Appendix A

Boring and Well Construction Logs

UNIFIED SOIL CLASSIFICATION SYSTEM
(From ASTM D 2488-93 & 2487-93)

MAJOR DIVISIONS			GROUP/GRAPHIC SYMBOL②		TYPICAL DESCRIPTION
Coarse-Grained Soils *(more than 50% retained on No. 200 sieve)* *[Use Dual Symbols for 5 - 12% Fines (i.e. GP-GM)]*①	Gravels *(more than 50% of coarse fraction retained on No. 4 sieve)*	Clean Gravels① *(less than 5% fines)*	GW		Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			GP		Poorly Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
		Gravels with① Fines *(more than 12% fines)*	GM		Silty Gravels, Gravel-Sand-Silt Mixtures
			GC		Clayey Gravels, Gravel-Sand-Clay Mixtures
	Sands *(50% or more of coarse fraction passes the No. 4 sieve)*	Clean Sands① *(less than 5% fines)*	SW		Well-Graded Sands, Gravelly Sands, Little or No Fines
			SP		Poorly Graded Sand, Gravelly Sands, Little or No Fines
		Sands with① Fines *(more than 12% fines)*	SM		Silty Sands, Sand-Silt Mixtures
			SC		Clayey Sands, Sand-Clay Mixtures
Fine-Grained Soils *(50% or more passes the No. 200 sieve)*	Silts and Clays *(liquid limit less than 50)*	Inorganic	ML		Inorganic Silts of Low to Medium Plasticity, Rock Flour, or Clayey Silts with Slight Plasticity
			CL		Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
		Organic	OL		Organic Silts and Organic Silty Clays of Low Plasticity
	Silts and Clays *(liquid limit 50 or more)*	Inorganic	CH		Inorganic Clays of Medium to High Plasticity, Sandy Fat Clay, Gravelly Fat Clay
			MH		Inorganic Silts, Micaceous or Diatomaceous Fine Sands or Silty Soils, Elastic Silt
		Organic	OH		Organic Clays of Medium to High Plasticity, Organic Silts
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor		PT		Peat, Humus, Swamp Soils with High Organic Content (See D 4427-92)

NOTES

1. Dual symbols (symbols separated by a hyphen, i.e., SP-SM, slightly silty fine SAND) are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

2. Borderline symbols (symbols separated by a slash, i.e., CL/ML, silty CLAY/clayey SILT; GW/SW, sandy GRAVEL/gravelly SAND) indicated that the soil may fall into one of two possible basic groups.

Denny Way/Lake Union CSO Project
Elliott West Outfall
Seattle, Washington

SOIL CLASSIFICATION AND LOG KEY

August 1998 W-7808-43

SHANNON & WILSON, INC.
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FIG. A-1
Sheet 2 of 2

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff	15 to 30	2000 - 4000
			Hard	over 30	>4000

USCS SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse Grained Soils	Gravel and Gravelly Soils	Clean Gravel (little or no fines)	GW	Well-graded GRAVEL
			GP	Poorly-graded GRAVEL
	More than 50% of Coarse Fraction Retained on No. 4 Sieve	Gravel with Fines (appreciable amount of fines)	GM	Silty GRAVEL
			GC	Clayey GRAVEL
	Sand and Sandy Soils	Clean Sand (little or no fines)	SW	Well-graded SAND
More than 50% Retained on No. 200 Sieve Size			SP	Poorly-graded SAND
	50% or More of Coarse Fraction Passing No. 4 Sieve	Sand with Fines (appreciable amount of fines)	SM	Silty SAND
			SC	Clayey SAND
Fine Grained Soils	Silt and Clay	Liquid Limit Less than 50%	ML	SILT
			CL	Lean CLAY
			OL	Organic SILT/Organic CLAY
50% or More Passing No. 200 Sieve Size	Silt and Clay	Liquid Limit 50% or More	MH	Elastic SILT
			CH	Fat CLAY
			OH	Organic SILT/Organic CLAY
Highly Organic Soils			PT	PEAT

TEST SYMBOLS

%F	Percent Fines
AL	Atterberg Limits: PL = Plastic Limit, LL = Liquid Limit
CBR	California Bearing Ratio
CN	Consolidation
DD	Dry Density (pcf)
DS	Direct Shear
GS	Grain Size Distribution
K	Permeability
MD	Moisture/Density Relationship (Proctor)
MR	Resilient Modulus
PID	Photoionization Device Reading
PP	Pocket Penetrometer Approx. Compressive Strength (tsf)
SG	Specific Gravity
TC	Triaxial Compression
TV	Torvane Approx. Shear Strength (tsf)
UC	Unconfined Compression

SAMPLE TYPE SYMBOLS

- 2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
- Shelby Tube
- 3.0" OD Split Spoon with Brass Rings
- Small Bag Sample
- Large Bag (Bulk) Sample
- Core Run
- Non-standard Penetration Test (with split spoon sampler)

GROUNDWATER SYMBOLS

- Groundwater Level (measured at time of drilling)
- Groundwater Level (measured in well or open hole after water level stabilized)

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

COMPONENT PROPORTIONS

PROPORTION RANGE	DESCRIPTIVE TERMS
< 5%	Clean
5 - 12%	Slightly (Clayey, Silty, Sandy)
12 - 30%	Clayey, Silty, Sandy, Gravelly
30 - 50%	Very (Clayey, Silty, Sandy, Gravelly)
Components are arranged in order of increasing quantities.	

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation in general accordance with ASTM D 2487 and ASTM D 2488. Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content. Proportion, gradation, and angularity of constituents, additional comments. (GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

DWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

PROJECT NO.: 97061 FIGURE: A-1

Contract A

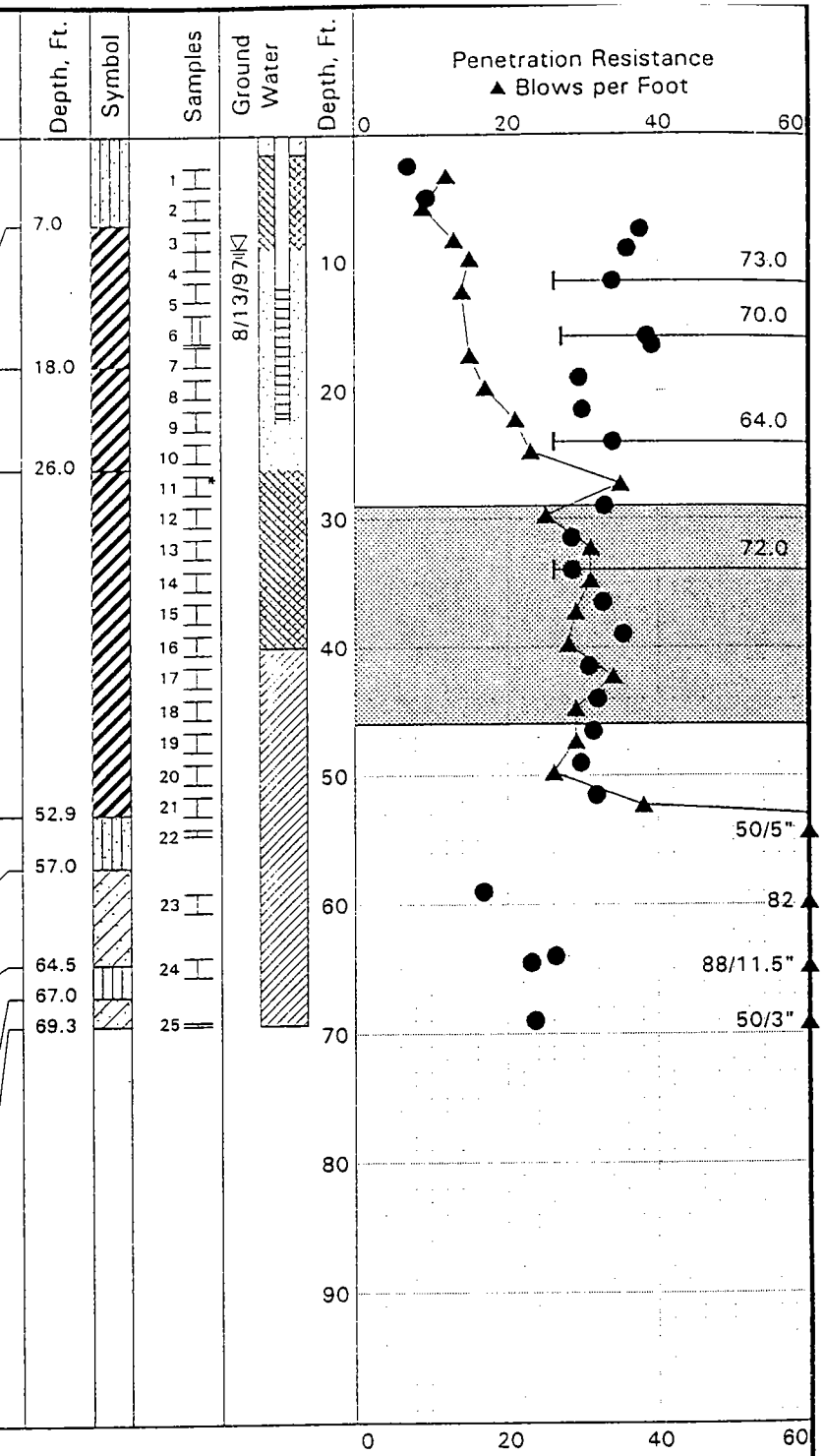
SOIL DESCRIPTION

STA.: 1 + 88 OFFSET: 48 Ft. North
Surface Elevation: 119.7 Ft.

Description	Depth, Ft.
Loose to medium dense, dark gray, silty fine SAND, trace of medium to coarse sand and fine gravel; dry to moist; (Hf) SM.	7.0
Stiff, gray-brown, silty CLAY, trace of sand; moist; blocky structure and slickensides; (Hls) CH.	18.0
Very stiff, gray-brown, silty CLAY; moist; disturbed; blocky structure; slickensides; (Ql(disturbed)) CH.	26.0
Very Stiff to hard, gray, silty CLAY; moist; laminated and some slickensides; (Ql) CH.	52.9
Very dense, gray, gravelly, silty fine SAND; wet; (Qgm) SM.	57.0
Very dense, gray, silty, gravelly, clayey SAND; moist to wet; (Qgm) SC.	64.5
Hard, gray, clayey SILT, trace of fine sand; moist to wet; lenses of silty clay; (Qgm) ML.	67.0
Very dense, gray, silty, gravelly, clayey SAND; moist to wet; (Qgm) SC.	69.3

BOTTOM OF BORING
COMPLETED 5/20/97

Groundwater was initially encountered at 7 feet during drilling.



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-1

October 1997 W-7808-21

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-2
Sheet 1 of 1

SOIL DESCRIPTION

STA.: 4 + 16 OFFSET: 10 Ft. North
Surface Elevation: 145.9 Ft.

Description	Depth, Ft.
Loose to very loose, brown, silty SAND, trace of gravel; moist to wet; fragments of silty clay, wood debris, material jumbled; (Hf) SM.	12.5
Very loose to medium dense, gray to orange-brown, slightly clayey, slightly gravelly to gravelly, silty fine to medium SAND; wet; scattered wood debris; (Hls) SM.	34.0
Stiff to very stiff, gray, silty CLAY; moist; disturbed; (Ql (disturbed)) CH.	38.5
Very stiff to hard, gray, silty CLAY; moist; laminated (<2 mm); occasional light gray silt partings from 47 feet down; (Ql) CH.	74.5
Hard, gray, clayey SILT to silty CLAY, trace of fine to medium sand; moist; silt partings; (Ql) ML-CL.	84.0
Very dense, gray, silty, clayey SAND grading to gravelly, silty, clayey SAND; moist; (Qgm) SC.	96.5
BOTTOM OF BORING	

At 60 to 62 feet - trace of coarse sand.

At 70 feet - becomes very silty.

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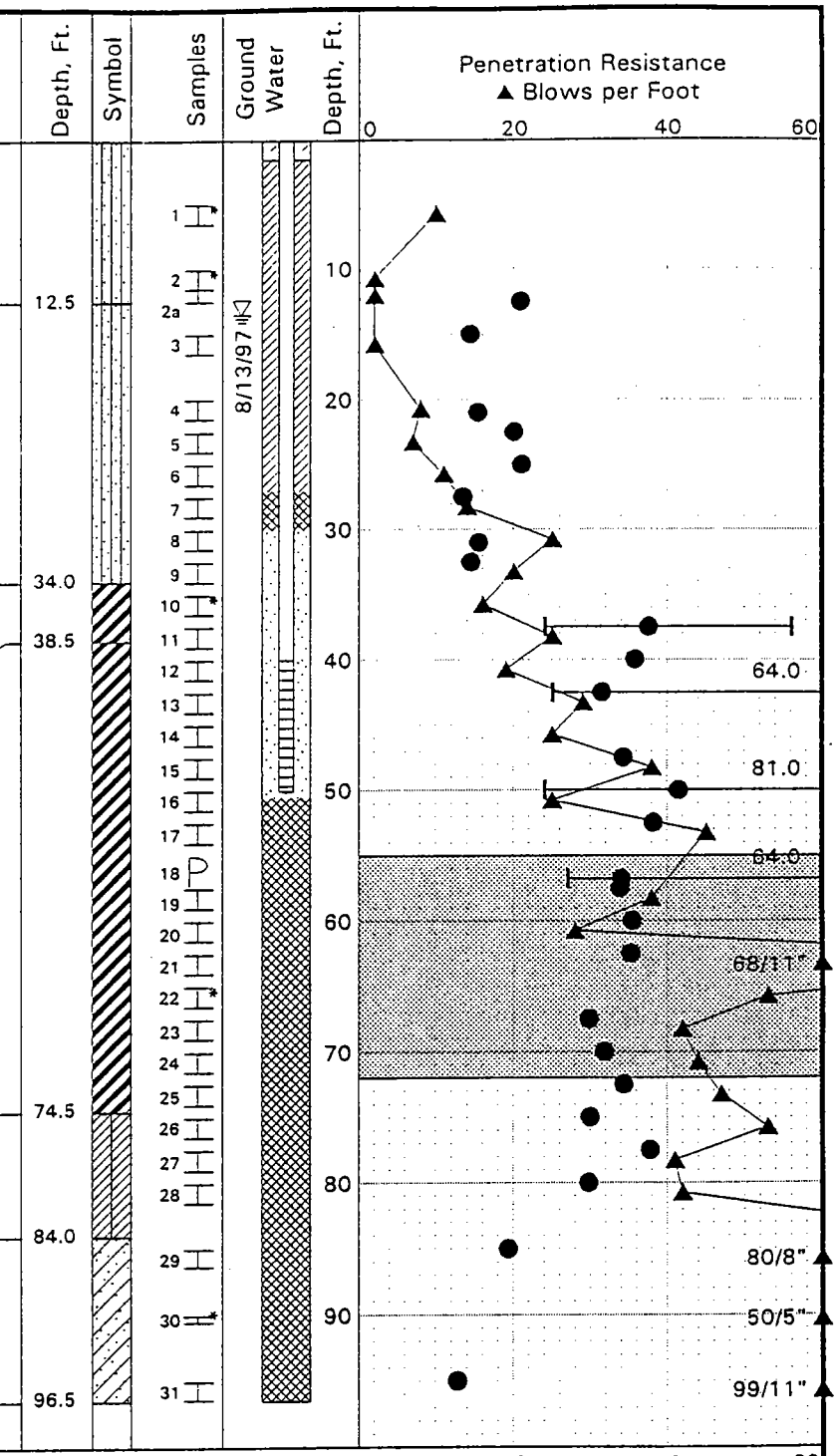

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- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

● % Water Content

Plastic Limit |—●—| Liquid Limit
Natural Water Content

NOTES

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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-2

October 1997 W-7808-21

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FIG. A-3
Sheet 1 of 2

SOIL DESCRIPTION STA.: 4+16 OFFSET: 10 Ft. North Surface Elevation: 145.9 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance ▲ Blows per Foot 0 20 40 60
COMPLETED 5/27/97 Groundwater was initially encountered at 12 feet during drilling.					110 120 130 140 150 160 170 180 190	

0 20 40 60

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-2

October 1997 W-7808-21

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FIG. A-3
Sheet 2 of 2

SOIL DESCRIPTION

STA.: 10+98 OFFSET: 40 Ft. North
Surface Elevation: 205.9 Ft.

Description	Depth, Ft.
Loose to medium dense, brown, silty SAND, trace of gravel; moist; roots to 0.5 feet; (Qva) SM.	5.2
Medium dense to very dense, gray-brown to dark gray, fine SAND, trace of silt; moist to wet; (Qva) SP.	21.0
Hard, dark gray, silty CLAY; moist; disturbed and some slickensides; (Ql(disturbed)) CH.	40.0
Hard, gray, silty CLAY; moist; zones of silt; (Ql) CL.	94.0
Hard, gray, silty CLAY; moist; some slickensides; (Ql) CH.	

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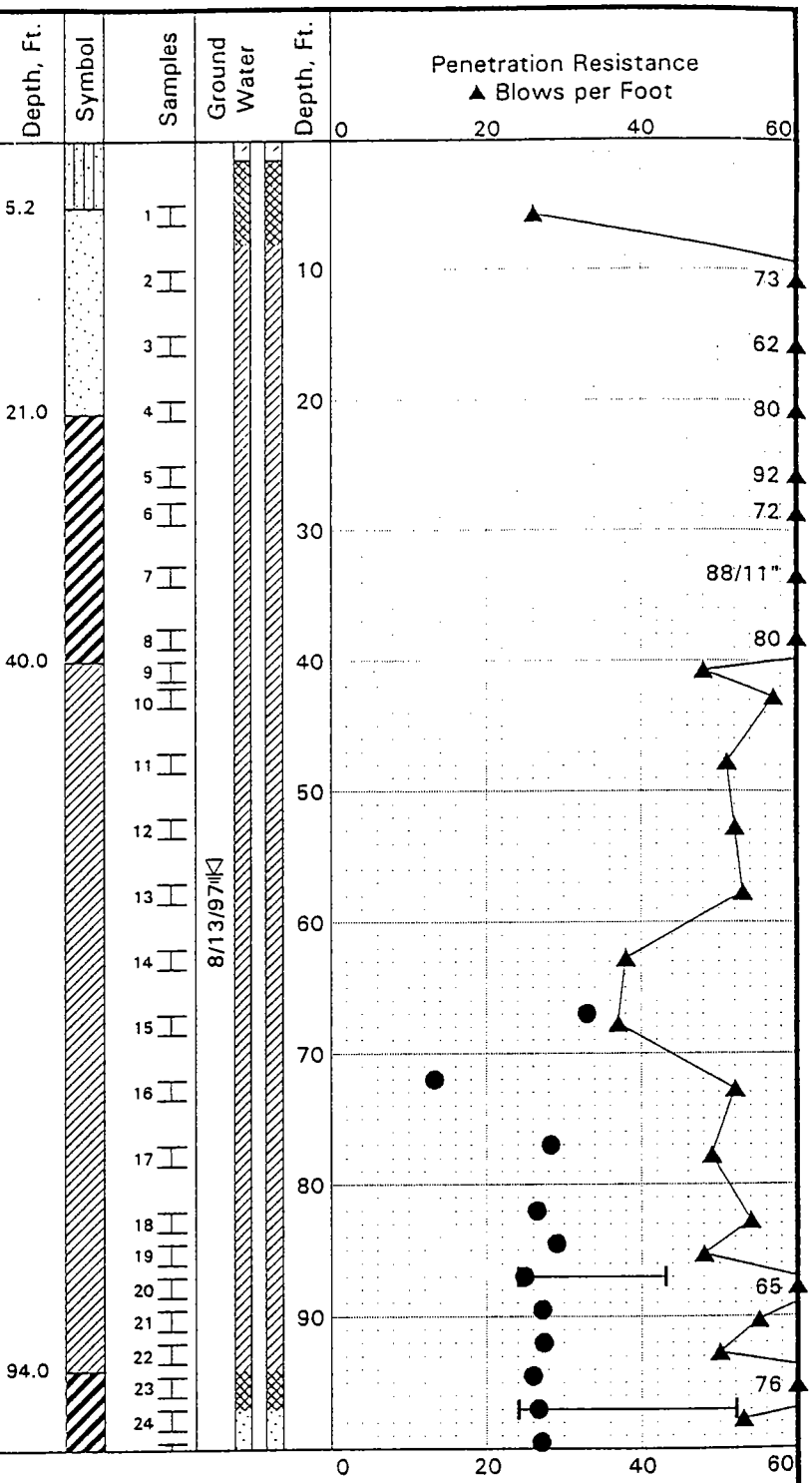

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

NOTES

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5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-3

October 1997 W-7808-21

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 1 of 2

SOIL DESCRIPTION

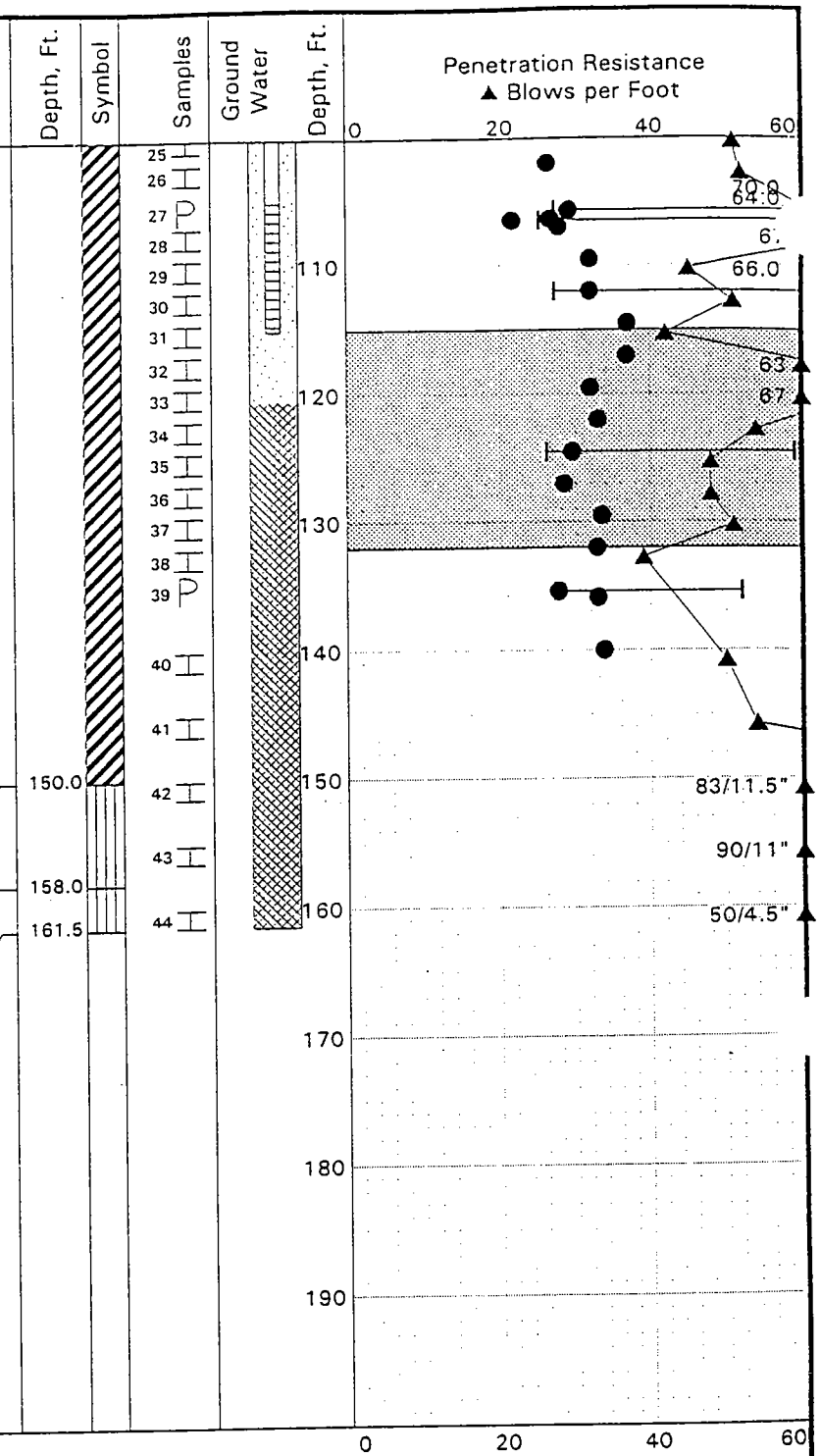
STA.: 10+98 OFFSET: 40 Ft. North
Surface Elevation: 205.9 Ft.

Hard, gray, clayey SILT, trace of gravel; grading to gravelly, sandy, clayey SILT; moist; (Qgm) ML.

Hard, dark gray, sandy SILT, trace of gravel, trace of clay; moist; (Qgm) ML.

BOTTOM OF BORING
COMPLETED 6/4/97

Groundwater was initially encountered at 8 feet during drilling.



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

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5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-3

October 1997 W-7808-2

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-4
Sheet 2 of 2

SOIL DESCRIPTION

STA.: 16+68 OFFSET: 108 Ft. North
Surface Elevation: 217.5 Ft.

Depth, Ft.	Soil Description
0.5	Asphalt Concrete Pavement
	Dense to very dense, light brown, fine to medium SAND, trace of silt; dry; (Qva) SP.
18.0	Very dense, brown, slightly silty to silty fine to medium SAND, trace of gravel; wet; (Qva) SM/SW.
	At 40 ft - layers of sandy SILT.
47.0	Hard, gray, clayey SILT grading to silty CLAY; dry to moist; (Ql) CL/CH.
87.0	Hard, gray, silty CLAY to clayey SILT; moist; blocky structure with some slickensides; (Ql) CH/MH.

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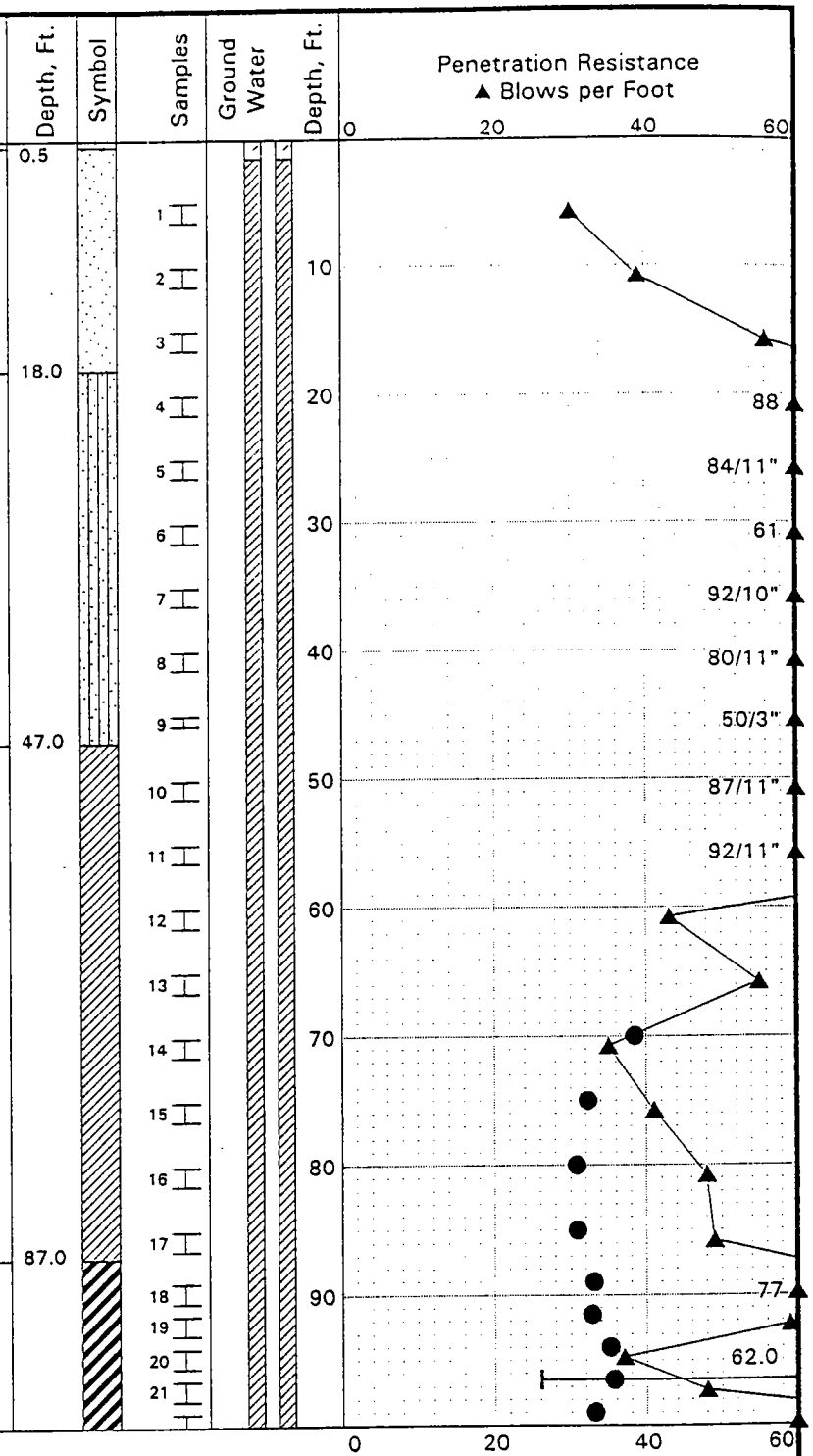

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

NOTES

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3. Water level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-4

October 1997 W-7808-21

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Geotechnical and Environmental Consultants

FIG. A-5
Sheet 1 of 2

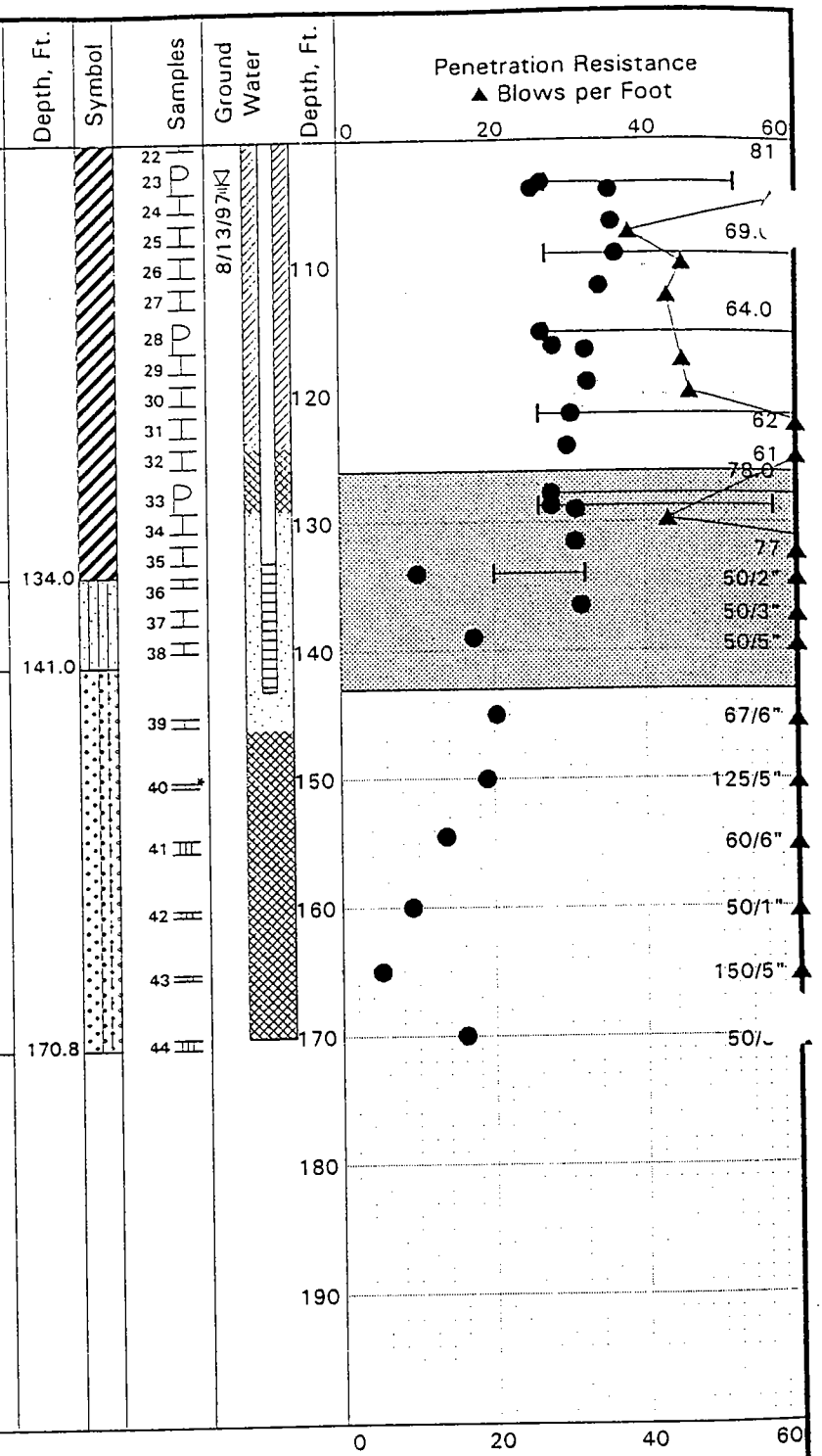
SOIL DESCRIPTION

STA.: 16+68 OFFSET: 108 Ft. North
Surface Elevation: 217.5 Ft.

