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- [x] Executive Summary / Introduction of the report
- [x] Table of contents
- [x] Project Location Map / Vicinity Map
- [x] **Site / Exploration Plans, Boring Location Plans**
- [x] Cross-sections / Subsurface profiles
- [x] **Exploration Logs**
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GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Geotechnical Engineering Report
Public Safety Building Demolition and Shoring Project
Seattle, Washington

November 24, 2004

SHANNON & WILSON, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

At Shannon & Wilson, our mission is to be a progressive, well-managed professional consulting firm in the fields of engineering and applied earth sciences. Our goal is to perform our services with the highest degree of professionalism with due consideration to the best interests of the public, our clients, and our employees.

Submitted To:
City of Seattle
c/o Mr. Brad Tong
Shiels Obletz Johnsen
700 Fifth Avenue, Suite 2475
Seattle, Washington 98104

By:
Shannon & Wilson, Inc.
400 N 34th Street, Suite 100
Seattle, Washington 98103

21-1-20116-002

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GEOTECHNICAL ENGINEERING REPORT
PUBLIC SAFETY BUILDING DEMOLITION AND SHORING PROJECT
SEATTLE, WASHINGTON

1.0 INTRODUCTION

This report presents the results of our subsurface explorations, geotechnical laboratory testing, and geotechnical engineering studies for the Seattle Public Safety Building (PSB) Demolition and Shoring Project in Seattle, Washington. The purpose of this study is to evaluate subsurface conditions at the project site and provide geotechnical engineering recommendations for the design of a shoring system that will be installed during the demolition of the PSB.

Our work was performed in general accordance with our proposal dated April 26, 2004.

2.0 SITE AND PROJECT DESCRIPTION

The project location is shown on the Vicinity Map, Figure 1. The existing PSB is on the city block bounded by Cherry Street to the north, James Street to the south, Fourth Avenue to the east, and Third Avenue to the west. The project site is shown on the Site and Exploration Plan, Figure 2.

The ground surface surrounding the site is paved with streets and sidewalks. The surrounding ground surface slopes down to the west from elevation 111 feet on the northeast corner of the building to elevation 76 feet on the southwest corner. The existing PSB is supported by spread footings, which reportedly bear at elevations between approximately 54 feet in the southwest corner of the building and 68 feet at the northeast corner of the block. The foundation subgrade is about 20 to 45 feet below the street level, with the deepest foundations in the northeast corner of the building.

Existing buildings occupy the blocks surrounding the PSB:

- King County Courthouse is south of project site.
- Seattle City Hall Building is east of project site.
- Arctic Club Building and Grand Central Garage are north of project site.
- St. Charles Hotel and Lyon Building are west of project site.

The street rights-of-way surrounding the project site contain numerous buried utilities. We understand a skid road may be buried under James Street. Logs and wood debris were encountered during construction of the tunnel between the City of Seattle Justice Center and the King County Correction Facility. In our review of historical records and previous borings, we did not find evidence of the skid road near the PSB.

The Burlington Northern Santa Fe (BNSF) railroad tunnel is under Fourth Avenue and between approximate elevations 12 and 54 feet. A zone of soil outside of this railroad tunnel likely has been disturbed from the construction of the tunnel. The zone of disturbed soil may include areas where tiebacks are installed. The Downtown Seattle Transit Project (DSTP) bus tunnel and Pioneer Station is under Third Avenue, adjacent to the PSB. The crown of the bus tunnel is between approximate elevations 36 feet at Cherry Street and elevation 32 feet at James Street.

We understand that the plans for the project site have not been completed but will likely include a multi-level building and a large plaza with parking below the plaza. The existing building probably will be demolished before plans for the site are completed. We understand the planned demolition will extend to the basement slab-on-grade but not deeper. However, deeper excavations could be made at a later date.

A temporary support system of tieback anchors installed through existing basement walls will be installed and will remain in place following demolition until the development plans are completed and the new building and plaza are constructed. The temporary shoring system may be in use for several years until the development plans are made and the permanent lateral bracing system is constructed.

3.0 SUBSURFACE EXPLORATIONS

Subsurface explorations for the project included two borings completed at the project site, designated B-1 and B-2. Subsurface information from previous studies that have been performed by Shannon & Wilson, Inc. and others dating back to 1948 was compiled. The approximate locations of the recent and previous borings are shown on the Site and Exploration Plan, Figure 2.

Methods and procedures used for drilling and sampling of the borings are presented in Appendix A. Logs for borings B-1 and B-2 are presented in Appendix A as Figures A-2 and A-3. Logs of selected previous borings are shown in Appendix C. A guide to the soil classification terms used in the recent boring and in this report by Shannon & Wilson, Inc. is included as Figure A-1 (2 sheets).

4.0 GEOTECHNICAL LABORATORY TESTING

Geotechnical laboratory tests were performed on selected samples retrieved from current subsurface explorations. The testing included visual classification, moisture content, grain size analyses, and Atterberg Limits determinations. Laboratory testing was performed to aid in classifying the soil and to determine soil index and engineering properties. The laboratory test results are incorporated into the borings logs presented in Appendix A. Descriptions of laboratory test procedures and the results are presented in Appendix B, Laboratory Test Results.

