charge of 1.5% per month (18 A.P.R.) will be charged on accounts after 30 days.

[redacted]
169 North Halstead Street, Pasadena, California 91107-3127
Telephone (818) 568-2807

CHAIN OF CUSTODY RECORD

Envirolab Log Number 92-71-07-133

Project Name	Project Number
METRO RAIL MID-CITY	91-31-208-01
Project Location	**Phone Number**
CRENSHAW BLVD.	
Project Manager	**Sample Collector**
MARK SCHLUTER	ART / GREG

Analyses Required: 418.1 (TRPH)

Turn Around: ✓ Normal - 10 working days; 1 week RUSH; 24-48 hour RUSH; < 24 hour RUSH

Lab sample number	Date sampled	Time sampled	Matrix	Sample identification	Comp. Instr.	418.1 (TRPH)	Remarks
1	6/3/92	—	SOIL	BORING MC-2, SAMPLE R25		X	NATURAL PETROLEUM
				DEPTH 69'-70'			IMPREGNATED SAMPLE
2	6/29/92	—	SOIL	BORING MC-9, SAMPLE C-3		X	
				DEPTH 14'-15'			
				"SPECIALIZED TESTING"			SAVE ALL REMAINING
							SAMPLE - RETURN
							TO MARK SCHLUTER
							FOR STORAGE.

	Signature	Print Name	Company	Date	Time
Relinquished by		MARK SCHLUTER	CCW	7/9/92	11:10 am
Received by	Andre Al-Ghani	Andre Al-Ghani	Converse Envirolab	7/9/92	11:10 am
Relinquished by					
Received by					
Relinquished by					
Received by					

Converse Envirolab
169 North Halstead Street, Pasadena, California 91107-3127

Telephone (818) 351-2330
FAX (818) 568-9165

Aug. 06, 1992

PROJECT/CLIENT : METRO RAIL/MID CITY PROJECT NO. : 91-31-208-01
PROJECT ENG/MGR: Mark Schluter ENVIROLAB NO. : 92-71-07-158

Subject : Analysis of Samples

On Jul. 16, 1992, 2 water sample(s) was/were delivered to the laboratory for analysis. The water sample(s) was/were analyzed using the following methods:

8015G/8020 ppb
CAC Metals
Chloride
Nitrate
pH
Sulfide
Sulfate

The results which were obtained are listed in the attached table(s).

George Colovos, Ph.D.
Laboratory Director

Converse Envirolab
169 North Halstead Street, Pasadena, California 91107-3127

Telephone (818) 351-2330
FAX (818) 568-9165

Envirolab No. : 92-71-07-158
Project No. : 91-31-208-01
Project/Client : METRO RAIL/MID CITY
Project Eng/Mgr: Mark Schluter

Date Sampled : Jul 16, 1992
Date Received : Jul 16, 1992
Report Date : Aug 06, 1992

Analysis Method: 8015G/8020 ppb

Sample ID:	158-01	158-02	DL
Client Sample ID	MC-4	MC-1	
Batch Number	Q203G121	Q203G121	
Date Analyzed	07/21/92	07/21/92	
Benzene	N.D.	N.D.	0.3
Chlorobenzene	N.D.	N.D.	0.3
1,2-Dichlorobenzene	N.D.	N.D.	0.3
1,3-Dichlorobenzene	N.D.	N.D.	0.3
1,4-Dichlorobenzene	N.D.	N.D.	0.3
Ethyl Benzene	N.D.	N.D.	0.3
Toluene	N.D.	N.D.	0.3
Xylenes	N.D.	N.D.	0.3
Total Petroleum Hydrocarbons	N.D.	N.D.	50.0

Units: ug/l
DL : Detection Limits
N.D. : Not Detected
Trace: Detected, but less than DL

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Converse Envirolab
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FAX (818) 568-9165

Envirolab No. : 92-71-07-158
Project No. : 91-31-208-01
Project/Client : METRO RAIL/MID CITY
Project Eng/Mgr: Mark Schluter

Date Sampled : Jul 16, 1992
Date Received : Jul 16, 1992
Report Date : Aug 06, 1992

Analysis Method: CAC Metals

Sample ID:	158-01	158-02	DL
Client Sample ID	MC-4	MC-1	
Batch Number	Q217A261	Q217A261	
Date Analyzed	08/04/92	08/04/92	
Antimony (6010)	N.D.	N.D.	0.40
Arsenic (7060)	N.D.	N.D.	0.005
Barium (6010)	0.18	0.19	0.05
Beryllium (6010)	N.D.	N.D.	0.01
Cadmium (6010)	N.D.	N.D.	0.04
Chromium (6010)	N.D.	N.D.	0.05
Cobalt (6010)	N.D.	N.D.	0.08
Copper (6010)	N.D.	N.D.	0.04
Lead (7421/6010)	N.D.	N.D.	0.005
Mercury (7470/7471)	N.D.	N.D.	0.0002
Molybdenum (6010)	N.D.	N.D.	0.15
Nickel (6010)	N.D.	N.D.	0.15
Selenium (7740)	N.D.	N.D.	0.005
Silver (6010)	N.D.	N.D.	0.05
Thallium (6010)	N.D.	N.D.	1.0
Vanadium (6010)	N.D.	N.D.	0.04
Zinc (6010)	N.D.	N.D.	0.04

Units: mg/l
DL : Detection Limits
N.D. : Not Detected
Trace: Detected, but less than DL

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FAX (818) 568-9165

Envirolab No.	: 92-71-07-158	Date Sampled	: Jul 16, 1992
Project No.	: 91-31-208-01	Date Received	: Jul 16, 1992
Project/Client	: METRO RAIL/MID CITY	Report Date	: Aug 06, 1992
Project Eng/Mgr:	Mark Schluter		

Analysis Method: Chloride

Sample ID:	158-01	158-02	DL
Client Sample ID	MC-4	MC-1	
Batch Number	Q2101031	Q2101031	
Date Analyzed	07/28/92	07/28/92	
Chloride	210.00	130.00	1.00

Units: mg/l
DL : Detection Limits
N.D. : Not Detected
Trace: Detected, but less than DL

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FAX (818) 568-9165

Envirolab No.	: 92-71-07-158	Date Sampled	: Jul 16, 1992
Project No.	: 91-31-208-01	Date Received	: Jul 16, 1992
Project/Client	: METRO RAIL/MID CITY	Report Date	: Aug 06, 1992
Project Eng/Mgr:	Mark Schluter		

Analysis Method: Nitrate

Sample ID:	158-01	158-02	DL
Client Sample ID	MC-4	MC-1	
Batch Number	Q2101051	Q2101051	
Date Analyzed	07/28/92	07/28/92	
Nitrate (as N)	N.D.	N.D.	1.0
Nitrate (as NO3)	3.6	2.3	1.0