Hard, gray, CLAY grading to very dense, silty, gravelly SAND; moist; (Qgm) CL/SM.

Very dense, gray, slightly silty SAND grading to clean, gravelly SAND; wet; (Qow) SW-SM.

BOTTOM OF BORING
COMPLETED 6/20/97
Groundwater was initially encountered at 20 feet during drilling.



LEGEND

- Sample Not Recovered
- 2" O.D. Split Spoon Sample
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- VWP groundwater level
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- Annular Sealant
- Grout

● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

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3. Water level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-4

October 1997 W-7808-2

SHANNON & WILSON, INC.
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FIG. A-5
Sheet 2 of 2

SOIL DESCRIPTION

STA.: 23+50 OFFSET: 103 Ft. North
Surface Elevation: 241.6 Ft.

Soil Description	Depth, Ft.
Loose, brown, slightly silty to silty SAND; moist; (Hf) SM.	7.0
Medium dense, gray, silty fine SAND to fine sandy SILT; wet; (Qva) ML/SM.	14.0
Very stiff to hard, gray CLAY; dry to moist; slightly disturbed; (Ql) CL.	33.0
Hard, gray, silty CLAY, trace of sand; moist; (Ql) CL/CH.	

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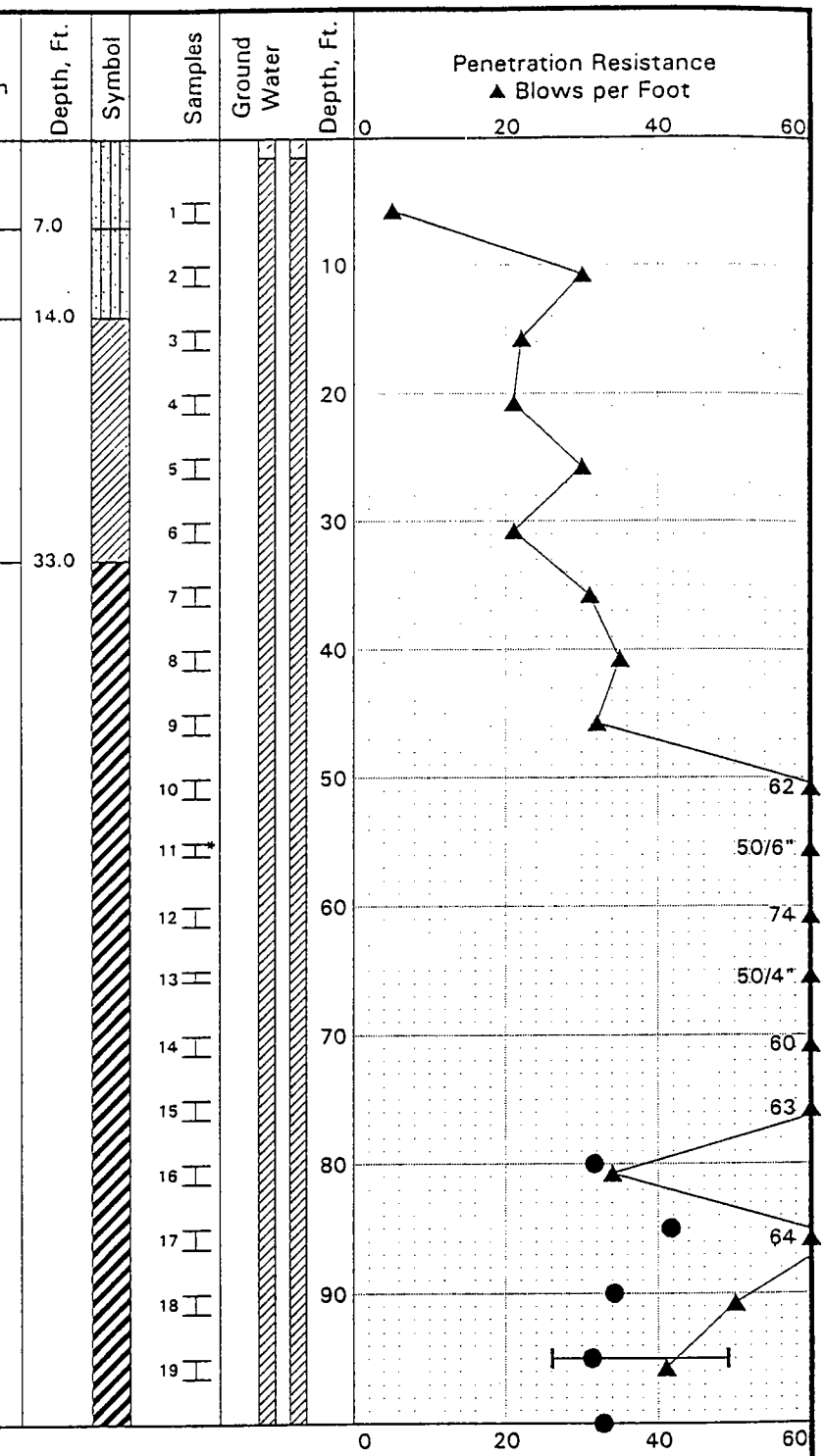

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
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NOTES

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3. Water level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-5

October 1997 W-7808-21

SHANNON & WILSON, INC.
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FIG. A-6
Sheet 1 of 3

SOIL DESCRIPTION

STA.: 23+50 OFFSET: 103 Ft. North
Surface Elevation: 241.6 Ft.

Hard, gray gravelly, sandy, silty CLAY to very dense, silty, gravelly SAND, trace of clay; dry to moist; (Qgm) CH/SM.

Very dense, gray, silty, gravelly, SAND grading to slightly silty, gravelly SAND; moist to wet; (Qow) SP-SM.

Very dense, gray, slightly silty to silty, gravelly SAND to slightly silty, sandy fine GRAVEL; moist to wet; (Qow) SP-SM/SW-GW.

Very dense, gray to olive-gray, silty gravelly SAND; moist; (Qgm) SM.

Very dense, olive-gray, medium to coarse SAND, trace of silt; moist to wet; (Qow)

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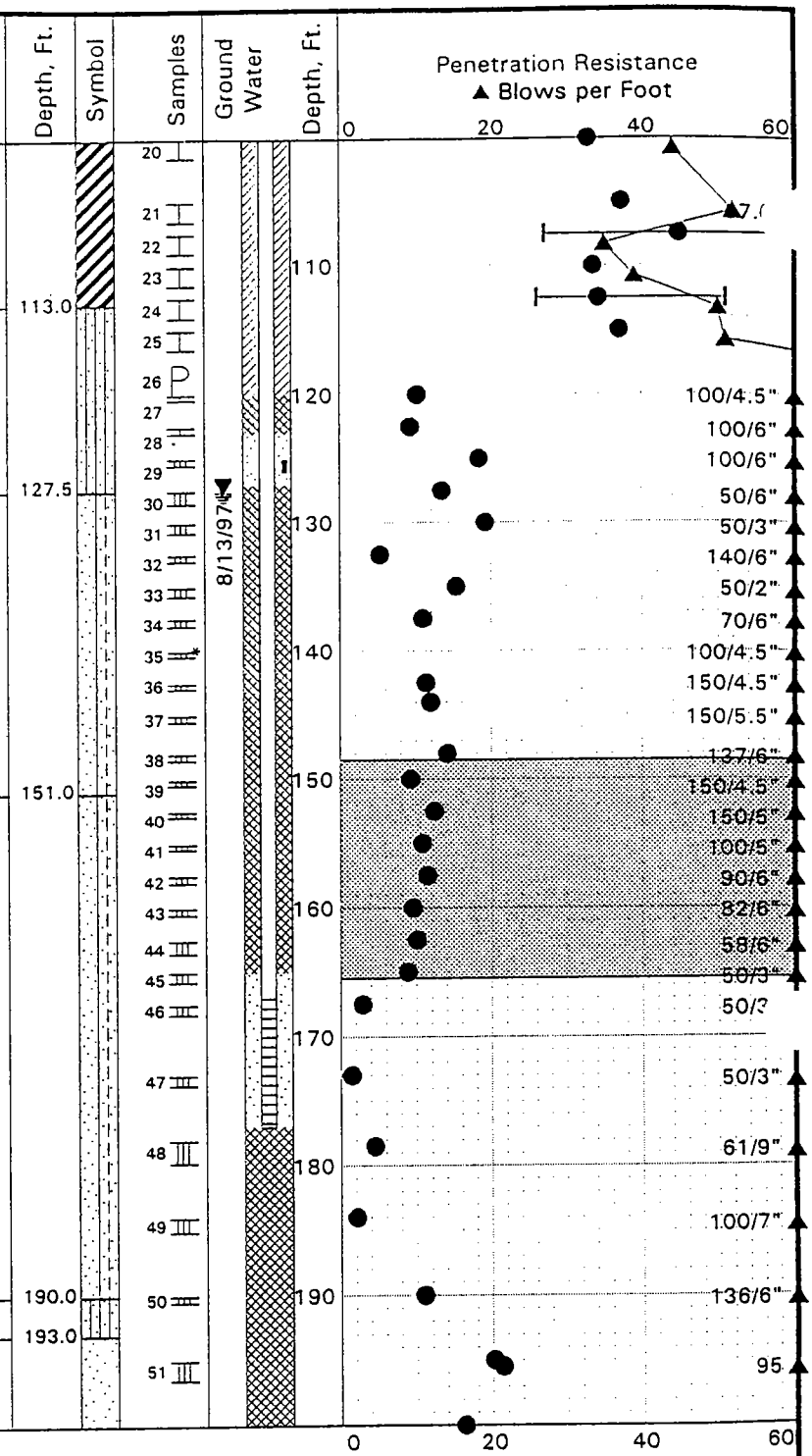

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
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- Grout

NOTES

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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-5

October 1997 W-7808-21

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-6
Sheet 2 of 3

SOIL DESCRIPTION STA.: 23+50 OFFSET: 103 Ft. North Surface Elevation: 241.6 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance ▲ Blows per Foot (0 20 40 60)
SP.	200.5		52			62/6"
BOTTOM OF BORING COMPLETED 7/14/97 Groundwater was initially encountered at 7 feet during drilling.					210 220 230 240 250 260 270 280 290	

0 20 40 60

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-5

October 1997 W-7808-21

SHANNON & WILSON, INC.
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FIG. A-6
Sheet 3 of 3

SOIL DESCRIPTION STA.: 29+80 OFFSET: 55 Ft. South Surface Elevation: 235.2 Ft.	Depth, Ft.
Asphalt Concrete Pavement.	0.3
Very stiff, gray to brown, sandy CLAY, trace of gravel; moist; (Hf) CH.	0.8
Very stiff, brown to gray, silty CLAY; dry to moist; scattered organics, disturbed, some slickensides; (Ql(disturbed)) CH.	17.0
Very stiff to hard, gray, silty CLAY; dry to moist; occasional slickensides; (Ql) CH.	96.0
Hard, gray, clayey, gravelly, sandy SILT;	

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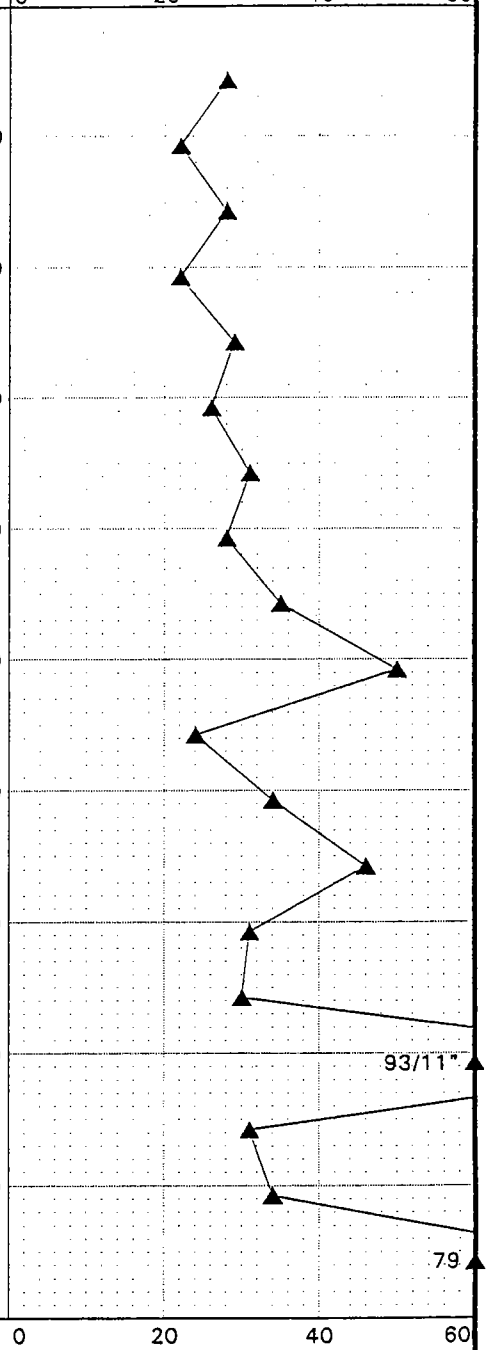
Symbol | Samples | Ground Water | Depth, Ft.



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-6

October 1997 W-7808-21

SHANNON & WILSON, INC.
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FIG. A-7
Sheet 1 of 3

SOIL DESCRIPTION STA.: 29+80 OFFSET: 55 Ft. South Surface Elevation: 235.2 Ft.	Depth, Ft.
dry to moist; (Qgm) ML.	
Hard, silty CLAY, trace of sand; moist; lenses of hard clay; disturbed; some slickensides; (Ql(disturbed)) CL.	109.0
Hard, gray, silty CLAY, trace of sand; moist; interbedded sand and silt layers; (Ql/Qgm) CH/CL.	127.0
Interbedded, very dense, gray, silty fine SAND, trace of gravel and hard, fine sandy, silty CLAY; moist to wet; (Qsis) SM/CL.	154.0
Very dense, gray, slightly silty, slightly gravelly SAND; wet; (Qow) SW-SM.	175.0
Very dense, fine sandy SILT; wet; laminated, livery texture; (Qsis) ML	188.4 189.5

BOTTOM OF BORING
COMPLETED 6/26/97
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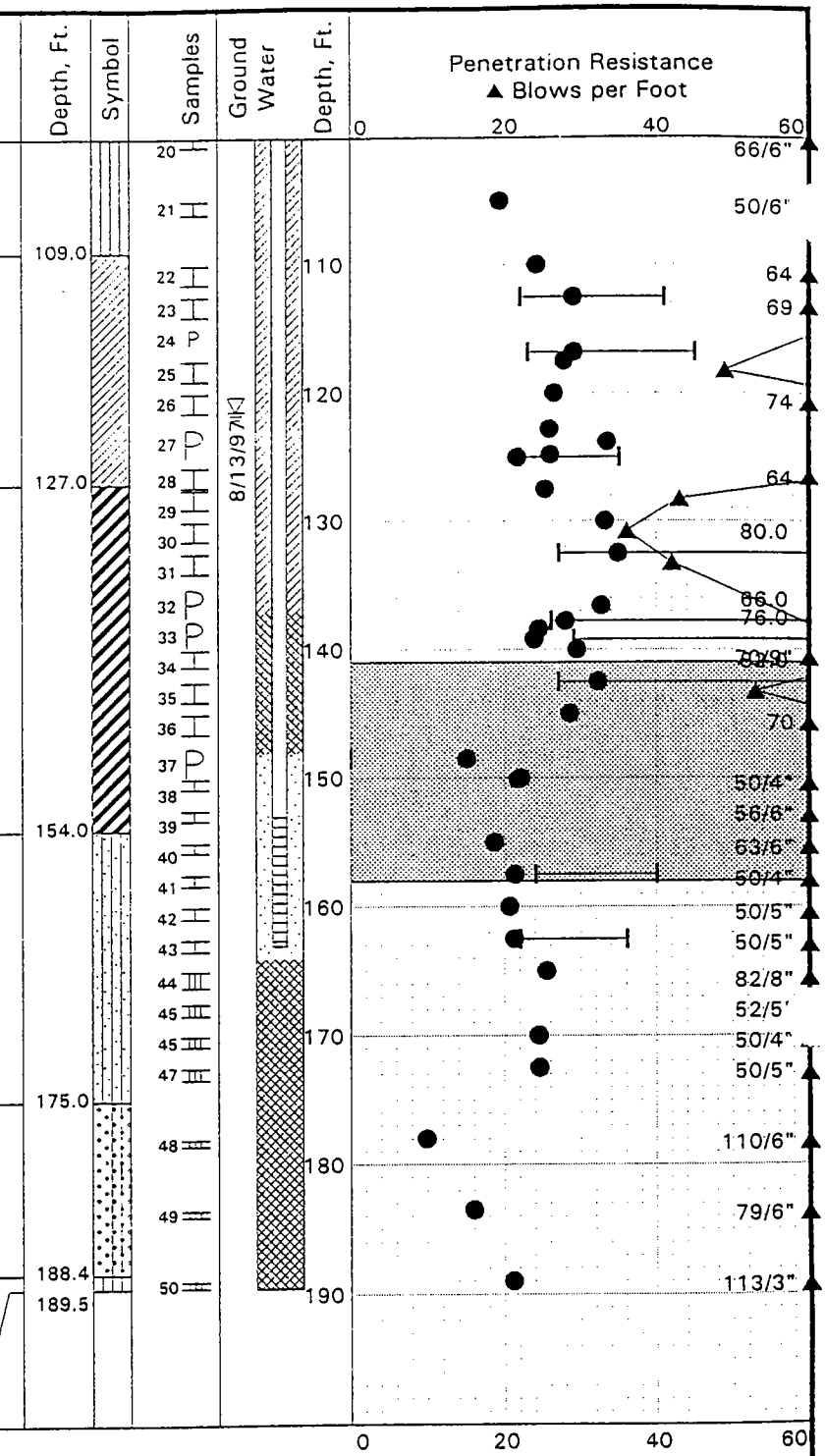

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

NOTES

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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-6

October 1997 W-7808-21

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FIG. A-7
Sheet 2 of 3

SOIL DESCRIPTION STA.: 29+80 OFFSET: 55 Ft. South Surface Elevation: 235.2 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance ▲ Blows per Foot 0 20 40 60
Groundwater was initially encountered at 35 feet during drilling.					210 220 230 240 250 260 270 280 290	

0 20 40 60

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
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- Grout

NOTES

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3. Water level, if indicated above, is for the date specified and may vary.
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5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-6

October 1997 W-7808-21

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FIG. A-7
Sheet 3 of 3

SOIL DESCRIPTION

STA.: 34 + 46 OFFSET: 73 Ft. North
Surface Elevation: 206.7 Ft.

Description	Depth, Ft.
Loose to medium dense, brown CLAY; moist; layers of sand (Hf) CH.	3.0
Very stiff, gray to brown CLAY; moist; layers of medium dense, gray to brown, slightly silty fine to medium sand; (Qvr) CH.	16.3
Stiff to very stiff, gray, silty CLAY; dry to moist; slickensides and blocky structure; (Ql(disturbed)) CH.	28.0
Very stiff to hard, gray CLAY; dry to moist; some laminated layering and slickensides; (Ql) CH.	67.0
Hard, gray, gravelly, sandy, clayey SILT; moist; trace of shell fragments; zones of fine sand; (Qgm) ML.	80.0
Hard, gray, silty CLAY, trace of sand and gravel; moist; blocky structure and slickensides; sand zones at 95ft; (Ql/Qgm) CH.	

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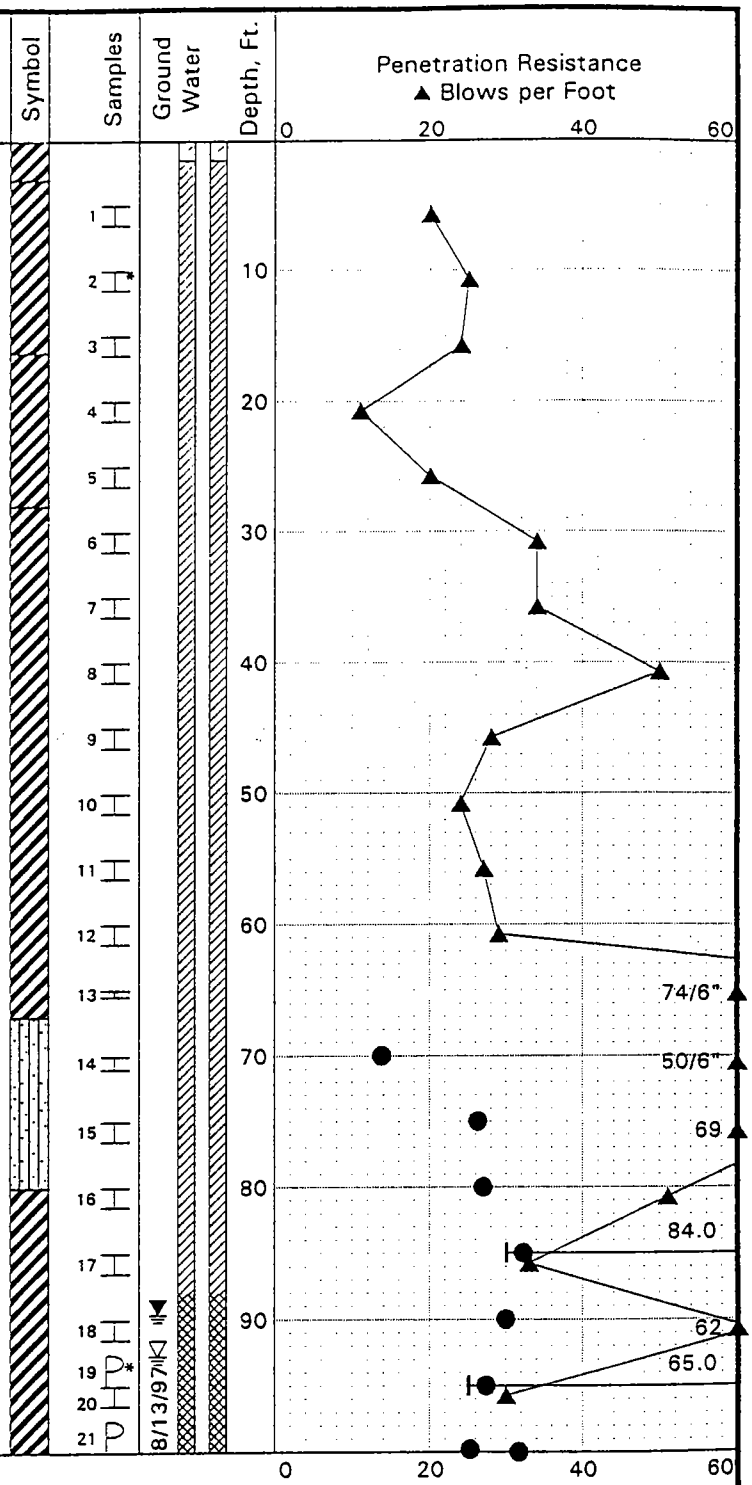

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

NOTES

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5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-7

October 1997 W-7808-21

SHANNON & WILSON, INC.
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FIG. A-8
Sheet 1 of 2

SOIL DESCRIPTION

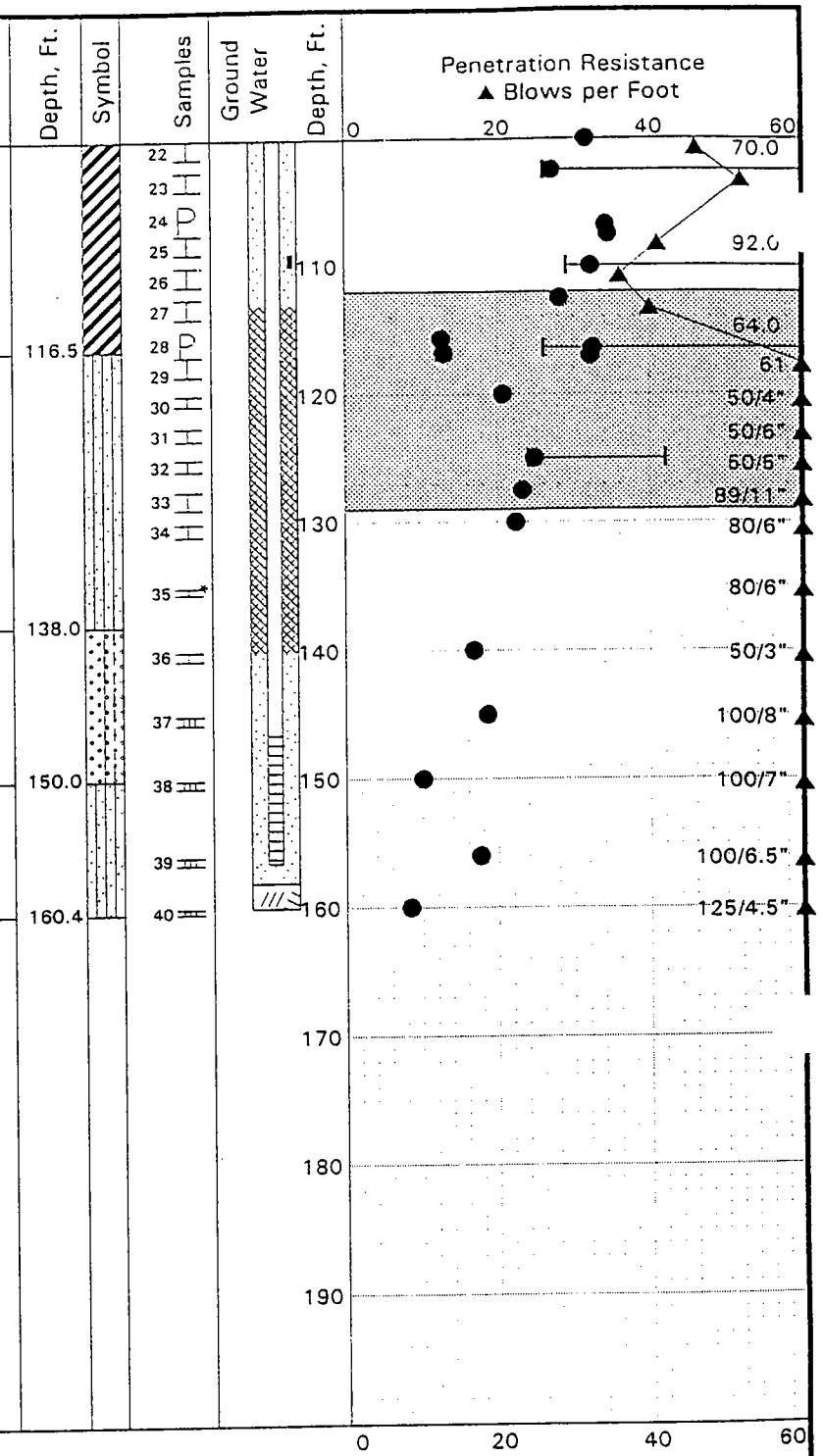
STA.: 34+46 OFFSET: 73 Ft. North
Surface Elevation: 206.7 Ft.

Hard, gray, slightly clayey, fine sandy SILT to silty CLAY and very dense, slightly silty fine SAND; moist to wet; (Qsis) CL/SM.

Very dense, gray, clean to slightly silty SAND; wet; (Qow) SW/SM.

Very dense, gray, clayey, trace to slightly silty, gravelly SAND; wet; silt lenses; (Qow) SM.

BOTTOM OF BORING
COMPLETED 7/2/97
Groundwater was initially encountered at 8 feet during drilling.



● % Water Content
Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
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- VWP groundwater level
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- Groundwater Level
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5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-7

October 1997 W-7808-2

SHANNON & WILSON, INC.
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FIG. A-8
Sheet 2 of 2

SOIL DESCRIPTION STA.: 39 + 21 OFFSET: 398 Ft. North Surface Elev.: 207.2 Ft.	Depth, Ft.
Soft to medium stiff, brown, sandy, silty CLAY; moist at 3.5 feet; (Qt) CL	5.0
Very dense, gray, slightly silty, slightly gravelly SAND; moist; occasional silt seams; (Qt) SM.	27.0
Hard, gray, silty CLAY, trace of gravel; moist; (Qtl) CL.	37.0
Hard, gray, trace to gravelly, slightly clayey to clayey, sandy SILT; interbedded very dense, gray, silty fine SAND and silty CLAY; moist to wet; (Qgm) SM/ML.	67.0
Hard, gray, silty CLAY to clayey SILT, trace of sand; moist; occasional silt seams; some slickensides; disturbed; (Ql) CL/CH.	