5.0 GEOLOGY AND GEOLOGIC HAZARDS

The project site is within the Puget Lowland, a structural trough between the Cascade Range and the Olympic Mountains. This trough was subjected to several major glaciations during the Pleistocene Epoch. As a result of these glaciations, the Puget Lowland was filled to significant depths with glacial and nonglacial sediments. Many of these glacial and nonglacial sediments have been glacially overridden and consolidated to dense or hard conditions. The last glaciation experienced by the Puget Lowland, the Vashon Stade, occurred approximately 13,000 years ago. The native soils at the project site predominantly consist of pre-Vashon nonglacial soil layers, which are primarily lacustrine fine sandy silt, silty fine sand, and clayey silt (Qpnl). Interbeds of nonglacial fluvial fine to medium sand (Qpnf) exist within the nonglacial lacustrine silt and fine sand. Several thin, less than ½-inch-thick, hard peat seams exist within the nonglacial deposits. Relatively thin, discontinuous layers of pre-Vashon glacial till (Qpgt) and glacial marine drift (Qpgm) overlie the nonglacial soils at the site. These soil layers have been overridden by glacial ice and, consequently, have high strength and low compressibility.

Earthquake hazards in the Puget Sound region can include fault-related ground rupture, liquefaction, settlement, and landsliding. Based on the dense nature of the glacially overridden soils at the project site, the topography, and the estimated depth to groundwater, it is our opinion that the risk of liquefaction, settlement, and landsliding at the site is low. In our opinion, the potential for fault-related ground rupture affecting the site is low. This opinion is based on published and unpublished reports that show the closest, identified, potentially active fault is the Seattle Fault, which is located about ½ mile to the south. While there is evidence that this fault may have moved about 1,100 years ago, no conclusive evidence of surface rupture in Seattle has been detected. It is generally believed that the recurrence interval for this fault is on the order of thousands of years.

6.0 SUBSURFACE CONDITIONS

The project site is underlain by glacially overridden soil layers that have been glacially consolidated to a hard or very dense condition. Our interpretation of the subsurface conditions at the site are summarized on the Generalized Subsurface Profiles A-A', and B-B', presented on Figures 3 and 4. Approximate locations of the subsurface profiles are shown on the Site and Exploration Plan, Figure 2. The approximate elevations of the base of the building foundation for the Public Safety Building have been projected onto these profiles.

Historical photographs show the basement walls for the PSB were constructed in an open excavation. Therefore, fill material is present between the basement wall and the old cut slope. From our study of the photographs, we estimate that the cut slopes were made at 1 Horizontal to 1 Vertical (1H to 1V) or steeper.

Fill deposits encountered in the borings were variable and generally very loose to loose or soft to medium stiff. The fill material included slightly silty to silty, gravelly sand; silty, sandy, clayey gravel; and sandy, silty clay. Debris encountered within the fill soil included brick fragments, wood debris, and chunks of silty clay soil intermixed within the sandy fill soils. Boring B-1 was terminated at 37.0 feet after refusal on concrete. The boring was drilled approximately 2.5 feet away from the retaining wall; therefore, we assumed that the concrete obstruction encountered was the footing for the existing PSB.

Below the footing elevations, the subsurface conditions consist primarily of interbedded, pre-Vashon nonglacial lacustrine (Qpnl) and fluvial (Qpnf) soils. A thin discontinuous layer of pre-Vashon glaciomarine drift (Qpgm) overlies the nonglacial deposits. Pre-Vashon nonglacial lacustrine deposits consist of very dense, massive to laminated, silty fine sand and fine sandy silt with scattered, thin, silty clay seams; peat seams; and fine gravel. The pre-Vashon nonglacial fluvial (Qpnf) soils consist of very dense, fine to medium sand with various amounts of gravel. Abundant fine organic fragments exist within all the pre-Vashon nonglacial soils.

Underground structures within the project area include the DSTP tunnel and Pioneer Square Station under 3rd Avenue, and the BNSF railroad tunnel under 4th Avenue, between the PSB and the City Hall. Please refer to Section 7.5 for additional descriptions of the DSTP structures.

7.0 ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

7.1 General

The proposed demolition and excavation will require temporary lateral restraint to support the existing basement-level walls as the interior of the structure is removed. We recommend using post-grouted tieback anchors to provide lateral restraint. These tiebacks could be installed through the existing basement wall and post-tensioned to reduce wall deflection as the demolition progresses. If future excavations are performed below the existing basement slab-on-grade, we recommend underpinning the existing basement walls with soldier piles and installing a soldier pile with lagging wall with tieback anchors to support the excavation.

The following sections present our recommendations for shoring and other pertinent geotechnical design issues such as lateral resistance and lateral earth pressures, drainage, and construction considerations.

7.2 Foundation Design

Based on previous and recent explorations, we interpret the soil underlying the building site at or just below the existing basement slab is heterogeneous and likely consists of dense to very dense, granular soil and hard, cohesive soil. Plans for the existing PSB show that the existing spread footings bear at elevations ranging between approximately 54 feet in the southwest building corner and 68 feet at the northeast corner of the block. It is likely that all existing footings bear in very dense sand and gravel or hard, silty clay.

