January 19, 2005

Interstate 405 Project Team
600 – 108th Avenue NE, Suite 405
Bellevue, Washington 98004

Attention: Anthony Stirbys

We are pleased to submit our report titled "Geotechnical Baseline Report, I-405, SR 520 to SR 522 Stage 1 (Kirkland Stage I), Kirkland, Washington." Our services were completed in general accordance with those described in Work Order No. XL2068 of Agreement No. Y-8124, Task No. AA.

Preliminary information, conclusions and recommendations were provided to the project team throughout the course of the project. We submitted a draft report for the project dated July 14, 2004 for review by the project team. The information presented in this report incorporates comments on our draft report and is consistent with that given previously.

DRAFT

We appreciate the opportunity to provide geotechnical engineering services on this interesting project. We are available to meet with the project team to discuss the information presented in this report. Please call if you have any questions, or if you require additional information.

Respectfully submitted,

GeoEngineers, Inc.

Daniel J. Campbell, PE
Principal

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I-405 Congestion Relief and
Bus Rapid Transit Projects
Kirkland Nickel Project

I-405, SR-520 to SR-522 Stage 1 (Kirkland Stage I)
Geotechnical Baseline Report

DRAFT

Washington State
Department of Transportation

January 2005
Version 1

GEOTECHNICAL BASELINE REPORT
I-405, SR 520 TO SR 522 STAGE 1
(KIRKLAND STAGE I)
KIRKLAND, WASHINGTON

DRAFT

JANUARY 19, 2005

FOR
INTERSTATE 405 PROJECT TEAM

File No. 0180-152-00

Geotechnical Baseline Report
I-405, SR-520 to SR-522 Stage 1
(Kirkland Stage I)
File No. 0180-152-00

January 19, 2005

Prepared for:

Interstate 405 Project Team
600 – 108th Avenue NE, Suite 405
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GEOTECHNICAL BASELINE REPORT
I-405, SR 520 TO SR 522 STAGE 1
(KIRKLAND STAGE I)
KIRKLAND, WASHINGTON
FOR
INTERSTATE 405 PROJECT TEAM

1.0 INTRODUCTION

1.1 GENERAL

This report presents the results our geotechnical baseline evaluation for the Interstate 405 Kirkland Segment Design-Build project. The Kirkland Segment project corridor extends from approximately the north end of the State Route 520 intersection near Bellevue, Washington to approximately the south end of the State Route 522 intersection near Bothell, Washington. The project corridor is shown on the Project Location Plan, Figure 1.

1.2 PROJECT UNDERSTANDING

We understand the Kirkland Segment includes the addition of a new north bound lane to Interstate 405 between NE 70th Street and NE 124th Street, and a new south bound lane to Interstate 405 between NE 70th Street and State Route 522. The Kirkland Segment is broken into two stages:

- Stage 1 focuses on the area between NE 85th Street and NE 124th Street
- Stage 2 (Stage II) focuses on the area between State Route 520 and NE 85th Street and on the area between NE 124th Street and State Route 522.

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This report focuses on the Stage 1 improvements which include:

Structure	Location	Station	
		Begin Station	End Station
Bridges			
405/55E	NB NE 116th Street	4216+90 NB	4218+40 NB
405/55W	SB NE 116th Street	4217+00 SB	4218+50 SB
Retaining Walls			
3005	NB NE 85th Street On Ramp	4145+68 NB	4154+08 NB
3010	SB NE 116th Street On Ramp	332+62 SB	345+16 SB
3020	NB NE 116th Street Off Ramp	136+44 NB	147+55 NB
3030	NB Infield at NE 116th Street	4214+60 NB	4216+89 NB
3040	SB Infield at NE 116th Street	4210+99 SB	4217+09 SB
Noise Walls			
U4	SB NE 85th Street Off Ramp	4143+12 SB	4147+01 SB
R2	NB NE 85th Street Off Ramp	4144+58 NB	4155+55 NB
N3	SB NE 85th Street to NE 100th Street	4155+85 SB	4165+08 SB
Detention Facilities	**Milepost**	**Station**	
B4 Pond	18.22	4132+00 NB	
C Pond	19.10	4179+00 SB	
C Vault	19.35 to 19.50	4192+50 SB	4200+00 SB

Structure	Location	Station	
		Begin Station	End Station
Ecology Embankments			
B4.1	18.16 – 18.25	4129+50 NB	4134+50 NB
B4.2	18.34 – 18.58	4139+00 NB	4151+00 NB
C1.1	18.58 – 19.36	4151+50 SB	4192+50 SB
C1.2	19.10 – 19.60	4179+00 NB	4205+00 NB
D1.1	19.85 – 19.95	4219+00 SB	4224+00 SB

The proposed improvements for Stage 1, as well as existing facilities along the entire Kirkland Segment (both Stages) are presented on the Site Plans, Figures 3A-3N.