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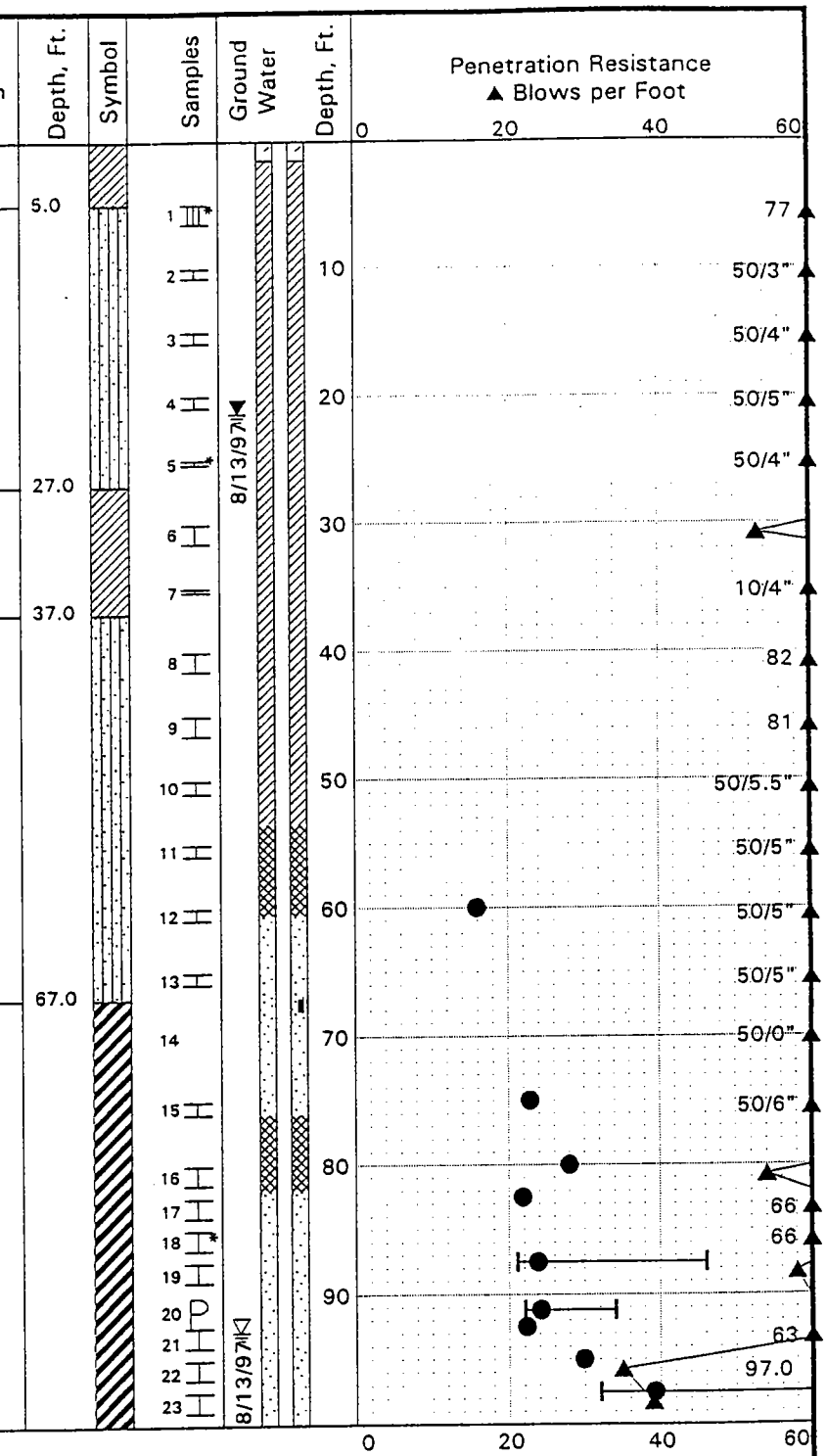

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
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- VWP groundwater level
- Piezometer Screen
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- Grout

NOTES

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4. Refer to KEY for explanation of "Symbols" and definitions.
5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-8

October 1997 W-7808-21

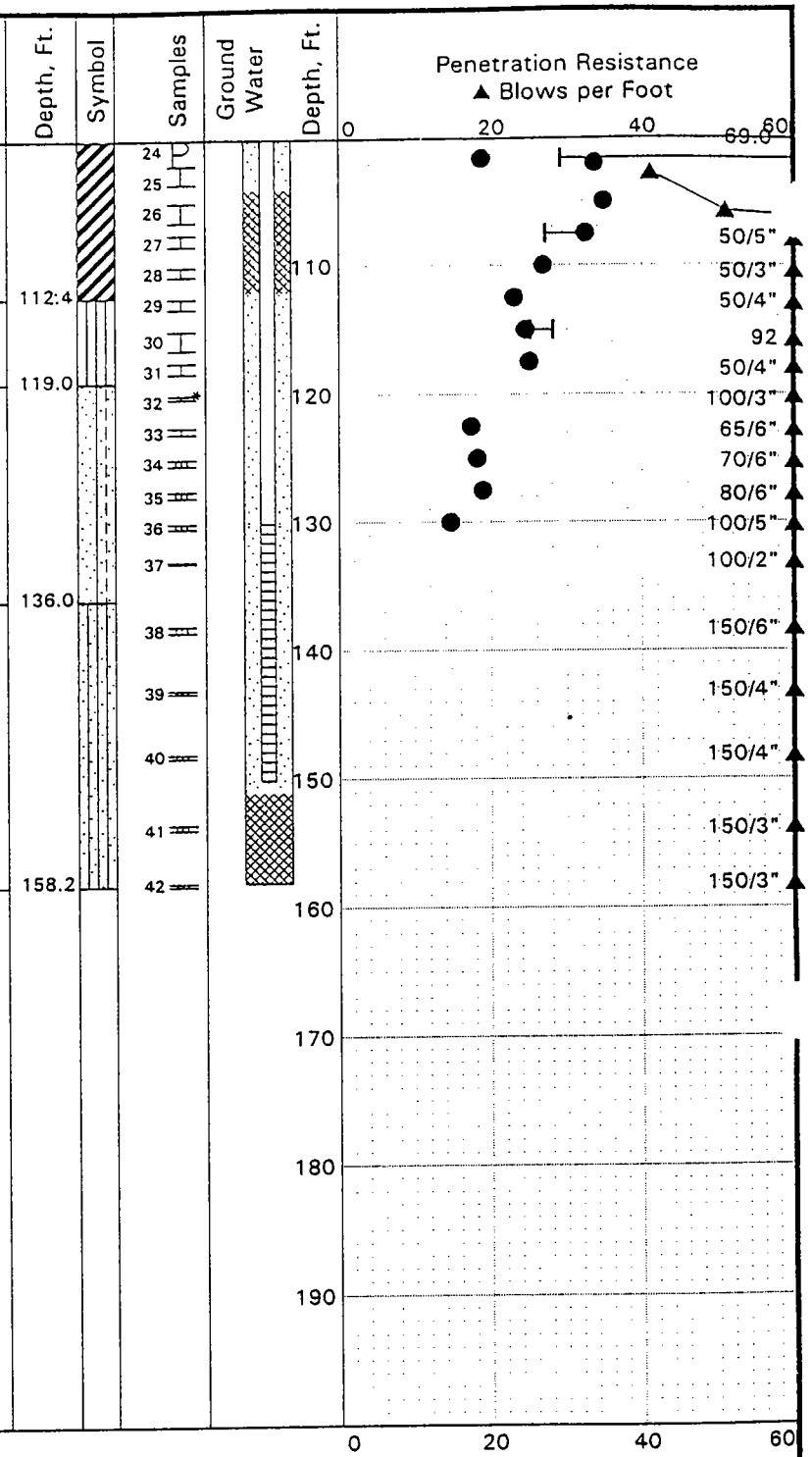
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-9
Sheet 1 of 2

SOIL DESCRIPTION

STA.: 39 + 21 OFFSET: 398 Ft. North
Surface Elev.: 207.2 Ft.

Description	Depth, Ft.
Hard, gray, clayey SILT, trace of sand; moist to wet; occasional fine to medium sand seams, laminated; (Qsis) ML.	112.4
Very dense, gray, fine to medium SAND, trace of silt, trace of gravel; moist to wet; occasional fine sandy silt seams, interbeds of coarse gravel and cobbles; (Qow) SP-SM.	119.0
Very dense, gray, silty, gravelly SAND; moist; (Qgm) SM.	136.0
BOTTOM OF BORING COMPLETED 6/10/97 Groundwater was initially encountered at 6 feet during drilling.	158.2



● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
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- Grout

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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-8

October 1997 W-7808-21

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-9
Sheet 2 of 2

SOIL DESCRIPTION STA.: 44+53 OFFSET: 305 Ft. North Surface Elevation: 201.0 Ft.	Depth, Ft.
Brown to gray, clayey, gravelly SAND; moist; (Hf) SC.	4.0
Hard, tan SILT; moist; (Qvr) ML.	6.5
Very dense, gray, slightly gravelly, fine to medium SAND, trace of silt; moist; (Qvr) SM.	11.0
Very dense, gray, fine sandy SILT; wet; lens of silty, fine sand; (Qvr) ML.	24.0
Very dense, gray, silty, gravelly SAND; moist; (Qt) SM.	57.0
Very dense, gray, clayey, silty SAND to clayey, silty, gravelly SAND; wet; (Qtl) SM.	91.0
Very dense, gray, slightly gravelly, clayey, silty SAND; moist to wet; occasional layers of fine sandy SILT and slightly	

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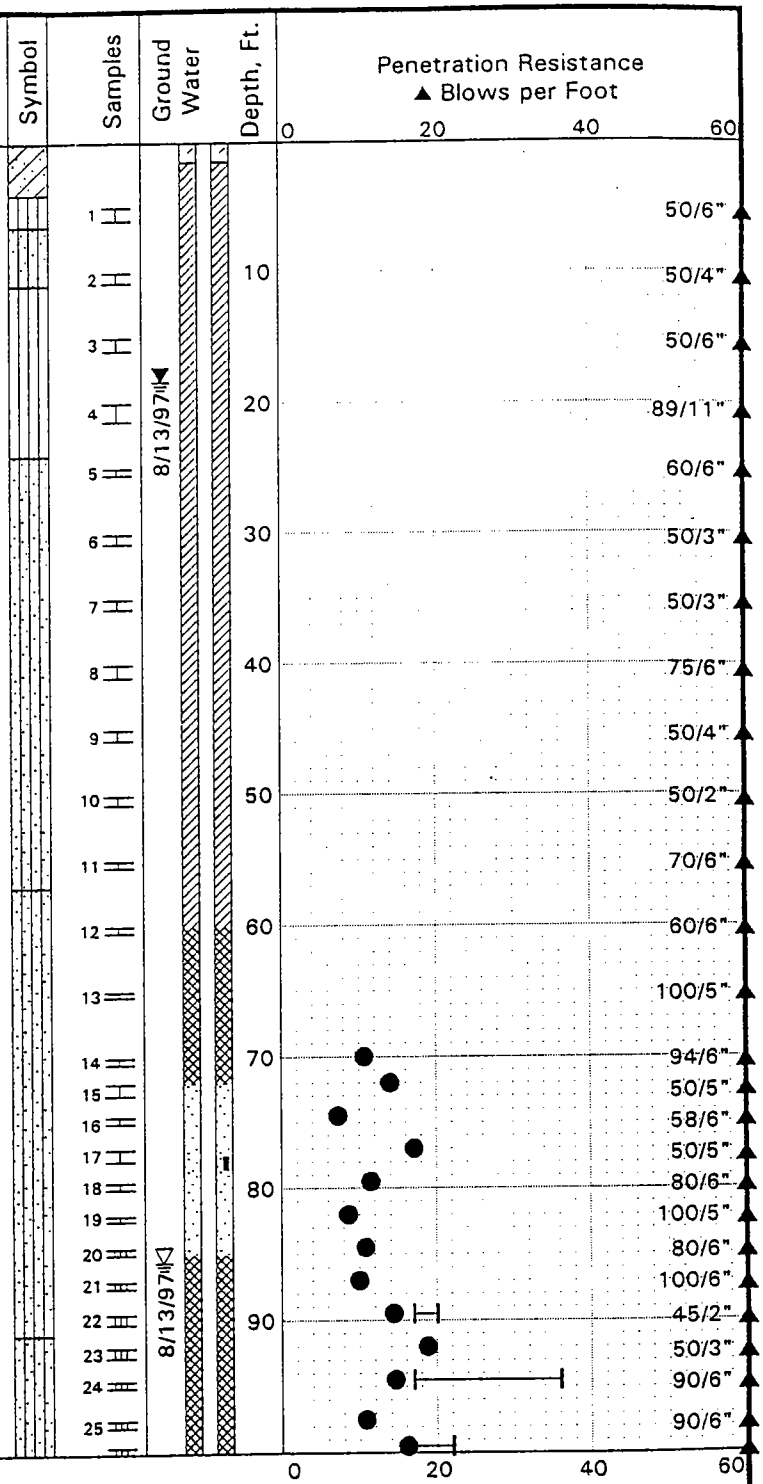

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-9

October 1997 W-7808-21

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-10
Sheet 1 of 2

SOIL DESCRIPTION

STA.: 44+53 OFFSET: 305 Ft. North
Surface Elevation: 201.0 Ft.

gravelly, sandy, silty CLAY; (Qgm) SM.

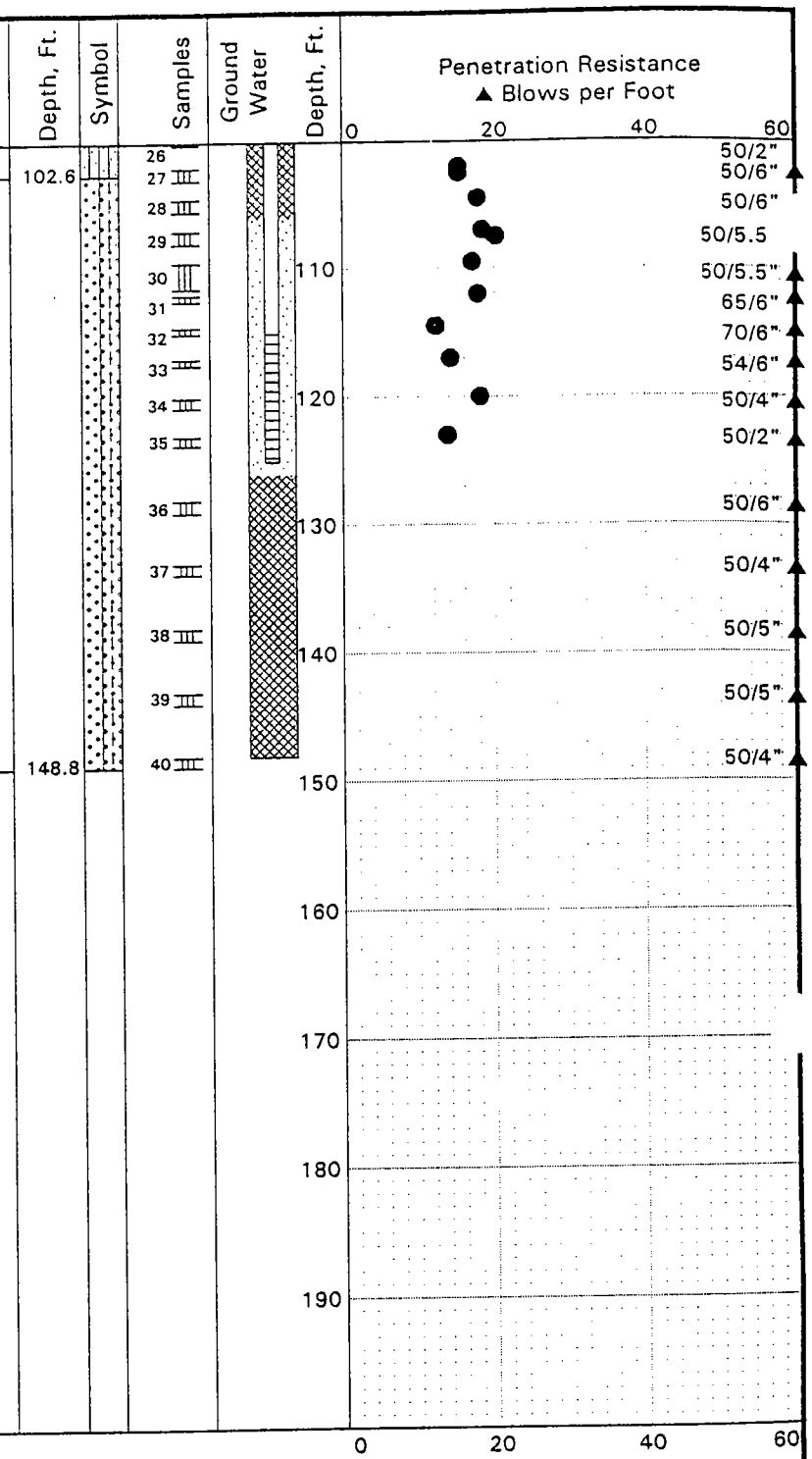
102.6

Very dense, olive-gray, slightly gravelly, slightly silty to silty fine to medium SAND; moist to wet; (Qow) SW-SM/SM.

148.8

BOTTOM OF BORING
COMPLETED 6/16/97

Groundwater was initially encountered at 17 feet during drilling.



● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-9

October 1997 W-7808-21

SHANNON & WILSON, INC.
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FIG. A-10
Sheet 2 of 2

SOIL DESCRIPTION

STA.: 54 + 22 OFFSET: 308 Ft. North
Surface Elevation: 173.2 Ft.

Description	Depth, Ft.
Loose to medium dense, brown, clayey SAND; dry to moist;(Hf) SC.	4.0
Very dense, gray, slightly gravelly to gravelly, silty SAND; trace of cobbles; moist to wet; (Qtl); SM.	17.0
Very dense, gray to brown, trace to slightly clayey, gravelly, silty SAND; moist to wet; sand lenses; (Qt) SM.	45.2
Very dense, gray to brown, slightly gravelly to gravelly, slightly silty to silty, SAND, trace of clay; moist; (Qtl) SM.	58.0
Very dense, dark gray, trace to slightly silty SAND, trace of gravel; moist; occasional cobbles; (Qtl) SM/SP.	84.0
Very dense, gray, gravelly, silty SAND; wet; (Qgm) SM.	

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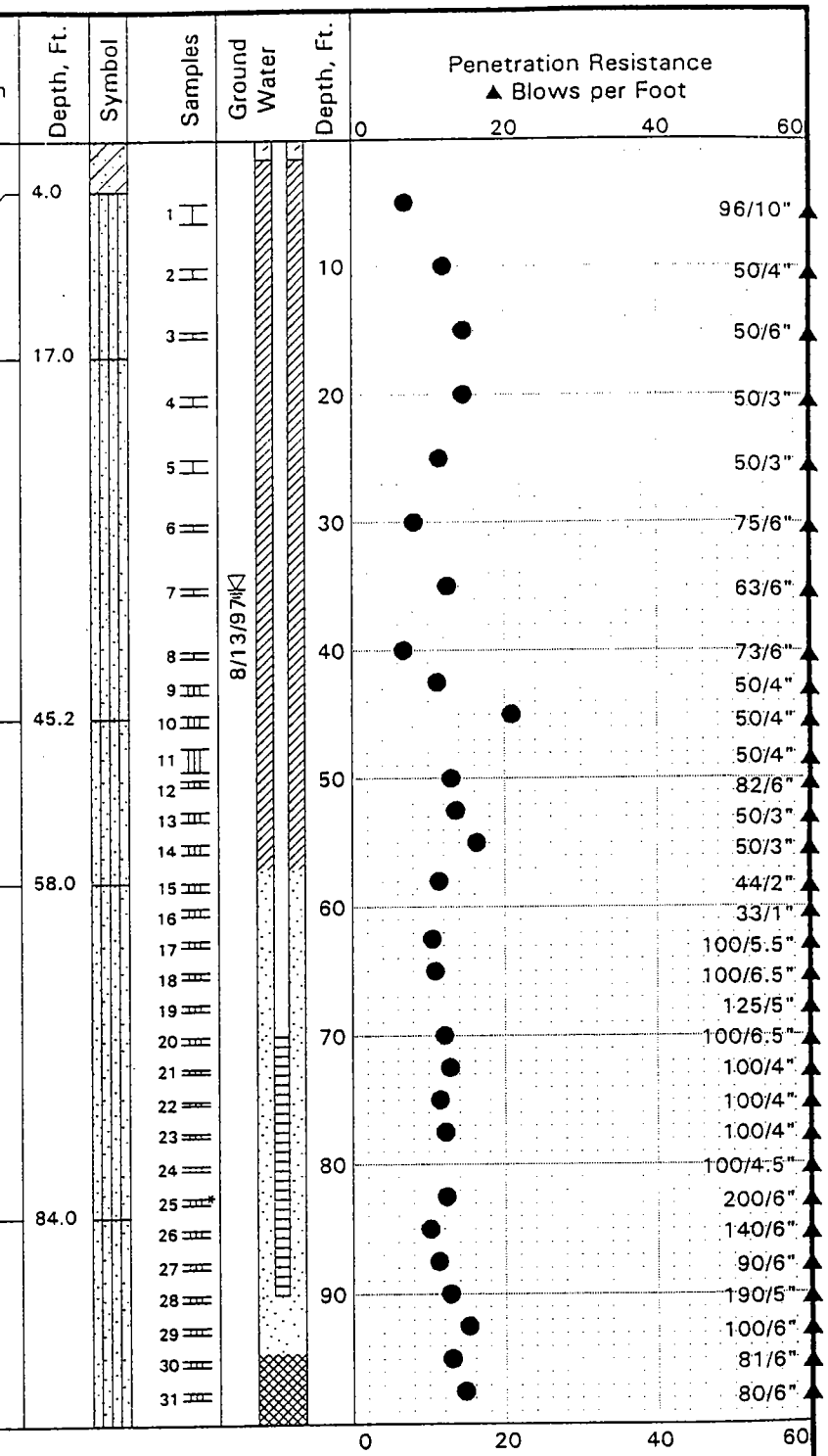

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-11

October 1997 W-7808-21

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FIG. A-11
Sheet 1 of 2

SOIL DESCRIPTION STA.: 54+22 OFFSET: 308 Ft. North Surface Elevation: 173.2 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance ▲ Blows per Foot (0 20 40 60)
			32			68
	107.0		33			82
Very dense, gray, slightly silty, slightly gravelly SAND grading to slightly silty SAND, trace of gravel; wet; (Qow) SP-SM.			34		110	50/4"
			35			50/4"
					120	
	122.8		36			50/4"
BOTTOM OF BORING COMPLETED 6/4/97 Groundwater was initially encountered at 34 feet during drilling.					130 140 150 160 170 180 190	

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-11

October 1997 W-7808-2

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FIG. A-11
Sheet 2 of 2

SOIL DESCRIPTION

STA.: 60 + 15 OFFSET: 2 Ft. South
Surface Elevation: 151.4 Ft.

Soil description	Depth, Ft.
Loose, sandy GRAVEL, dry; (Hf) GP.	2.0
Interbedded, very dense, brown, gravelly, slightly silty to silty, fine to medium SAND, to silty to sandy CLAY and clayey SILT, trace of gravel; dry to moist; (Qt) SM/CL-ML.	20.0
Very dense, gray, slightly gravelly to gravelly, silty, clayey SAND; occasional gravelly, sandy, silty clay layers; dry to moist; (Qtl/Qow); SC.	74.0
Very dense, gray to olive-gray, gravelly, fine to medium SAND grading to slightly silty SAND, trace of gravel; wet; occasional layers and lenses of silt and sand with apparent cohesion from 85 to 95 feet (Qow) SP/SP-SM.	

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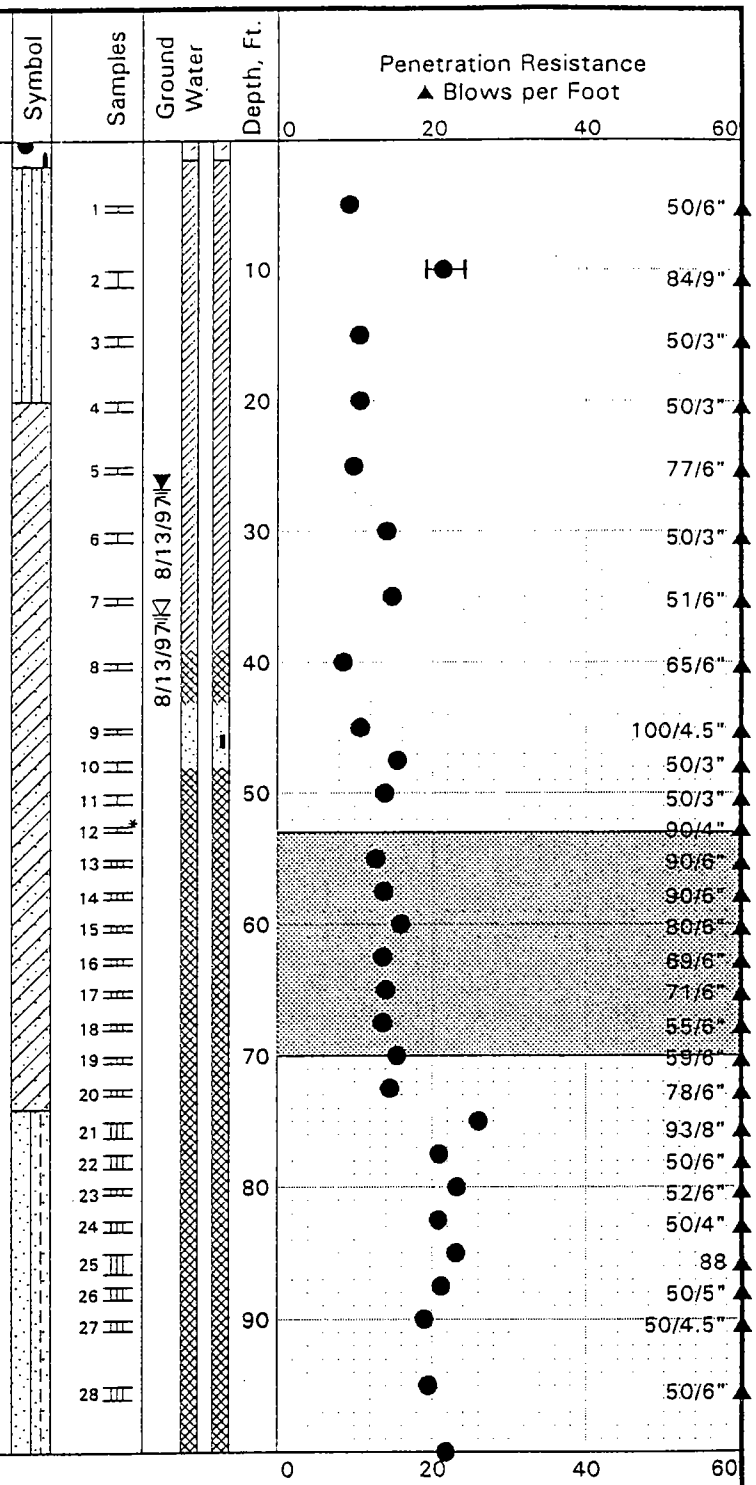

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
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- VWP groundwater level
- Piezometer Screen
- Groundwater Level
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Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-12

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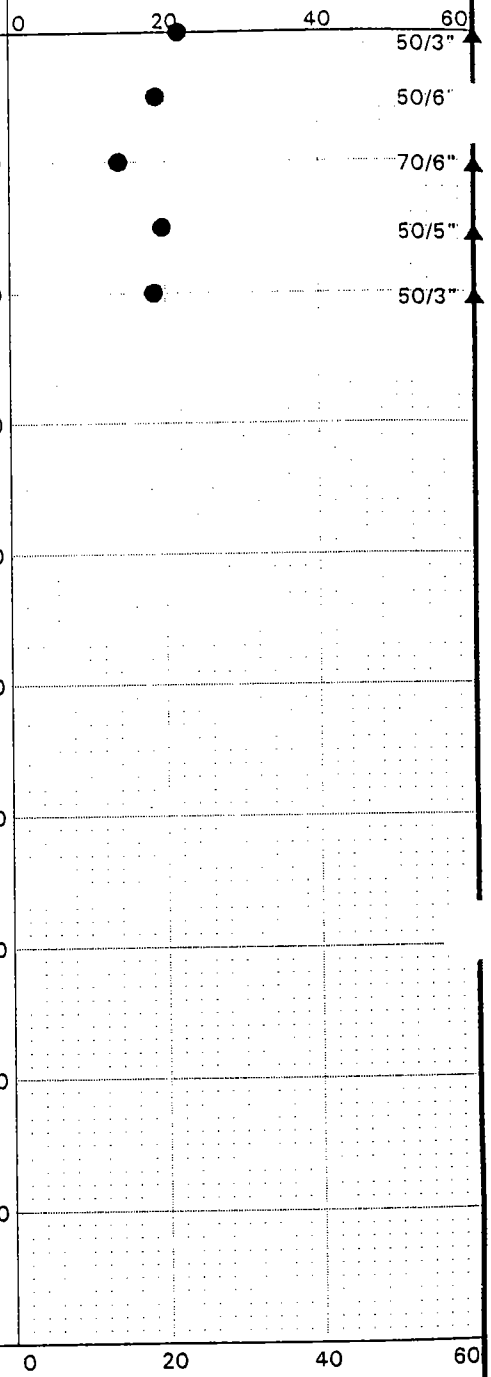
FIG. A-12
Sheet 1 of 2

SOIL DESCRIPTION	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance ▲ Blows per Foot (0 20 40 60)
STA.: 60+15 OFFSET: 2 Ft. South Surface Elevation: 151.4 Ft.						
			29			50/3"
			30			50/6"
			31		110	70/6"
			32			50/5"
	120.8		33		120	50/3"
BOTTOM OF BORING COMPLETED 8/1/97 Groundwater was initially encountered at 31 feet during drilling. NOTE: This boring was moved 5 feet north due to an obstruction encountered during drilling.					130 140 150 160 170 180 190	



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G - Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING TB-12

October 1997 W-7808-2

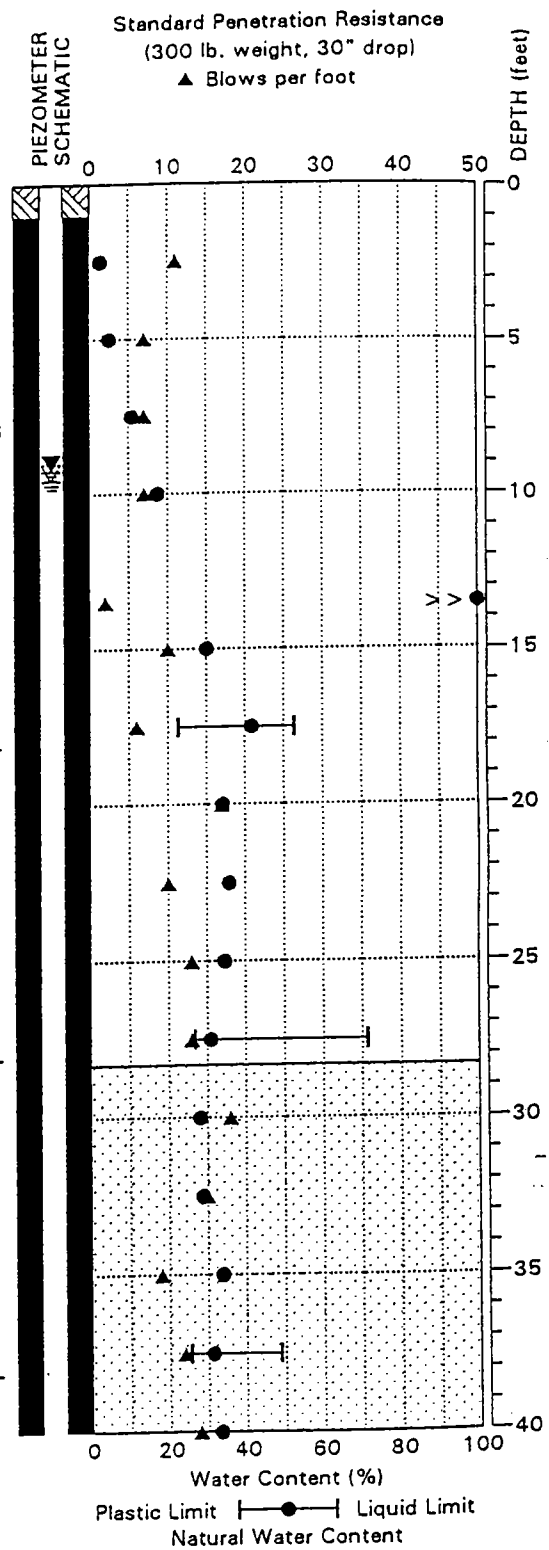
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-12
Sheet 2 of 2

DRILLING METHOD: B-59 Mobile, 4.5" ID HSA
SURFACE ELEVATION: 119 ± Feet

DATE COMPLETED: 3/5/98
LOGGED BY: AS

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	SM	4" asphalt over 8" concrete Loose, gray, silty fine SAND, dry. Trace shell fragments. (FILL)	S-1	2-5-6	
			S-2	4-3-4	
5			S-3	1-2-5	GS
			S-4	6-4-3	
10	GM	Loose, silty, sandy GRAVEL, wet. Gravel subrounded, to 1/2" diameter.			
	PT	Very soft, dark brown, PEAT / wood chips, wet. (LAGOON/MARSH DEPOSITS)	S-5	0-1-1	
15	CH	Medium stiff to stiff, gray, fat CLAY, very moist to wet. Organics and wood debris. (DISTURBED GLACIOLACUSTRINE DEPOSITS)	S-6	2-3-7	
			S-7	1-3-3	AL
20	CH	Stiff, gray, fat CLAY, moist. Disturbed. Slickensides.	S-8	1-5-12	
			S-9	2-4-6	
25			S-10	2-3-10	
			S-11	2-5-8	AL
30			S-12	4-9-9	
		At 32.5 feet, thin lens of fine sand.	S-13	5-6-9	
35			S-14	2-4-5	
	CL	Stiff, gray, lean CLAY, moist. (GLACIOLACUSTRINE DEPOSITS)	S-15	3-5-7	AL
40					