Because we do not know if a specific footing is underlain by hard clay or very dense sand, we recommend that an allowable bearing pressure of 8 kips per square foot (ksf) be used to analyze the capacity of existing footings. Greater allowable bearing pressures could be used if larger

0 1/8 1/4 1/2

Scale in Miles

NOTE

PSB Demolition and Shoring Project
Seattle, Washington

VICINITY MAP

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FIG. 1

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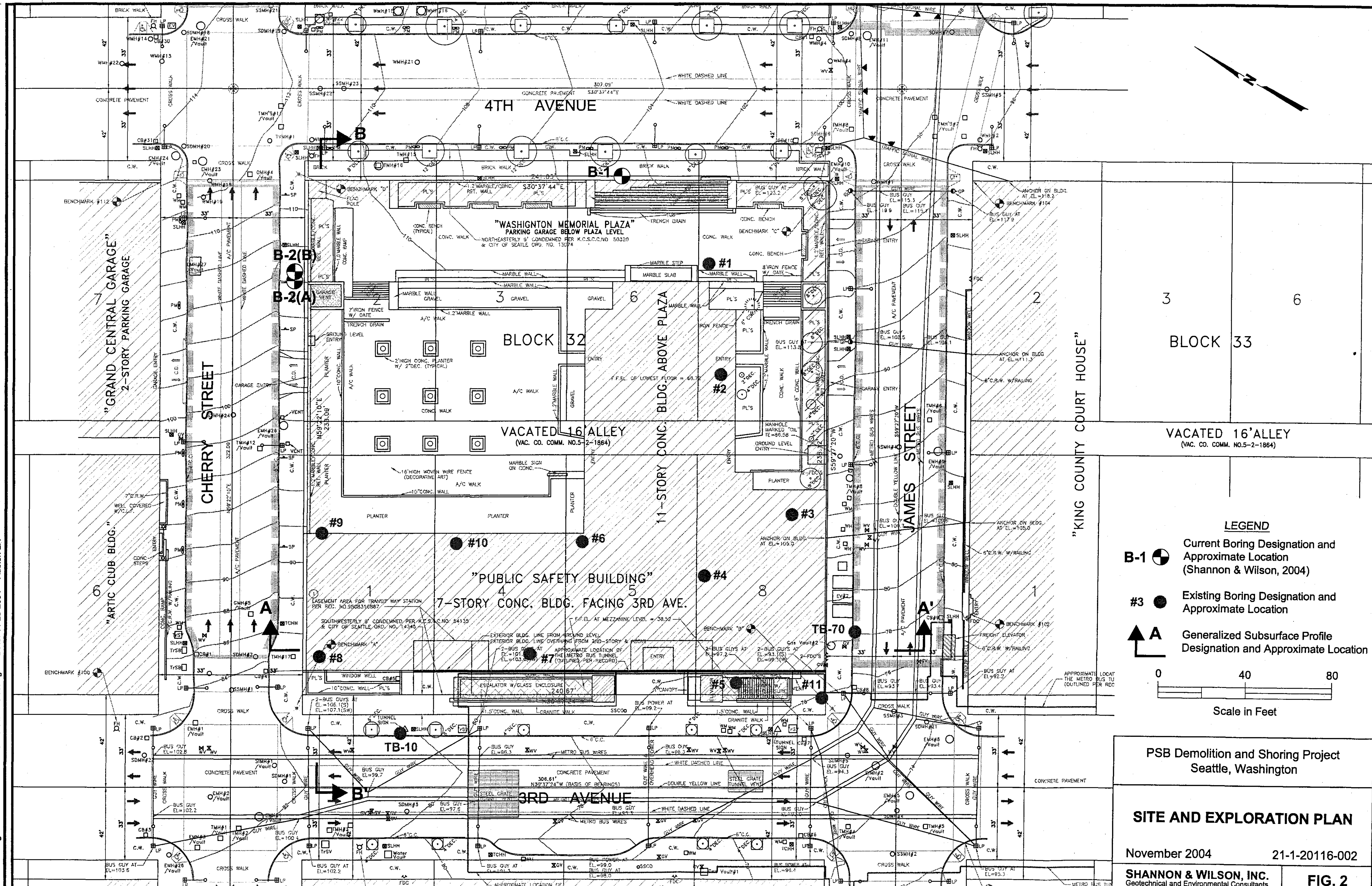

