Geotechnical Investigation
Proposed 18-Inch Diameter Water Line Crossing Beneath Mint Canyon Channel Adjacent to Vasquez Canyon Road, Unincorporated Los Angeles County, California.

Project Number 600105-001

June 27, 2003

Prepared for:

Newhall County Water District
23780 North Pine Street
Santa Clarita, California 92322

Leighton Consulting, Inc.

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June 27, 2003

Project Number 600105-001

To: Newhall County Water District
23780 North Pine Street
Santa Clarita, California 92322

Attention: Mr. Kenneth Peterson

Subject: Geotechnical Investigation for a Proposed 18-Inch Diameter Water Line Crossing Beneath Mint Canyon Channel Adjacent to Vasquez Canyon Road, Unincorporated Los Angeles County, California.

1. Introduction

In accordance with your request and authorization, Leighton Consulting, Inc. (Leighton) is pleased to present this report of a geotechnical investigation for a proposed 18-inch diameter water line crossing beneath Mint Canyon Channel adjacent to Vasquez Canyon Road, in an unincorporated portion of Los Angeles County, California. Leighton's services were performed in general conformance with our proposal dated May 22, 2003.

2. Project Description

2.1 Site Location

The site of the proposed water line crossing is under the Mint Canyon Channel, parallel to Vasquez Canyon Road. The proposed pipeline is located on the northeastern side of the Vasquez Canyon Road bridge that spans Mint Canyon Channel. The site location is shown on the attached Site Location Map, Figure 1.

2.2 Proposed Development

The subject area covered in this report is shown on Sheet 13 of the referenced plans (dated July 17, 2001). The water line crossing of Mint canyon channel is planned to be installed by pipe jacking or microtunnelling methods, rather than open cut-and-cover techniques.

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The approximate diameter of the proposed water line is 18 inches. The invert to the water line is planned at approximately 9.5 feet below existing grades (approximate elevation of 1698 feet) in the canyon channel bottom.

3. Purpose

The purpose of Leighton's services is to assess the geotechnical conditions at the site, evaluate the feasibility of the work and to provide recommendations for construction.

4. Scope of Services

Our scope of services performed for this study comprised the following tasks:

- Reconnoiter the site and mark the boring locations for the underground utility locating service;
- Drill two borings at the closest reach of each end of the pipejacked or microtunnelled run of the proposed waterline. The borings were drilled to a depth of 40 feet and 50 feet beneath the ground surface;
- Obtain relatively undisturbed drive samples and bulk samples of drill cuttings;
- Perform laboratory testing of selected samples. Tests included moisture content, in-situ dry density, direct shear strength tests, sieve and hydrometer tests, maximum density and optimum moisture content, and Atterburg tests;
- Review the available boring log data associated with the adjacent Vasquez Canyon Road bridge. These data from the Los Angeles County Department of Public Works were provided by you.
- Perform engineering analyses, including the derivation of recommended lateral earth pressures for use in shoring and jacking pit design; and,
- Prepare this written report presenting the field and laboratory test data that were developed, and conclusions and recommendations for construction.

[Note: We did not perform a geophysical study (electrical resistivity imaging) to indirectly obtain subsurface information in the upper 10 feet of the Mint Canyon channel bottom, as described in our proposal. This was because it was judged that the existing high voltage power line in this area would disrupt the planned geophysical data acquisition.

5. Field Exploration Program

Subsurface conditions were explored by drilling at two locations with a truck-mounted hollow-stem auger drill rig. Details of the field exploration program, together with the boring logs, are presented in Appendix B. The approximate boring locations are shown on Figure 2.

6. Laboratory Test Program

Laboratory tests performed on samples obtained from the borings included in-situ dry density and moisture content, direct shear strength, sieve and hydrometer tests, maximum dry density and optimum moisture content, and Atterburg limits. The in-situ dry density and moisture content test results are presented on the boring logs in Appendix B. Descriptions of the test procedures and the remainder of the laboratory test results are presented in Appendix C.

7. Geotechnical Findings, Conclusions and Recommendations

7.1 Subsurface Conditions

The soils encountered in our borings consisted of a surficial layer of artificial fill underlain by alluvium. These soils and ground water conditions are described in more detail below.

Artificial Fill: Medium dense to dense silty sand. This soil was encountered in the upper 5 feet of the site at the locations where we drilled.

Alluvium: Predominantly dense to very dense silty sand, silty sand with gravel, sandy gravel gravelly sand. Very dense sandy gravel and gravelly sand were observed in the borings associated with the adjacent Vasquez Canyon bridge, especially in the channel area. A layer of clayey silt/silty clay was observed in boring LB-2 at 25 feet (approximate elevation of 1695').

Ground Water: Ground water was not encountered in either boring. However in the borings associated with the design and construction of the existing Vasquez Canyon Road bridge indicate that ground water was encountered at an approximate elevation of 1702. These borings were drilled in January, 1985.

Our understanding of the subsurface conditions are based on our field investigation and review of borings associated with the adjacent Vasquez Canyon Road bridge. It is possible that in alluvial deposit, especially in channel area, the soil types including density and grain size could greatly vary from place to place.

7.2 Microtunnelling and Pipejacking

The site conditions encountered indicate that microtunnelling or pipejacking of the sewer beneath the bridges is a feasible method of construction. We understand that employment of microtunnelling versus pipejacking techniques depends upon the excavation diameter. Microtunneling uses a remote-control machine for the excavation, for excavation diameters deemed too small for entry by workmen. Pipejacking is used for excavations large enough for entry by workmen. We understand that 900 millimeters (roughly 3 feet) is considered the minimum diameter of excavation where pipejacking techniques can be used. For either technique, the water line pipe would be advanced, by jacking from an access pit, as the excavation progresses.

7.3 Ground Water Considerations

We do not anticipate ground water to affect the proposed construction, considering the fact that we did not encounter groundwater in our borings. If ground water is encountered during the excavation of the jacking pit, collection of the water by constructing sump(s) at a lower elevation within the excavation bottom and pumping the water out will likely be sufficient to take care of the ground water problems during construction. Also, selecting the construction period out side the rainy season may also be appropriate to avoid any ground water problems during construction.

7.4 Lateral Earth Pressures

For design of braced shoring, we recommend a lateral earth pressure corresponding to a rectangular pressure distribution with a constant pressure of 50H from top to bottom. (H is the height of the excavation in feet, and the pressure is expressed in pounds per square foot (psf).)

For the design of jacking gear, we recommend a passive lateral resistance of an equivalent fluid pressure of 400 pcf. This value does not include any factor of safety.

7.5 Trench Backfilling

Trenches should be backfilled with suitable backfill, placed, and compacted in accordance with applicable public works specifications and the contract plans and specifications. Backfill materials should be free from trash, debris, rocks larger in size than 8 inches, and any other deleterious materials. Fill materials should be moisture conditioned to slightly above the optimum moisture content, placed in layers not exceeding 8 inches of uncompacted thickness, and compacted to at least 90% relative compaction (ASTM D1557 standard).

8. Summary

In our opinion, the geotechnical conditions are suitable for the planned water line crossing, provided the recommendations of this report are implemented and good construction practices are employed, along with suitable equipment.

9. Limitations

Leighton's work was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional opinions included in this report.

The conclusions and recommendations in this report are based in part upon data that were obtained from a necessarily limited number of observations, site visits, excavations, samples and tests. Such information can be obtained only with respect to the specific locations explored, and therefore may not completely define all subsurface conditions throughout the site. The nature of many sites is that differing geotechnical or geological conditions can occur within small distances and under varying climatic conditions. Furthermore, changes in subsurface conditions can and do occur over time.

Therefore, the findings, conclusions and recommendations presented in this report can be relied upon only if Leighton has the opportunity to observe the subsurface conditions during any subsequent investigations, grading and construction of the project, in order to confirm that our preliminary findings are representative of the site.

The findings of this report are considered valid as of the present time. However, changes in the conditions of a site can occur with the passage of time, whether they are caused by natural processes and events, or to human activities on the subject site or on adjacent sites. Furthermore, changes in codes and standards of practice may occur as a result of legislation or from the broadening of knowledge. Accordingly, this report may at some future time become invalidated wholly or partially by changes outside Leighton's control. This report is therefore subject to review and revision should changed conditions become identified.