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

BORING: TB-13

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PAGE: 1 of 3

PROJECT NO.: 97061

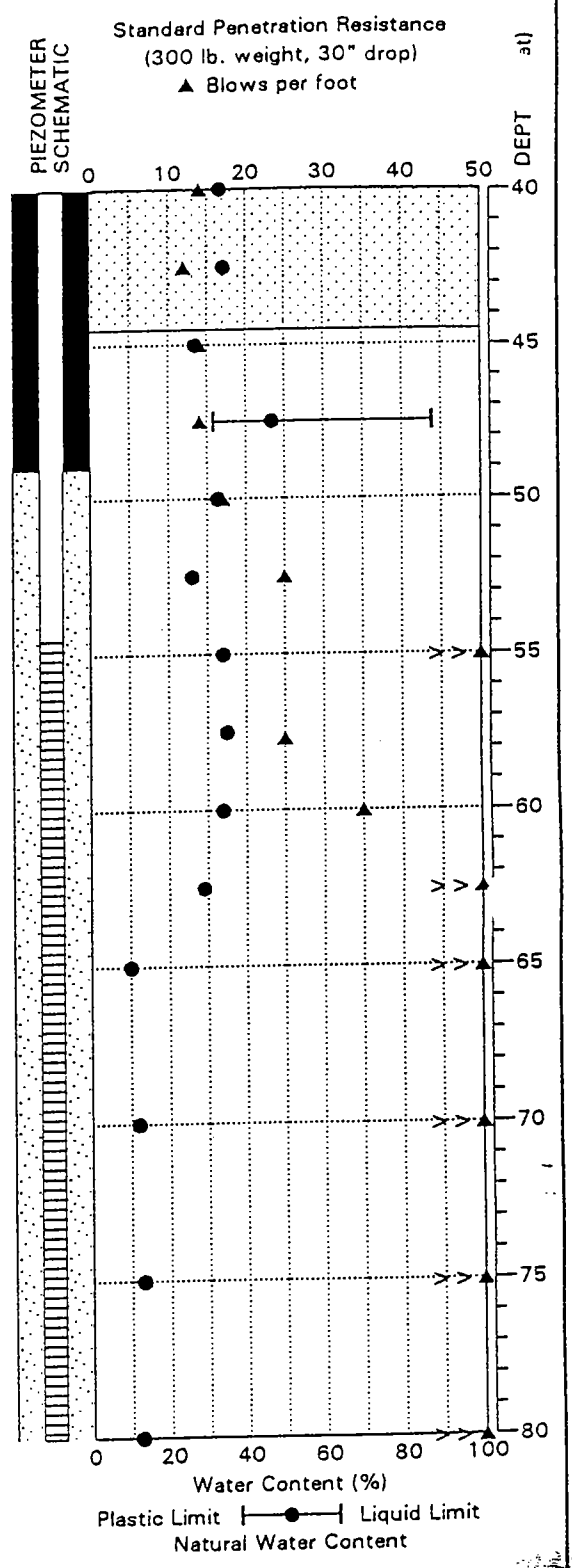
FIGURE: A-2

PZO300 DWA 5/1/98

DRILLING METHOD: B-59 Mobile, 4.5" ID HSA
SURFACE ELEVATION: 119 ± Feet

DATE COMPLETED: [illegible]
LOGGED BY: AS

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
40		Stiff, gray, lean CLAY, moist. (GLACIOLACUSTRINE DEPOSITS)	S-16	5-5-9	
			S-17	4-5-7	
45			S-18	3-6-8	
	CH	Stiff, gray, elastic CLAY, very moist.	S-19	4-7-7	AL
50			S-20	3-8-9	
	CL	Very stiff, gray, slightly sandy lean CLAY with gravel, very moist.	S-21	4-11-14	
55	SM	Very dense, gray, silty fine to coarse SAND, wet. Some clay. (GLACIOMARINE DRIFT)	S-22	9-26-37	
	CL	Hard, gray, lean CLAY, wet. Some thin sand lenses. Some sand and gravel.	S-23	5-10-15	
60		At 60 feet, lenses of clayey fine sand.	S-24	3-14-21	
			S-25	17-17 50/5"	
65		At 65 feet, becomes sandy. Some gravel to 1-1/2" diameter.	S-26	12-30 50/5"	
70			S-27	38-48 50/5"	
75		At 75 feet, wet. Some rounded gravel to 2" diameter.	S-28	50/5.5"	
80					



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BORING: TB-13

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-2

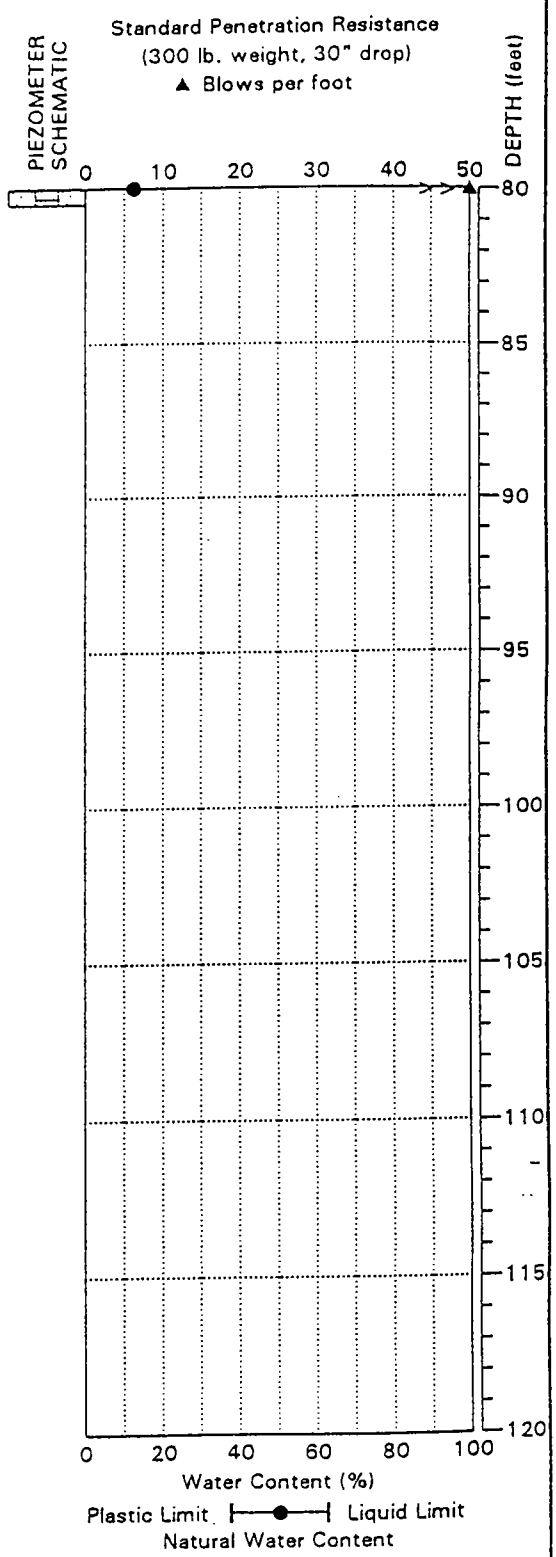
PZO300 DWA 5/1/98

DRILLING METHOD: B-59 Mobile, 4.5" ID HSA
SURFACE ELEVATION: 119 ± Feet

DATE COMPLETED: 3/5/98
LOGGED BY: AS

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC
80					S-29	50/6"		

Total depth = 80.5 feet.



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BORING: TB-13

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PAGE: 3 of 3

PROJECT NO.: 97061 FIGURE: A-2

PZO300 DWA 5/1/98

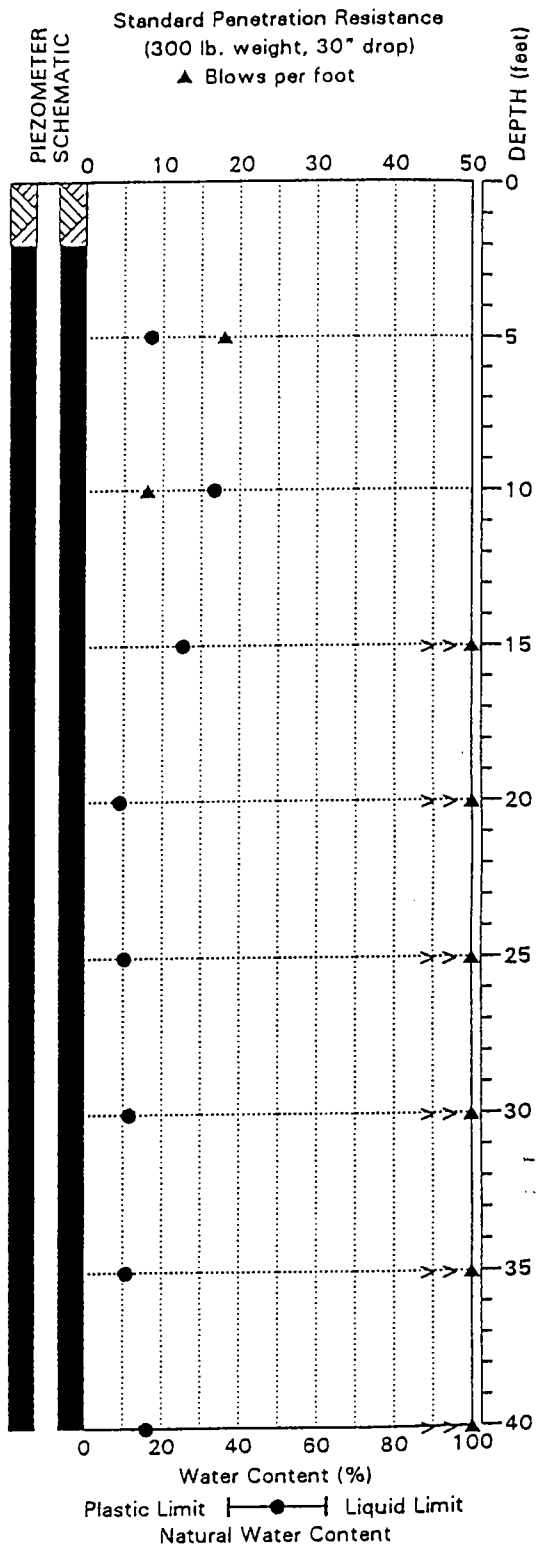
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 193 ± Feet

DATE COMPLETED: 4/2/98
LOGGED BY: GWE/MB/AS

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)
0	ML	Very stiff, olive gray, gravelly sandy SILT, moist. (FILL)	S-1	6-7-11
5				
10	CL	Medium stiff, dark gray mottled, lean CLAY, moist. Some roots.	S-2	5-4-4
15	SP	Dense, olive gray, slightly gravelly, fine to medium SAND, moist. (GLACIAL TILL)	S-3	4-25-34
20	ML	Hard, olive gray, gravelly, sandy SILT, moist.	S-4	14-21-30
25	SM	Very dense, olive gray, gravelly, silty fine to coarse SAND, wet. Rounded gravel.	S-5	45-50/3"
30		At 30 feet, fine grained.	S-6	61-50/5"
35	ML	Hard, olive gray, gravelly, sandy SILT, moist.	S-7	65-50/2"
40				

OTHER TESTS

PIEZOMETER SCHEMATIC



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BORING: TB-14

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PAGE: 1 of 6

PROJECT NO.: 97061 FIGURE: A-3

PZ0300 DWA 5/1/98

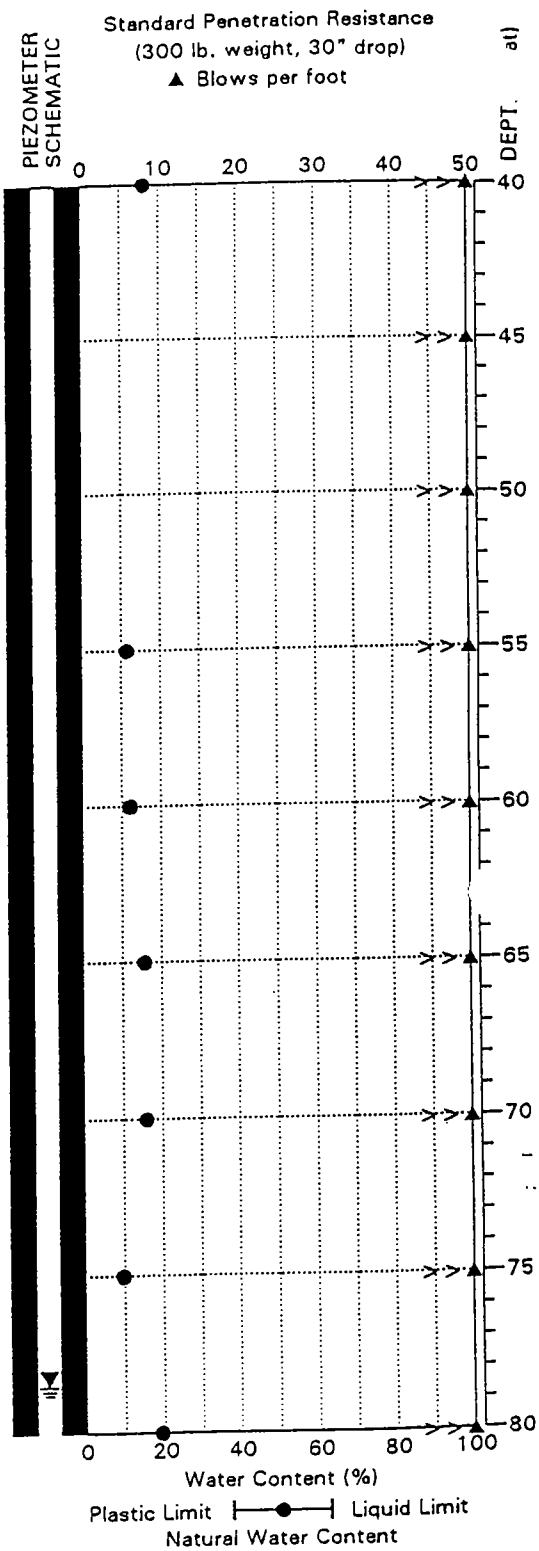
DRILLING COMPANY: [illegible]
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 193 ± Feet

DATE COMPLETED: 4/2/98
LOGGED BY: GWE/MB/AS

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)
40		(GLACIAL TILL)	S-8	50-50/2"
	SM	Very dense, gray, gravelly, silty SAND, moist. (TILL-LIKE DEPOSITS)		
45		No Sample Recovery.	S-9	100/5"
50		No Sample Recovery.	S-10	100/2"
55			S-11	100/4"
60			S-12	100/3"
65			S-13	100/3"
	ML	Hard, dark gray, sandy SILT, moist. No gravel. (GLACIOMARINE DRIFT)	S-14	100/3"
70	SM	Very dense, greenish gray, slightly gravelly, silty fine SAND, moist. Trace clay.		
75			S-15	100/6"
80				

OTHER TESTS

PIEZOMETER SCHEMATIC



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BORING: TB-14

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061

FIGURE: A-3

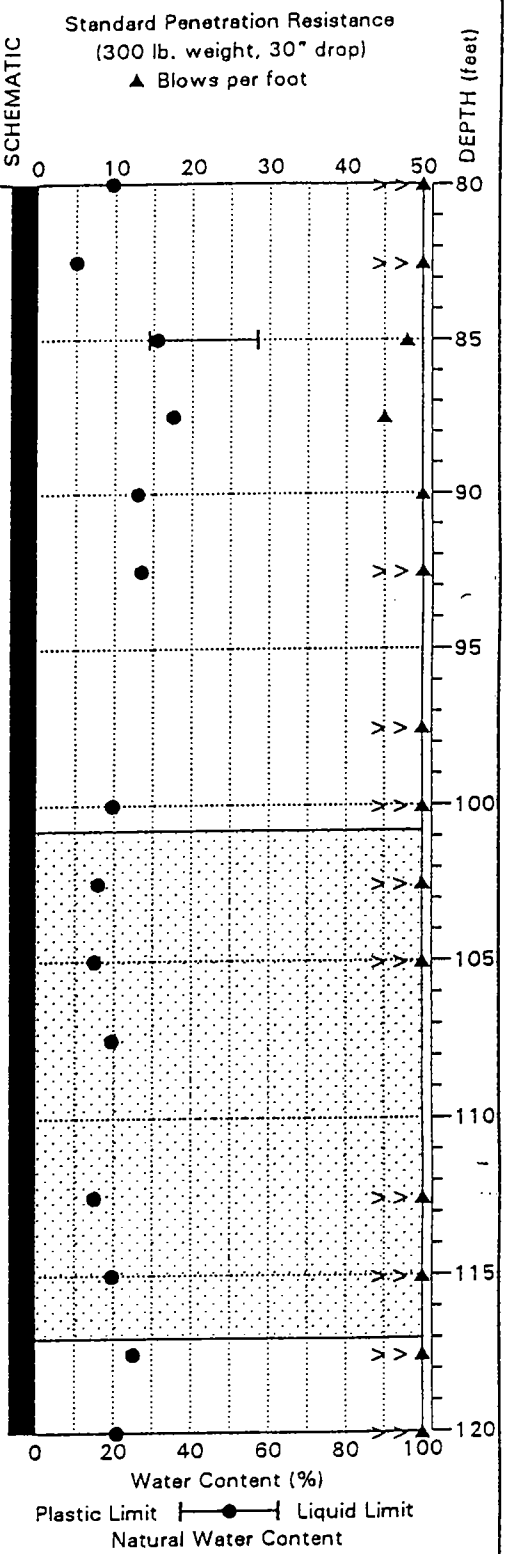
PZO300 DWA 5/1/98

DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 193 ± Feet

DATE COMPLETED: 4/2/98
LOGGED BY: GWE/MB/AS

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
80			At 80 feet, interbeds of gray silt.		S-18	93/6"	
					S-17	100/7"	
		ML	Hard, gray, SILT, moist. Some dropstones and slickensides. (GLACIOLACUSTRINE DEPOSITS)		S-18	18-18-30	AL
85					S-19	9-17-28	
90			At 90 feet, interbeds of silty fine sand.		S-20	11-18-32	
					S-21	20-21-30	
95		SM	Very dense, greenish gray, silty fine to medium SAND, moist. No Sample Recovery. (OUTWASH)		S-22	P	
			Sampler on rock. No Recovery.		S-23	80/1"	
100					S-24	75/6"	GS
			Becomes slightly gravelly to gravelly.		S-25	100/3"	
105					S-26	100/2"	
		SP SM	Very dense, greenish gray, slightly silty to silty fine to medium SAND, moist.		S-27	P	
110					S-29	100/5"	GS
115					S-30	100/6"	
		SM ML	Very dense, gray, interbedded silty fine SAND and slightly sandy to sandy SILT, moist. (FINE SAND/SILT DEPOSIT)		S-31	100/6"	
120							

PIEZOMETER SCHEMATIC



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BORING: TB-14

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-3

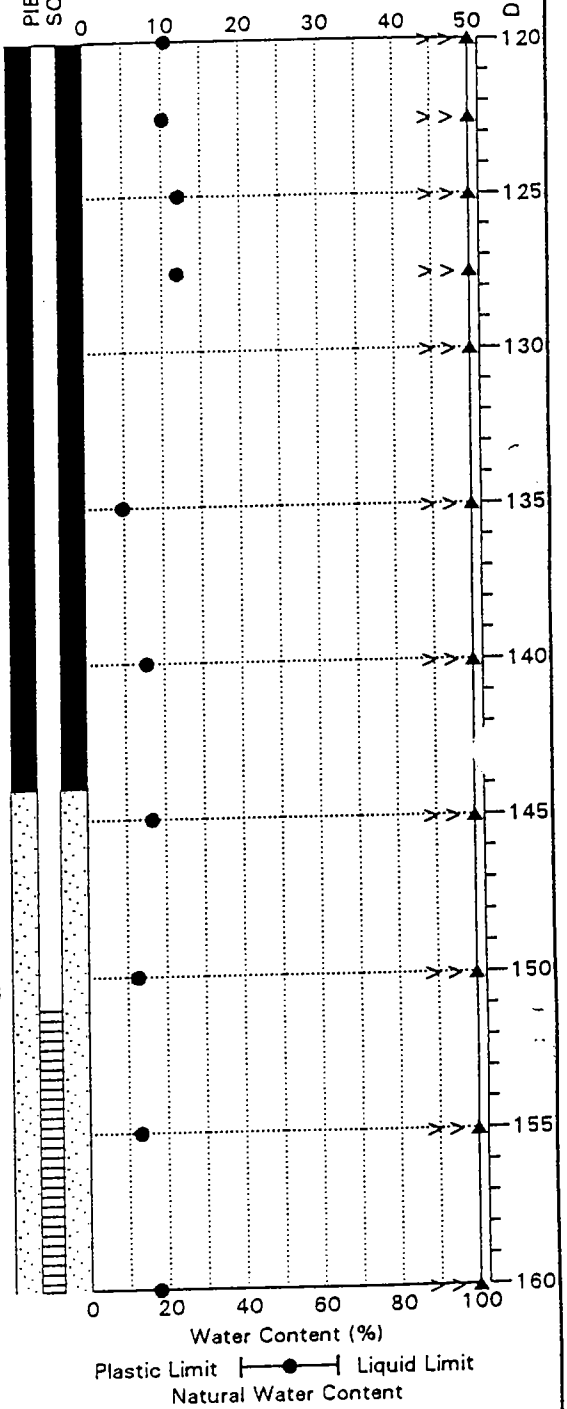
PZ0300 DWA 5/1/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 193 ± Feet

DATE COMPLETED: 4/2/98
LOGGED BY: GWE/MB/AS

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
120			Very dense, gray, interbedded silty fine SAND and slightly sandy to sandy SILT, moist. (FINE SAND/SILT DEPOSIT)		S-32	100/6"	GS
					S-33	100/5"	
125					S-34	100/4"	
					S-35	100/6"	GS
130			No Sample Recovery.		S-36	100/4"	
		GM	Very dense, greenish gray, silty sandy GRAVEL, wet. (OUTWASH)		S-37	100/1"	
135							
		SP	Very dense, dark gray, slightly gravelly, fine to medium SAND, moist.		S-38	100/2"	
140							
		SM	Very dense, dark grayish brown, slightly gravelly, silty fine to medium SAND, wet. Trace clay. (GLACIOMARINE DRIFT)		S-39	100/3"	
145							
					S-40	100/4"	GS
150							
					S-41	65-35/2"	
155							
		SP SM	Very dense, dark gray, slightly silty fine to medium SAND, wet. (OUTWASH)				
160							

PIEZOMETER SCHEMATIC



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BORING: TB-14

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-3

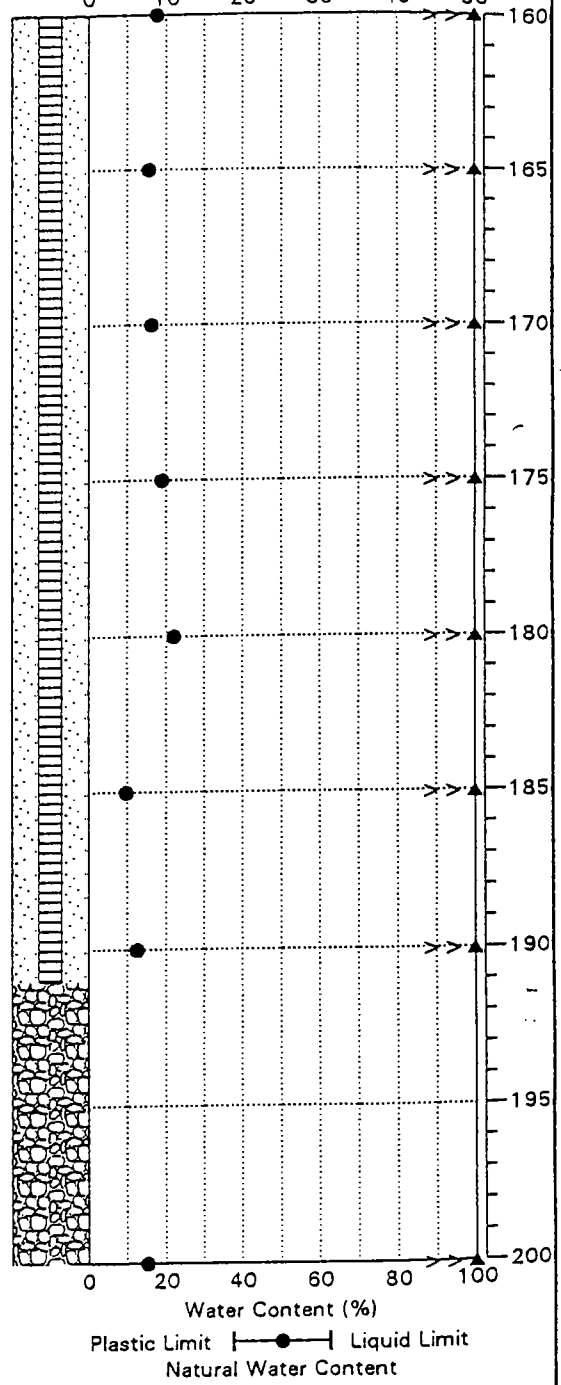
PZ0300 DWA 5/1/98

DRILLING COMPANY: Underco
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 193 ± Feet

DATE COMPLETED: 4/2/98
LOGGED BY: GWE/MB/AS

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
160			Very dense, dark gray, slightly silty to silty fine to medium SAND, wet. (OUTWASH)		S-42	27-50/6"	
165			Becomes fine to coarse grained.		S-43	55-50/3"	
170					S-44	30-50/5"	GS
175			Becomes fine to medium grained.		S-45	33-60	
180					S-46	28-31-38	
185			Becomes fine to coarse grained.		S-47	100/4"	
190					S-48	75-50/1"	
195							
200			Becomes gravelly.				

PIEZOMETER SCHEMATIC



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BORING: TB-14

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-3

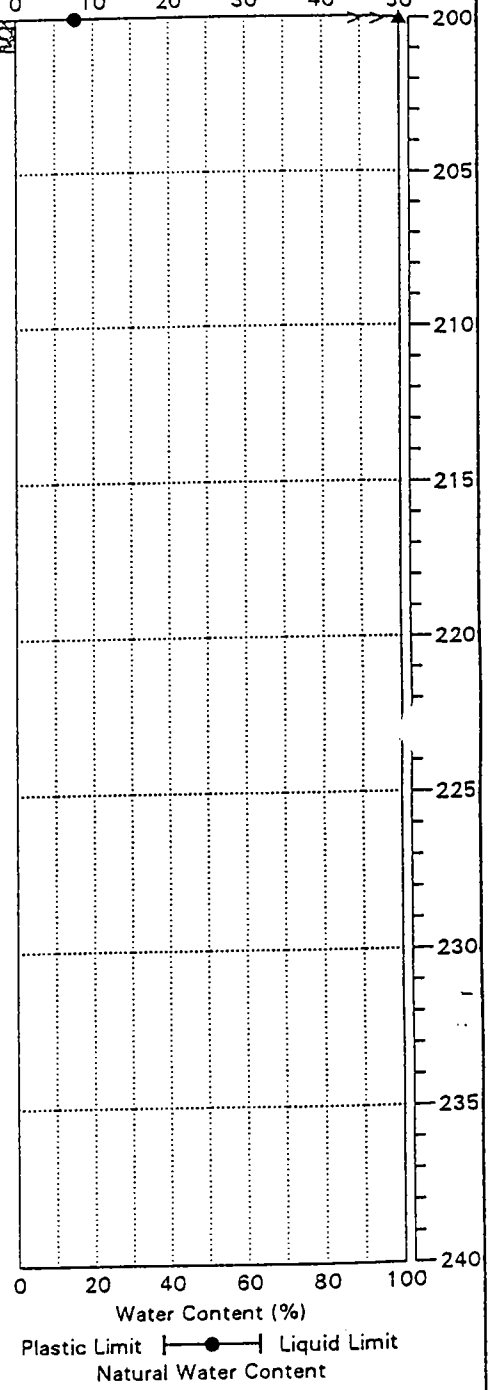
PZO300 DWA 5/1/98

DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 193 ± Feet

DATE COMPLETED: 4/2/98
LOGGED BY: GWE/MB/AS

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC
200			Total Depth = 200.5 feet.	⊠	S-49	100/6"	GS	

Standard Penetration Resistance
(300 lb. weight, 30" drop)
▲ Blows per foot



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BORING: TB-14

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-3

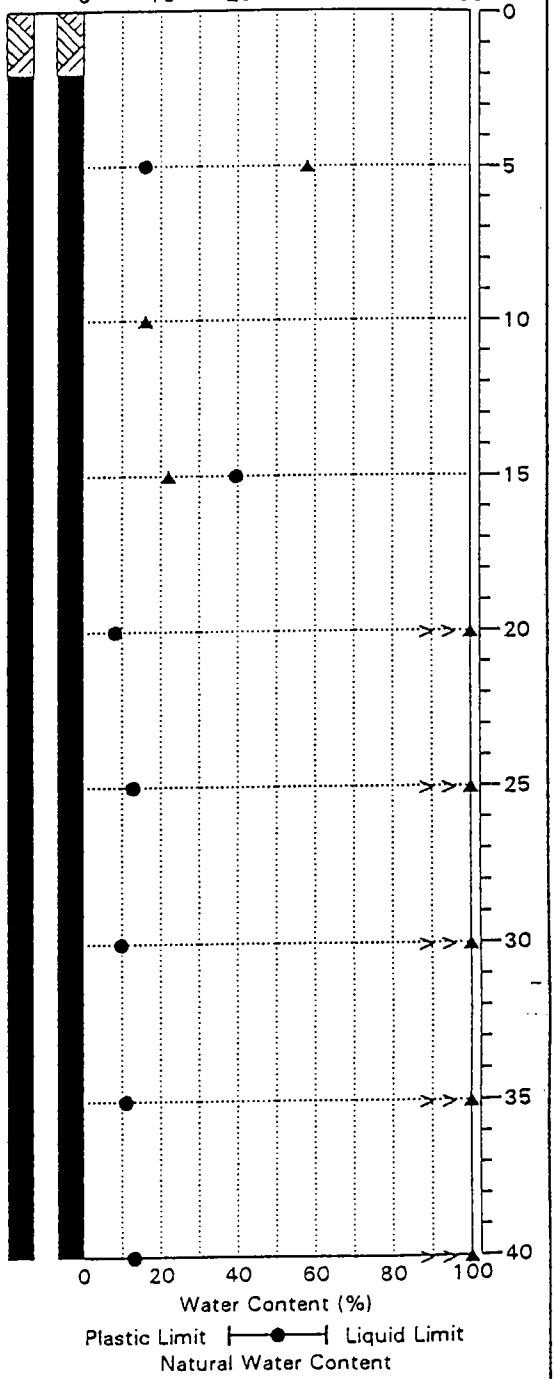
PZ0300 DWA 5/1/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 188 ± Feet

DATE COMPLETED: 4/13/98
LOGGED BY: MB/GWE

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0	SM	Medium dense, dark grayish brown, slightly gravelly, silty fine to medium SAND, moist. Coarse subrounded to subangular gravel. Trace organics, roots. (FILL)			
5			S-1	6-18-11	
		No Sample Recovery (S-2).			
10	CL	Stiff, dark gray, lean CLAY, moist. Some iron oxide staining. Trace organics, roots.	S-2	3-4-4	
15			S-3	2-3-8	
	SM	Very dense, dark grayish brown, silty gravelly fine to coarse SAND, moist. Fine to coarse subrounded to subangular gravel. Some iron oxide staining. (RECESSIONAL OUTWASH)			
20			S-4	16-35-30	
25	SP	Very dense, dark gray, slightly gravelly fine to medium SAND, moist. Fine to coarse subrounded to subangular gravel. 1" thick silt layer with fine to coarse sand and fine gravel.	S-5	20-31-34	
	SM	Very dense, dark gray, slightly gravelly, silty fine to coarse SAND, moist. (TILL-LIKE DEPOSITS)			
30			S-6	21-35-43	
35		At 35 feet, 1/2" thick layer of dark yellowish brown sand. Two 1" thick silt layers with fine to coarse sand and fine gravel.	S-7	27-30-33	GS
40					

PIEZOMETER SCHEMATIC



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BORING: TB-15

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PAGE: 1 of 6

PROJECT NO.: 97061

FIGURE: A-4

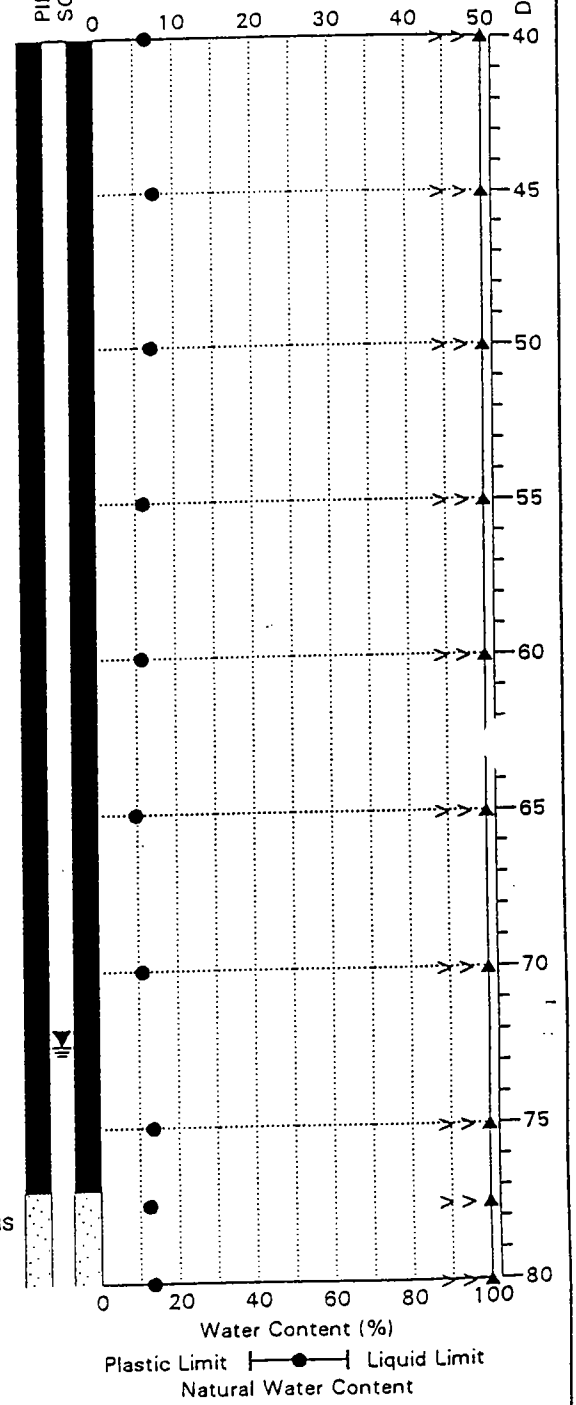
PZO300 DWA 5/4/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 188 ± Feet