PSB Demolition and Shoring Project
Seattle, Washington

SITE AND EXPLORATION PLAN

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FIG. 2

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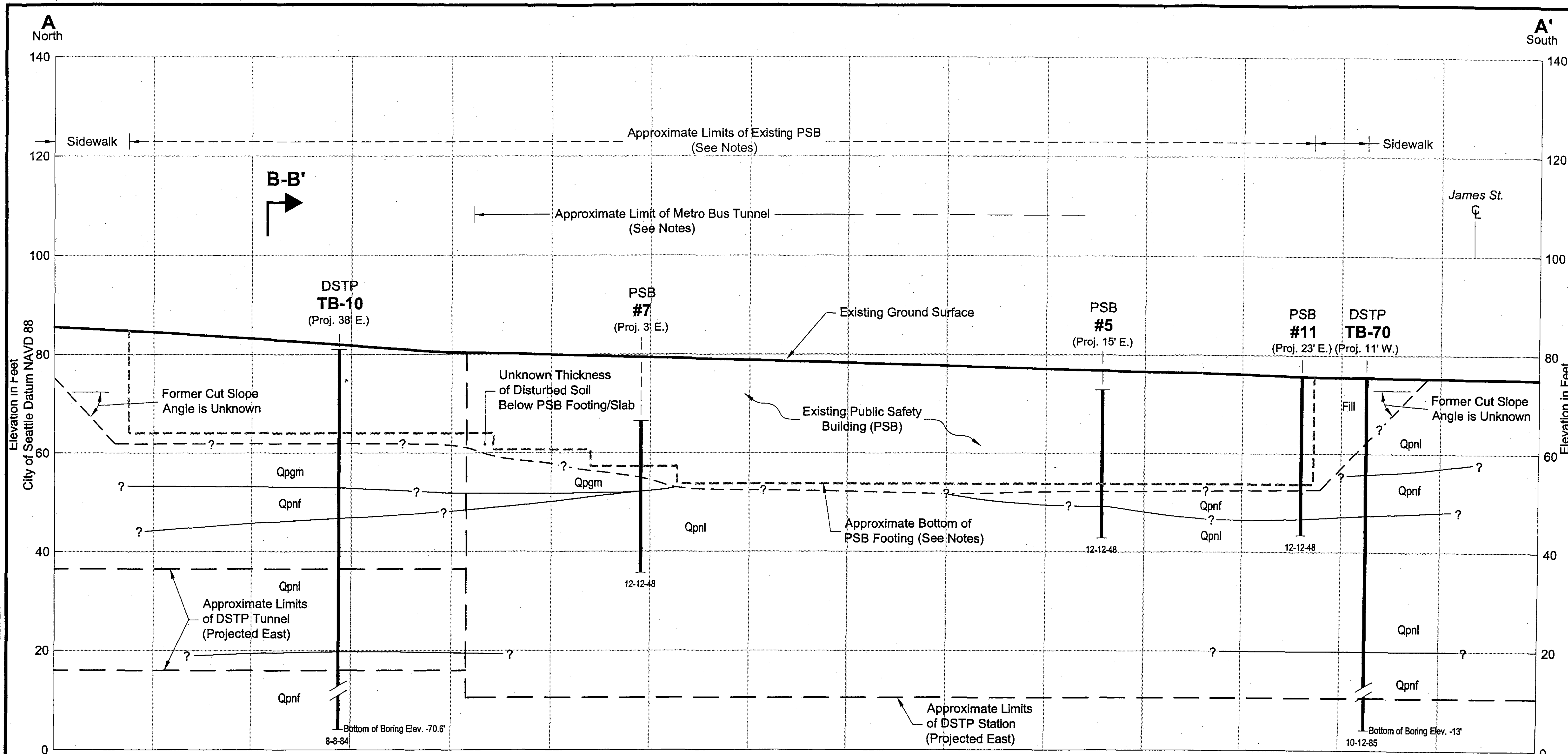

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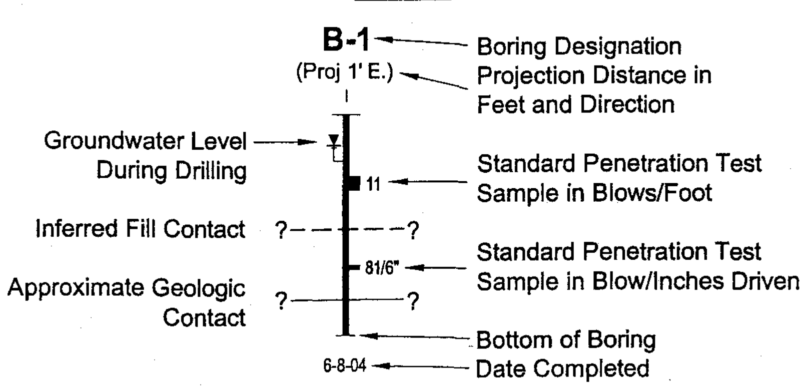

0 20 40

Scale in Feet
Horizontal = Vertical

NOTES

1. This subsurface profile is generalized and interpreted from materials observed in soil borings and reported on borings by others. Variations between the profile and actual conditions may exist.

2. Existing limits of PSB taken from "Public Safety Building, City of Seattle" dated 5-20-1948.

3. Existing limits of the Metro Bus Tunnel taken from "Contract No. T/F16-86, Contract Documents Vol. 3 of 3 Part D: Design Summary Report, Tunnels and 3rd Ave. South Station Excavation," by Parsons Brinkerhoff Quade & Douglas, Inc., dated 3-3-1986.