This report is issued with the understanding that it is your responsibility to ensure that the information and recommendations contained herein are brought to the attention of the appropriate design consultants for the project, and are incorporated into the project plans and specifications; and that the necessary steps are taken to ensure that the contractors implement all such recommendations in the field.

If parties other than Leighton are engaged by you to provide grading or construction-phase geotechnical services, they must be notified by you that they will be required to assume complete responsibility for the geotechnical aspects of the project by signifying their concurrence with the findings and recommendations presented in this report or by providing alternative recommendations.

Any persons using this report for bidding or construction purposes should perform such independent investigations as they deem necessary to satisfy themselves as to the surface and subsurface conditions, and regarding the procedures to be used in the execution of the work.

This report is intended only for the use of Newhall County Water District, and its design consultants, and only as related expressly to the proposed development.

10. Closure

The opportunity to provide our services for this project is sincerely appreciated. Please call if you have any questions or require any clarifications.

Respectfully submitted,

LEIGHTON CONSULTING, INC.

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Project Engineer

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6/27/03.

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Distribution: Addressee (5 copies)

Attachments:

Appendices

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Appendix B – Field Exploration Program
Appendix C – Laboratory Test Program

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Figure 1 – Site Location Map
Figure 2 – Boring Locations Map

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

Leighton Consulting, Inc., Proposal to Perform a Geotechnical Investigation for a Proposed 18-Inch Diameter Water Line Crossing Beneath Mint Canyon Channel Adjacent to Vasquez Canyon Road, Santa Clarita, California, dated May 22, 2003

Los Angeles County Department of Public Works, Plans for Bridge on Vasquez Canyon Road over Mint Canyon Channel, Dated December 3, 1985.

Newhall County Water District, Plans for the Construction of Water Lines in Sand Canyon Road, Sierra Highway and Vasquez Canyon Road from 4100' SE of Sierra Highway to Vasquez Canyon Way, 21 Sheets, Job No. 4246, dated July 17, 2001.

APPENDIX B

FIELD EXPLORATION PROGRAM

APPENDIX B

FIELD EXPLORATION PROGRAM

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Boring Logs

LB-1 and LB-2 .... Rear of Text

APPENDIX B

FIELD EXPLORATION PROCEDURES

B-1 General

Before Leighton's field exploration, its personnel performed a site reconnaissance. The boring locations were marked and Underground Service Alert (USA), the underground utility locating service, was contacted to verify that the boring locations were clear of buried utilities. Leighton personnel also performed a visual survey to verify that the borings would not encounter any buried utility lines.

B-2 Drilling and Sampling

Subsurface conditions were explored by drilling two borings using an 8-inch-diameter, hollow-stem auger powered by a truck-mounted drill rig. The boring depths were 40 feet to 50 feet below ground surface. The borings are designated LB-1 and LB-2; their approximate locations are shown on Figure 2.

Relatively undisturbed ring samples were obtained at the depths indicated on the boring logs. The ring samples were obtained by driving a Modified California split-spoon sampler into the bottom of the boring as it was incrementally advanced. The number of blows to achieve a 12-inch penetration under a 30-inch drop of a 140-pound hammer was recorded. The blow counts provide a measure of the density or consistency of the soils. Bulk samples of drill cuttings were obtained from the borings at selected intervals. Bulk samples were transported in labeled plastic bags.

The sampling rings were 2.41 inches inside diameter and 1 inch high. The ring samples were placed in plastic tubes, labeled, and transported to our laboratory in cushioned containers.

B-3 Miscellaneous

All the borings were logged by a Leighton engineering geologist, who also supervised drilling operations and collected the samples.

The earth materials were classified visually, in substantial accordance with the Unified Soil Classification System (USCS). The boring logs are attached.

Stratification lines on the logs represent the approximate boundaries between predominant types of soil materials. Stratification may contain differing soil materials, with transitions generally occurring gradually.

The borings were backfilled with native soils.

Ground water was not encountered in either boring.

GEOTECHNICAL BORING LOG LB-1

Date: 6-6-03 | Sheet 1 of 2
Project: NCWD/Vasquez | Project No.: 990000-529
Drilling Co.: C&C Drilling | Type of Rig: HSA
Hole Diameter: 8 inches | Drive Weight: 140lbs | Drop: 30"
Elevation Top of Hole: 1722' | Location:

Logged By: JBW
Sampled By: JBW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								**FILL**	
1720									SILTY SAND: medium reddish to brown, slightly moist, medium dense, with trace of gravel	MD
				B-1				SM		
	5								**ALLUVIUM**	
				R-1	60	98.7	11.7	SM	SILTY SAND: medium reddish to brown, slightly moist, dense, with trace of gravel	
1715										
	10									
				R-2	73	105.7	2.3	SM	SILTY SAND: medium brown, moist, dense, fine grained	
1710										
	15									
				R-3	80	113.1	3.1	SM	GRAVELLY SILTY SAND: reddish brown, slightly moist, very dense	
1705										
				B-2				SM		
	20									DS
				R-4	46	114.7	2.6	SM	SILTY SAND: medium brown, moist, medium dense, with trace of gravel	
1700										
	25									SA
				R-5	53	106.0	21.6	SM	At bottom: GRAVELLY SILTY SAND: reddish brown, moist, dense; At tip: SILTY CLAY TO CLAY, medium brown, moist	
1695										
	30									

SAMPLE TYPES:
- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE
- G GRAB SAMPLE
- SH SHELBY TUBE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION
- SA SIEVE ANALYSIS
- CU TRIAXIAL SHEAR
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG LB-1

Date 6-6-03 **Sheet** 2 **of** 2
Project NCWD/Vasquez **Project No.** 990000-529
Drilling Co. C&C Drilling **Type of Rig** HSA
Hole Diameter 8 inches **Drive Weight** 140lbs **Drop** 30"
Elevation Top of Hole 1722' **Location**

Logged By JBW
Sampled By JBW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	30			R-6	50/6"			SM	SILTY SAND: medium gray, slightly moist, very dense, with trace of gravel	
1690										
	35			R-7	50/top4"	113.6	6.8	SM	SILTY SAND: medium gray, slightly moist, very dense, medium to fine grained	
1685										
	40			R-8	50/top0"	110.9	6.9		No Recovery	
1680									**Total Depth Drilled = 40 feet** **Total Depth Sampled = 35.5 feet** **No Ground Water Encountered** **Boring Hole Backfilled with Cuttings**	
	45									
1675										
	50									
1670										
	55									
1665										
	60									

SAMPLE TYPES:
- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE
- G GRAB SAMPLE
- SH SHELBY TUBE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
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- SA SIEVE ANALYSIS
- CU TRIAXIAL SHEAR
- EI EXPANSION INDEX
- RV R-VALUE

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GEOTECHNICAL BORING LOG LB-2

Date 6-6-03 **Sheet** 1 **of** 2
Project NCWD/Vasquez **Project No.** 990000-529
Drilling Co. C&C Drilling **Type of Rig** HSA
Hole Diameter 8 inches **Drive Weight** 140lbs **Drop** 30"
Elevation Top of Hole 1724' **Location**

Logged By JBW
Sampled By JBW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								**FILL** SILTY SAND: medium brown, slightly moist, medium dense	
				B-1				SM		
1720	5								**ALLUVIUM**	
				R-1	17	127.3	6.1	SM	SILTY SAND: medium reddish brown, slightly moist, medium dense, fine grained	
1715	10			R-2	30	123.1	7.9	SM	SILTY SAND: medium brown, moist, medium dense, medium grained	
1710	15			R-3	70	107.6	5.2	SM	SILTY SAND: reddish brown, moist, dense, with trace of gravel	DS
1705	20			R-4	50/6"	113.6	6.5	SM	same as above	SA
1700	25			R-5	50/6"	111.4	6.0	SM	CLAYEY SILT: medium brown, moist, very dense	
1695				B-2				ML		
	30									

SAMPLE TYPES:
- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE
- G GRAB SAMPLE
- SH SHELBY TUBE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
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- CU TRIAXIAL SHEAR
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG LB-2