Units: mg/l
DL : Detection Limits
N.D. : Not Detected
Trace: Detected, but less than DL

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Envirolab No. : 92-71-07-158
Project No. : 91-31-208-01
Project/Client : METRO RAIL/MID CITY
Project Eng/Mgr: Mark Schluter

Date Sampled : Jul 16, 1992
Date Received : Jul 16, 1992
Report Date : Aug 06, 1992

Analysis Method: pH

Sample ID:	158-01	158-02	DL
Client Sample ID	MC-4	MC-1	
Batch Number	Q2091111	Q2091111	
Date Analyzed	07/27/92	07/27/92	
pH	7.3	7.2	

Units: SU
DL : Detection Limits
N.D. : Not Detected
Trace: Detected, but less than DL

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FAX (818) 568-9165

Envirolab No.	: 92-71-07-158	Date Sampled	: Jul 16, 1992
Project No.	: 91-31-208-01	Date Received	: Jul 16, 1992
Project/Client	: METRO RAIL/MID CITY	Report Date	: Aug 06, 1992
Project Eng/Mgr:	Mark Schluter		

Analysis Method: Sulfide

Sample ID:	158-01	158-02	DL
Client Sample ID	MC-4	MC-1	
Batch Number	Q2001231	Q2001231	
Date Analyzed	07/18/92	07/18/92	
Sulfide	N.D.	N.D.	0.10

Units: mg/l
DL : Detection Limits
N.D. : Not Detected
Trace: Detected, but less than DL

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Telephone (818) 351-2330
FAX (818) 568-9165

Envirolab No. : 92-71-07-158
Project No. : 91-31-208-01
Project/Client : METRO RAIL/MID CITY
Project Eng/Mgr: Mark Schluter

Date Sampled : Jul 16, 1992
Date Received : Jul 16, 1992
Report Date : Aug 06, 1992

Analysis Method: Sulfate

Sample ID:	158-01	158-02	DL
Client Sample ID	MC-4	MC-1	
Batch Number	Q2101081	Q2101081	
Date Analyzed	07/28/92	07/28/92	
Sulfate	220.00	540.00	1.00

Units: mg/l
DL : Detection Limits
N.D. : Not Detected
Trace: Detected, but less than DL

Reviewed by:

Approved by:

George Colovos, Ph.D
Laboratory Director

A Wholly Owned Subsidiary of
The Converse Professional Group

[redacted]
169 North Halstead Street, Pasadena, California 91107-3127
Telephone (818) 568-2807

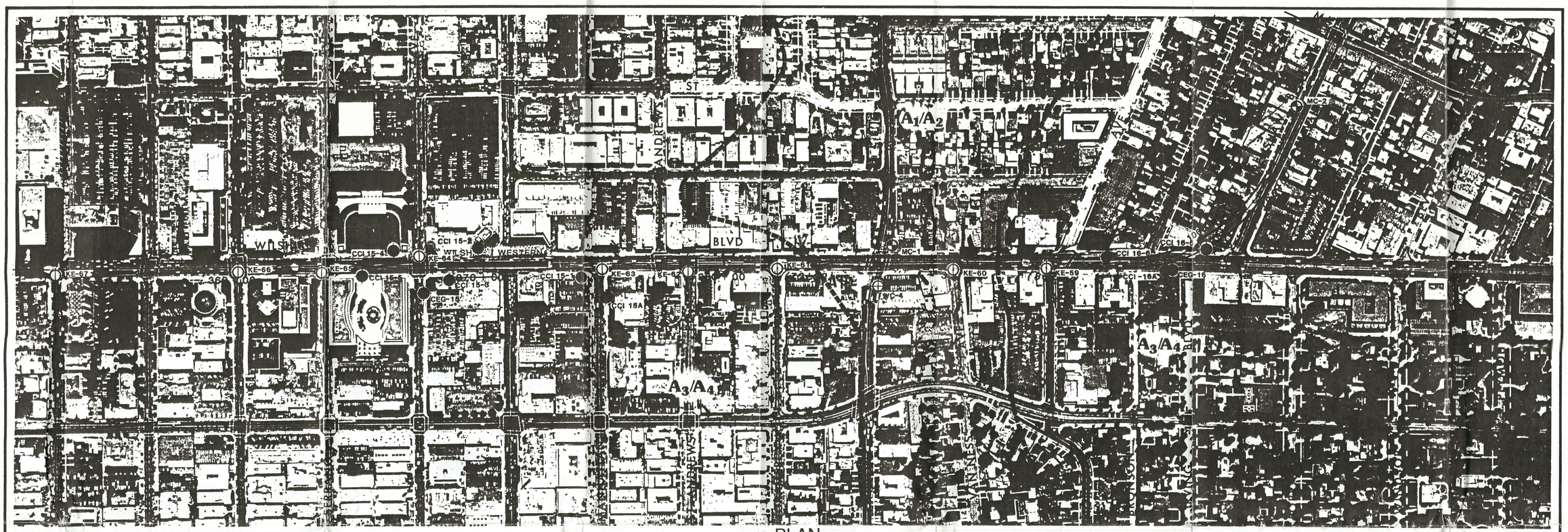
CHAIN OF CUSTODY RECORD

Envirolab Log Number 92-71-07-158

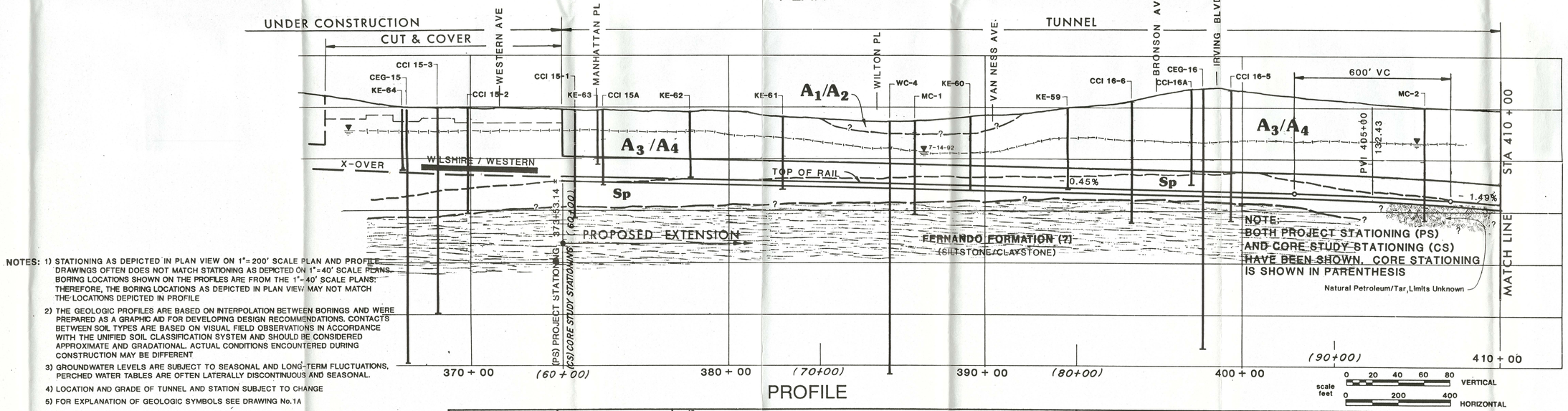
Project Name	Project Number
PB/Metro Rail Mid-City	91-31-208-01
Project Location	**Phone Number**
MC-4/Olympic & Crenshaw MC-1 Wilshire + Dilton	(818) 796-8200
Project Manager	**Sample Collector**
Mark Schluter	CMB/PL