PSB Demolition and Shoring Project
Seattle, Washington

GENERALIZED SUBSURFACE PROFILE A-A'

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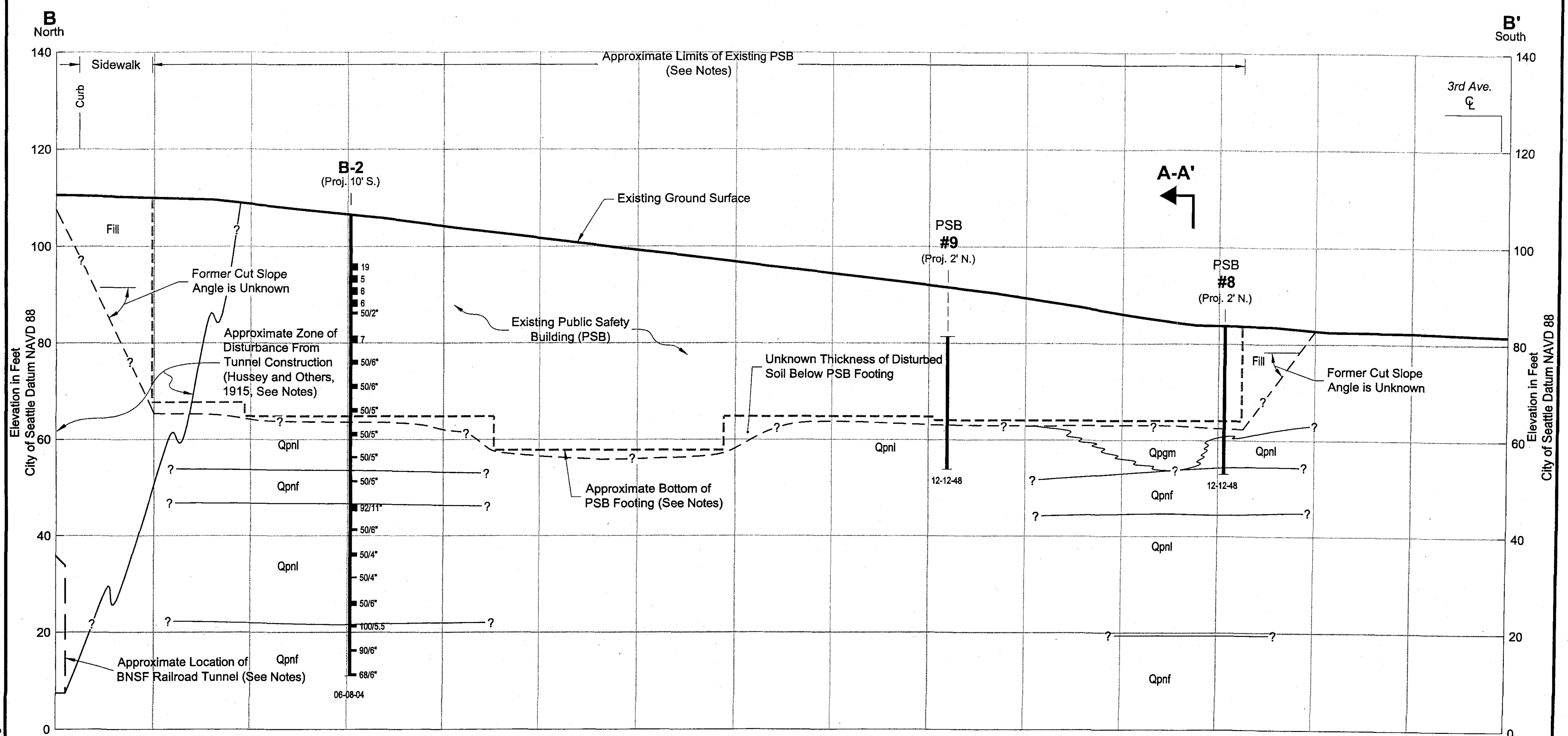
FIG. 3



LEGEND

B-1 ← Boring Designation
(Proj 1' E.) ← Projection Distance in Feet and Direction

Groundwater Level During Drilling

11 ← Standard Penetration Test Sample in Blows/Foot

Inferred Fill Contact ?— — — —?

81/6" ← Standard Penetration Test Sample in Blow/Inches Driven

Approximate Geologic Contact ?————?

← Bottom of Boring

6-8-04 ← Date Completed

0 20 40

Scale in Feet
Horizontal = Vertical

NOTES

1. This subsurface profile is generalized and interpreted from materials observed in soil borings and reported on borings by others. Variations between the profile and actual conditions may exist.
2. Existing limits of PSB taken from "Public Safety Building, City of Seattle" dated 5-20-1948.
3. Existing limits of the Metro Bus Tunnel taken from "Contract No. T/F16-86, Contract Documents Vol. 3 of 3 Part D: Design Summary Report, Tunnels and 3rd Ave. South Station Excavation," by Parsons Brinkerhoff Quade & Douglas, Inc., dated 3-3-1986.
4. Approximate location of BNSF Railroad Tunnel taken from "Columbia Center" report by Shannon & Wilson dated 1982. Approximate Zone of Disturbance from Tunnel Construction (Hussey and Others, 1915) taken from Subsurface Profile C-C' in the above referenced report.

PSB Demolition and Shoring Project
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GENERALIZED SUBSURFACE PROFILE B-B'

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FIG. 4

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APPENDIX A

SUBSURFACE EXPLORATIONS

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APPENDIX A

SUBSURFACE EXPLORATIONS

A.1 INTRODUCTION

Field explorations performed for this project consisted of drilling two soil borings designated borings B-1 and B-2. The approximate locations of the explorations are shown on Figure 2. Shannon & Wilson, Inc. determined the boring locations by measuring from existing site features with a tape measure.