Date 6-6-03 Sheet 2 of 2

Project NCWD/Vasquez Project No. 990000-529

Drilling Co. C&C Drilling Type of Rig HSA

Hole Diameter 8 inches Drive Weight 140lbs Drop 30"

Elevation Top of Hole 1724' Location

Logged By JBW

Sampled By JBW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	30			R-6	50/6"	111.4	5.5	SM	GRAVELLY SILTY SAND: reddish brown, moist, very dense, with trace of gravel	DS,SA
1690										
	35			R-7	46	118.9	2.9	SM	SILTY SAND: medium reddish brown, slightly moist to moist, medium dense, medium grained	
1685										
	40			R-8	54	102.5	6.7	SM	SILTY SAND: medium brown, slightly moist, dense, fine grained	
1680										
	45			R-9	50/6"	111.9	5.5	SM	SILTY SAND: medium brown, slightly moist, hard, medium grained	
				B-3				SM		
1675										
	50			R-10	50/5"	105.8	6.4	SM	SILTY SAND: medium brown, slightly moist, hard, medium grained	
1670									**Total Depth Drilled = 50 feet Total Depth Sampled =51 feet No Ground Water Encountered Boring Hole Backfilled with Cuttings**	
	55									
1665										
	60									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
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- G GRAB SAMPLE
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TYPE OF TESTS:

- DS DIRECT SHEAR
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APPENDIX C

LABORATORY TEST PROGRAM

APPENDIX C

LABORATORY TEST PROGRAM

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APPENDIX C

LABORATORY TEST PROGRAM

C-1 General

The laboratory test program comprised the testing of selected representative specimens prepared from representative samples of the earth materials to obtain the following properties and characteristics: in-situ dry density and moisture content, direct shear strength, sieve analysis/hydrometer tests, maximum dry density and optimum moisture content, and corrosion suite tests.
The laboratory tests were performed in substantial accordance with the applicable procedures of: American Society For Testing and Materials (ASTM) and State of California, Department of Transportation, Standard Test Methods (CTM), as relevant.

C-2 Soil Classification: Visual Method (ASTM D2488)

Classifying soils in accordance with standardized methods enables their properties and characteristics to be evaluated in a broad-based manner, and to correlate soils found on various sites. Visual classifications made in the field are often refined after more detailed observations of the materials are made in the laboratory, and after subsequent laboratory testing.
The classifications made in respect of selected soil samples are shown on the logs of borings in Appendix B. The classifications of specific specimens that were tested are indicated in Appendix C. Because the types of in-situ materials may change abruptly, there may be apparent discrepancies between the classifications as indicated on the logs and in the test result documentation.

C-3 In-Situ Dry Density and Moisture Content (ASTM D2937, 2216)

The in-situ dry density provides a measure of the degree of densification of a material, while the moisture content serves to establish a correlation between the properties and behavior of a soil.

The in-situ dry density (in lb/ft^3) and moisture content (as a percentage of dry weight of soil) were determined for relatively undisturbed specimens. The results are presented on the logs of borings (Appendix B).

C-4 Direct Shear Strength (ASTM D 3080)

The shear strength of an earth material is obtained by successively shearing separate specimens partially contained within rings, utilizing a direct-shear machine. Varying normal pressures are applied, and the perpendicularly applied stress required to shear the specimen is recorded. The cohesion (c, in lb/ft^2) and angle of internal friction (ϕ, in degrees) are then calculated: these constitute the shear strength characteristics of the material. The shearing stress is applied at a constant rate of strain. In order to simulate possibly adverse moisture conditions, the specimens are soaked prior to the test, and are sheared under water.

Four specimens were tested. The test results are presented Figures C-1.1 through C-1.4.

C-5 Particle Size Analysis (ASTM D 422)

This test establishes the distribution, within a specimen of the soil, of soil particles of given sizes. Three specimens were tested. The gradations, in terms of the weights of the material finer of specified sizes, expressed as percentages of the total weight of the specimen, are presented in Figures C-2.1 and C-2.3.

C-6 Maximum Dry Density and Optimum Moisture Content(ASTM D 1557)

This test determines the maximum dry density and optimum moisture content of a soil specimen. One specimen was tested. The test results are presented in Table C-1.

C-7 Atterberg Limits (ASTM D4318-98)

This test is to determine the liquid limit, plastic limit, and the plasticity index of soils. Two specimens were tested. The test results are presented in Table C-2.

TABLE C-1

MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT

Specimen	Sample Location	Material Description	Maximum Density (lbs/ft^3)	Optimum Moisture Content (%)
1	LB-1 @ 0-5 feet	Silty Sand	118.5	10.0

TABLE C-2

ATTERBERG LIMITS

Specimen	Sample Location	Material Description	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)
1	LB-1 @ 30 ft.	Silty Sand	Non-plastic	Non-plastic	Non-plastic
2	LB-2 @ 25 ft.	Silty Sand	Non-plastic	Non-plastic	Non-plastic

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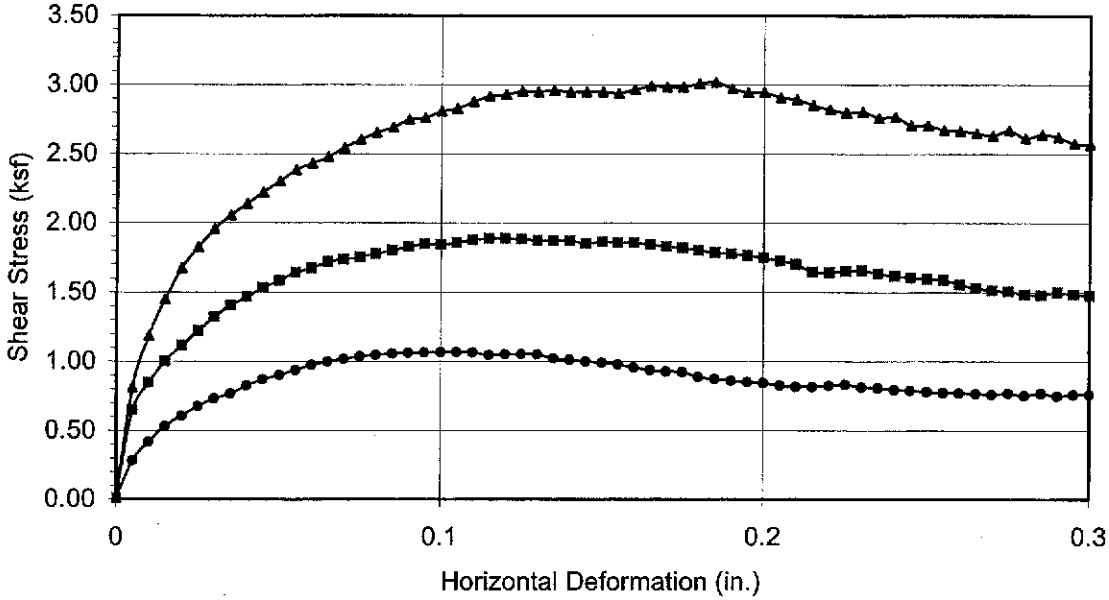