Lab sample number	Date sampled	Time sampled	Matrix	Sample Identification	Comp. Instr.	Analyses Required: pH, sulfate, chloride, Nitrate, Cam metals, 8015a/8020	Turn Around: Normal - 10 working days	1 week RUSH	24-48 hour RUSH	< 24 hour RUSH	Remarks
1	7-16-92	11 15 a	GW	MC-4		X X X X X	X				Hold 8015 D
2	↓	1 30 p	↓	MC-1		X X X X X					samples - CALL
											Mark Schluter
											before analyzing
											Also call Mark
											about Detection
											Limits

	Signature	Print Name	Company	Date	Time
Relinquished by	L. Belton	L. Belton	CEW	7-16-92	2 40 pm
Received by	Andre Al-Ghani	Andre Al-Ghani	Converse Envirolab	7-16-92	2.40PM
Relinquished by					
Received by					
Relinquished by					
Received by					



PLAN



PROFILE

NOTES:
1) STATIONING AS DEPICTED IN PLAN VIEW ON 1"=200' SCALE PLAN AND PROFILE DRAWINGS OFTEN DOES NOT MATCH STATIONING AS DEPICTED ON 1"=40' SCALE PLANS. BORING LOCATIONS SHOWN ON THE PROFILES ARE FROM THE 1"=40' SCALE PLANS; THEREFORE, THE BORING LOCATIONS AS DEPICTED IN PLAN VIEW MAY NOT MATCH THE LOCATIONS DEPICTED IN PROFILE
2) THE GEOLOGIC PROFILES ARE BASED ON INTERPOLATION BETWEEN BORINGS AND WERE PREPARED AS A GRAPHIC AID FOR DEVELOPING DESIGN RECOMMENDATIONS. CONTACTS BETWEEN SOIL TYPES ARE BASED ON VISUAL FIELD OBSERVATIONS IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM AND SHOULD BE CONSIDERED APPROXIMATE AND GRADATIONAL. ACTUAL CONDITIONS ENCOUNTERED DURING CONSTRUCTION MAY BE DIFFERENT
3) GROUNDWATER LEVELS ARE SUBJECT TO SEASONAL AND LONG-TERM FLUCTUATIONS, PERCHED WATER TABLES ARE OFTEN LATERALLY DISCONTINUOUS AND SEASONAL.
4) LOCATION AND GRADE OF TUNNEL AND STATION SUBJECT TO CHANGE
5) FOR EXPLANATION OF GEOLOGIC SYMBOLS SEE DRAWING No.1A

LOCATION OF BORINGS and GEOLOGIC SECTION

METRO RAIL MID-CITY SEGMENT

Converse Consultants West

Scale	as shown
Project No.	91-31-208-01
Date	8-14-92
Drawing No.	1
Prepared By	DSS
Checked By	DS
Approved By	MBS

DESIGNED BY	JV
DRAWN BY	NM
CHECKED BY	SSO
APPROVED BY	JC
DATE	OCT. 1991

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
LACTC
Mid-City Segment Re-Evaluation Project

Parsons Brinckerhoff

SUBMITTED: _____ APPROVED: _____

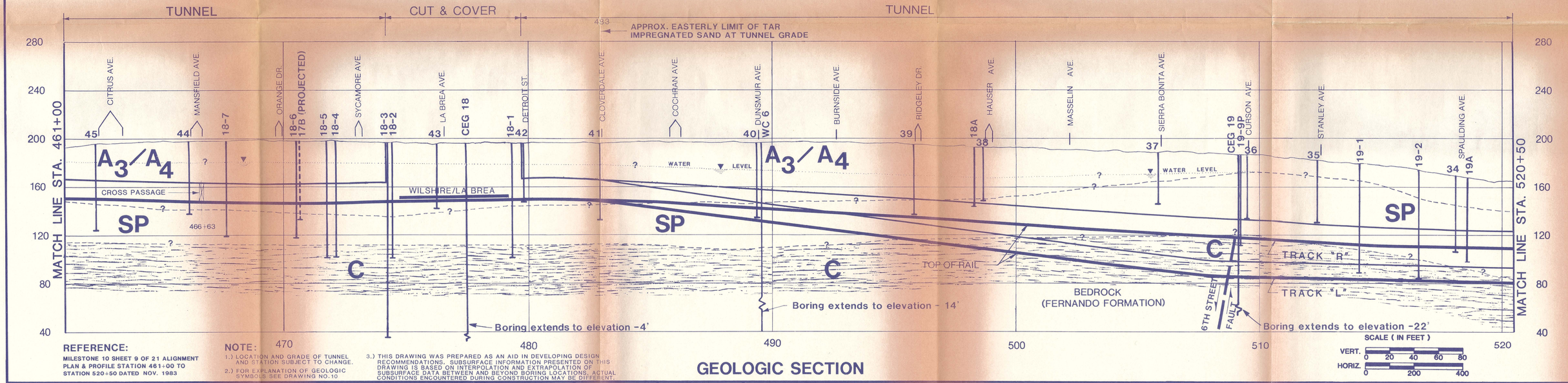
PLAN AND PROFILE

STA 373+53 TO STA 410+00 (PS)
STA (60+00) TO STA (96+45) (CS)

CONTRACT NO. R86 - D8602
DRAWING NO.
REV. | SHEET NO.
SCALE AS NOTED



LOCATION OF BORINGS



GEOLOGIC SECTION

SCALE (IN FEET)
VERT. 0 20 40 60 80
HORIZ. 0 200 400

REFERENCE:
MILESTONE 10 SHEET 9 OF 21 ALIGNMENT PLAN & PROFILE STATION 461+00 TO STATION 520+50 DATED NOV. 1983

NOTE:
1.) LOCATION AND GRADE OF TUNNEL AND STATION SUBJECT TO CHANGE.
2.) FOR EXPLANATION OF GEOLOGIC SYMBOLS SEE DRAWING NO.10
3.) THIS DRAWING WAS PREPARED AS AN AID IN DEVELOPING DESIGN RECOMMENDATIONS. SUBSURFACE INFORMATION PRESENTED ON THIS DRAWING IS BASED ON INTERPOLATION AND EXTRAPOLATION OF SUBSURFACE DATA BETWEEN AND BEYOND BORING LOCATIONS. ACTUAL CONDITIONS ENCOUNTERED DURING CONSTRUCTION MAY BE DIFFERENT.