A.2 DRILLING PROCEDURES

The borings were drilled to depths ranging from 37.0 to 95.5 feet on June 3 through 8, 2004. Boart Longyear, formerly Geo-Tech Explorations, Inc., of Kent, Washington, under subcontract to Shannon & Wilson, Inc., drilled the borings using a track-mounted drill-rig. The upper 6 to 7.5 feet were excavated using an air lance and vactor truck to reduce the potential for damaging utilities. Hollow-stem auger methods were used to drill to a depth of approximately 15 feet in boring B-1 and a depth of 26.5 feet in boring B-2. The mud rotary method was used to drill the rest of the boring. The open-hole mud-rotary method consists of drilling subsurface soils and removing the cuttings by circulation of drilling mud. The drilling mud is a mixture of bentonite and water. Cuttings from the boring are deposited in a settling tank at the ground surface and the mud is recirculated into the boring. Steel casing below the hollow-stem auger was not required to advance the borings.

A.3 SOIL SAMPLING

A geologist from our firm was present throughout the boring program to observe drilling, collect representative samples for subsequent laboratory testing, and prepare descriptive field logs of the borings. Disturbed samples were taken at approximately 2.5-foot depth intervals in the upper 20 feet and at 5-foot depth intervals at depths greater than 20 feet. Sampling was performed in conjunction with Standard Penetration Tests (SPTs). All samples retrieved were classified by our field representative, placed in airtight containers, and transported to the Shannon & Wilson, Inc. laboratory in Seattle for further classification and testing. Each soil sample was classified according to a modified version of the Unified Soil Classification System (USCS), which is presented in the Soil Classification and Log Key (Figure A-1). Sample classification was based on American Society for Testing and Materials (ASTM) D 2487-98, Standard Test Method for Classification of Soil for Engineering Purposes, or ASTM D 2488-93, Standard Recommended Practice for Description of Soils (Visual-Manual Procedure).

SPTs were performed in general accordance with ASTM Designation: D 1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils. The SPT consists of driving a 2-inch outside-diameter (O.D.), 1.375-inch inside-diameter (I.D.), split-spoon sampler 18 inches into the bottom of the borehole with a 140-pound hammer falling 30 inches. The number of blows required to achieve each of three 6-inch increments of sampler penetration is recorded. The number of blows required to cause the last 12 inches of penetration is termed the Standard Penetration Resistance (N-value), or blow count. This value is an indicator of the relative density or consistency of the soils. Whenever 50 or more blows are required to cause 6 inches of penetration, driving is generally stopped and the number of blows and corresponding penetration recorded. Samples recovered from the split-spoon sampler are disturbed but are generally representative of the soils encountered. The results of the SPTs are plotted on the boring logs in this Appendix.

A.4 BORING LOGS

Boring logs for borings B-1 and B-2 are presented as Figures A-2 and A-3. A boring log is a written record of the subsurface conditions encountered. It describes the geologic units (layers) encountered in the boring and the USCS symbol of each geologic layer. It also includes the water content (where tested) and blow counts. Other information shown on the boring logs includes groundwater level observations made during drilling, approximate surface elevation, types and depths of sampling, and Atterberg Limits (where tested). No groundwater monitoring wells were installed in borings B-1 and B-2.

SOIL DESCRIPTION

Surface Elevation: Approx. 104.5 Ft.

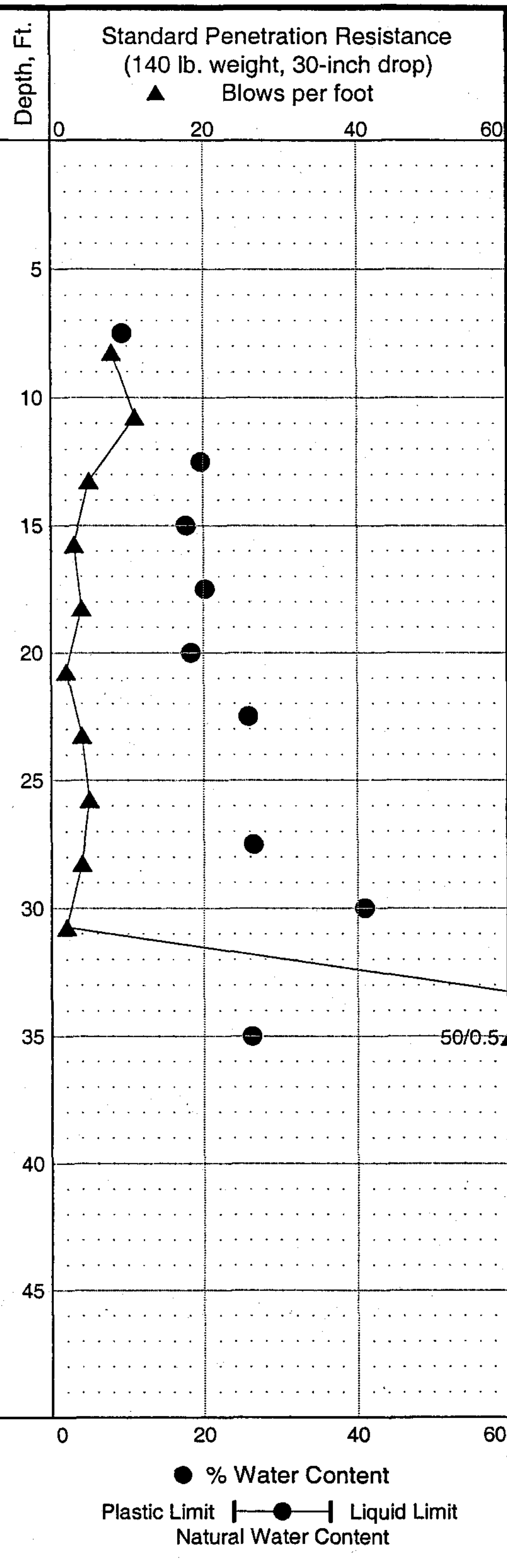
Soil Description	Depth, Ft.
Brick pavement.	0.2
Crushed rock subbase.	1.0
Loose, brown, gravelly, silty SAND; moist; scattered wood debris and roots in upper 7 feet; (Fill) SM. Note: Boring was vacuum excavated to 7.5 feet. Soil descriptions above 7.5 feet are inferred from field observations.	12.0
Very loose to loose, gray, silty, sandy, clayey GRAVEL; moist; scattered brick debris; (Fill) GC/CL.	22.0
Medium stiff to soft, gray, trace of sand to sandy, silty CLAY, trace of gravel; moist to wet; disturbed texture, scattered brick fragments; (Fill) CL.	35.0
Concrete.	37.0