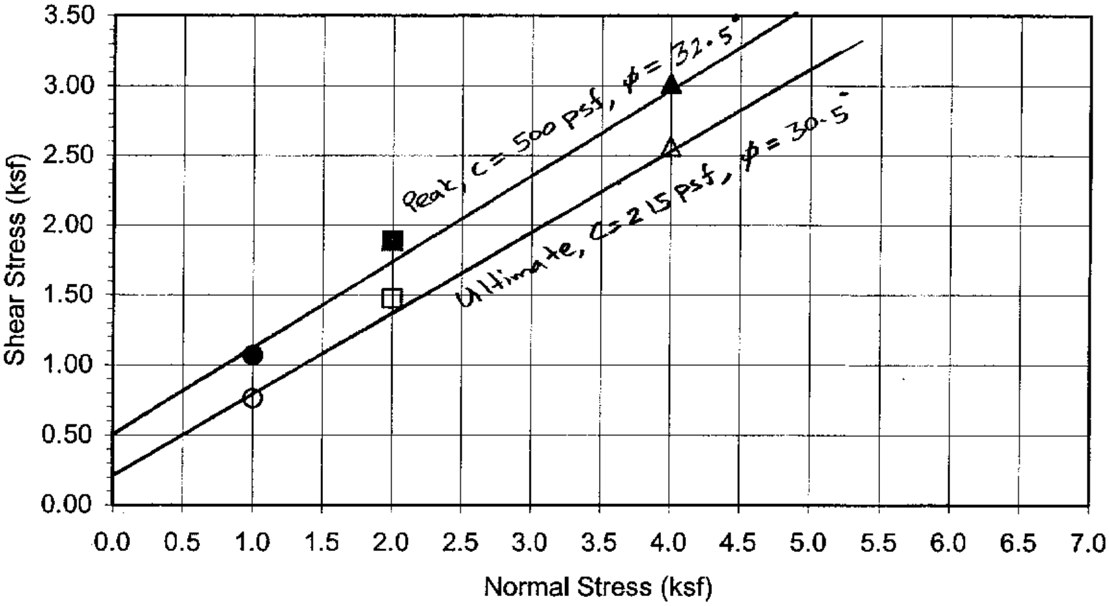

Boring No.	**LB-1**
Sample No.	**R-2**
Depth (ft)	**10**
Sample Type: Drive	
Soil Identification: Brown Poorly-graded Sand (SP)	

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 1.069	■ 1.886	▲ 3.018
Shear Stress @ End of Test (ksf)	○ 0.761	□ 1.475	△ 2.566
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	2.27	2.27	2.27
Dry Density (pcf)	106.6	106.1	108.5
Saturation (%)	10.6	10.4	11.1
Soil Height Before Shearing (in.)	0.9926	0.9892	0.9838
Final Moisture Content (%)	18.6	18.0	17.9

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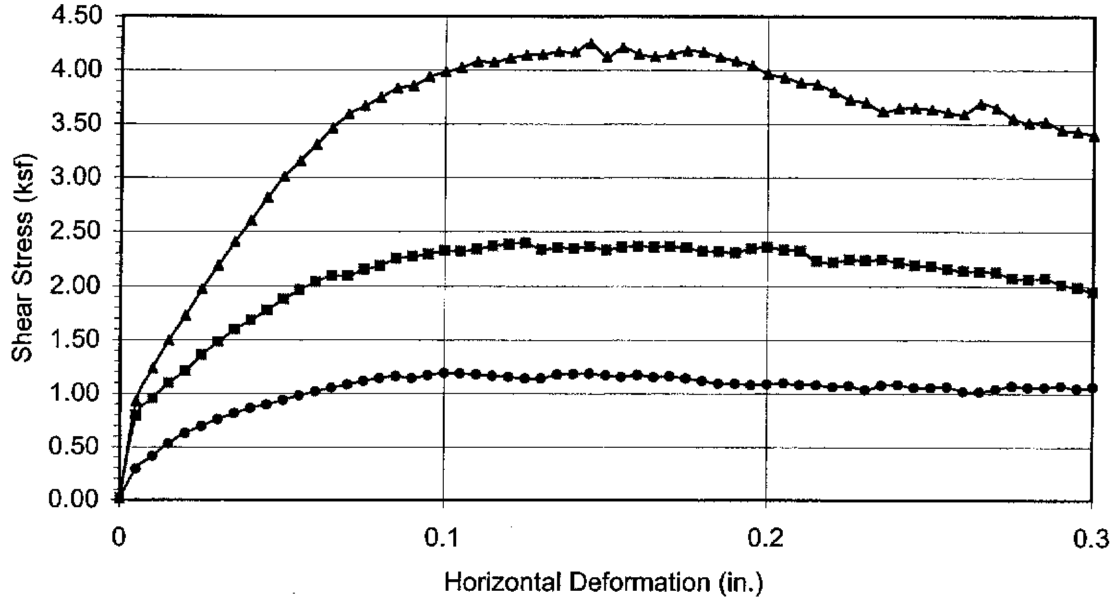
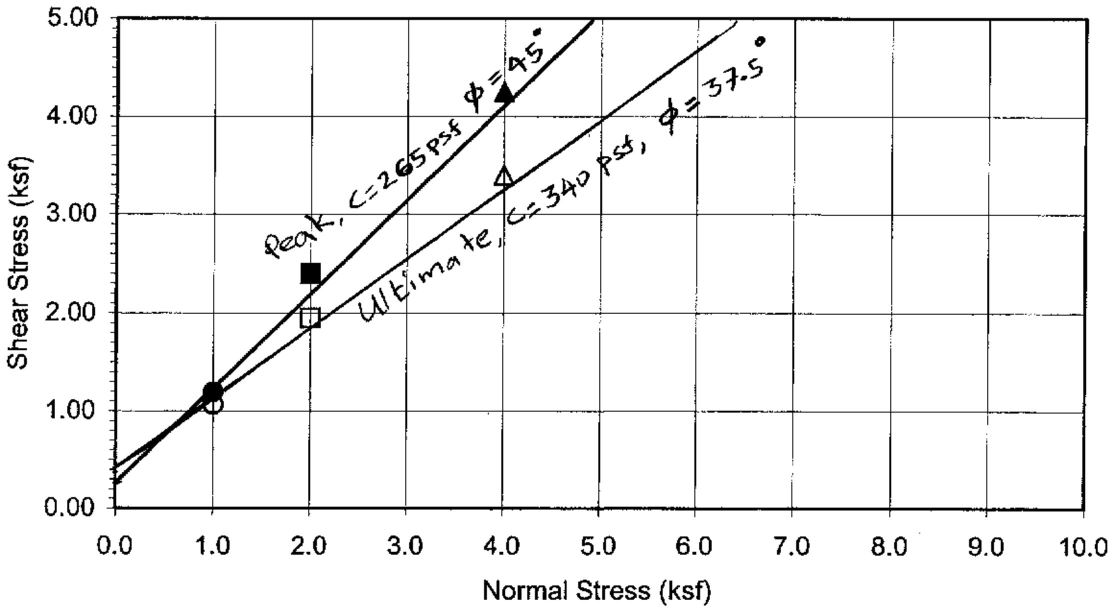
DIRECT SHEAR TEST RESULTS
Consolidated Undrained

Project No.: 600105-001
NCWD / Vasquez Canyon Pipeline
Figure C-1.1
06-03





Boring No.	**LB-1**
Sample No.	**R-4**
Depth (ft)	**20**
Sample Type: Drive	
Soil Identification: Brown Poorly-graded Sand with Gravel (SP)g	

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 1.194	■ 2.398	▲ 4.253
Shear Stress @ End of Test (ksf)	○ 1.066	□ 1.949	△ 3.398
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	2.63	2.63	2.63
Dry Density (pcf)	111.0	113.1	115.8
Saturation (%)	13.7	14.5	15.6
Soil Height Before Shearing (in.)	0.9877	0.9867	0.9802
Final Moisture Content (%)	13.9	13.8	13.2

Teratest Labs, Inc.
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DIRECT SHEAR TEST RESULTS
Consolidated Undrained