REV.	DATE	BY	SUB.	APP.	DESCRIPTION

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

REV.	DATE	BY	SUB.	APP.	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE

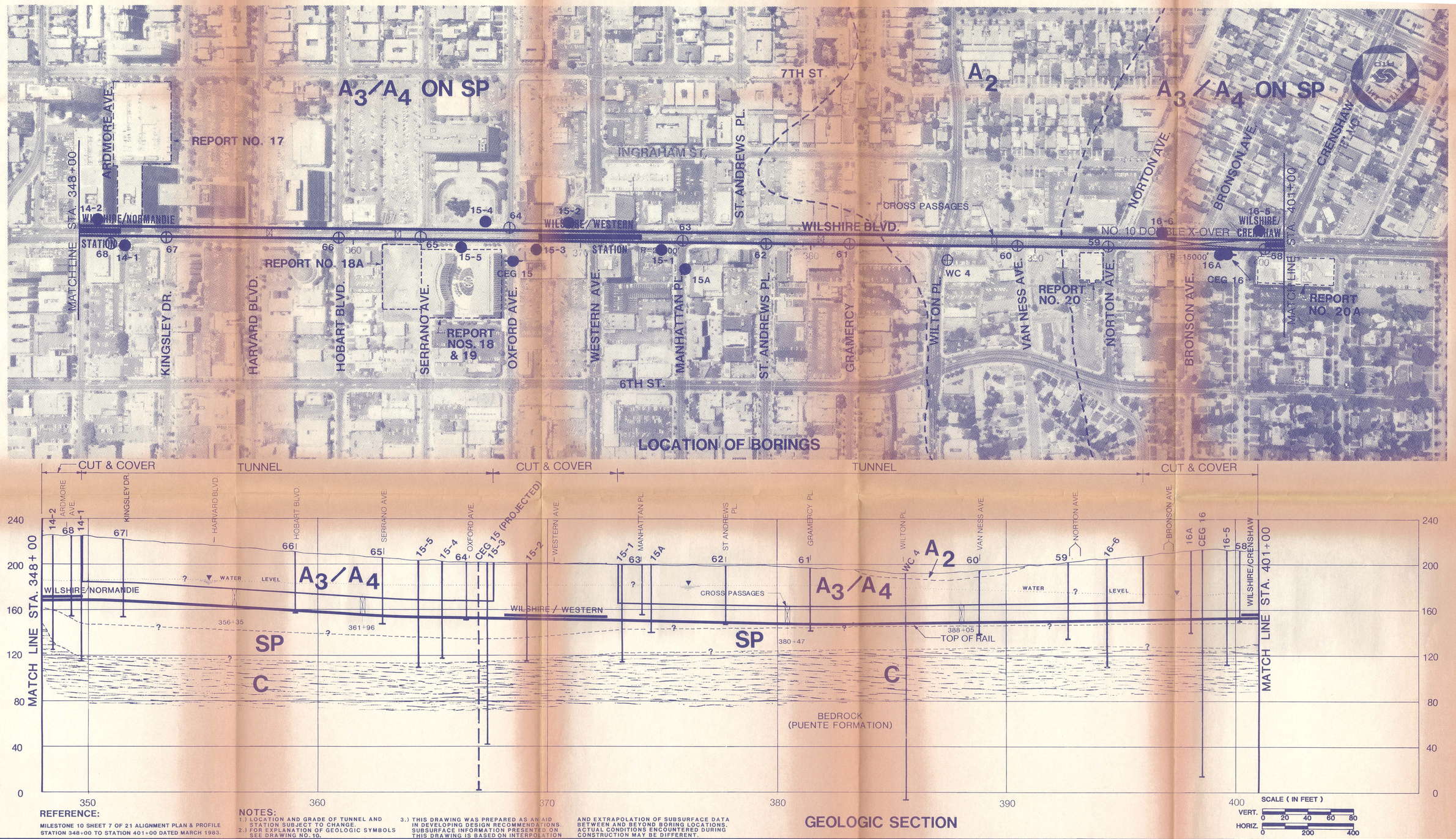
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

CCI/ESA/GRC
General Geotechnical Consultants
Submitted K.M. Pride Date Mar 1984

DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS
APPROVED

DESIGN UNIT A220
LOCATION OF BORINGS AND GEOLOGIC SECTION

PROJECT NO. 83-1140
DRAWING NO. 5
REV.
SCALE AS SHOWN



REFERENCE:
MILESTONE 10 SHEET 7 OF 21 ALIGNMENT PLAN & PROFILE STATION 348+00 TO STATION 401+00 DATED MARCH 1983.

NOTES:
1.) LOCATION AND GRADE OF TUNNEL AND STATION SUBJECT TO CHANGE.
2.) FOR EXPLANATION OF GEOLOGIC SYMBOLS SEE DRAWING NO. 10.
3.) THIS DRAWING WAS PREPARED AS AN AID IN DEVELOPING DESIGN RECOMMENDATIONS. SUBSURFACE INFORMATION PRESENTED ON THIS DRAWING IS BASED ON INTERPOLATION AND EXTRAPOLATION OF SUBSURFACE DATA BETWEEN AND BEYOND BORING LOCATIONS. ACTUAL CONDITIONS ENCOUNTERED DURING CONSTRUCTION MAY BE DIFFERENT.