DATE COMPLETED: 4/13/98
LOGGED BY: MB/GWE

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
40			Very dense, dark gray, slightly gravelly, silty fine to coarse SAND, moist. (TILL-LIKE DEPOSITS)		S-8	100/5.5"	
45			At 45 feet, sand becomes fine to medium. Gravel becomes fine, rounded.		S-9	34-50/6"	
50					S-10	65/6"-50/3"	
55			At 55 feet, sand becomes fine to coarse. Trace of fine to coarse subrounded gravel.		S-11	50-50/3"	
60			At 60 feet, recovered broken cobble.		S-12	100/5"	
65			At 65 feet, recovered broken cobble.		S-13	100/4"	
70					S-14	100/5"	
75					S-15	100/5"	
		SM	Very dense, dark olive gray, silty slightly gravelly, fine to coarse SAND, moist. Fine to coarse subrounded gravel. (ADVANCE OUTWASH)		S-16	100/4"	GS
80							

PIEZOMETER SCHEMATIC



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BORING: TB-15

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061

FIGURE: A-4

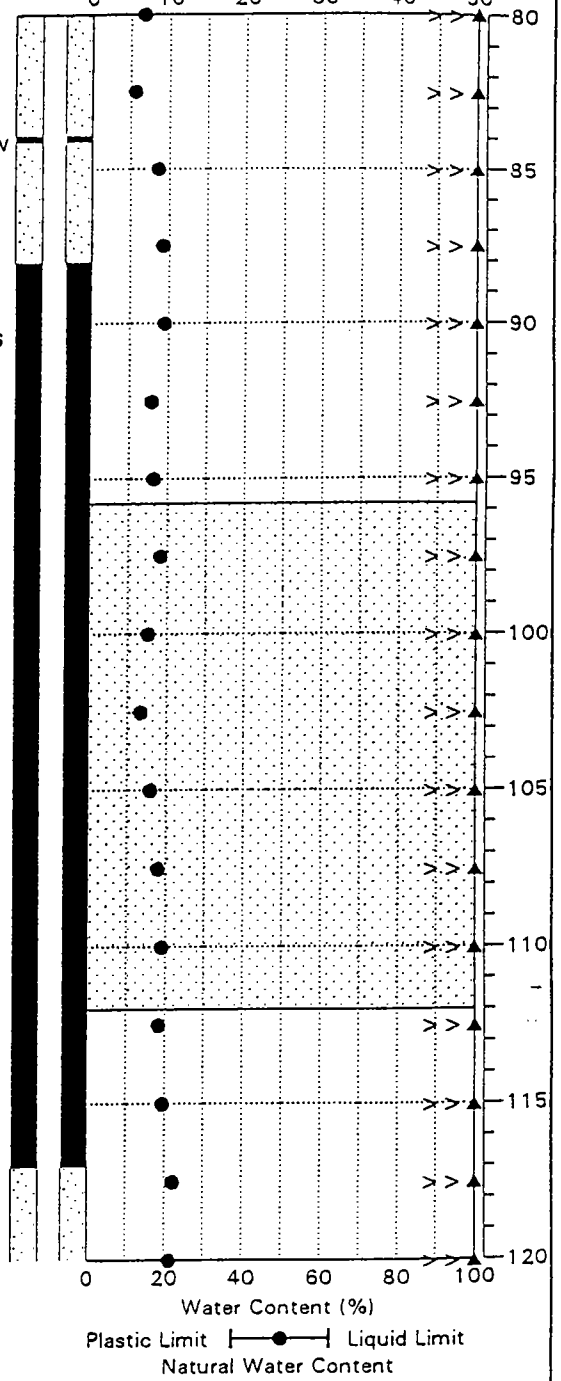
PZO300 OWA 5/4/98

DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 188 ± Feet

DATE COMPLETED: 4/13/98
LOGGED BY: MB/GWE

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
80			(ADVANCE OUTWASH) At 80 feet, fine grained. Some clasts of weathered granite.		S-17	100/6"	
					S-18	39-100/4"	
85			At 85 feet, becomes dark grayish brown.		S-19	24-50/5"	VW
					S-20	30-50/3"	
		SM	Very dense, dark gray, silty fine to medium SAND, moist.		S-21	48-50/5"	GS
90					S-22	50/6"	
		SM	Very dense, dark gray, silty gravelly fine to coarse SAND, moist. Fine to coarse subrounded to subangular gravel.		S-23	50/5"	
95					S-24	33-50/2"	
100			Rock in sample tip.		S-25	50/3"	
			At 102.5, some red sand.		S-26	50/6"-50/2"	GS
105					S-27	50/4"	
					S-28	50/5"	
110					S-29	50/5"	
					S-30	50/4"	
115					S-31	50/6"	GS
		SP SM	Very dense, dark gray, slightly silty fine to medium SAND, moist.		S-32	31-50/3"	
120							

PIEZOMETER SCHEMATIC



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BORING: TB-15

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-4

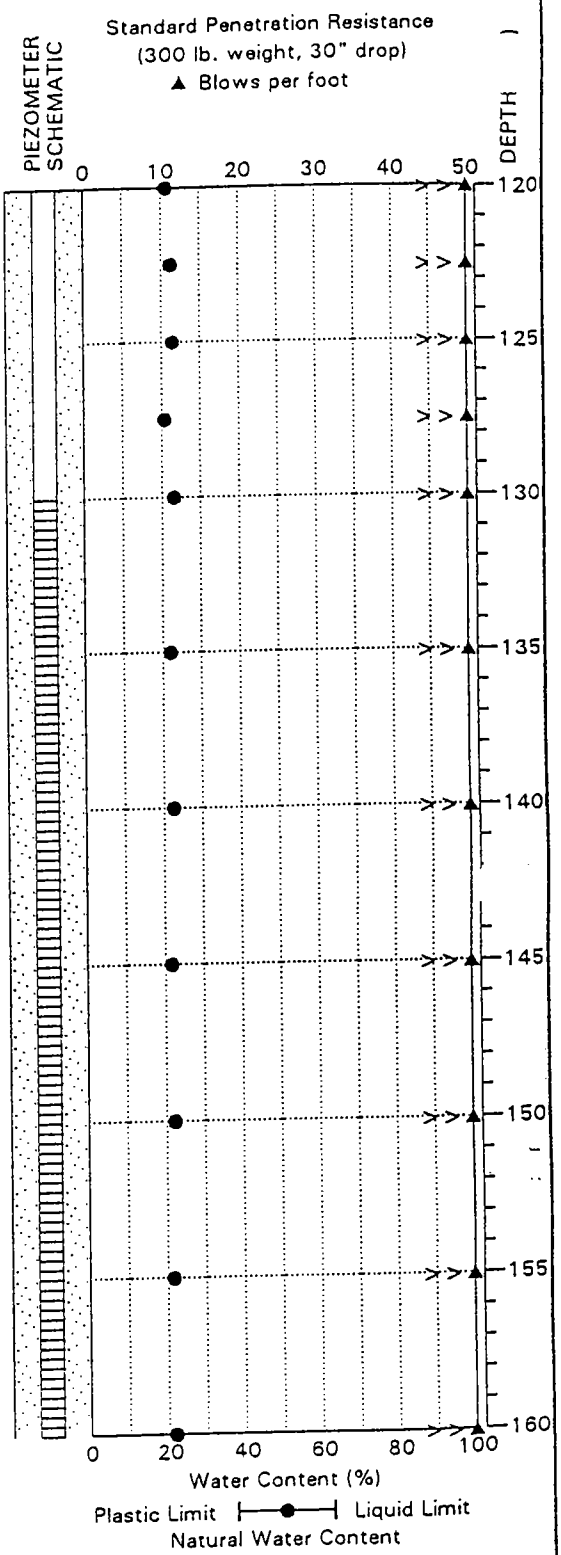
PZ0300 DWA 5/4/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 188 ± Feet

DATE COMPLETED: 4/13/98
LOGGED BY: MB/GWE

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
120			Very dense, dark gray, slightly silty fine to medium SAND, moist. (ADVANCE OUTWASH)		S-33	50/6"	
					S-34	50/5"	
125					S-35	50/4"	
		SP	Very dense, gray, fine to medium SAND, wet.		S-36	50/5"	
130					S-37	50/5"	
135					S-38	50/5"	
		SP SM	Very dense, brownish gray, slightly silty fine to medium SAND, wet.		S-39	28-50/2"	GS
140							
		SP	Very dense, gray, fine to medium SAND, wet.				
145					S-40	50/5"	
150					S-41	50/5"	
155			At 155 feet, trace gravel.		S-42	50/3"	
160		SP SM	Very dense, brownish gray, slightly silty fine to medium SAND, wet.				

PIEZOMETER SCHEMATIC



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BORING: TB-15

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PAGE: 4 of 6

PROJECT NO.: 97061

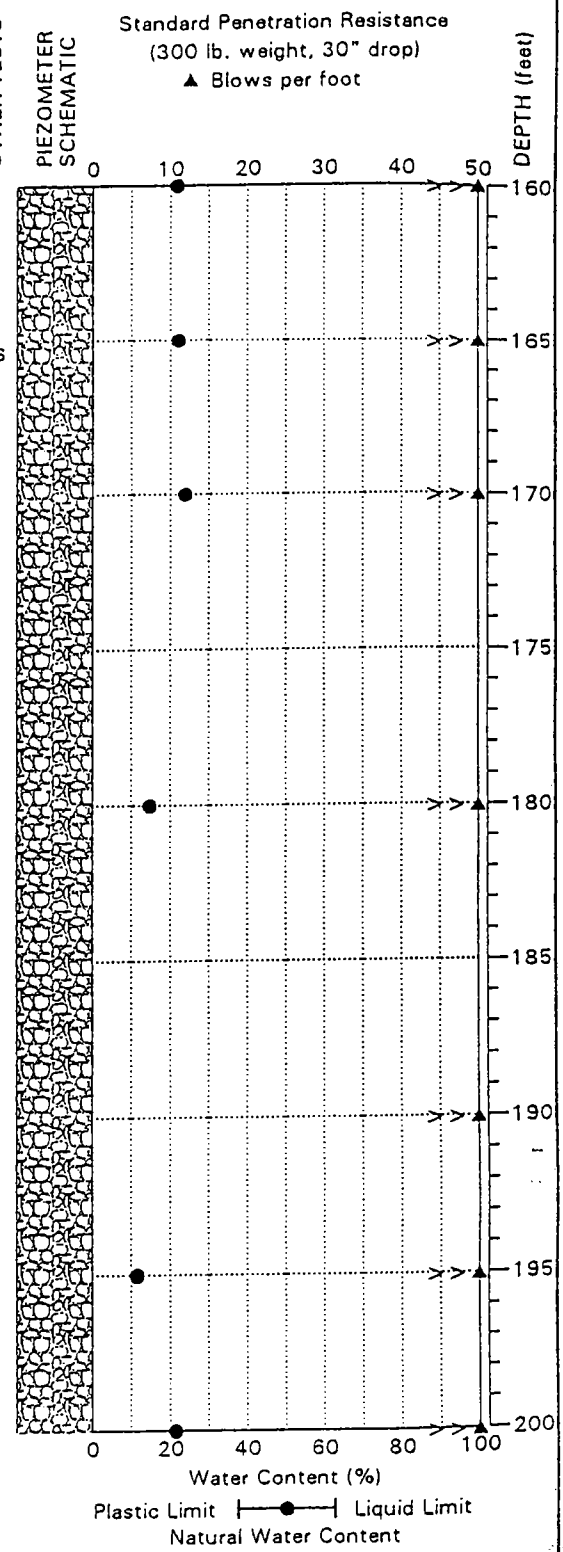
FIGURE: A-4

PZO300 DWA 5/4/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 188 ± Feet

DATE COMPLETED: 4/13/98
LOGGED BY: MB/GWE

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
160		Very dense, brownish gray, slightly silty fine to medium SAND, wet. (ADVANCE OUTWASH)	S-43	50/4"	
165			S-44	50/4"	GS
	SP	Very dense, gray, fine to medium SAND, wet.			
170			S-45	50/5"	
175		Driller comment: gravel/cobble zone, 175' to 179'			
	SW SM	Very dense, gray, slightly silty fine to coarse SAND with gravel, wet. Well graded.			
180			S-46	100/4"	
185		Driller comment: Cobble zone from 184' to 188'			
190		No Sample Recovery.	S-47	100/3"	
	SM	Very dense, greenish gray, gravelly, silty SAND, wet.			
195			S-48	100/4"	
	SP	Very dense, gray, fine to medium SAND, wet. Trace gravel.			
200					



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BORING: TB-15

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PAGE: 5 of 6

PROJECT NO.: 97061

FIGURE: A-4

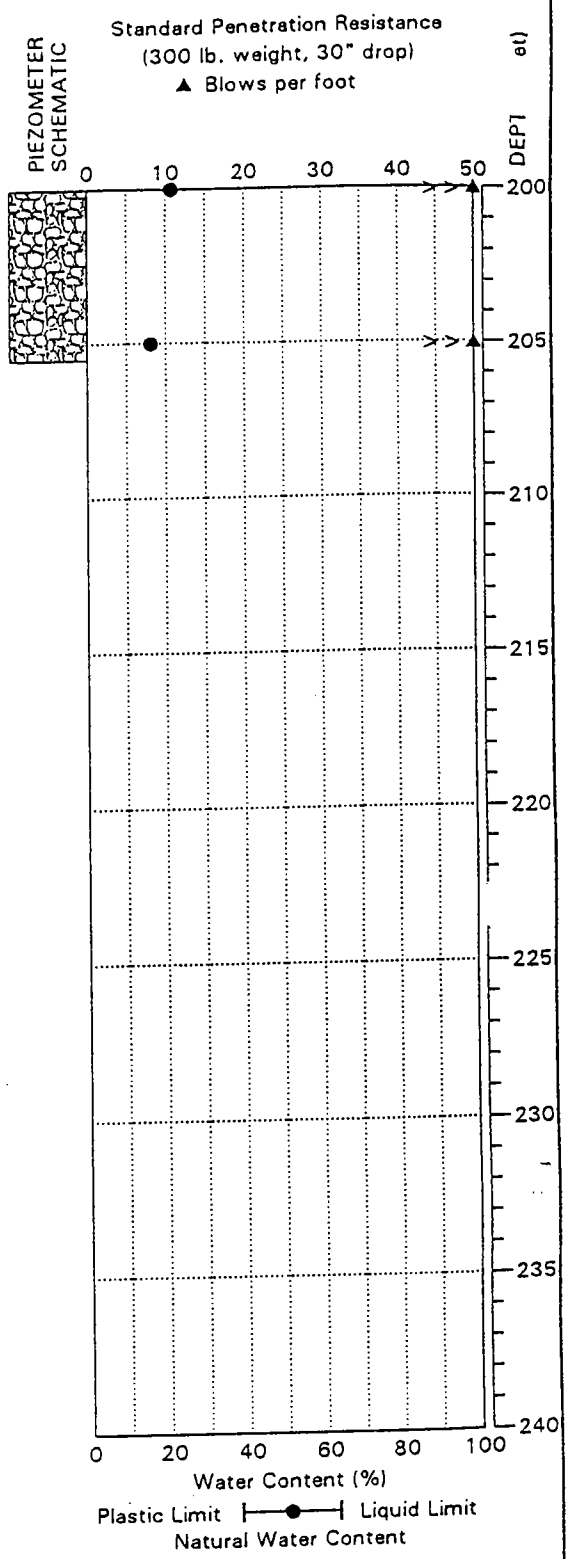
PZO300 DWA 5/4/98

DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 188 ± Feet

DATE COMPLETED: 4/13/98
LOGGED BY: MB/GWE

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC
200			Very dense, gray, fine to medium SAND, wet. Trace gravel. (ADVANCE OUTWASH)		S-49	100/4"		
205					S-50	100/3"		

Total Depth = 205.5 feet.



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BORING: TB-15

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-4

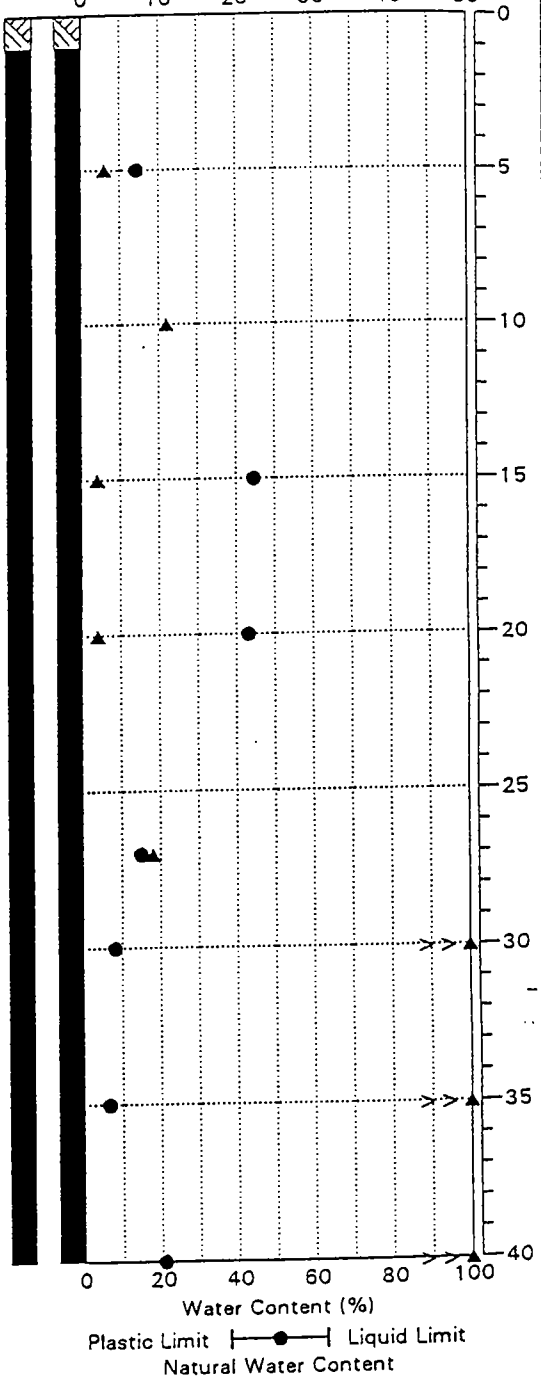
PZ0300 DWA 5/4/98

DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 177 ± Feet

DATE COMPLETED: 5/22/98
LOGGED BY: MR/MB/AS

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
0		SM	Loose, grayish brown, slightly gravelly silty fine to medium SAND, moist. Trace organics. (FILL)			
5				S-1	2-1-2	
10			No Sample Recovery.	S-2	7-7-4	
		ML	Very soft, gray, slightly sandy SILT, moist to wet. Some roots. (LACUSTRINE DEPOSITS)			
15				S-3	1-1-1	
20			Faint laminae. Some fine gravel.	S-4	P-1-1	
		SM	Loose, gray, silty medium to coarse SAND, moist. Few 1-1/2 to 2" thick layers of silt. (RECESSIONAL OUTWASH)	S-4B		
25				S-5	1-1-8	
		SM	Very dense, gray, gravelly silty fine to medium SAND, moist to wet. (ADVANCE OUTWASH)			
30				S-6	22-29-32	
35			Sampler bouncing on cobble.	S-7	60/6"	
		SP	Very dense, gray, fine to medium SAND, moist.			
40						

PIEZOMETER SCHEMATIC



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BORING: TB-16

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PAGE: 1 of 5

PROJECT NO.: 97061 FIGURE: A-5

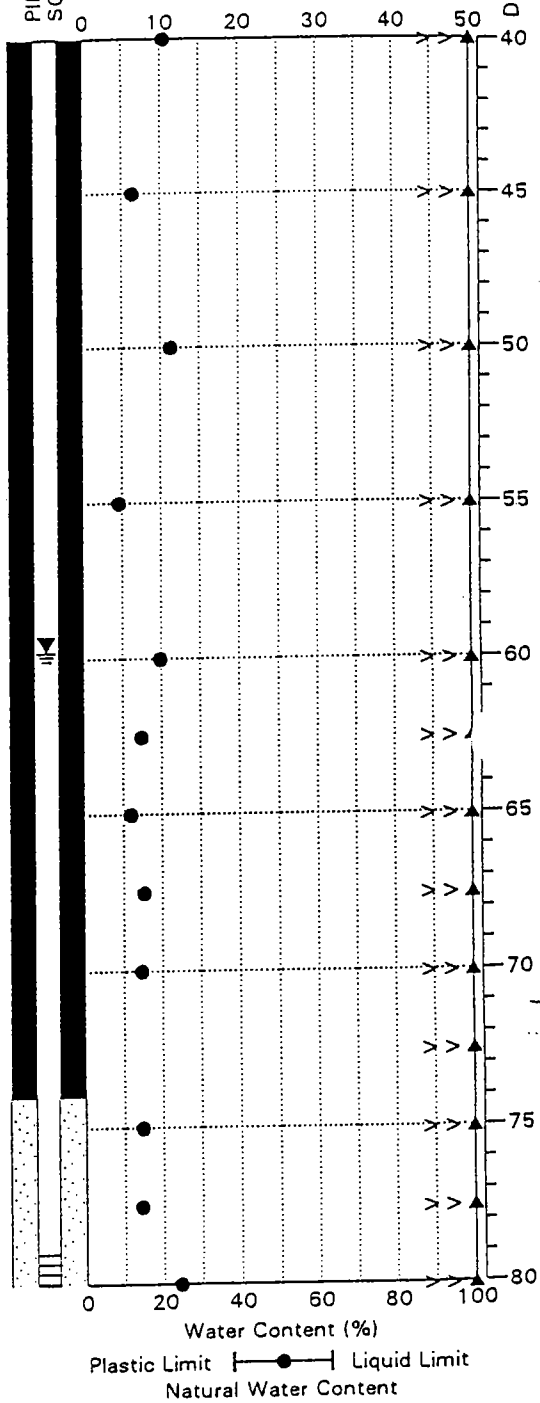
PZO300 DWA 5/4/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 177 ± Feet

DATE COMPLETED: 3/22/98
LOGGED BY: MR/MB/AS

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
40			(ADVANCE OUTWASH)		S-8	22-38 50/4"	
45		ML	Very dense, gray, gravelly sandy SILT, moist. Fine to medium sand. (GLACIOMARINE DRIFT)		S-9	20-50/2"	
50		SP ML	Very dense, gray, interbedded sandy SILT and medium to coarse SAND, moist. Trace fine embedded gravel.		S-10	23-41 50/4"	
55		ML	Hard, gray, gravelly sandy SILT, moist. (GLACIAL TILL)		S-11	100/4"	
60		SM	Very dense, gray, gravelly, silty fine to medium SAND, moist. Gap-graded. Embedded gravel.		S-12	19-50/6"	GS
		SP	Very dense, gray, gravelly fine to coarse SAND, moist. (ADVANCE OUTWASH)		S-13	50-50/4"	
65		SM	Very dense, gray, silty fine to coarse SAND, moist.		S-14	100/6"	
			Becomes fine to medium grained, gravelly.		S-15	92/6"	
70					S-16	48-50/3"	
			Sampler on rock. No recovery.		S-17	100/3"	
75		SP SM	Very dense, dark gray, gravelly, slightly silty fine to coarse SAND, moist to wet.		S-18	65/6"	
			Becomes fine to medium grained.		S-19	36-50/3"	
80							

PIEZOMETER SCHEMATIC



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BORING: TB-16

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

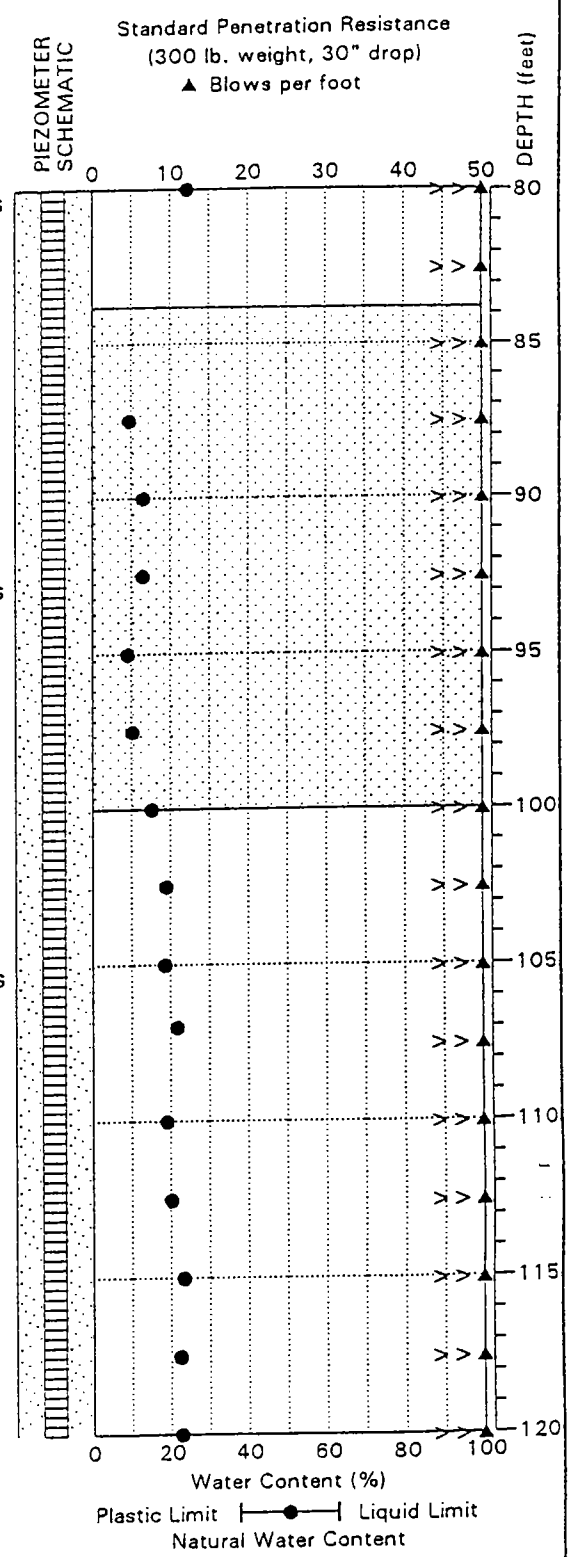
PROJECT NO.: 97061 FIGURE: A-5

PZO300 DWA 5/4/98

DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 177 ± Feet

DATE COMPLETED: 3/22/98
LOGGED BY: MR/MB/AS

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
80	SM	Very dense, grayish brown, silty fine SAND, moist. Trace gravel. One 1/8" thick clay lens. (ADVANCE OUTWASH)	S-20	30-30-35	GS
		No Sample Recovery.	S-21	39-50/3"	
85	SP SM	Very dense, gray, gravelly, slightly silty fine to coarse SAND, moist. No sample recovery at 85 feet.	S-22	100/4"	
			S-23	35-60/6"	
90			S-24	35-50/3"	
			S-25	41-50/3"	GS
95			S-26	81/6"	
			S-27	82/6"	
100			S-28	100/4"	
	SP SM	Very dense, olive-gray, slightly gravelly, slightly silty, fine to coarse SAND, moist to wet.	S-29	50-50/5"	
105		Becomes fine to medium grained.	S-30	50-50/4"	GS
			S-31	50-50/4"	
110	SM	Very dense, olive gray, silty fine SAND, moist to wet.	S-32	32-50/3"	
			S-33	50-50/2"	
115			S-34	40-50/3"	
			S-35	40-50/3"	
120					



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BORING: TB-16

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-5

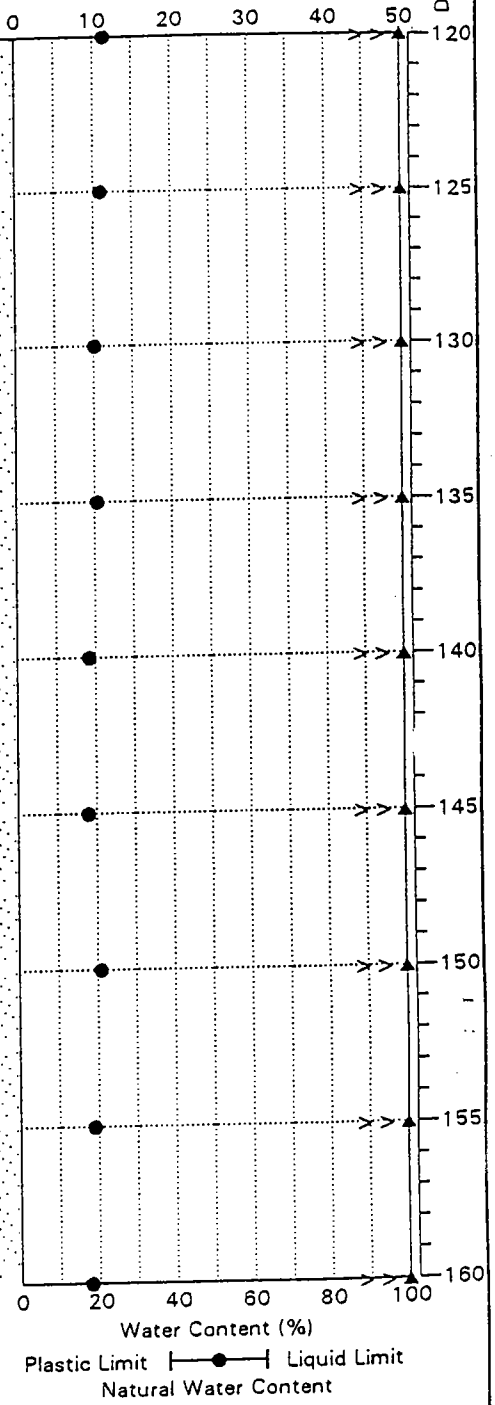
PZO300 DWA 5/4/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 177 ± Feet

DATE COMPLETED: 3/22/98
LOGGED BY: MR/MB/AS

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
120		SP SM	Very dense, olive gray, slightly silty fine SAND, moist to wet. (ADVANCE OUTWASH)		S-36	18-38-50/2"	
125					S-37	40-50/4"	GS
		SP	Very dense, olive gray, slightly gravelly, fine to medium SAND, moist. Some iron oxide staining.				
130					S-38	38-50/4"	
		SM	Very dense, olive gray, slightly gravelly, silty fine SAND, moist.				
135					S-39	80-50/2"	
		SP SM	Very dense, olive gray, gravelly, slightly silty, fine to coarse SAND, moist to wet. Fine gravel.				
140					S-40	75-50/3"	
145					S-41	100/6"	GS
150			Becomes fine grained.		S-42	100/6"	
155					S-43	44-50/3"	
160							

PIEZOMETER SCHEMATIC



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BORING: TB-16

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-5

PZ0300 DWA 5/4/98

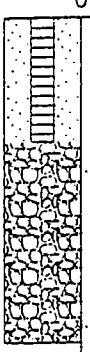
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 177 ± Feet

DATE COMPLETED: 3/22/98
LOGGED BY: MR/MB/AS

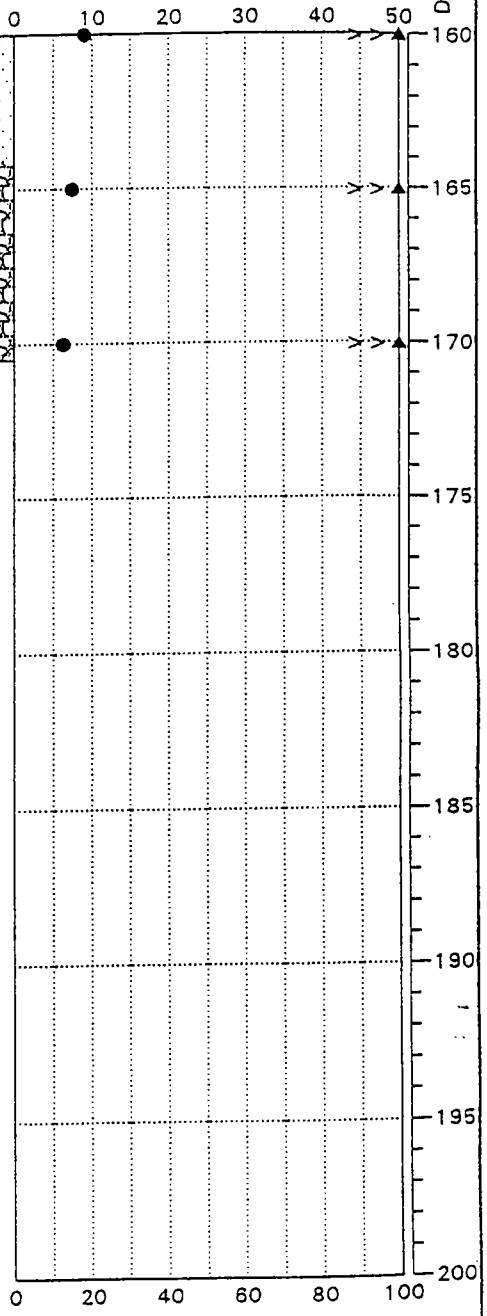
DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
160		SP	Very dense, olive gray, gravelly, silty SAND, wet. (ADVANCE OUTWASH)		S-44	48-50/2"	
165					S-45	100/5"	GS
170					S-46	100/4"	

Total Depth = 170.5 feet.