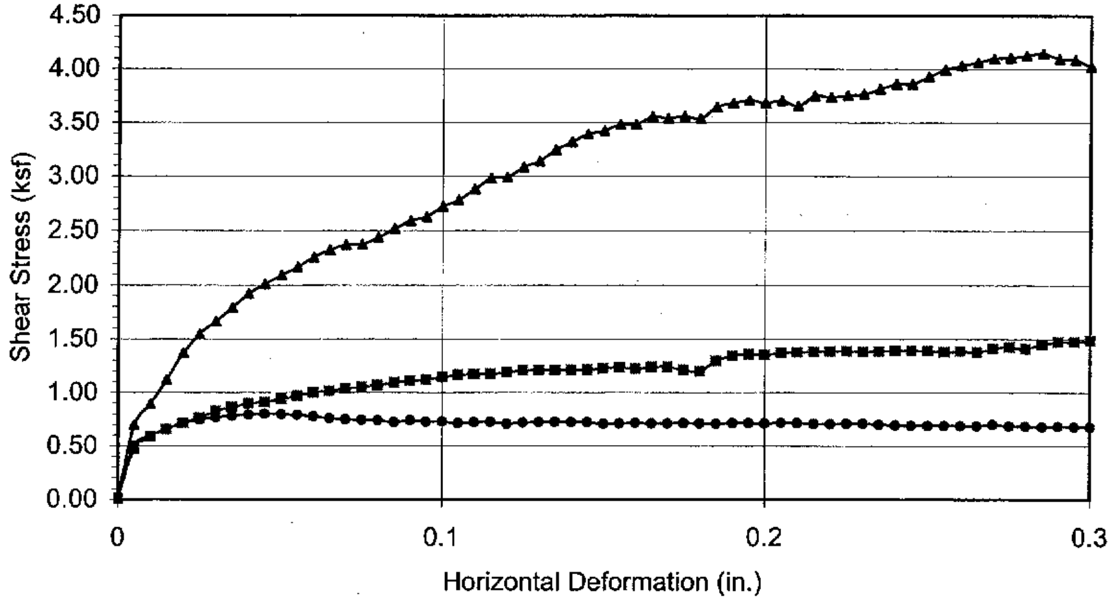
Project No.: 600105-001

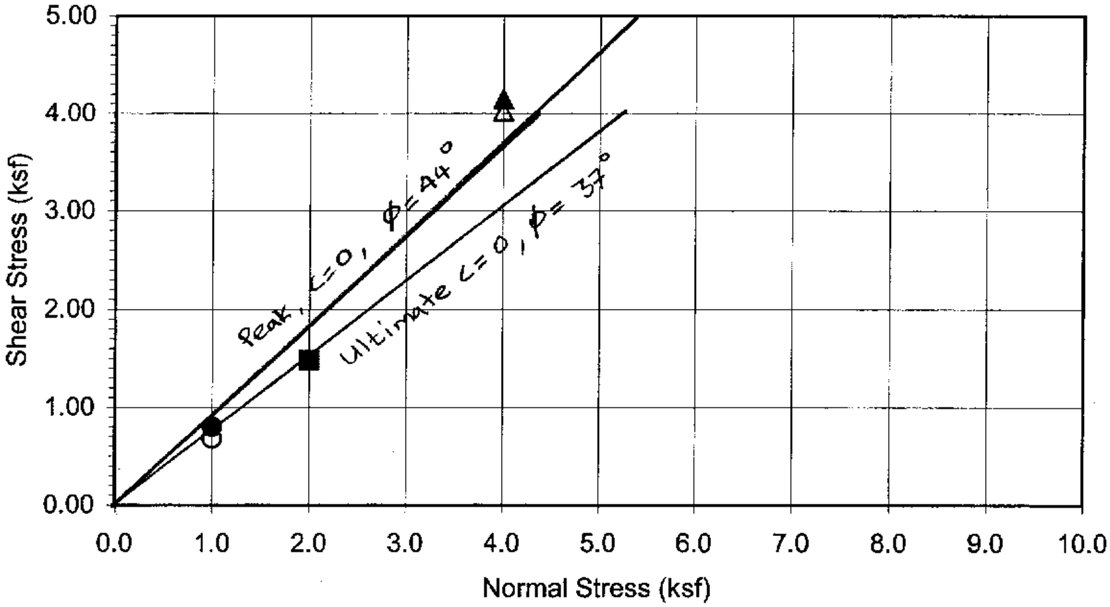
NCWD / Vasquez Canyon Pipeline

Figure C-1.2

06-03

DS LB-1, R-4 @ 20





Boring No.	**LB-2**
Sample No.	**R-3**
Depth (ft)	**15**
Sample Type: Drive	
Soil Identification: Brown Silty Sand (SM) [For 4 ksf: Reddish Brown (SP)g]	

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 0.801	■ 1.484	▲ 4.147
Shear Stress @ End of Test (ksf)	○ 0.680	□ 1.484	△ 4.022
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	5.24	5.24	5.24
Dry Density (pcf)	99.1	104.7	105.2
Saturation (%)	20.2	23.2	23.5
Soil Height Before Shearing (in.)	0.9951	0.9757	0.9628
Final Moisture Content (%)	19.6	16.7	14.1

Teratest Labs, Inc.
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DIRECT SHEAR TEST RESULTS
Consolidated Undrained

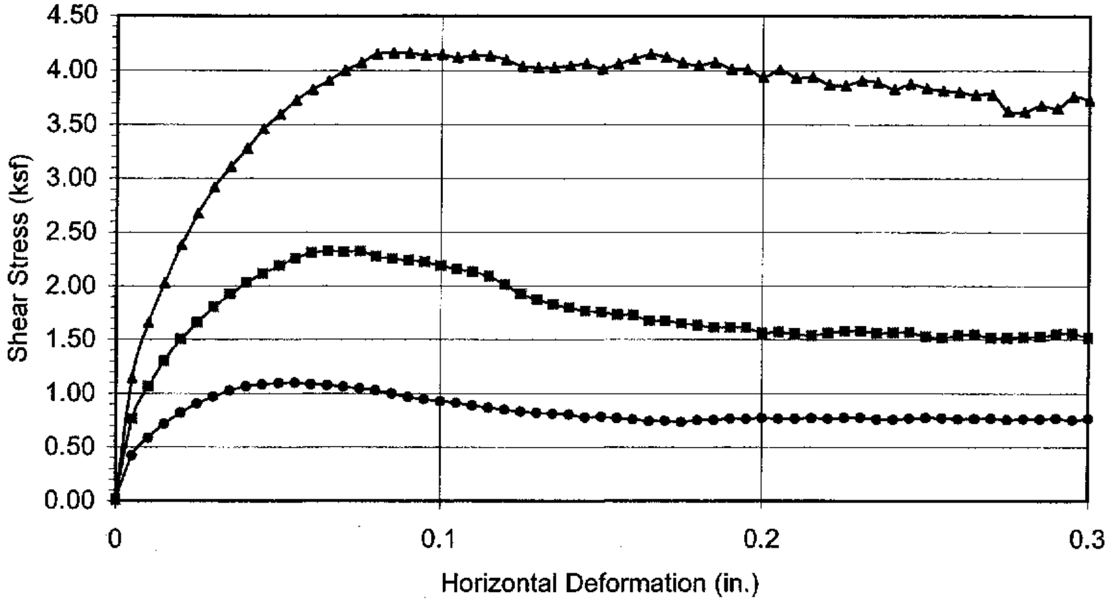
Project No.: 600105-001

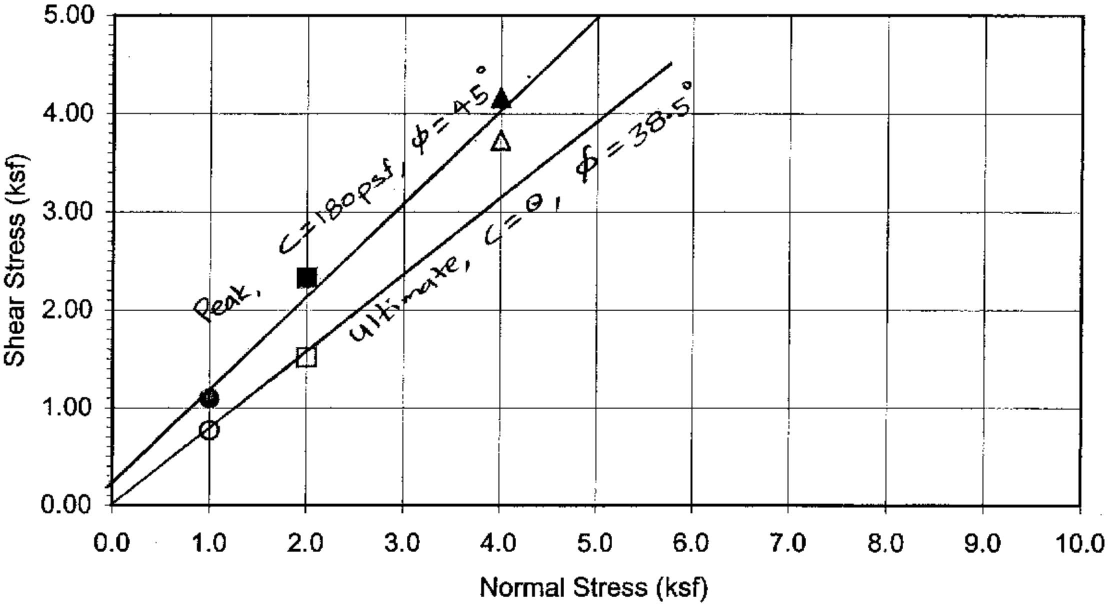
NCWD / Vasquez Canyon Pipeline

Figure C-1.3

06-03

DS LB-2, R-3 @ 15





Boring No.	**LB-2**
Sample No.	**R-6**
Depth (ft)	**30**
Sample Type: Drive	
Soil Identification: Brown Poorly-graded Sand with Gravel (SP)g	