SCALE (IN FEET)
VERT. 0 20 40 60 80
HORIZ. 0 200 400

GEOLOGIC SECTION

REV.	DATE	BY	SUB.	APP.	DESCRIPTION

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

REV.	DATE	BY	SUB.	APP.	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE

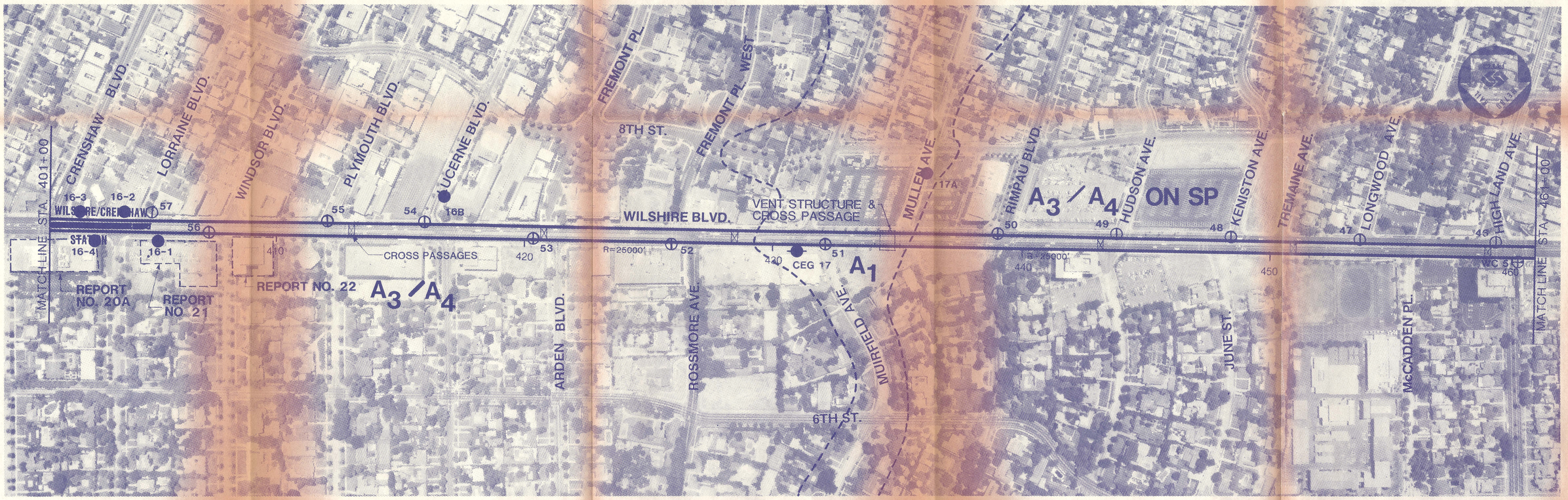
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

CCI/ESA/GRC
General Geotechnical Consultants
Submitted R.M. Pradel Date Mar 1984

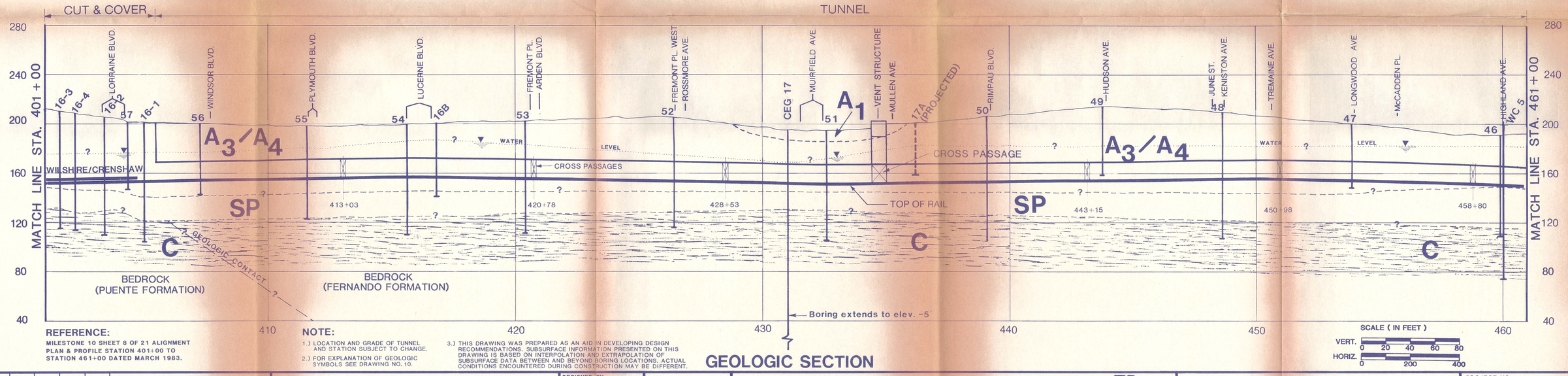
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS
APPROVED

DESIGN UNIT A220
LOCATION OF BORINGS AND GEOLOGIC SECTION

PROJECT NO. 83-1140
DRAWING NO. 3
REV.
SCALE AS SHOWN



LOCATION OF BORINGS



GEOLOGIC SECTION

REFERENCE:
MILESTONE 10 SHEET 8 OF 21 ALIGNMENT PLAN & PROFILE STATION 401+00 TO STATION 461+00 DATED MARCH 1983.

NOTE:
1.) LOCATION AND GRADE OF TUNNEL AND STATION SUBJECT TO CHANGE.
2.) FOR EXPLANATION OF GEOLOGIC SYMBOLS SEE DRAWING NO. 10.
3.) THIS DRAWING WAS PREPARED AS AN AID IN DEVELOPING DESIGN RECOMMENDATIONS. SUBSURFACE INFORMATION PRESENTED ON THIS DRAWING IS BASED ON INTERPOLATION AND EXTRAPOLATION OF SUBSURFACE DATA BETWEEN AND BEYOND BORING LOCATIONS. ACTUAL CONDITIONS ENCOUNTERED DURING CONSTRUCTION MAY BE DIFFERENT.