PIEZOMETER SCHEMATIC



Standard Penetration Resistance
(300 lb. weight, 30" drop)
▲ Blows per foot



Plastic Limit ⊢●⊣ Liquid Limit
Natural Water Content

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BORING: TB-16

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

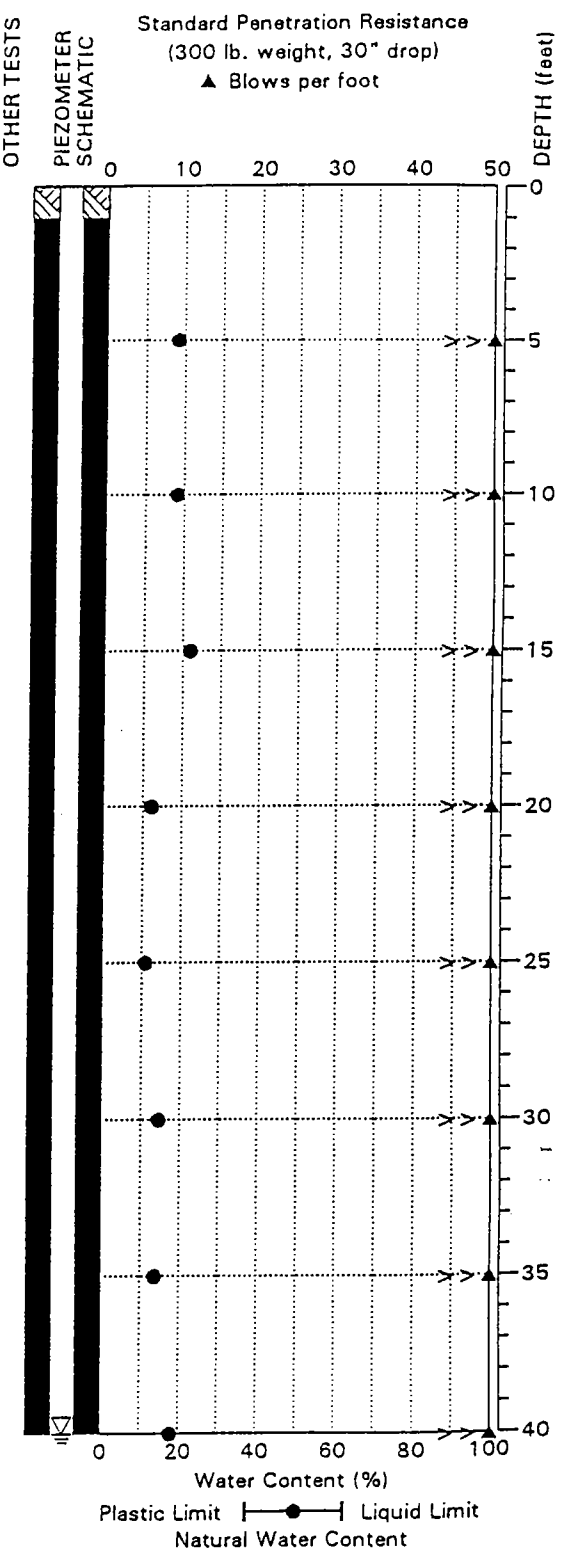
PROJECT NO.: 97061 FIGURE: A-5

PZO300 DWA 5/4/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 163 ± Feet

LOCATION:
DATE COMPLETED: 3/18/98
LOGGED BY: ADM/ST

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)
0	SM	Medium dense, dark brown, silty gravelly fine SAND, moist. Coarse to fine gravel. Layers of silt. (FILL)	S-1	50/6"
5			S-2	50/5"
10	ML	Hard, yellowish brown, slightly gravelly sandy SILT, moist. Fine gravel. (GLACIAL TILL)		
15	SM ML	Very dense / hard, olive, slightly gravelly sandy SILT / silty fine to medium SAND, moist. Layers of silt and clean sand.	S-3	26-42-47
20	SM	Very dense, brown to grayish brown, slightly gravelly, silty fine to medium SAND, moist. (ADVANCE OUTWASH)	S-4	50/6"
25			S-5	50/6"
30			S-6	33-50/4"
		Driller: Cobbley zone, 33' - 34'.		
35	ML	Hard, yellowish brown, sandy, gravelly SILT, moist. (GLACIOMARINE DRIFT)	S-7	25-50/4"
40				



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BORING: TB-17

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PAGE: 1 of 4

PROJECT NO.: 97061 FIGURE: A-6

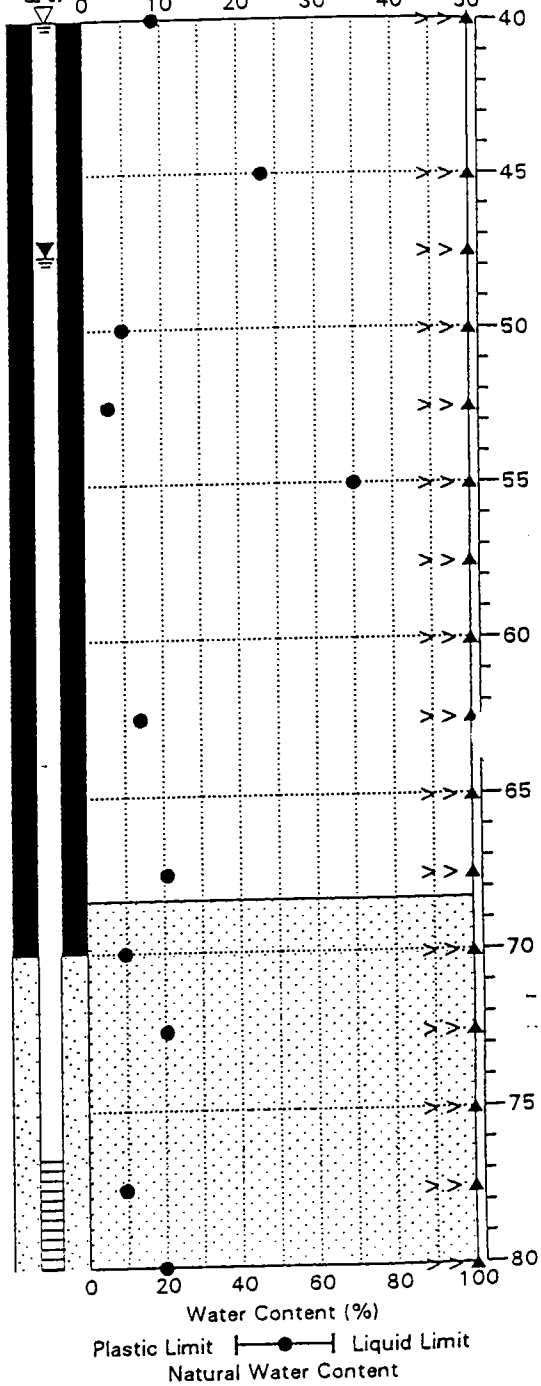
PZO300 DWA 5/1/98

DRILLING COMPANY: [illegible]
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 163 ± Feet

DATE COMPLETED: 3/13/98
LOGGED BY: ADM/ST

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
40		SM ML	Hard, gray, sandy SILT with interbeds of fine silty sand, wet. (GLACIOMARINE DRIFT)		S-8	17-36-50	
45			At 45 feet, 3" layer of clean coarse sand with gravel.		S-9	43-50/5"	
			No Sample Recovery.		S-10	50-50/4"	
50		SM ML	Very dense, gray, gravelly, silty SAND / sandy SILT, wet.		S-11	23-35 50/2"	GS
		SM	Very dense, mottled gray and yellowish brown, silty, gravelly SAND, wet.		S-12	50/4"	
55			At 55 feet, iron oxide staining.		S-13	50-39 50/2"	
			No Sample Recovery.		S-14	23-40 50/3"	
60			No Sample Recovery.		S-15	50/5"	
		ML	Hard, gray, slightly gravelly slightly sandy SILT, wet. Fine embedded gravel.		S-16	33-50/3"	
65		ML	Hard, gray, nonplastic SILT, moist. Massive. (GLACIOLACUSTRINE DEPOSITS) No sample recovery at 65 feet.		S-17	100/4"	
					S-18	50/5"	AL
70			At 70 feet, one 2-1/2" black gravel.		S-19	46-50/2"	
			At 72.5 feet, few fine gravel.		S-20	85-50/2"	
75			No Sample Recovery.		S-21	100/5"	
		SM	Very dense, dark gray, silty slightly gravelly fine SAND, moist. Fine gravel. (ADVANCE OUTWASH)		S-22	50-50/2"	
80							

PIEZOMETER SCHEMATIC



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BORING: TB-17

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

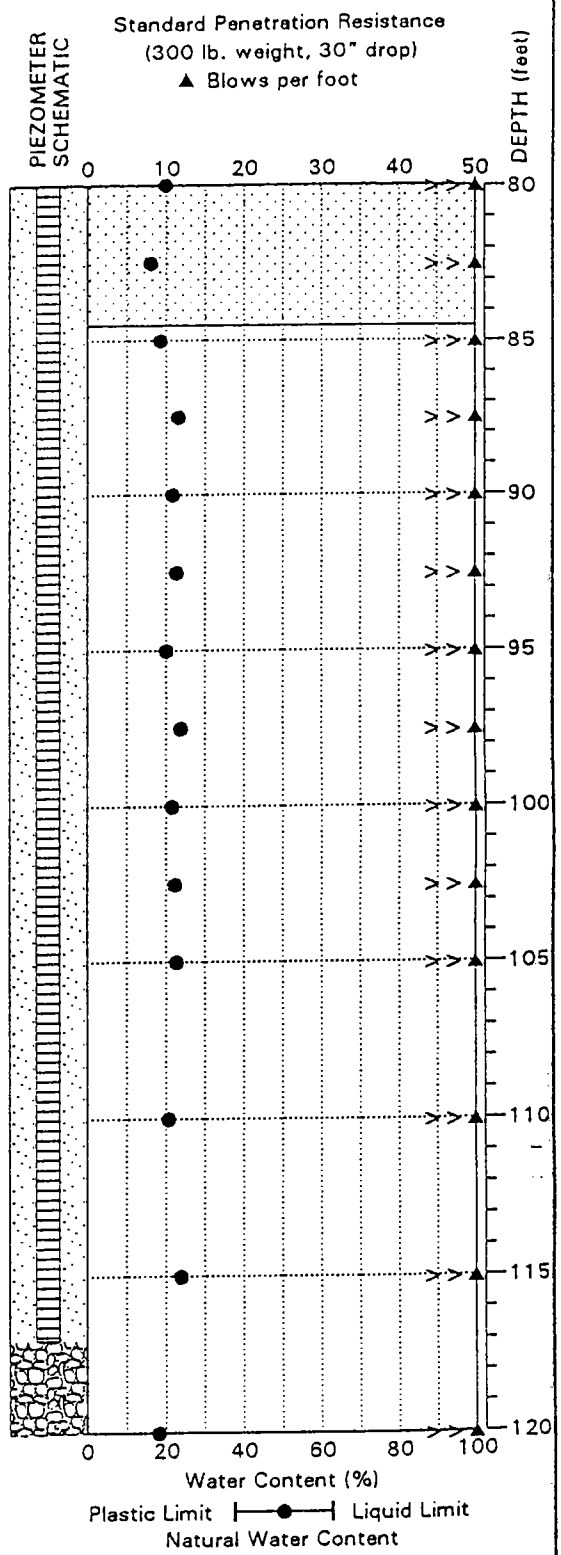
PROJECT NO.: 97061 FIGURE: A-6

PZO300 DWA 5/1/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 163 ± Feet

LOCATION:
DATE COMPLETED: 3/18/98
LOGGED BY: ADM/ST

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
80	SW SM	Very dense, gray, gravelly, slightly silty, fine to coarse SAND, moist to wet. (ADVANCE OUTWASH)	S-23	33-85	GS
			S-24	96/6"	
85			S-25	20-47 50/4"	
	SP	Very dense, gray, fine to medium SAND, moist to wet. Few silt layers. Trace gravel.	S-26	32-50/5"	
90			S-27	30-30 50/4"	
			S-28	30-50/3"	
	SP SM	Very dense, gray, slightly silty fine to medium SAND, moist to wet.	S-29	20-40 50/4"	
95			S-30	32-50/3"	
100			S-31	30-50/4"	
		At 102.5 feet, trace fine gravel.	S-32	34-50/5"	GS
105			S-33	32-50/5"	
	SP	Very dense, gray, fine to medium SAND, moist to wet.			
110			S-34	57-50/2"	
		Driller: Gravel layer, 112' - 114'.			
115	SM	Very dense, gray, silty fine to medium SAND, wet. Trace fine gravel.	S-35	32-50/3"	
120					



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BORING: TB-17

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-6

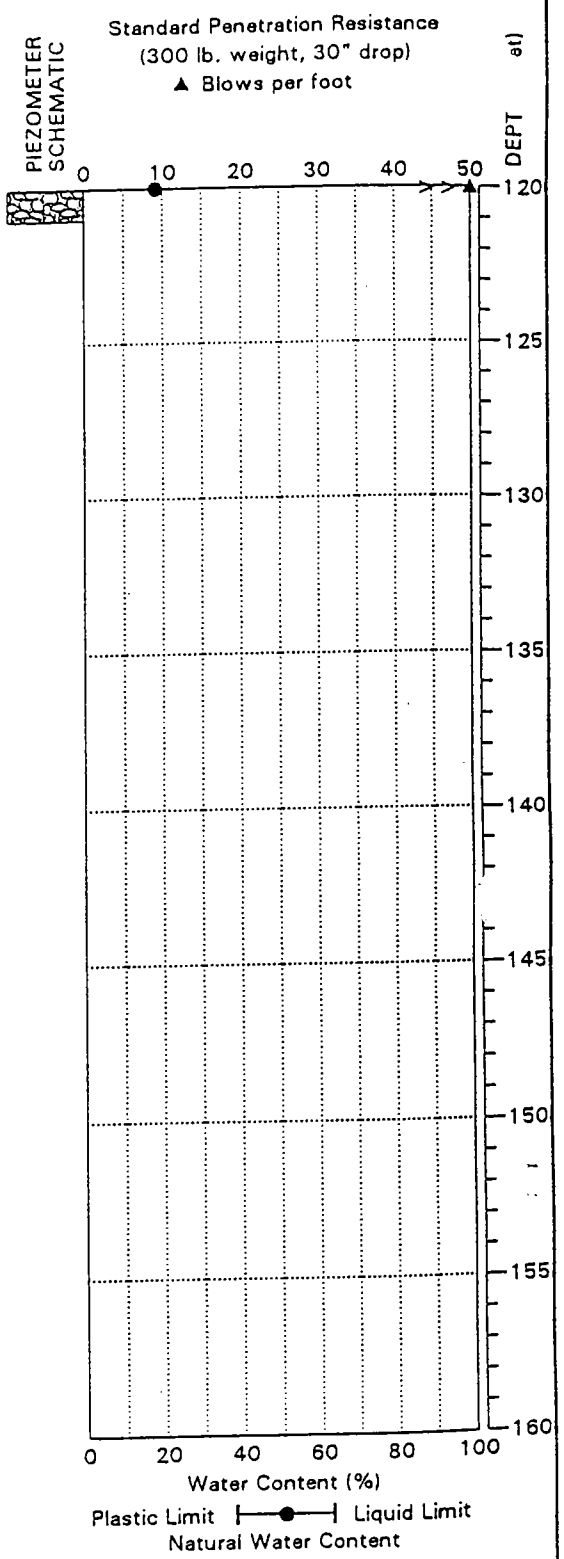
PZO300 DWA 5/1/98

DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 163 ± Feet

DATE COMPLETED: 3/18/98
LOGGED BY: ADM/ST

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC
120				■	S-36	45-50/2"		

Total depth = 121 feet.



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BORING: TB-17

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

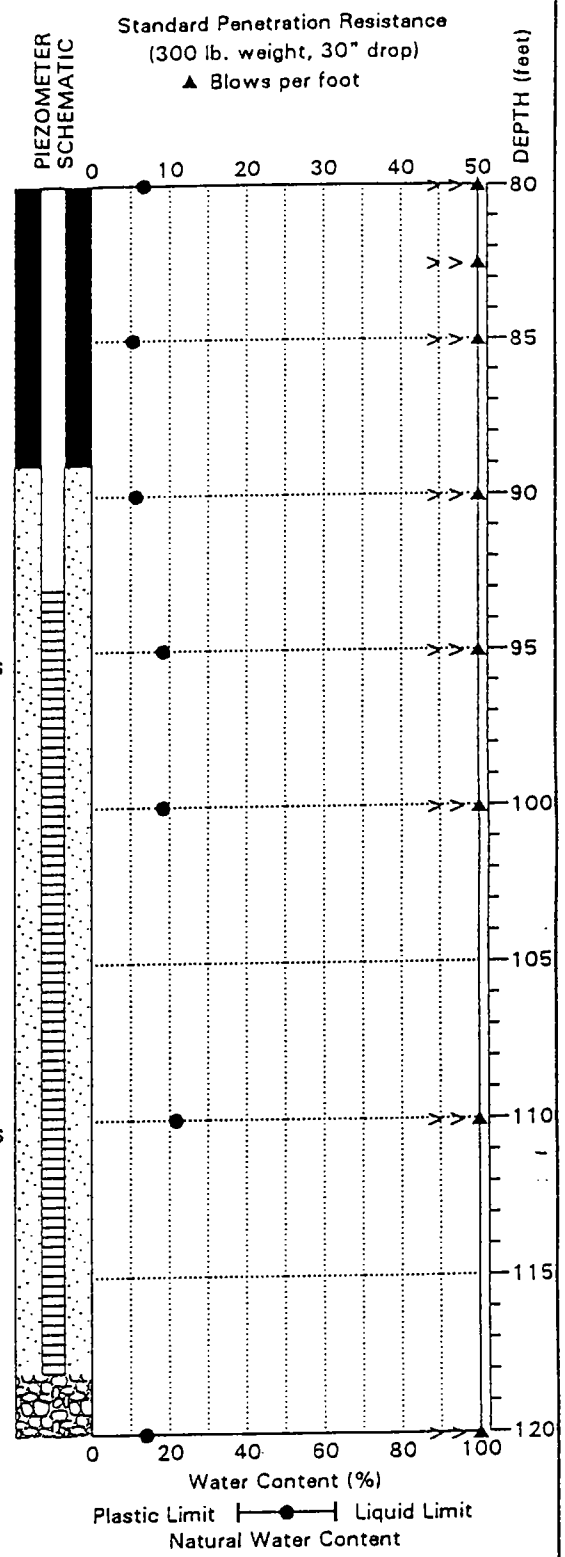
PROJECT NO.: 97061 FIGURE: A-6

PZO300 DWA 5/1/98

DRILLING COMPANY: Cherokee
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5"
SURFACE ELEVATION: 144 ± Feet

DATE COMPLETED: 3/17/98
LOGGED BY: SG/RD

DEPTH (feet)	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
80	SC	Very dense, greenish gray, clayey gravelly fine to coarse SAND, very moist to wet. Fine to coarse gravel.	S-32	100/6"	
			S-33	85/6"	
85	GM	Very dense, greenish gray, sandy, slightly silty GRAVEL, wet.	S-34	92/6"	
90	SM	Very dense, greenish gray, slightly gravelly, silty SAND, wet.	S-35	100/4"	
	SP SM	Very dense, greenish gray, slightly silty fine to coarse SAND, wet. (OUTWASH DEPOSITS)			
95			S-36	69/6" 50/3"	GS
100			S-37	54/6" 50/3"	
105		Driller notes gravelly zone, 106' - 110'.			
110	SM	Very dense, olive, silty fine to medium SAND, wet. Driller notes gravelly zone, 111' - 112'.	S-38	47/6" 40/3"	GS
115	SP SM	Very dense, olive, slightly silty, slightly gravelly, fine to coarse SAND, wet.			
120					



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BORING: TB-18

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PROJECT NO.: 97061 FIGURE: A-7

PZO300 .DWA 5/1/98

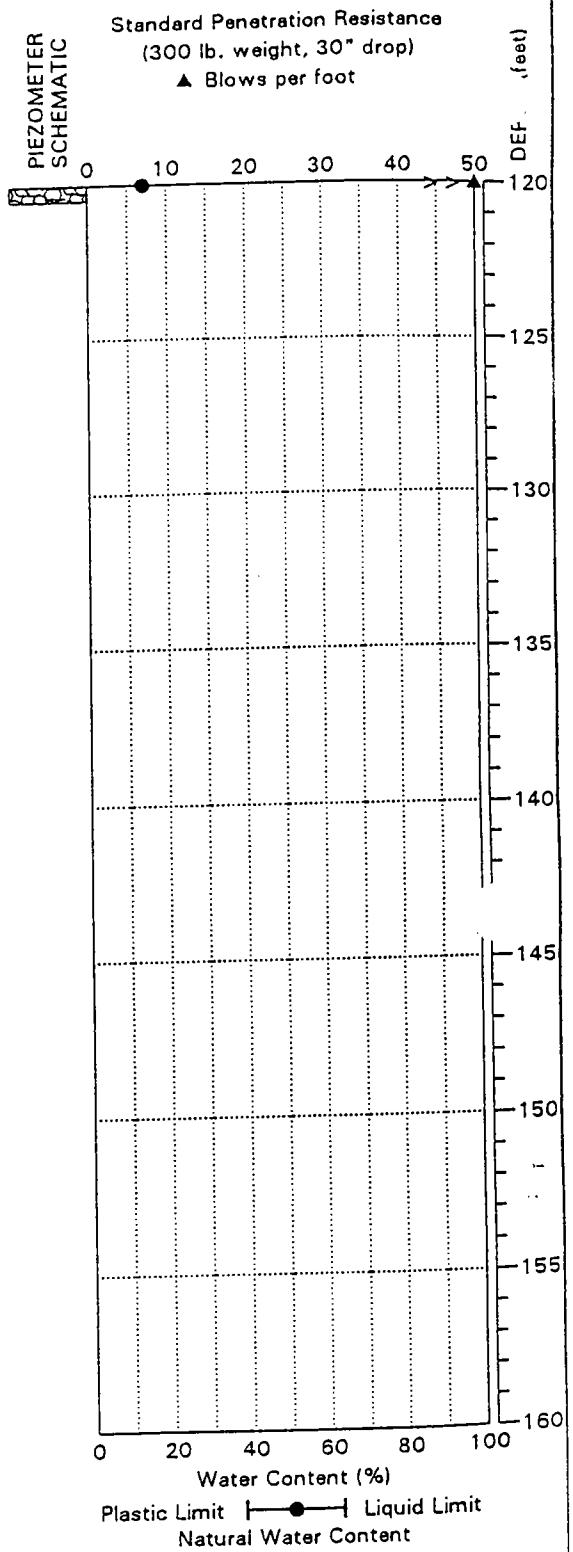
DRILLING METHOD: B-59 Mobile, Mud Rotary, 5

SURFACE ELEVATION: 144 ± Feet

LOGGED BY: SG/RD

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC
120					S-39	100/4"		

Total depth = 120.5 feet.



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BORING: TB-18

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A
Seattle, Washington

PAGE: 4 of 4

PROJECT NO.: 97061

FIGURE: A-7

PZO300 DWA 5/1/98

SOIL DESCRIPTION

STA.: 42+55 OFFSET: 88 Ft. South
Surface Elevation: 188.8 Ft.

Description	Depth, Ft.
Loose to medium dense, brown, slightly silty to silty, gravelly SAND; moist to dry; (Qvr) SM.	19.0
Very dense, gray, gravelly, silty SAND grading to gravelly, fine sandy SILT; dry to moist; (Qt) SM/ML.	27.0
Very dense, gray, slightly silty to silty, gravelly SAND to gravelly, silty SAND; moist; (Qtl) SM.	57.0
Very dense, gray, slightly gravelly to gravelly, silty SAND; moist; (Qtl) SM.	77.0
Very dense, gray, clayey, silty, gravelly SAND to gravelly, sandy, silty CLAY; dry to moist; (Qgm/Ql) SM/CL.	91.0
Very dense, gray, trace to slightly silty, fine to medium SAND, grading to silty, gravelly SAND; wet; (Qow) SP-SM/SM.	

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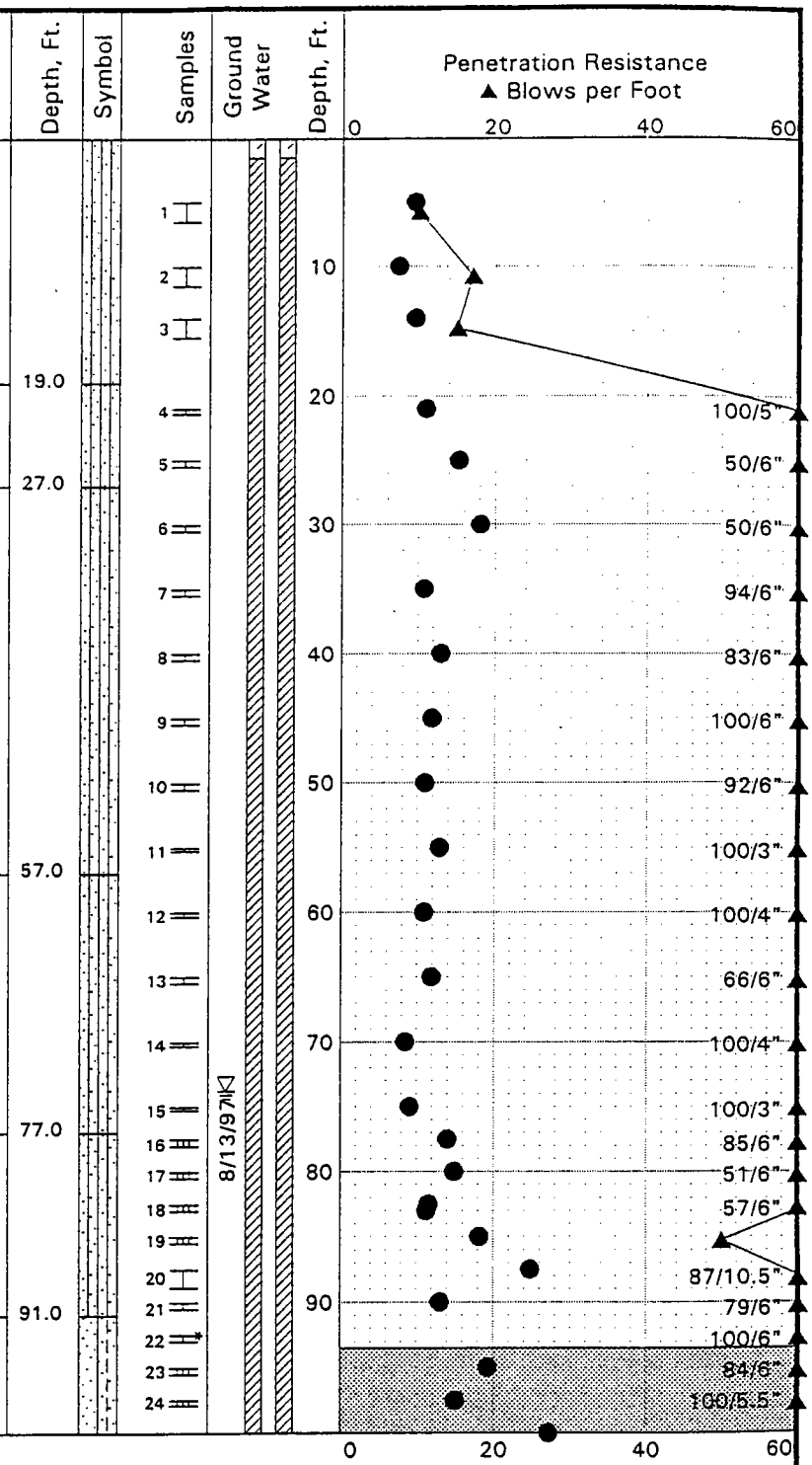


LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

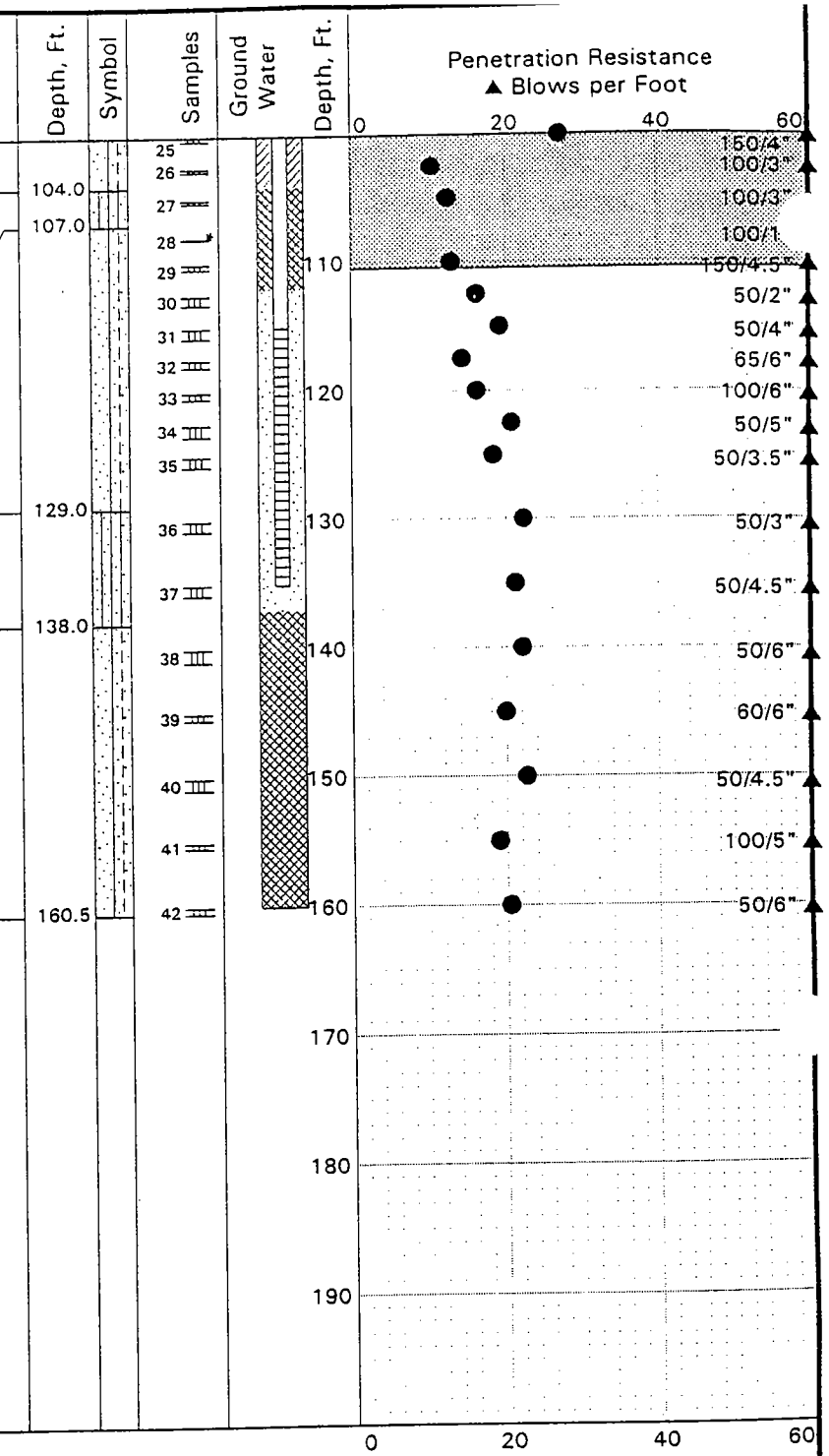
LOG OF BORING MB-1

October 1997 W-7808-21

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-13
Sheet 1 of 2

SOIL DESCRIPTION	Depth, Ft.
STA.: 42+55 OFFSET: 88 Ft. South Surface Elevation: 188.8 Ft.	
Very dense, gray, gravelly, clayey, silty SAND; moist to wet; (Qgm) SM.	104.0
Very dense, gray, slightly gravelly to gravelly, slightly silty to silty SAND; moist to wet; (Qow) SP-SM.	107.0
Very dense, gray, silty fine SAND; trace of gravel; wet; (Qsis) SM.	129.0
Very dense, gray, silty, fine SAND; wet; (Qow) SP-SM.	138.0
BOTTOM OF BORING COMPLETED 7/25/97 Groundwater was initially encountered at 15 feet during drilling.	160.5



LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
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5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING MB-1

October 1997 W-7808-2

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-13
Sheet 2 of 2

SOIL DESCRIPTION STA.: 52+23 OFFSET: 73 Ft. North Surface Elevation: 171.1 Ft.	Depth, Ft.
Medium dense, tan to brown, silty, gravelly SAND; moist; (Hf) SM.	7.0
Very stiff, gray, slightly fine sandy SILT, and slightly clayey SILT; moist; interbedded; scattered gravel; (Qvr) ML.	12.0
Dense to very dense, brown to gray, trace to slightly gravelly, silty SAND; moist; (Qt) SM.	23.0
Very dense, gray, interbedded, clean to silty, fine to medium SAND, and silty, slightly gravelly to gravelly SAND; moist to wet; (Qtl/Qow) SP/SM.	57.0
Very dense, gray, interbedded, clean to silty, fine to medium SAND and gravelly, sandy, clayey SILT, and slightly silty, slightly gravelly to gravelly SAND; moist to wet; (Qgm/Qow) SP/SM	77.0
Very dense, gray, slightly silty, slightly gravelly to gravelly SAND, grading to slightly silty, fine to medium SAND; wet; (Qow) SP-SM/SW-SM.	