Samples: 1, 2*, 3, 4, 5, 6, 7, 8*, 9, 10, 11*

Ground Water: None Observed During Drilling

BOTTOM OF BORING
COMPLETED 6/3/2004

Note: Boring terminated at 37.0 feet on concrete obstruction (footing).



LEGEND

* Sample Not Recovered

Ⅰ Standard Penetration Test

NOTES

1. The boring was performed using Mud Rotary and hollow-stem auger drilling methods.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. Refer to KEY for explanation of symbols, codes and definitions.
6. USCS designation is based on visual-manual classification and selected lab testing.

Public Safety Building Demolition
Seattle, Washington

LOG OF BORING B-1

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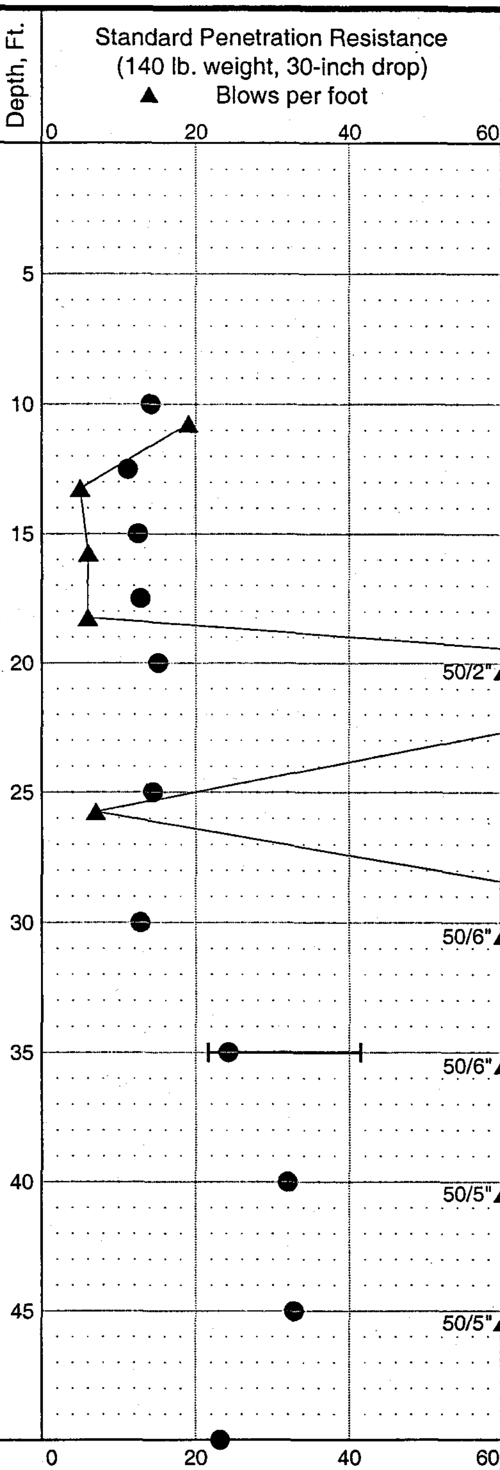
FIG. A-2

MASTER LOG2 21-20116.GPJ SHAN WIL.GDT 11/29/04 Log: XHL Rev: WLM Typ: LKD

SOIL DESCRIPTION Surface Elevation: Approx. 106.5 Ft.	Depth, Ft.	Samples
Concrete.	0.5	
Crushed rock.	1.5	
Loose to medium dense, brown, slightly silty, gravelly SAND; moist; scattered layers of sandy gravel, abundant brick debris, locally sandy clay at bottom; (Fill) SP-SM. - Brick debris between 4.5 and 6.5 feet. Note: Boring was vacuum excavated to 6 feet. Soil descriptions above 6 feet are inferred from field observations.	12.0	1
Loose, brown, slightly silty to silty, fine to medium SAND, trace of gravel; moist; scattered clayey silt clasts, scattered iron-oxide staining; (Fill) SP-SM/SM.	20.5	2, 3, 4, 5
Very dense, gray-brown, slightly gravelly, silty, clayey SAND; moist; intermixed with silty clay pockets; (Fill) SC.	25.0	
Loose, brown, silty, fine SAND, trace of coarse sand and fine gravel; moist; abundant slightly clayey silt clasts; (Fill) SM.	29.0	6
Very dense, gray, gravelly, silty SAND; moist; scattered iron-oxide staining; (Qpgt) SM.	34.0	7
Very dense, gray-brown, slightly fine sandy SILT to silty, fine SAND; moist; locally slightly clayey at top, abundant fine organics; (Qpnl) ML/SM. - Abundant thin peat seams below 45.0 feet.		8, 9, 10