Normal Stress (kip/ft²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft²)	● 1.097	■ 2.326	▲ 4.162
Shear Stress @ End of Test (ksf)	○ 0.767	□ 1.515	△ 3.729
Deformation Rate (in./min.)	0.0500	0.0500	0.0500
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	6.03	6.03	6.03
Dry Density (pcf)	109.5	112.0	116.0
Saturation (%)	30.1	32.3	35.9
Soil Height Before Shearing (in.)	0.9855	0.9830	0.9792
Final Moisture Content (%)	18.3	15.7	14.4

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DIRECT SHEAR TEST RESULTS
Consolidated Undrained

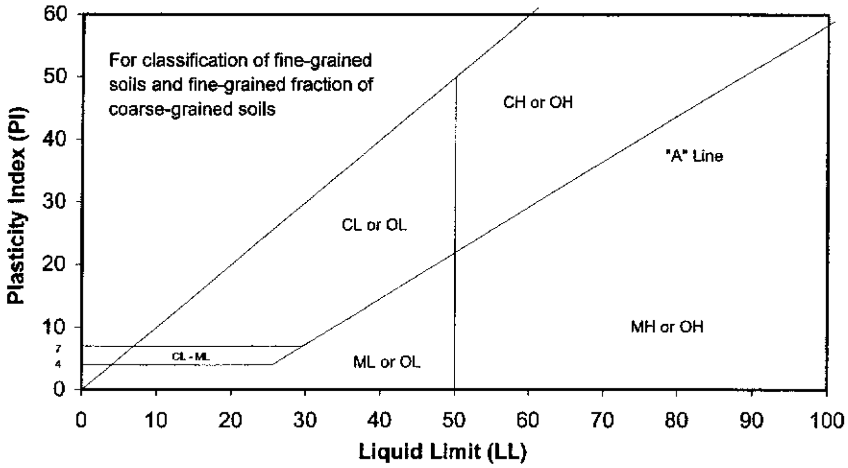
Project No.: 600105-001

NCWD / Vasquez Canyon Pipeline

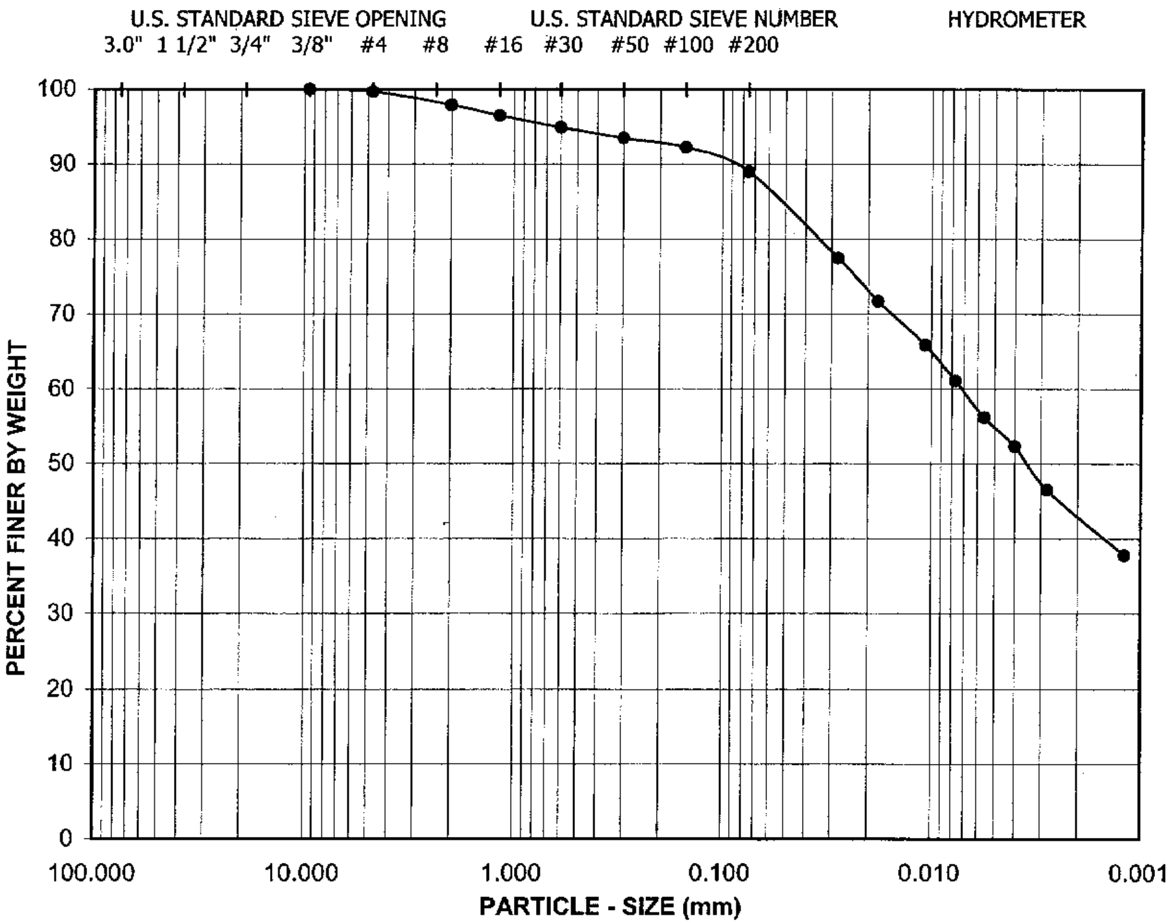
Figure C-1.4

06-03

DS LB-2, R-6 @ 30



GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

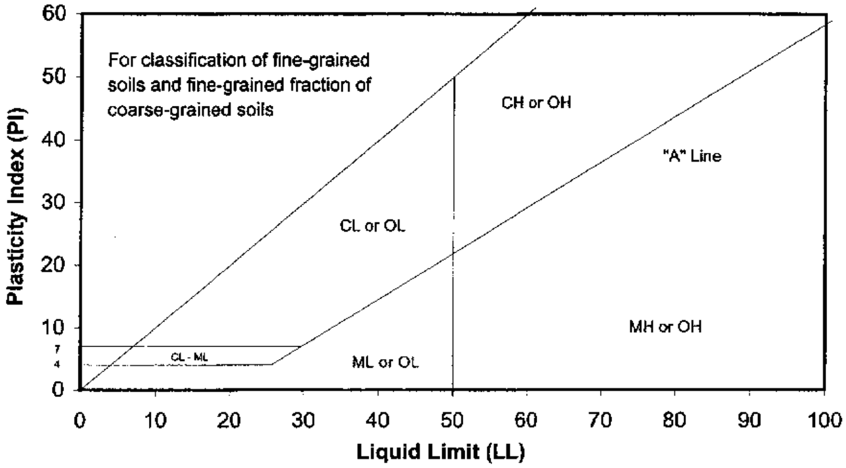


Boring No.:	Sample No.:	Depth (ft.) :	Soil Type	GR:SA:FI	LL,PL,PI
LB-1	R-5	25	(CL)	0:11:89	NA,,