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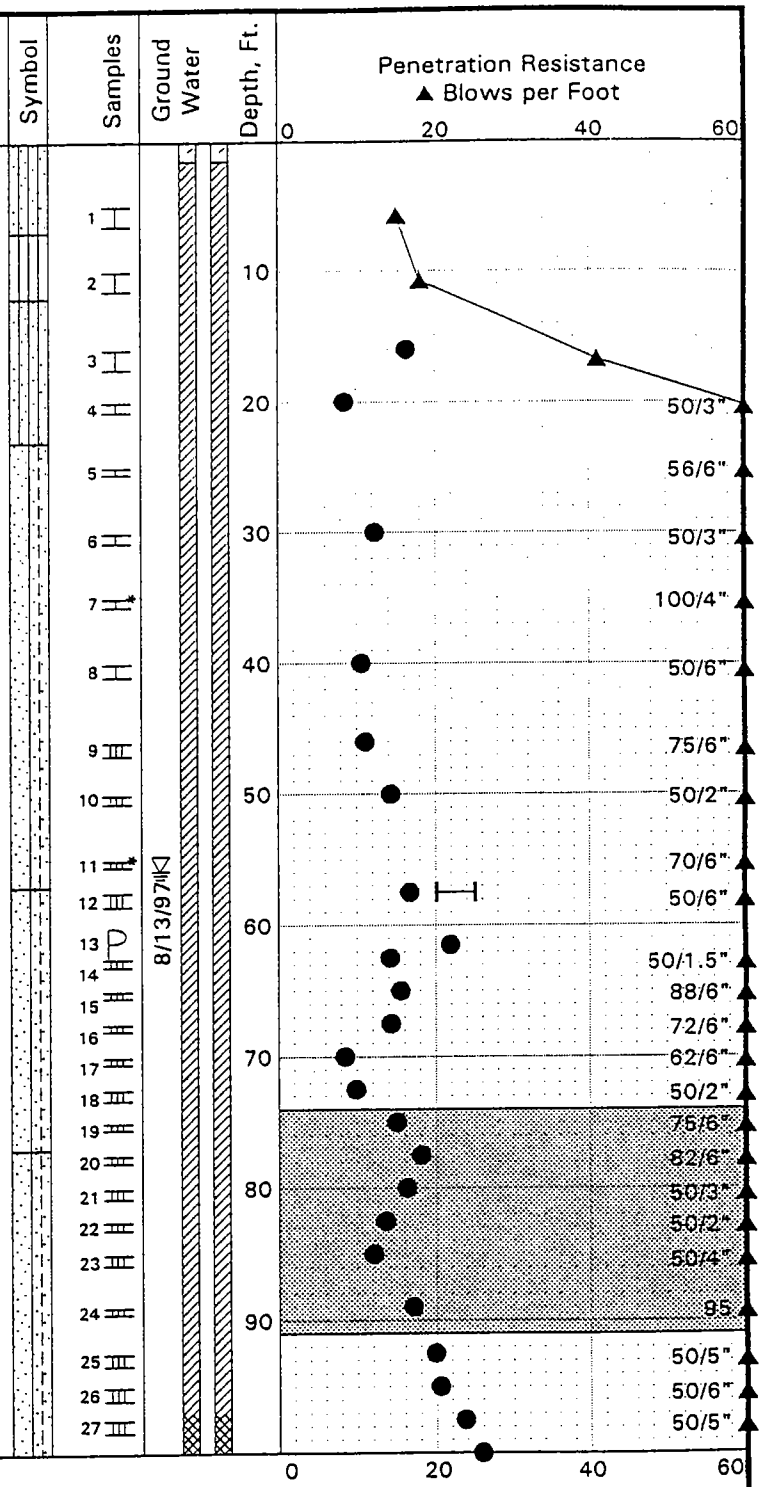

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
4. Refer to KEY for explanation of "Symbols" and definitions.
5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING MB-2

October 1997 W-7808-21

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-14
Sheet 1 of 2

SOIL DESCRIPTION	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.	Penetration Resistance ▲ Blows per Foot (0 20 40 60)
STA.: 52+23 OFFSET: 73 Ft. North Surface Elevation: 171.1 Ft.						
			28			50/4"
			29			50/4"
			30			50/3.5
			31		110	50/3"
			32			50/3"
			33		120	50/4"
			34			57/6"
	130.5		35		130	75/6"
BOTTOM OF BORING COMPLETED 7/21/97 Groundwater was initially encountered at 30 feet during drilling.					140 150 160 170 180 190	

0 20 40 60

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit
Natural Water Content

LEGEND

- * Sample Not Recovered
- 2" O.D. Split Spoon Sample
- 3" O.D. Shelby Tube Sample
- P Pitcher Barrel Sampler
- 3" O.D. Split Spoon Sample
- G Grab Sample
- Vibrating Wire Piezometer (VWP)
- VWP groundwater level
- Piezometer Screen
- Groundwater Level
- Annular Sealant
- Grout

NOTES

1. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
2. The discussion in the text of this report is necessary for a proper understanding of the nature of subsurface materials.
3. Water level, if indicated above, is for the date specified and may vary.
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5. USC letter symbol based on visual classification.

Denny Way/Lake Union CSO Project
Mercer Street Tunnel
Seattle, Washington

LOG OF BORING MB-2

October 1997 W-7808-2

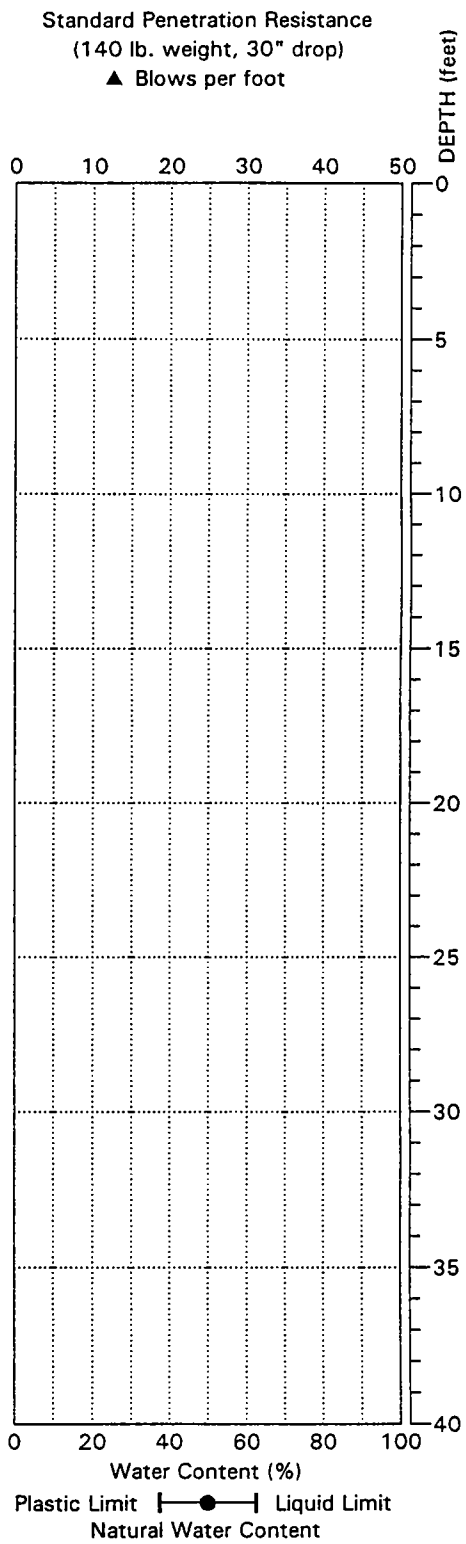
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-14
Sheet 2 of 2

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 15, Air Rotary
SURFACE ELEVATION: ± Feet

LOCATION: See Site Plan
DATE COMPLETED: 7/14/98
LOGGED BY: GWE & GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
0		SM	Medium brown, silty fine to medium SAND, moist.				
5				S-1			
10				S-2			
15		ML	Medium gray to gray, fine sandy SILT, moist.	S-3			
20		CH	Gray, silty CLAY (GLACIOLACUSTRINE)	S-4			
25		CH	Gray, CLAY	S-5			
30		CH	Gray, silty CLAY	S-6			
35				S-7			
40							



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

BORING: OW-2

PAGE: 1 of 7

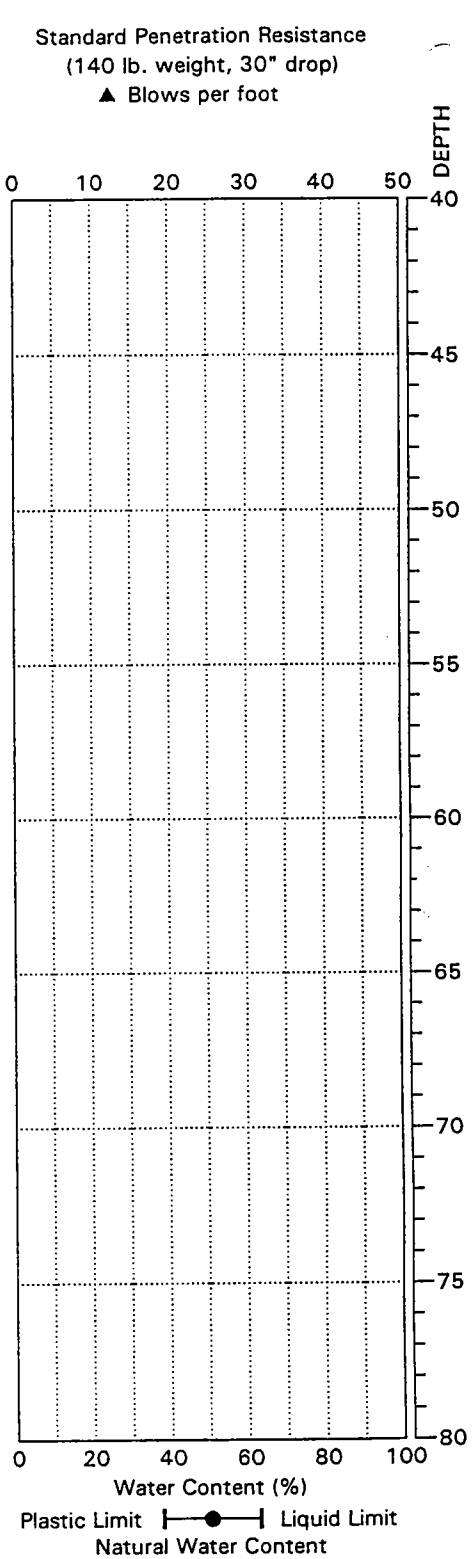
PROJECT NO.: 97061 FIGURE:

BORING DWA 8/3/98

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 15, Air Rotary
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/14/98
LOGGED BY: GWE & GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
40		CH	Hard, gray, CLAY, trace gravel.	S-8			
45				S-9			
50				S-10			
55		CH	Hard, gray, CLAY with trace sand.	S-11			
60			Trace gravel.	S-12			
65			Gravel.	S-13			
70		GC	Gray, clayey, snady GRAVEL, wet.	S-14			
75		ML CL	Gray, gravelly, sandy CLAY and SILT.	S-15			
80							



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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

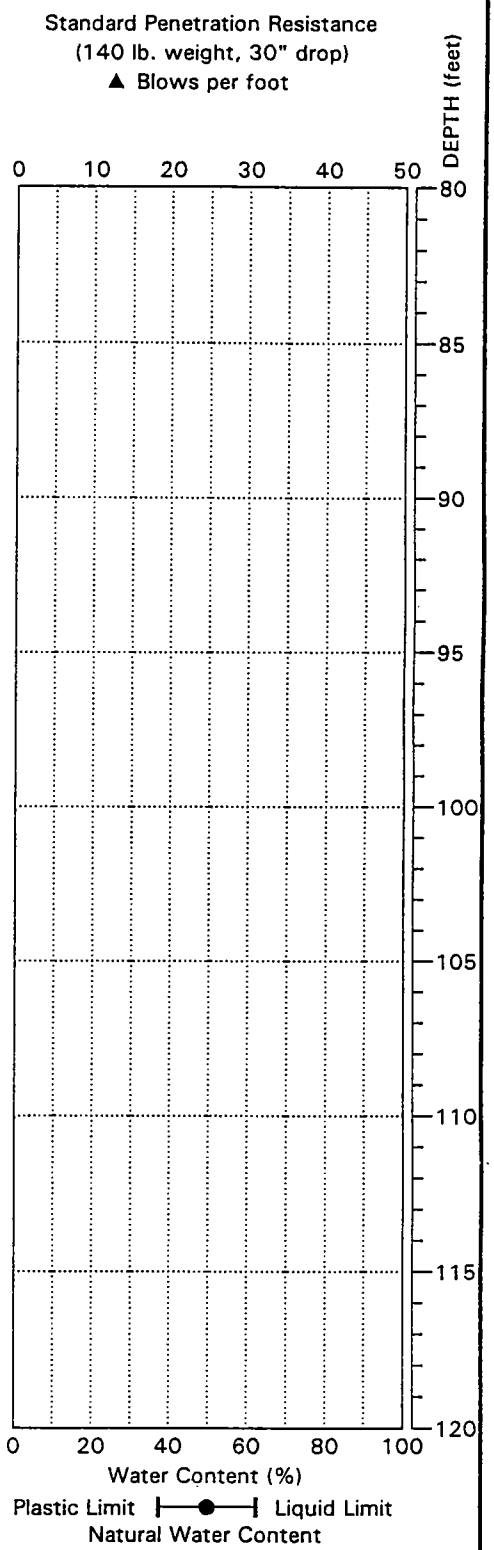
BORING: OW-2

PROJECT NO.: 97061 FIGURE:

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 15, Air Rotary
SURFACE ELEVATION: ± Feet

LOCATION: See Site Plan
DATE COMPLETED: 7/14/98
LOGGED BY: GWE & GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
80				S-16			
85		CL	Hard, gray, CLAY with trace gravel.	S-17			
90			Trace sand and gravel.	S-18			
95				S-19			
100				S-20			
105		CL	Hard, gray, CLAY.	S-21			
110			Trace sand.	S-22			
115		CL	Hard, gray, gravelly CLAY.	S-23			
120							



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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

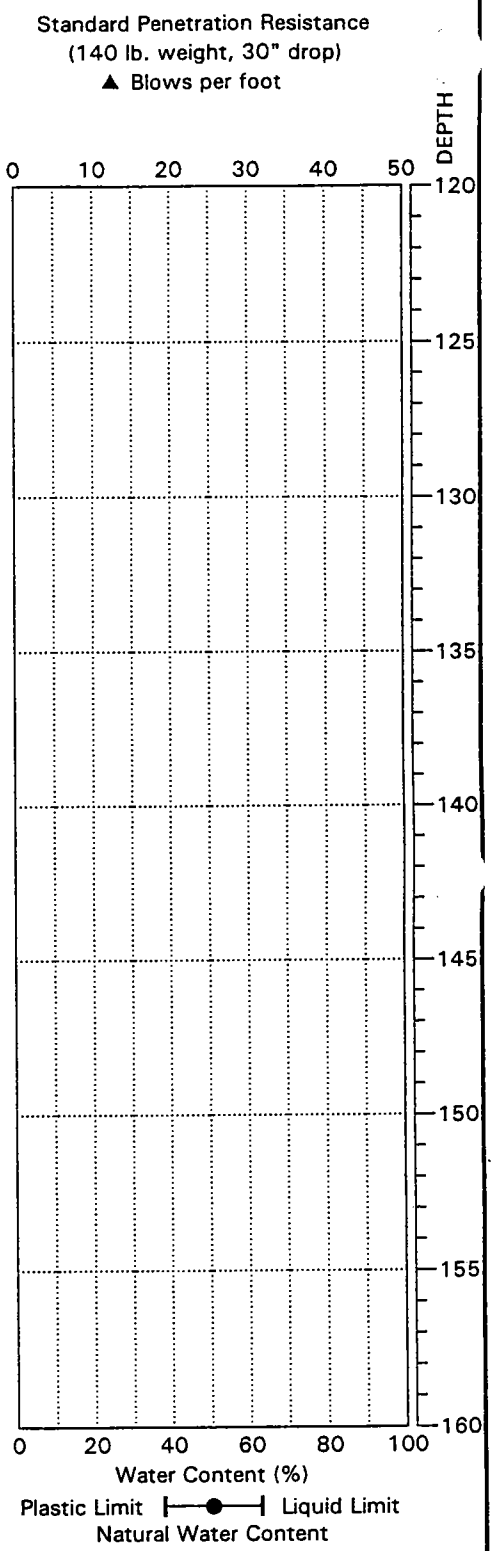
BORING: OW-2

PROJECT NO.: 97061 FIGURE:

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 15, Air Rotary
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/14/98
LOGGED BY: GWE & GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
120		ML	Gray, gravelly, sandy SILT.	S-24			
125		SM ML	Gray, fine sandy SILT and silty fine SAND, wet.	S-25			
130				S-26			
135				S-27			
140		SM	Gray, silty fine to medium SAND with trace coarse sand and fine gravel, wet.	S-28			
145		SP	Clean, poorly graded, fine to medium SAND, wet.	S-29			
150			With coarse sand and gravel.	S-30			
155		GW	Clean, sandy fine to coarse GRAVEL, wet.	S-31			
160							



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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

BORING: OW-2

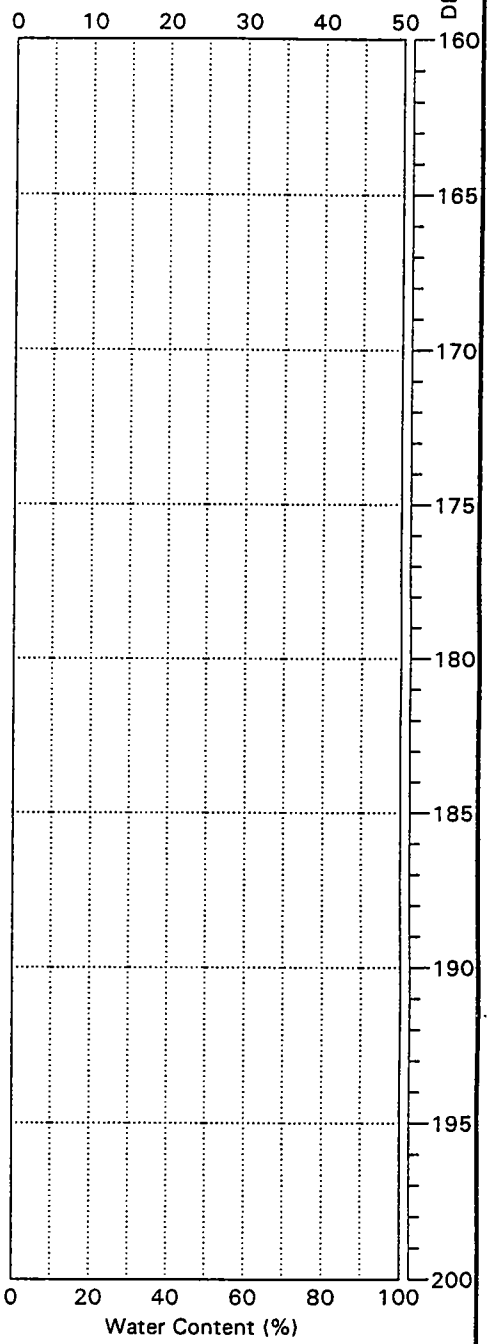
PROJECT NO.: 97061 FIGURE:

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 15, Air Rotary
SURFACE ELEVATION: ± Feet

LOCATION: See Site Plan
DATE COMPLETED: 7/14/98
LOGGED BY: GWE & GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
160		SW	Clean, gravelly, well-graded SAND, wet.	S-32			
165		GW	Clean, sandy well-graded GRAVEL, wet. Trace fine sand.	S-33			
170				S-34			
		SM	Greenish gray to olive gray, gravelly silty fine SAND. Trace fine to coarse gravel.	S-35			
175							
180							
185				S-36			
		SM	Olive gray to gray, silty fine SAND. Trace of medium sand and gravel.				
190				S-37			
195				S-38			
200							

Standard Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot



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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

BORING: OW-2

PROJECT NO.: 97061 FIGURE:

BORING DWA 8/3/98

DRILLING COMPANY: Hokkaido Drilling

DRILLING METHOD: Speedstar 15, Air Rotary

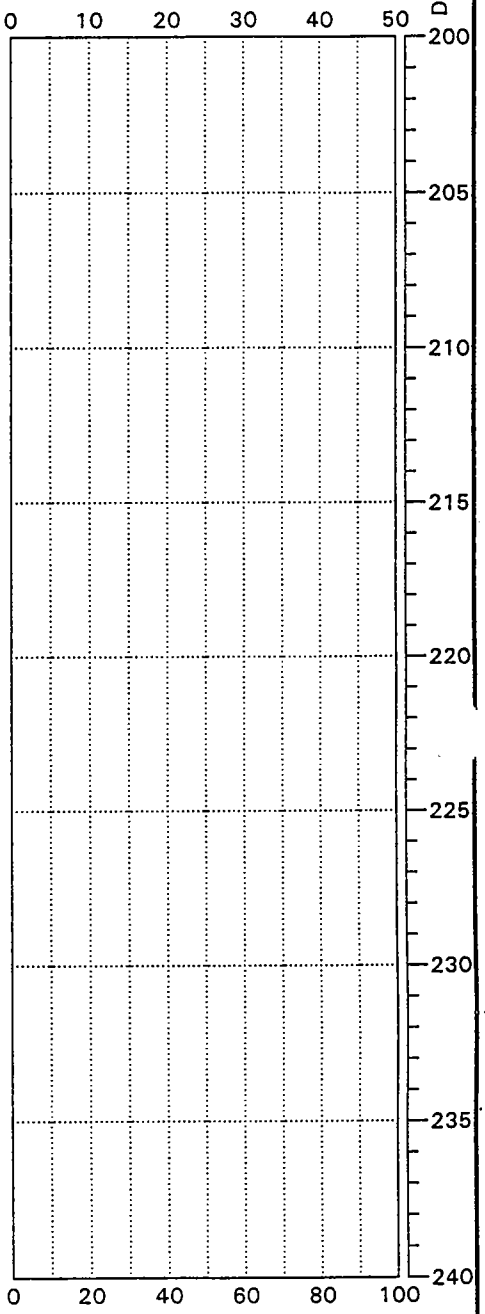
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/14/98

LOGGED BY: GWE & GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
200				S-39			
205				S-40			
		SW	Olive gray, gravelly fine SAND. Trace medium and coarse sand and silt.				
210				S-41			
215				S-42			
220				S-43			
		SP	Dark greenish gray, fine SAND. Trace medium and coarse sand.				
225				S-44			
230				S-45			
		ML	Medium gray, gravelly, fine sandy SILT. Trace of wood fibers.				
235				S-46			
240							

Standard Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot



Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

BORING: OW-2

PROJECT NO.: 97061

FIGURE:

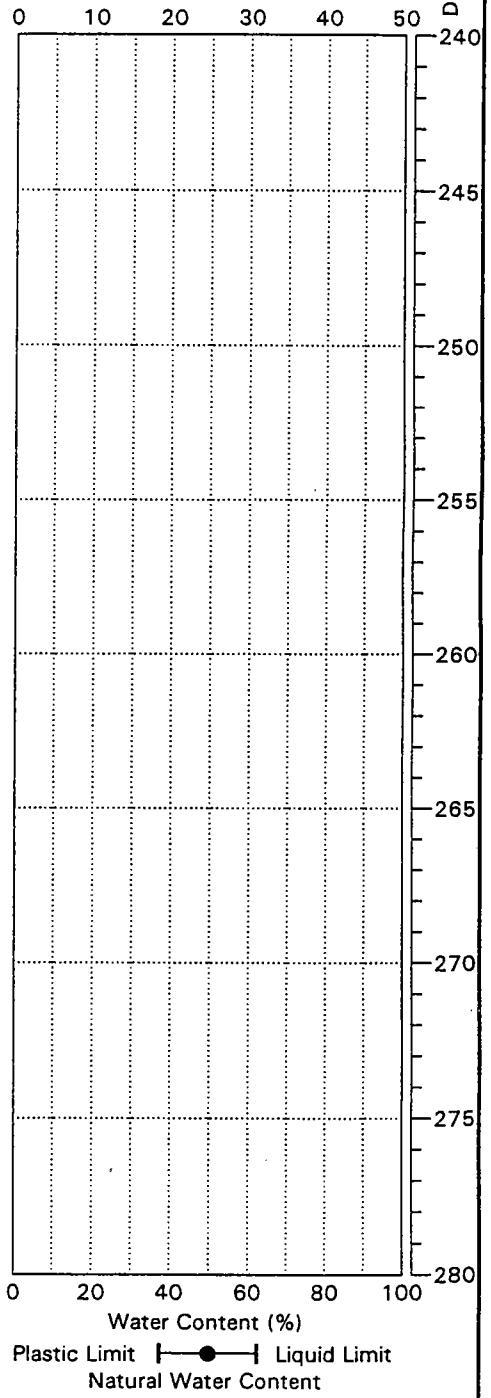
DRILLING METHOD: Speedstar 15, Air Rotary
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/14/98
LOGGED BY: GWE & GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	GROUNDWATER
240		ML	Very hard, dark greenish gray, SILT.		S-47			

Total casing to 239 feet 8 3/4 inches.
Total depth of boring to 241 feet.