Ground Water: None Observed During Drilling



CONTINUED NEXT SHEET

LEGEND

- * Sample Not Recovered
- Ⲧ Standard Penetration Test

● % Water Content

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

NOTES

1. The boring was performed using Mud Rotary and hollow-stem auger drilling methods.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. Refer to KEY for explanation of symbols, codes and definitions.
6. USCS designation is based on visual-manual classification and selected lab testing.

Public Safety Building Demolition
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LOG OF BORING B-2

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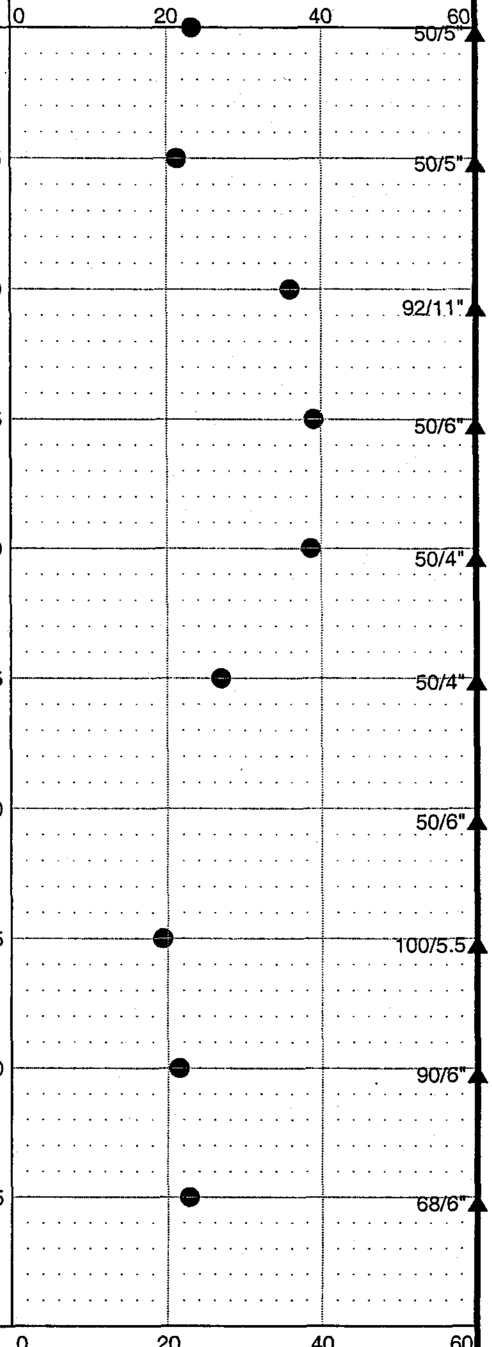
FIG. A-3
Sheet 1 of 2

MASTER_LOG2 21-20116.GPJ SHAN_WIL.GDT 11/29/04 Log: XHL Rev: WLM Typ: LKD

SOIL DESCRIPTION Surface Elevation: Approx. 106.5 Ft.	Depth, Ft.	Symbol	Samples	Ground Water	Depth, Ft.
			11		
Very dense, gray-brown, slightly silty, fine to medium SAND; wet; abundant pumice; (Qpnf) SP-SM.	53.0		12		55
Very dense, gray-brown, fine sandy SILT, hard slightly clayey SILT and silty CLAY, trace of fine sand; moist; interbedded, abundant very fine organic fragments, peat seams, and pumice fragments; (Qpnl) ML.	60.0		13 14 15 16 17		60 65 70 75 80
Very dense, dark gray-brown, slightly silty to silty SAND; moist to wet; abundant fine sand and silt seams, abundant pumice; (Qpnf) SP-SM/SM.	85.0		18 19 20		85 90 95
BOTTOM OF BORING COMPLETED 6/8/2004	95.5				

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



LEGEND

* Sample Not Recovered

Ɪ Standard Penetration Test

● % Water Content

Plastic Limit ├─●─┤ Liquid Limit

Natural Water Content

NOTES

1. The boring was performed using Mud Rotary and hollow-stem auger drilling methods.
2. The stratification lines represent the approximate boundaries between soil types, and the transition may be gradual.
3. The discussion in the text of this report is necessary for a proper understanding of the nature of the subsurface materials.
4. Groundwater level, if indicated above, is for the date specified and may vary.
5. Refer to KEY for explanation of symbols, codes and definitions.
6. USCS designation is based on visual-manual classification and selected lab testing.

Public Safety Building Demolition
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LOG OF BORING B-2

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FIG. A-3
Sheet 2 of 2