SCALE (IN FEET)
VERT. 0 20 40 60 80
HORIZ. 0 200 400

REV.	DATE	BY	SUB.	APP.	DESCRIPTION

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

REV.	DATE	BY	SUB.	APP.	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE

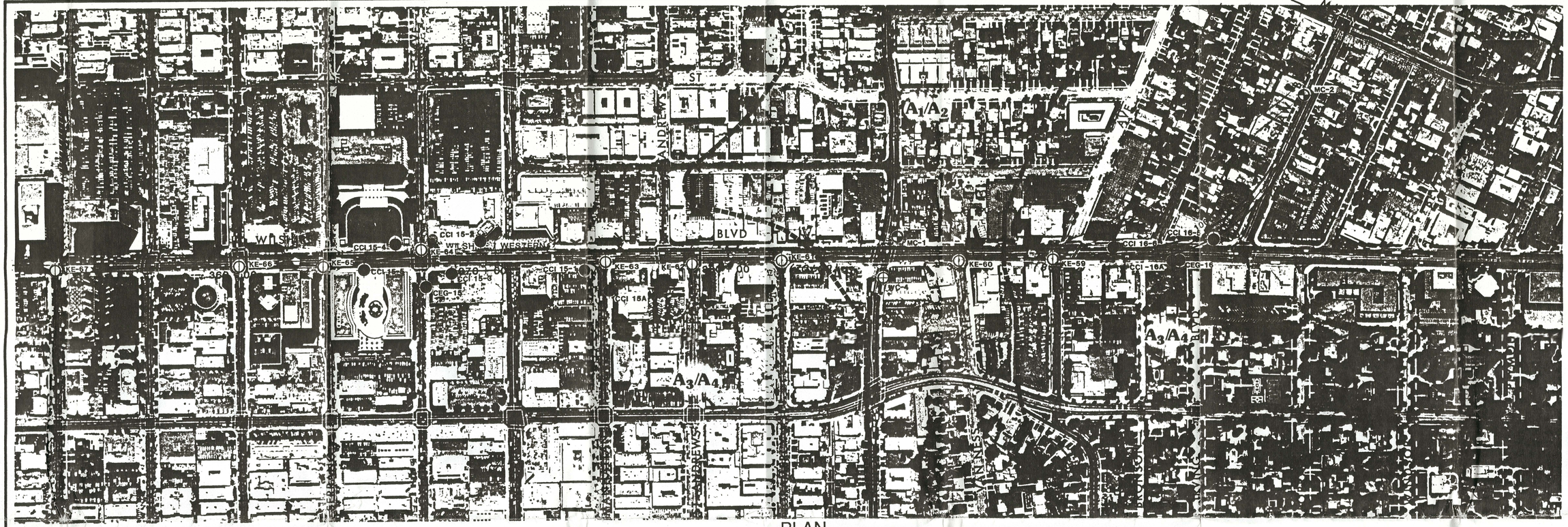
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

CCI/ESA/GRC
General Geotechnical Consultants
Submitted RM Price Date Mar 1984

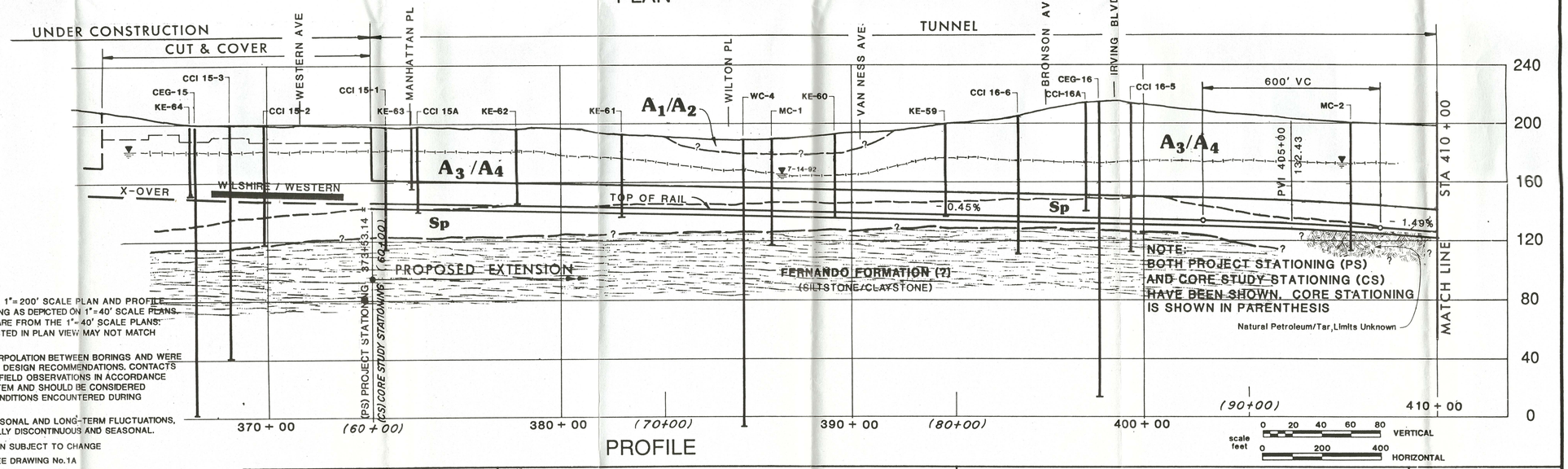
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS
APPROVED

DESIGN UNIT A220
LOCATION OF BORINGS AND GEOLOGIC SECTION

PROJECT NO. 83-1140
DRAWING NO. 4
REV.
SCALE AS SHOWN



PLAN



PROFILE

NOTES:
1) STATIONING AS DEPICTED IN PLAN VIEW ON 1"=200' SCALE PLAN AND PROFILE DRAWINGS OFTEN DOES NOT MATCH STATIONING AS DEPICTED ON 1"=40' SCALE PLANS. BORING LOCATIONS SHOWN ON THE PROFILES ARE FROM THE 1"=40' SCALE PLANS; THEREFORE, THE BORING LOCATIONS AS DEPICTED IN PLAN VIEW MAY NOT MATCH THE LOCATIONS DEPICTED IN PROFILE
2) THE GEOLOGIC PROFILES ARE BASED ON INTERPOLATION BETWEEN BORINGS AND WERE PREPARED AS A GRAPHIC AID FOR DEVELOPING DESIGN RECOMMENDATIONS. CONTACTS BETWEEN SOIL TYPES ARE BASED ON VISUAL FIELD OBSERVATIONS IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM AND SHOULD BE CONSIDERED APPROXIMATE AND GRADATIONAL. ACTUAL CONDITIONS ENCOUNTERED DURING CONSTRUCTION MAY BE DIFFERENT
3) GROUNDWATER LEVELS ARE SUBJECT TO SEASONAL AND LONG-TERM FLUCTUATIONS, PERCHED WATER TABLES ARE OFTEN LATERALLY DISCONTINUOUS AND SEASONAL.
4) LOCATION AND GRADE OF TUNNEL AND STATION SUBJECT TO CHANGE
5) FOR EXPLANATION OF GEOLOGIC SYMBOLS SEE DRAWING No.1A

LOCATION OF BORINGS and GEOLOGIC SECTION

METRO RAIL MID-CITY SEGMENT

Converse Consultants West

Scale	as shown
Date	8-14-92
Prepared By	DSS
Checked By	DS
Approved By	MBS
Project No.	91-31-208-01
Drawing No.	1

DESIGNED BY	JV
DRAWN BY	NM
CHECKED BY	SSO
APPROVED BY	JC
DATE	OCT. 1991

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Mid-City Segment Re-Evaluation Project

LACTC

Parsons Brinckerhoff

SUBMITTED: _____ APPROVED: _____

PLAN AND PROFILE

STA 373+53 TO STA 410+00 (PS)
STA (60+00) TO STA (96+45) (CS)

CONTRACT NO.	R86 - D8602
DRAWING NO.	
REV.	SHEET NO.
SCALE	AS NOTED

NOTE:
PROBES 67, 68 AND 69 LOCATED FURTHER NORTH.