Standard Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot



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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

BORING: OW-2

PAGE: 7 of 7

PROJECT NO.: 97061

FIGURE:

BORING DWA 8/3/98

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 5515, Air Rotory
SURFACE ELEVATION: ± Feet

LOCATION: Taylor St. & Mercer Ave.
DATE COMPLETED: 7/15/98
LOGGED BY: G. Mack

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES	DEPTH (feet)
0			Refer to boring logs PW-3 and TB-16 for soil descriptions from surface to 180 feet.							3.2-ft, 6-inch ID, steel, stickup monument.	0
5											5
10											10
15											15
20										6-inch, steel casing.	20
25											25
30											30
35											35
40											40

DRAFT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

OBSERVATION WELL: OW-3

PROJECT NO.: 97061

FIGURE: H-2-B3

OWELL DWA 8/13/98

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 5515, Air Rotory
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/15/98
LOGGED BY: G. Mack

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES	DEPTH
40			Refer to boring logs PW-3 and TB-16 for soil descriptions from surface to 180 feet.								40
45											45
50											50
55											55
60											60
65											65
70											70
75											75
80											80

DRAFT

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

OBSERVATION WELL: OW-3

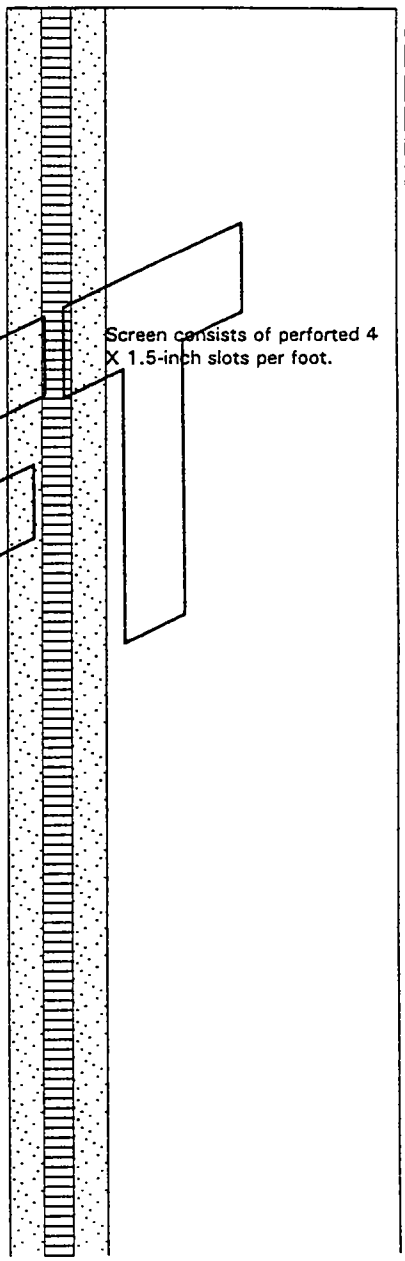
PROJECT NO.: 97061

FIGURE: 14.2-83

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 5515, Air Rotory
SURFACE ELEVATION: ± Feet

LOCATION: Taylor St. & Mercer Ave.
DATE COMPLETED: 7/15/98
LOGGED BY: G. Mack

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES	DEPTH (feet)
80			Refer to boring logs PW-3 and TB-16 for soil descriptions from surface to 180 feet.							Screen consists of perforted 4 X 1.5-inch slots per foot.	80
85											85
90											90
95											95
100											100
105											105
110											110
115											115
120											120



DRAFT

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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

OBSERVATION WELL: OW-3

PROJECT NO.: 97061

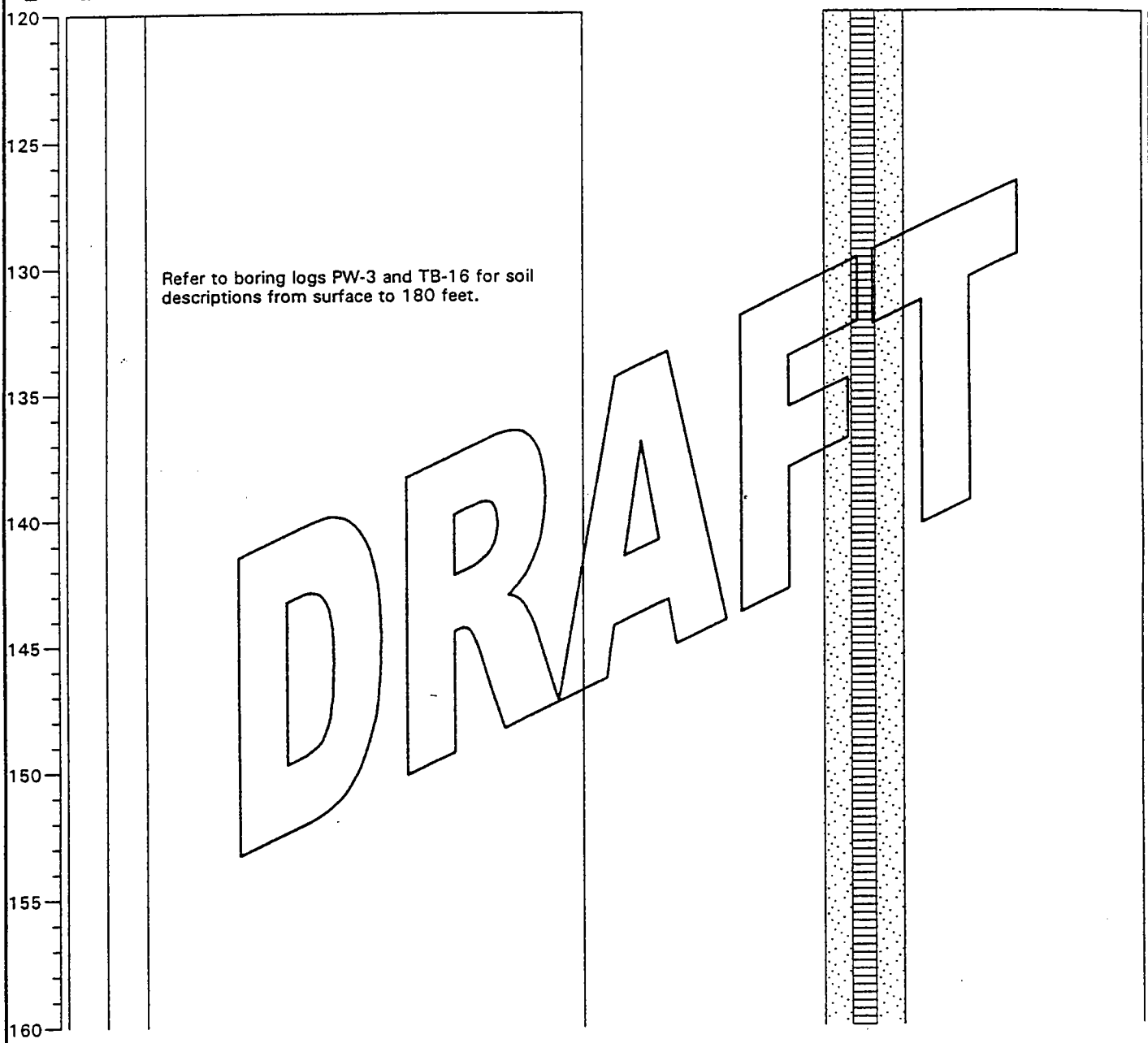
FIGURE: H.2-B3

OWELL DWA 8/13/98

DRILLING METHOD: Speedstar 5515, Air Rotory
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/15/98
LOGGED BY: G. Mack

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES	DEPTH
120			Refer to boring logs PW-3 and TB-16 for soil descriptions from surface to 180 feet.								120
125											125
130											130
135											135
140											140
145											145
150											150
155											155
160											160



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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

OBSERVATION WELL: OW-3

PROJECT NO.: 97061

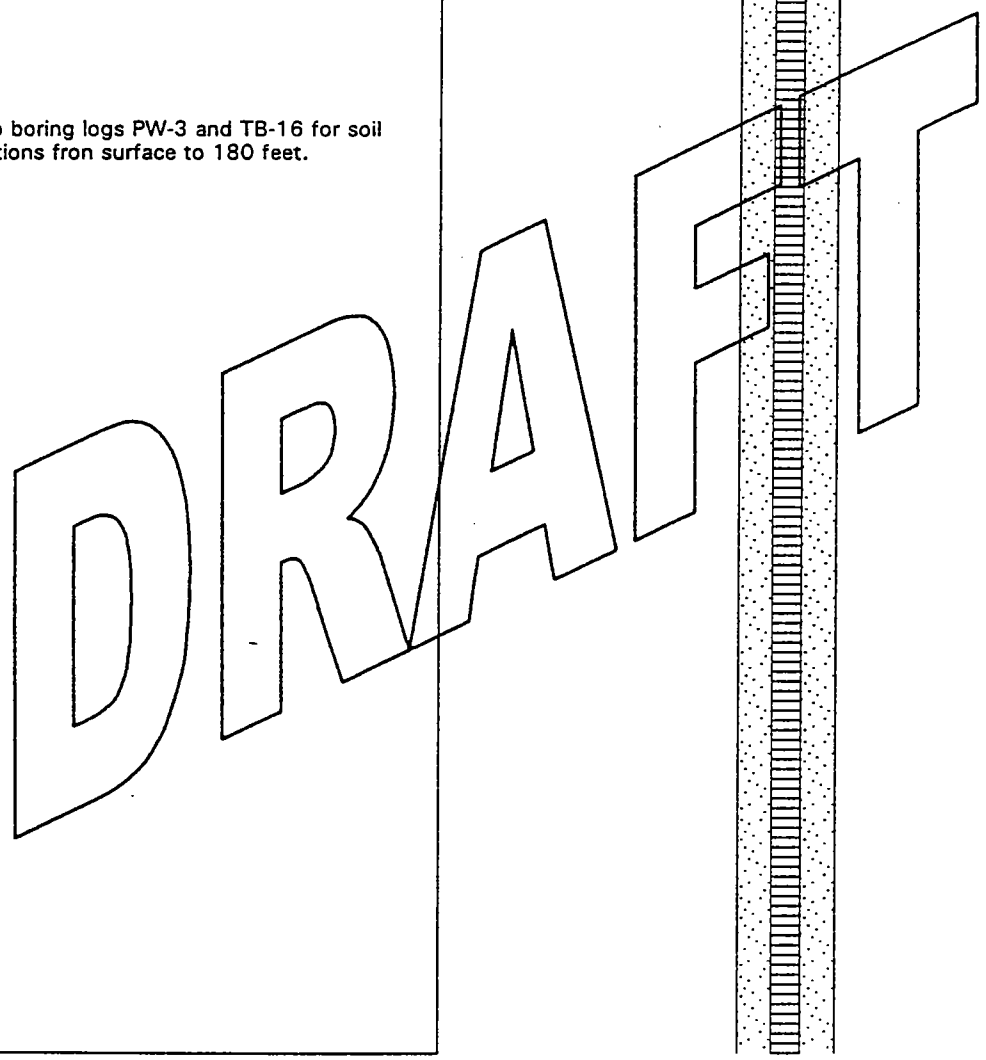
FIGURE: H.2-B3

OWELL DWA 8/13/98

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 5515, Air Rotory
SURFACE ELEVATION: ± Feet

LOCATION: Taylor St. & Mercer Ave.
DATE COMPLETED: 7/15/98
LOGGED BY: G. Mack

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES	DEPTH (feet)
160			Refer to boring logs PW-3 and TB-16 for soil descriptions fron surface to 180 feet.								160
165											165
170											170
175											175
180											180
185											185
190											190
195											195
200											200



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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

OBSERVATION WELL: OW-3

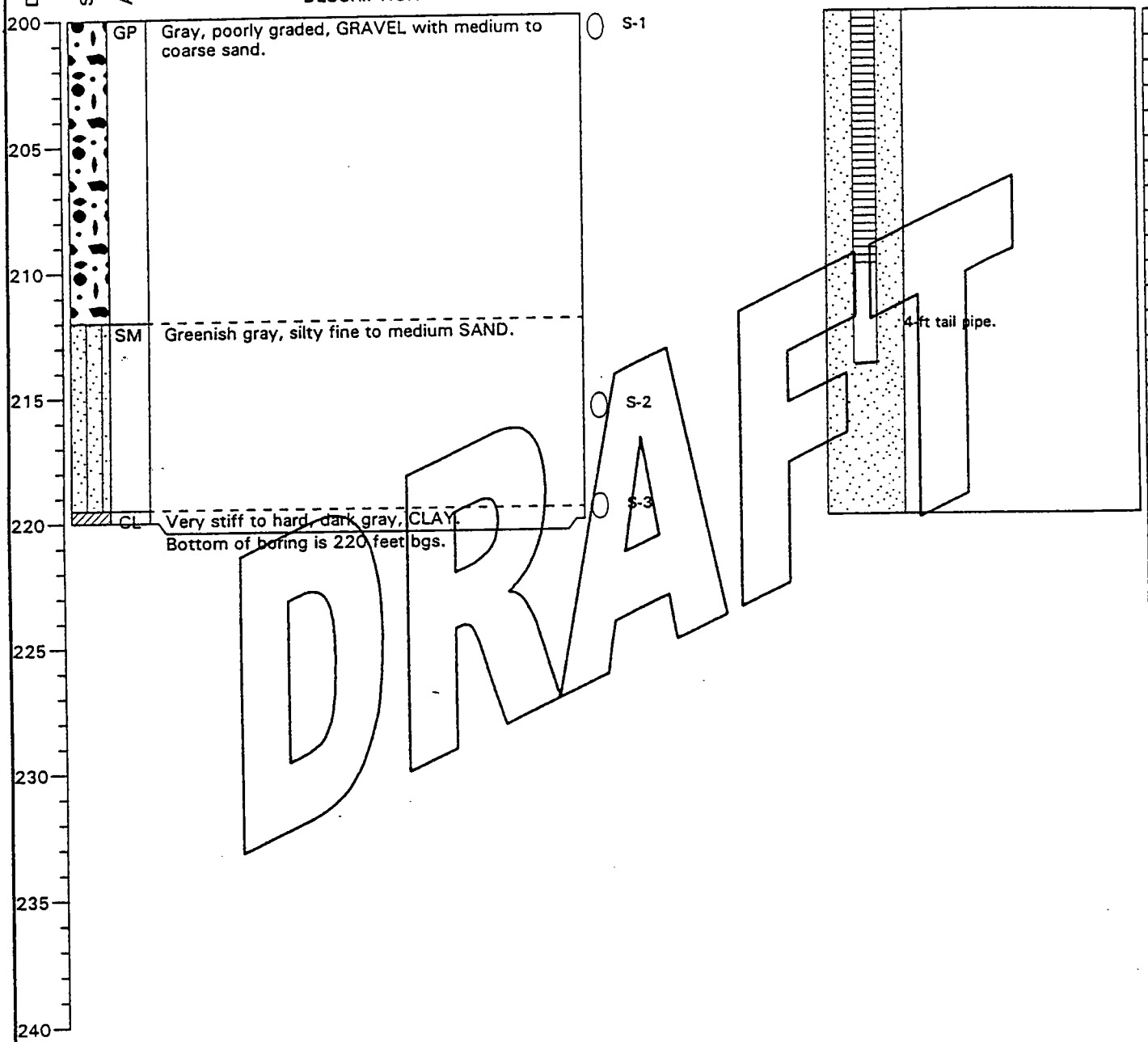
PROJECT NO.: 97061 FIGURE: H 2-83

OWELL DWA 8/13/98

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 5515, Air Rotory
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/15/98
LOGGED BY: G. Mack

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES	DEPTH
200		GP	Gray, poorly graded, GRAVEL with medium to coarse sand.		S-1						200
205											205
210											210
		SM	Greenish gray, silty fine to medium SAND.							4-ft tail pipe.	
215					S-2						215
220		CL	Very stiff to hard, dark gray, CLAY.		S-3						220
			Bottom of boring is 220 feet bgs.								
225											225
230											230
235											235
240											240



DRAFT

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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

OBSERVATION WELL: OW-3

PROJECT NO.: 97061

FIGURE: H.2-B3

OWELL DWA 8/13/98

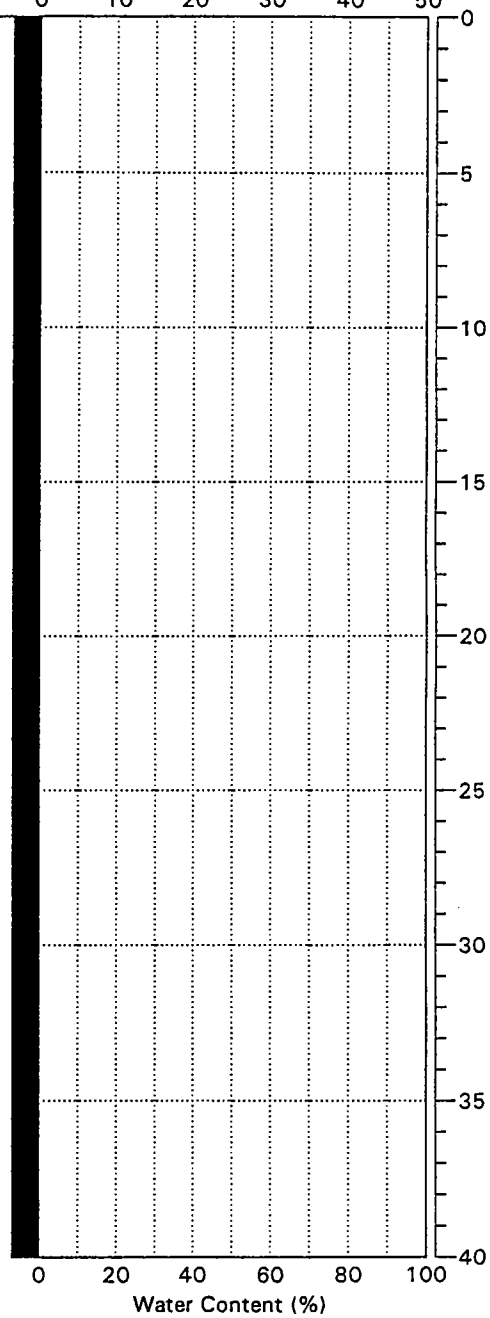
DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: 12" cable tool,
SURFACE ELEVATION: ± Feet

LOCATION: See Site Plan
DATE COMPLETED: 7/9/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION
0		SM	Medium brown, silty fine to medium SAND, moist.
14		ML	Brownish gray to medium gray, fine sandy SILT, moist.
19		CL	Medium gray, silty CLAY (GLACIOLACUSTRINE)

SAMPLE TYPE / SAMPLE NUMBER / PEN. RESISTANCE (blows/6 inches) / OTHER TESTS / PIEZOMETER SCHEMATIC

Standard Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot



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BORING: PW-2

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

PROJECT NO.: 97061 FIGURE:

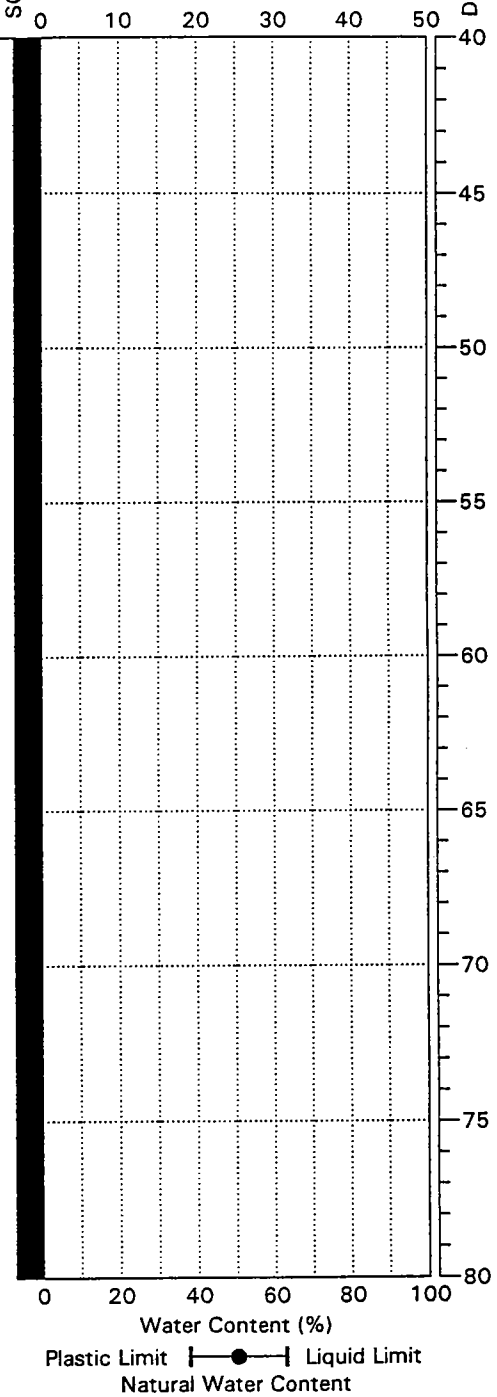
PZO DWA 7/31/98

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: 12" cable tool,
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/9/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC
40							
45			Trace, dark gray subangular gravel Cobbles				
50							
55							
60							
65							
		CL	Medium gray, gravelly, snady, clayey SILT. Trace coarse sand and gravel.				
70							
75							
80							

Standard Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot



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BORING: PW-2

HWA Denny Way / Lake Union CSO, Contract A

HWA GEOSCIENCES INC.

PROJECT NO.: 97061 FIGURE:

PZO DWA 7/31/98

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: 12" cable tool,
SURFACE ELEVATION: ± Feet

LOCATION: See Site Plan
DATE COMPLETED: 7/9/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC
80			m=ML Gray silty CLAY. Thin layers of fine to coarse sand.				
85							
90			Trace medium sand.	O			
95				X			
100			Trace medium sand.	X			
105				X			
			Some fine to medium sand.				
110				X			
			Some fine to medium sand and gravel.				
115			Medium gray to greensih gray, interbeds of silty CLAY, clayey SILT and silty fine SAND. Silty clay decreases downward, silt and fine sand increase. Layers are about 2" thick.	X			
120							

Standard Penetration Resistance
(140 lb. weight, 30" drop)
▲ Blows per foot

0 10 20 30 40 50

DEPTH (feet): 80, 85, 90, 95, 100, 105, 110, 115, 120

0 20 40 60 80 100
Water Content (%)

Plastic Limit ├──●──┤ Liquid Limit
Natural Water Content

NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

BORING: PW-2

HWA Denny Way / Lake Union CSO, Contract A

HWA GEOSCIENCES INC.

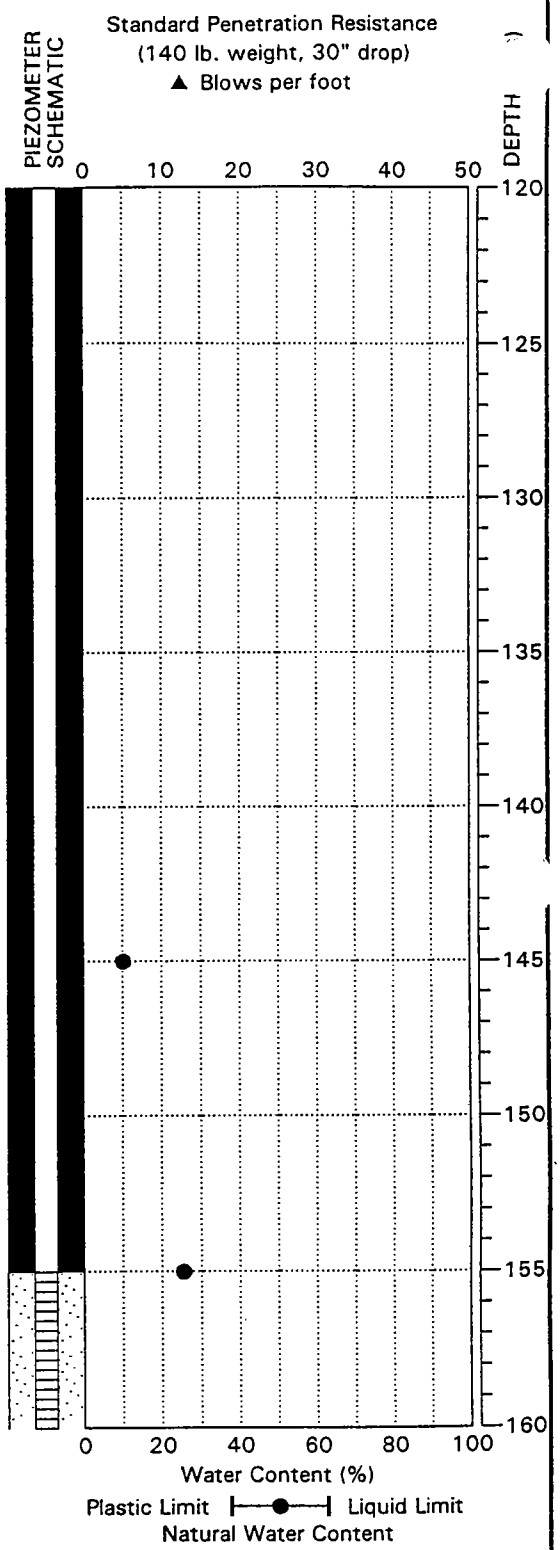
PROJECT NO.: 97061 FIGURE:

PZO DWA 7/31/98

DRILLING METHOD: 12" cable tool,
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/9/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS
120				X		
125				X		
130				X		
135				X		
140		SW	Greenish gray, fine SAND with trace medium and coarse sand. Trace gravel.	X		
145		SM	Greenish gray, gravelly silty fine to coarse SAND. Gravel is fine to coarse.	X		
		ML	Greenish gray, gravelly sandy SILT. Sand is fine to coarse. Gravel to 1 1/2 inches.			
150				O		
155		SW	Greenish gray, silty gravelly fine to coarse SAND with cobbles. Gravell is fine to coarse. Cobbles are well-rounded to 5 inches.	X		
160						



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BORING: PW-2

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

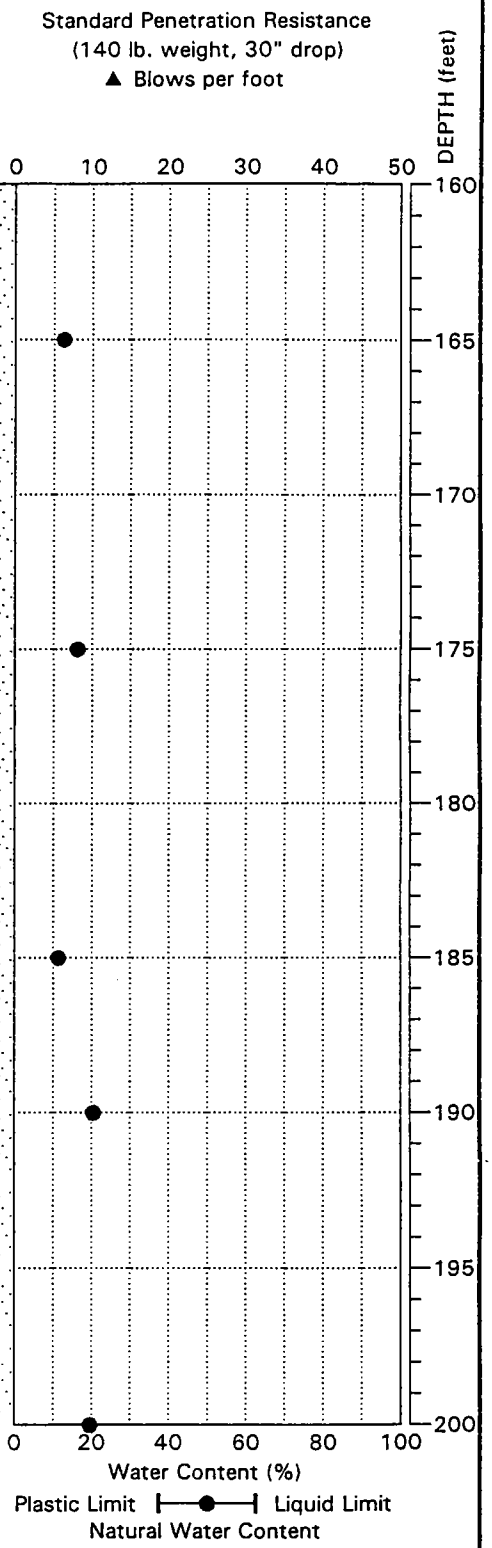
PROJECT NO.: 97061 FIGURE:

PZO DWA 7/31/98

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: 12" cable tool,
SURFACE ELEVATION: ± Feet

LOCATION: See Site Plan
DATE COMPLETED: 7/9/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC
160–165							
165–170		SM	Greenish gray, gravelly silty fine to very fine SAND. Trace medium and coarse sand. Gravel to 1 1/2 inch.				
170–175							
175–180							
180–185							
185–190		SM	Greenish gray, fine SAND with silt. Trace medium sand.				
190–195			Fine and coarse gravel.				
195–200			Greenish gray, silty fine SAND. Trace coarse sand. Trace fine and coarse gravel.				



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BORING: PW-2

HWA Denny Way / Lake Union CSO, Contract A

HWA GEOSCIENCES INC.

PAGE: 5 of 6

PROJECT NO.: 97061 FIGURE:

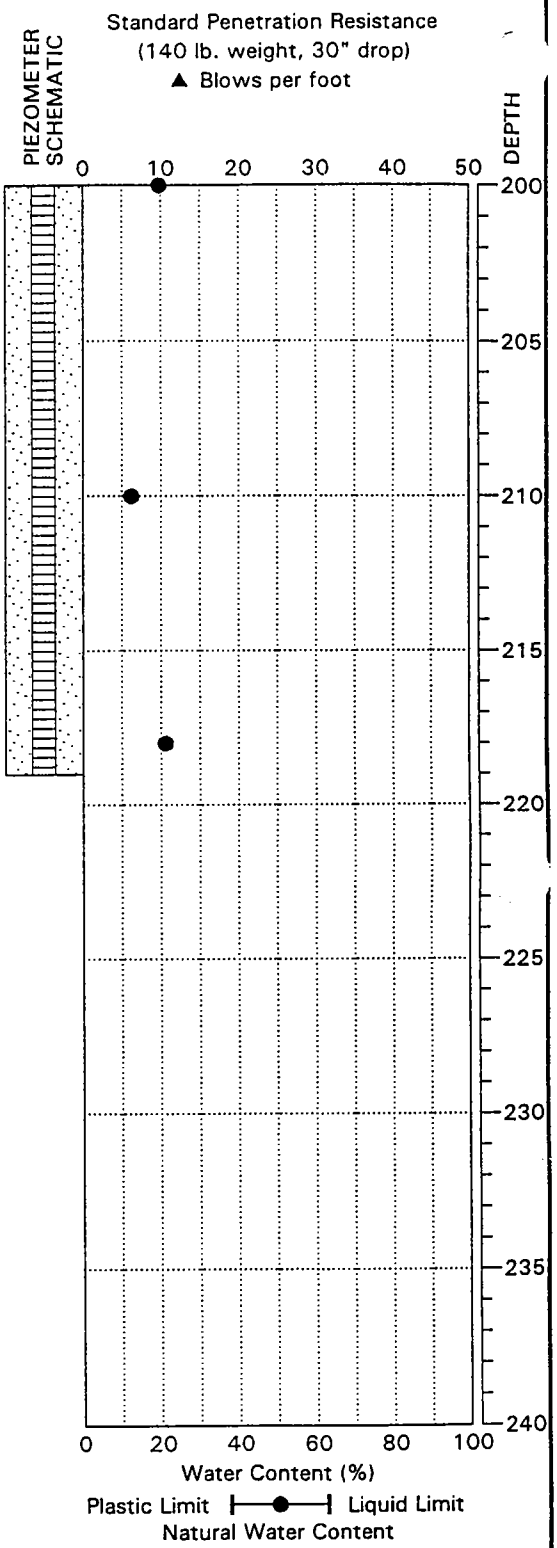
PZO DWA 7/31/98

DRILLING METHOD: 12" cable tool,
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 7/9/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE / SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PIEZOMETER SCHEMATIC
200–205				X			
205–210		SW	Olive gray, fine to coarse SAND. Trace fine gravel.	O			
210–215			Cobbles.	X			
215–220		SP	Greenish gray, silty gravelly fine to coarse SAND. Gravel is coarse.	O			
220				X			

Bottom of boring at 219 feet.
Casing length is 219.5 feet.



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BORING: PW-2

HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract A

PROJECT NO.: 97061 FIGURE:

PZO DWA 7/31/98

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 72, Cable Tool
SURFACE ELEVATION: ± Feet

LOCATION: Taylor St. & Mercer Ave.
DATE COMPLETED: 6/15/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES
0										2-ft high, 12-inch ID, steel stickup monument.
5			Refer to boring log TB-16 for soil discription to 20 feet bgs.							18-ft, bentonite grout, sanitary surface seal.
10										
15										
20		GM	Gray, silty GRAVEL with sand. Drilling becomes harder.							
25					S-1					12-inch steel casing.
		SM	Gray, gravelly, silty SAND with cobbles.							
30			(TILL-LIKE DEPOSITS)		S-2					
		GM	Gray, silty, sandy GRAVEL with cobbles.							
35					S-3					
		SM	Gray, gravelly, silty SAND, moist.							
40										

DRAFT

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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

PUMPING WELL: PW-3

PROJECT NO.: 97061 FIGURE: H-2-B2

PWELL DWA 8/13/98

DRILLING COMPANY: Hokkaido Drilling

DRILLING METHOD: Speedstar 72, Cable Tool

SURFACE ELEVATION: ± Feet

DATE COMPLETED: 6/15/98

LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES	DEPTH
40			Drilling becomes easier.		S-4						40
45			(OUTWASH)		S-5						45
50					S-6						50
55			Becomes more silty and medium sandy.		S-7						55
60			Becomes fine sand with trace medium to coarse sand. No gravel.		S-8						60
		SM	Grayish green to yellowish green, gravelly, silty SAND. Predominately fine sand with trace medium to coarse sand. Gravel up to 2.5-inches.								
65			Drilling becomes harder.		S-9						65
70			Becomes greenish gray.		S-10						70
		SM	Greenish gray, silty, fine SAND.								
75					S-11						75
			Trace to few gravel.								
80											80

DRAFT

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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

PUMPING WELL: PW-3

PROJECT NO.: 97061

FIGURE: H.2-B2

DRILLING COMPANY: Hokkaido Drilling
DRILLING METHOD: Speedstar 72, Cable Tool
SURFACE ELEVATION: ± Feet

LOCATION: Taylor St. & Mercer Ave.
DATE COMPLETED: 6/15/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES
80					S-12					
85					S-13					12-inch, galvanized steel, wire wrapped, 0.020-inch slot screen.
90					S-14					
95			Becomes more silty.		S-15					
100					S-16		GS			
		SM	Greenish gray, gravelly, silty fine SAND. Gravel up to 2-inches.							
105					S-17					
		SP SM	Greenish gray, silty fine to medium SAND.							
110					S-18		GS			
			Drilling becomes slightly harder.							
115										
120										

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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

PUMPING WELL: PW-3

PROJECT NO.: 97061

FIGURE: H-2-B2

PWELL DWA 8/13/98

DRILLING METHOD: Speedstar 72, Cable Tool
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 6/15/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES	DEPTH
120		SM	Greenish gray, fine SAND with silt.	X	S-19		GS				120
		SM	Greenish gray, silty fine SAND.								
125				O	S-20						125
		SP SM	Greenish gray, fine SAND with silt.								
130				X	S-21		GS				130
135			Drilling becomes harder.	O	S-22						135
140				X	S-23		GS				140
145			Well making water.	O	S-24						145
150		SP	Greenish gray, poorly graded, fine to medium SAND.	X	S-25		GS				150
155				O	S-26						155
160											160

DRAFT

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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

PUMPING WELL: PW-3

PAGE: 4 of 5

PROJECT NO.: 97061

FIGURE: H.2-B2

PWELL DWA 8/13/98

DRILLING METHOD: Speedstar 72, Cable Tool
SURFACE ELEVATION: ± Feet

DATE COMPLETED: 6/15/98
LOGGED BY: GM

DEPTH (feet)	SYMBOL	ASTM SOIL CLASS	DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	PEN. RESISTANCE (blows/6 inches)	OTHER TESTS	PID (ppm)	WELL COMPLETION SCHEMATIC	NOTES
160		SP SM	Greenish gray, poorly graded SAND with silt.	X	S-27		GS			
165			Encountered few gravel and cobbles.	O	S-28					
170		SP	Dark gray, poorly graded SAND.	X	S-29		GS			4 ft long tailpipe.
175		SM	Greenish gray, silty fine SAND with trace gravel.	O	S-30					Pressure grouted cement seal.
				O	S-31					
		SP	Greenish gray, fine to coarse SAND with few gravel.	X	S-32					
180			Bottom of boring at 180 feet.							
185										
190										
195										
200										

DRAFT

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HWA GEOSCIENCES INC.

Denny Way / Lake Union CSO, Contract C
Seattle, Washington

PUMPING WELL: PW-3

PROJECT NO.: 97061

FIGURE: H.2-B2

PWELL DWA 8/13/98