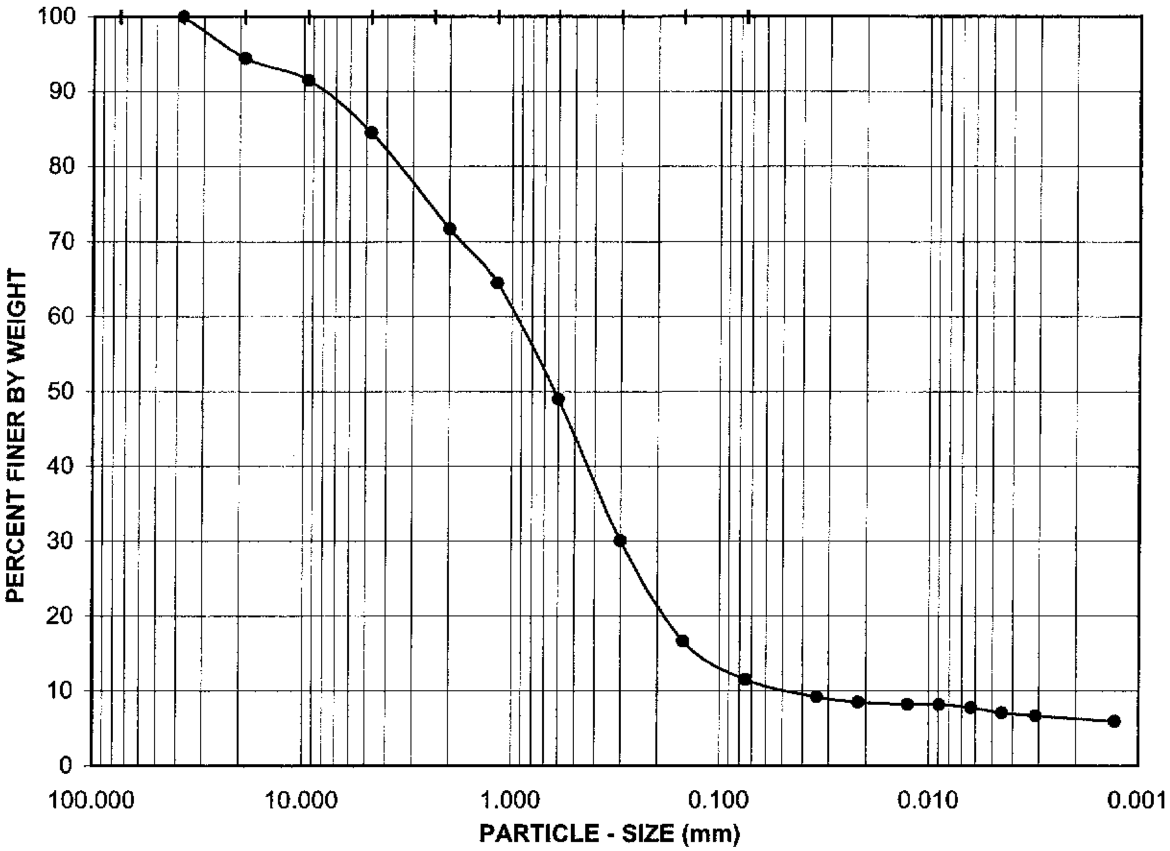
Soil Description: Brown Lean Clay (CL)

Teratest Labs, Inc. A LEIGHTON GROUP COMPANY	**ATTERBERG LIMITS, PARTICLE - SIZE CURVE** **ASTM D 4318, D 422**	Project No.: 600105-001 NCWD / Vasquez Canyon Pipeline Figure C-2.1 06-03

SA&Hydro LB-1, R-5 @ 25



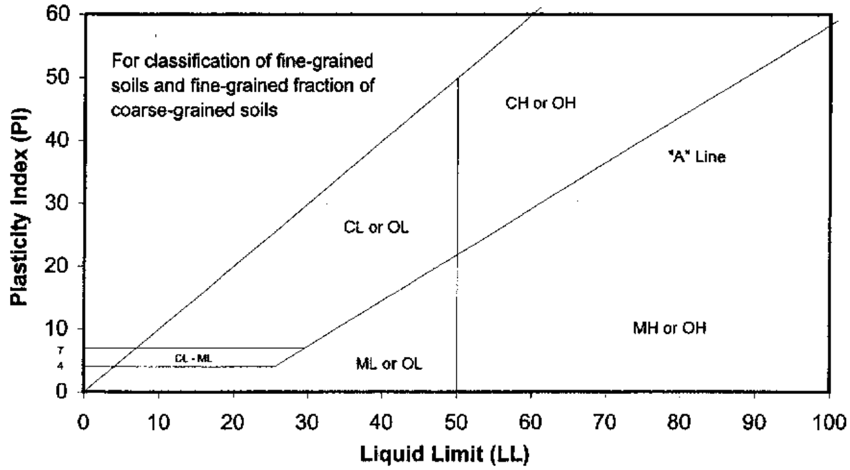
GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

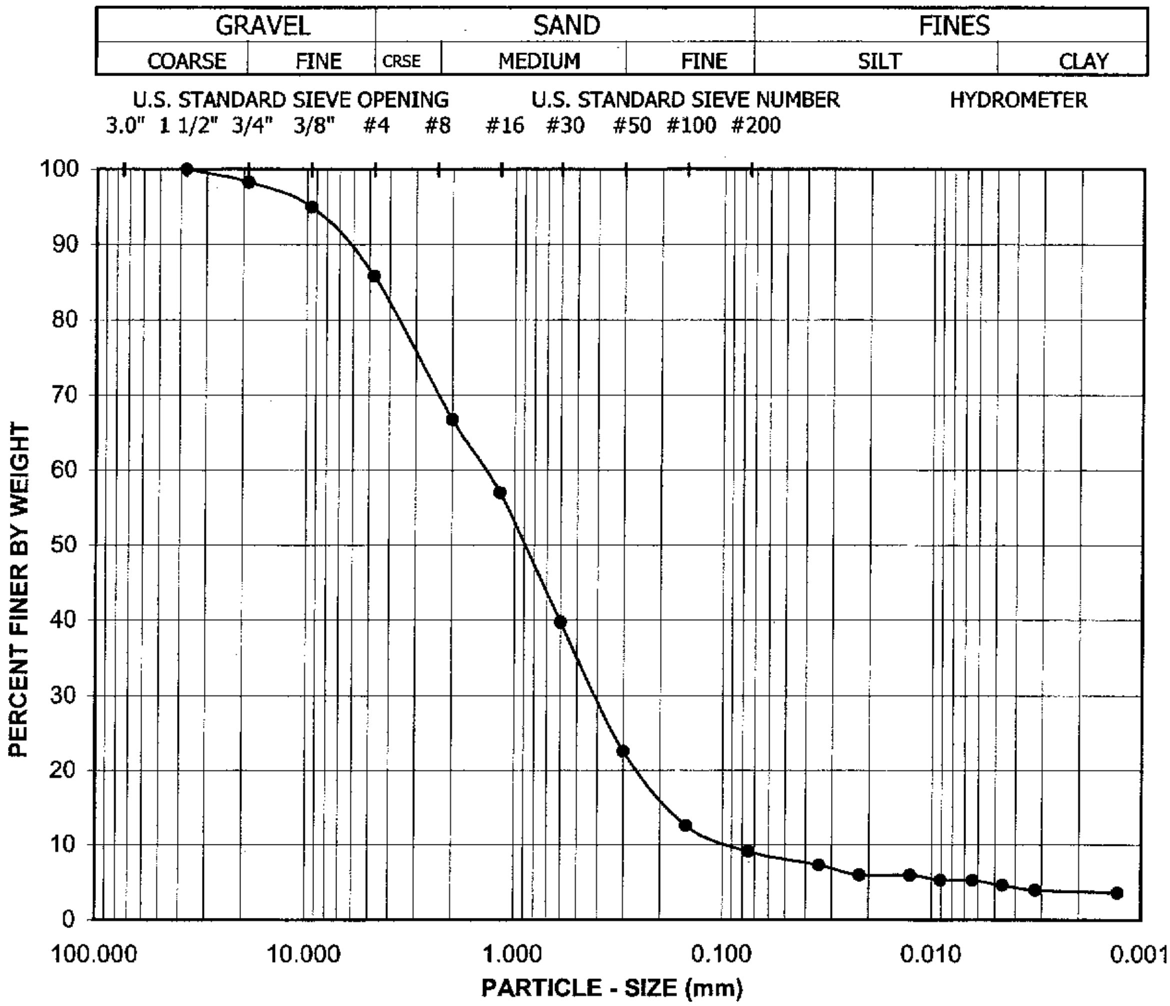


Boring No.:	Sample No.:	Depth (ft.) :	Soil Type	GR:SA:FI	LL,PL,PI
LB-2	R-4	20	(SW-SM)g	16:72:12	NA,,