NO.	DATE	REVISIONS	BY

		DATE
PROJECT NO.	PE 298.02	
DESIGNED BY		
DRAWN BY	WECK LIU	6.19.91
CHECKED BY	DENNIS KASPER	6.17.91
ENGINEER		
REGISTRATION NO.	DATE	

ENGINEERING-SCIENCE
DESIGN • RESEARCH • PLANNING
199 SOUTH LOS ROBLES P.O. BOX 7056 PASADENA, CALIFORNIA 91109
(818) 440-6161

FIGURE 1
PROBE LOCATION MAP

METRO-RAIL PROJECT

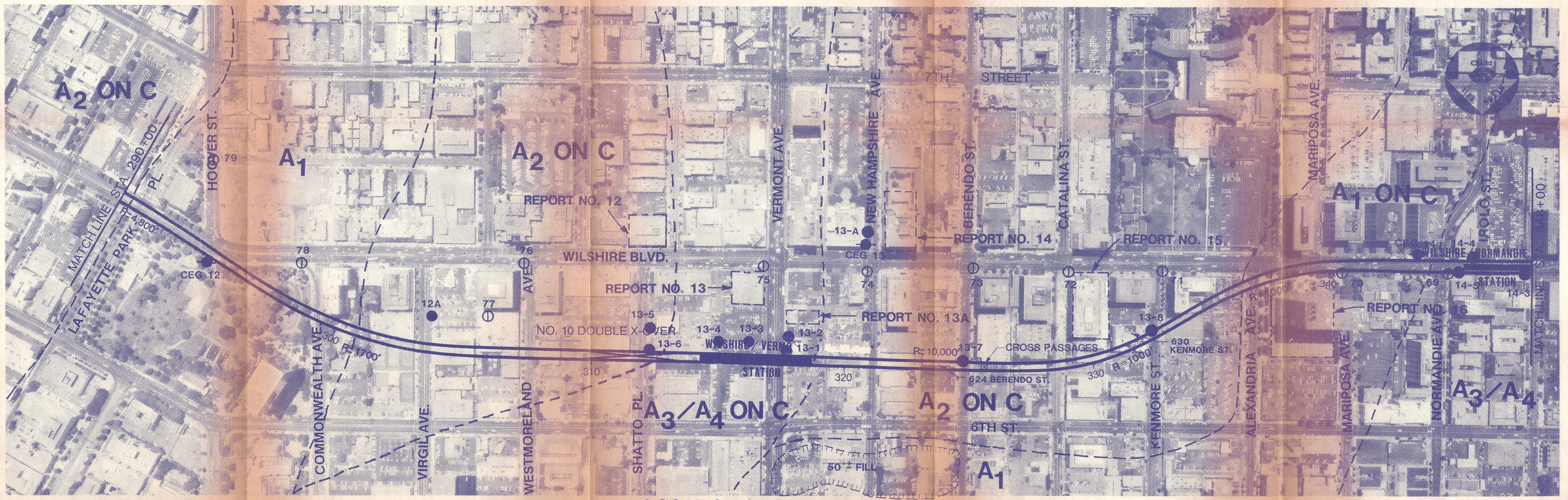
GAS PROBE LOCATIONS

SCALE: 1"=2000'-0"
SHEET NO.: P-1
FILE NO.:

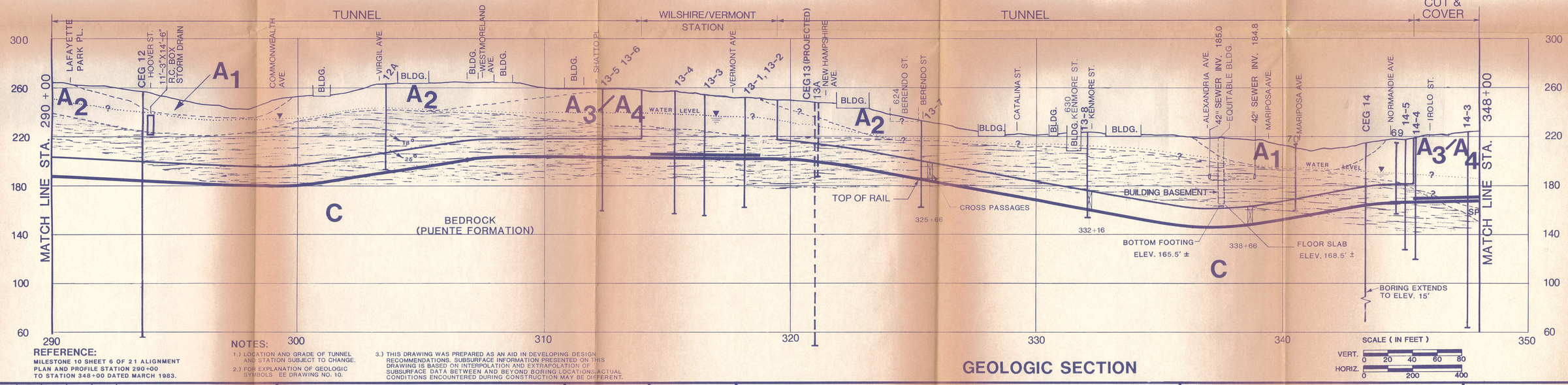
CADD FILE: \MRP\MRPPLAN.DGN

D: 08-24-92 : 06
LF

C:\DGN\METRO\MRPPLAN.DGN Aug. 24, 1992 10:08:03



LOCATION OF BORINGS



GEOLOGIC SECTION

SCALE (IN FEET)
VERT. 0 20 40 60 80
HORIZ. 0 200 400

REFERENCE:
MILESTONE 10 SHEET 6 OF 21 ALIGNMENT PLAN AND PROFILE STATION 290+00 TO STATION 348+00 DATED MARCH 1983.

NOTES:
1.) LOCATION AND GRADE OF TUNNEL AND STATION SUBJECT TO CHANGE.
2.) FOR EXPLANATION OF GEOLOGIC SYMBOLS SEE DRAWING NO. 10.
3.) THIS DRAWING WAS PREPARED AS AN AID IN DEVELOPING DESIGN RECOMMENDATIONS. SUBSURFACE INFORMATION PRESENTED ON THIS DRAWING IS BASED ON INTERPOLATION AND EXTRAPOLATION OF SUBSURFACE DATA BETWEEN AND BEYOND BORING LOCATIONS. ACTUAL CONDITIONS ENCOUNTERED DURING CONSTRUCTION MAY BE DIFFERENT.