Soil Description: Brown Well-graded Sand with Silt and Gravel (SV

Teratest Labs, Inc. A LEIGHTON GROUP COMPANY	ATTERBERG LIMITS, PARTICLE - SIZE CURVE ASTM D 4318, D 422	Project No.: 600105-001 NCWD / Vasquez Canyon Pipeline Figure C-2.2 06-03

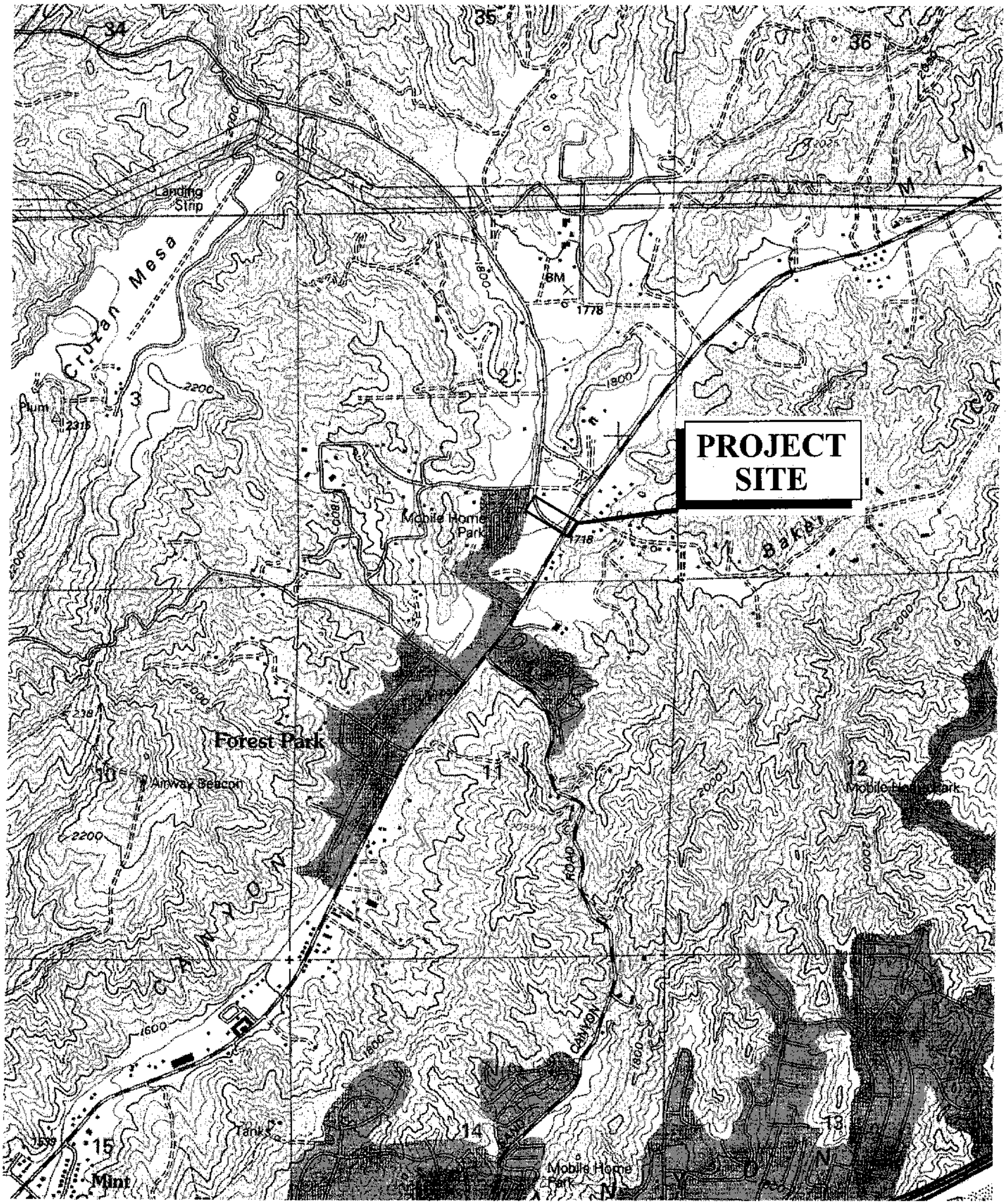




Boring No.:	Sample No.:	Depth (ft.) :	Soil Type	GR:SA:FI	LL,PL,PI
LB-2	R-6	30	(SW-SM)	14:77:9	NA,,

Soil Description: Brown Well-graded Sand with Silt (SW-SM)

Teratest Labs, Inc. A LEIGHTON GROUP COMPANY	**ATTERBERG LIMITS, PARTICLE - SIZE CURVE** **ASTM D 4318, D 422**	Project No.: 600105-001 NCWD / Vasquez Canyon Pipeline Figure C-2-3 06-03



SITE LOCATION MAP

NCWD Vasquez Canyon Pipeline
Los Angeles County, California

Project No.	600105-001
Scale (approx)	1:24,000
Engr..	VGG
Drafted By	JBW
Date	June, 2003

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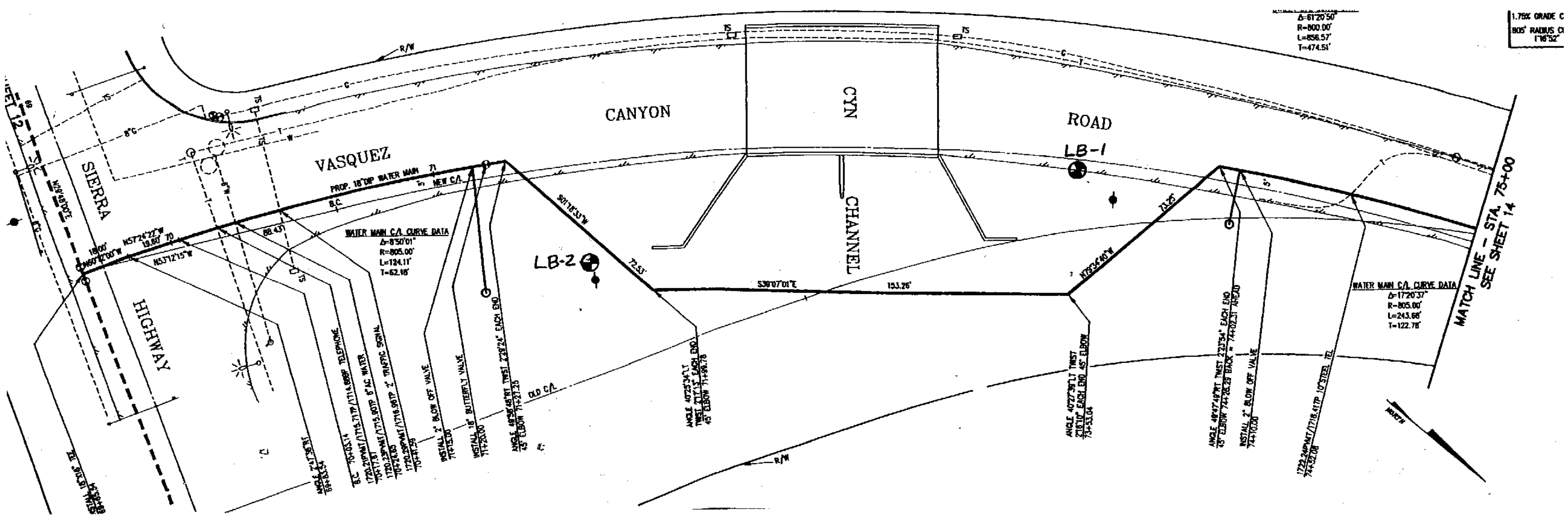
Figure No. 1



LB-2 ⊕ Approximate Location of Leighton Borings.

BORING LOCATION MAP

NCWD Vasques Canyon Pipeline
Los Angeles County, California

Project No.	600105-001
Scale (Approx)	1" = 45'
Engr./Geol.	VGG
Drafted By	JBW
Date	June, 2003

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Figure No. 2