REV.	DATE	BY	SUB.	APP.	DESCRIPTION

THE PREPARATION OF THIS DRAWING HAS BEEN FINANCED IN PART THROUGH A GRANT FROM THE U. S. DEPARTMENT OF TRANSPORTATION, URBAN MASS TRANSPORTATION ADMINISTRATION, UNDER THE URBAN MASS TRANSPORTATION ACT OF 1964, AS AMENDED, AND IN PART BY THE TAXES OF THE CITIZENS OF LOS ANGELES COUNTY AND OF THE STATE OF CALIFORNIA

REV.	DATE	BY	SUB.	APP.	DESCRIPTION

DESIGNED BY
DRAWN BY
CHECKED BY
IN CHARGE
DATE

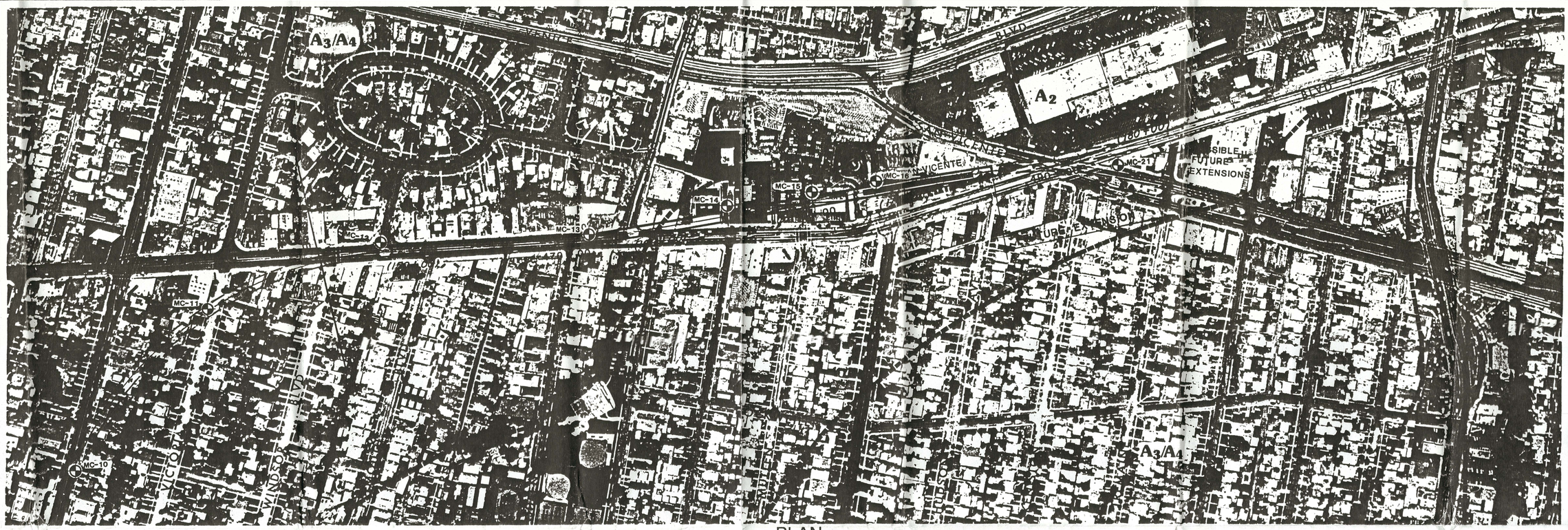
SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL PROJECT
RTD

CCI/ESA/GRC
General Geotechnical Consultants
Submitted [signature] Date Mar 1984

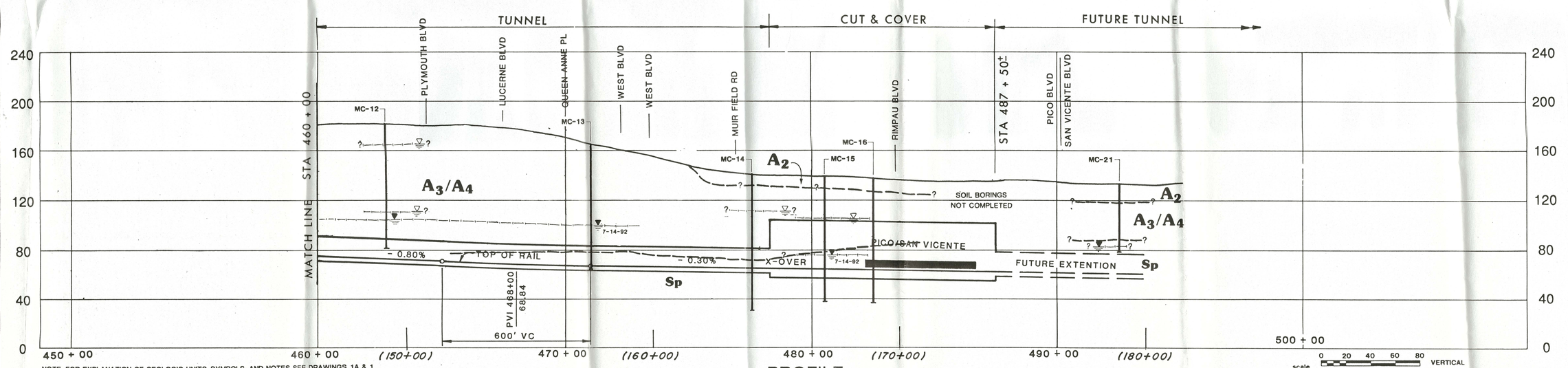
DMJM/PBQD/KE/HWA
A JOINT VENTURE
GENERAL CONSULTANTS
APPROVED

DESIGN UNIT A220
LOCATION OF BORINGS AND GEOLOGIC SECTION

PROJECT NO. 83-1140
DRAWING NO. 2
REV.
SCALE AS SHOWN



PLAN



PROFILE

NOTE: FOR EXPLANATION OF GEOLOGIC UNITS, SYMBOLS, AND NOTES SEE DRAWINGS 1A & 1.

LOCATION OF BORINGS and GEOLOGIC SECTION

METRO RAIL MID-CITY SEGMENT

Converse Consultants West

Scale	as shown
Date	8-14-92
Prepared By	DSS
Checked By	DS
Approved By	MBS
Project No.	91-31-208-01
Drawing No.	3

DESIGNED BY	JV
DRAWN BY	NM
CHECKED BY	SSO
APPROVED BY	JC
DATE	OCT. 1991

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
Mid-City Segment Re-Evaluation Project

LACTC

Parsons Brinckerhoff

SUBMITTED: _____ APPROVED: _____

PLAN AND PROFILE

STA 460+00 TO STA 487+50± (PS)
STA (146+45) TO STA (173+95) ± (CS)

CONTRACT NO. R86 - D8602
DRAWING NO.
REV. | SHEET NO.
SCALE AS NOTED