1.3 Scope of Services

The purpose of our geotechnical services is to characterize the existing subsurface conditions and document the as-built conditions for the existing structures along the Kirkland Segment project alignment, with limited geotechnical analyses. The characterization of subsurface conditions and documentation of structure as-built conditions addresses the entire Kirkland Segment (both Stages of the project). Preliminary geotechnical analyses and recommendations are limited to Stage 1 of the project alignment. Our specific scope of services is presented in Work Order No. XL2068 of Agreement No. Y-8124, Task No. AA.

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1.4 Previous Studies

Numerous geotechnical studies have been completed along the Kirkland Segment project alignment. The geotechnical studies, along with exploration logs, were provided to GeoEngineers by the Interstate 405 Project Team. The geotechnical studies reviewed by GeoEngineers are listed in the References section of this report.

2.0 GEOLOGY AND SEISMICITY

2.1 Geologic Setting

The project corridor is located within the central Puget Lowland bordered by the Cascade Mountains to the east and the Olympic Mountains to the west. The Puget Lowland is a north-south trending trough consisting of Holocene period deposits overlying a thick sequence of relatively unweathered glacial and interglacial sediments deposited during the ice ages of the Quaternary period.

In the central Puget Lowland, the most complete geologic record of the Quaternary period exists for the most recent glaciation, the Vashon Stade of the Fraser Glaciation. The advance and retreat of the Vashon age Puget Glacial Lobe, between roughly 18,000 to 13,000 years ago, deposited most of the near surface materials and sculpted most of the present landforms within much of the Puget Lowland. The deposits of this glacial episode reflect a wide range of glacial depositional environments. As the glacier advanced southward, streams deposited sediment that formed a broad plain in front of the advancing glacier. Gravel size material was deposited close to the glacier, while silt and clay material was transported farther from the glacier. The advance deposits therefore grade from coarse to fine with increasing depth, with silts and clays (lake deposits) at the base, then coarse grained sand and gravel at the top.

Lodgement till, consisting of a non-stratified well-graded deposit of particle sizes ranging from clay to large boulders, was deposited directly from the glacier itself. The most conspicuous aspect of the till is its consolidation, the result of being overridden by the glacial ice. The maximum ice thickness was roughly 3,000 feet in the project vicinity.

As the glacier retreated, the depositional sequence was repeated in the inverse order of the glacial advance, with first coarse grained gravel and sand, then fine grained silts and clays. The retreat was rapid relative to the advance of the glacier, and the recessional deposits are generally not as thick as the advance deposits.

Following the Fraser Glaciation, Holocene period sediments were deposited over the glacial soils. These deposits typically consist of alluvial soils in river valleys, beach and marine deposits along shorelines, and colluvial deposits (landslide materials) along slopes. Peat and other organic soils occur in numerous depressional areas at the surface. Some of these Holocene period sediments have been modified by human activity, including overexcavation and replacement beneath portions of the Kirkland Segment project alignment.

2.2 Published Geologic Maps

Published geologic information for the project vicinity includes United States Geological Survey (USGS) Maps for the Kirkland quadrangle (Minard, 1983) and the Bothell quadrangle (Minard, 1985). The maps indicate that five geologic units are present along the project alignment (youngest to oldest):

- **Recessional outwash** consisting mostly of loose, stratified sand and gravel with minor silt and clay layers. Locally (near Totem Lake area; milepost 20.3 to 20.9), thick silt and organic layers are present. Along the alignment right-of-way, the maximum thickness of peat is about 15 feet (Golder, 2004).
- **Glacial till** consisting of a very dense, nonsorted mixture of clay, silt, sand, gravel, cobbles and boulders. The upper 2 to 5 feet is often weathered and typically medium dense to dense.
- **Advance outwash** consisting mostly of dense to very dense, stratified sand with gravel and some cobbles. Locally the advance outwash is silty and contains layers of fine-grained sands and silts.
- **Transitional beds** consisting mostly of thick sections of hard clay and silt and dense to very dense fine sand and some layers of peaty sand.
- **Olympia gravel** (pre-Fraser Glaciation) consisting of fluvial deposited sand and gravel.

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The mapped alignment geology, based on the Washington State Department of Natural Resources GIS Layer, is depicted on Figures 4A through 4N. Figure 2 provides an index for the alignment geology figures.

2.3 Geologic Reconnaissance

2.3.1 General

A geologic reconnaissance was completed to identify geologic or other sensitive areas along the project alignment. Our geologic reconnaissance was completed in two steps. The first step consisted of a desk-level study and involved reviewing available geologic and sensitive areas maps (City of Kirkland, City of Bothell, and King County maps), previous explorations and geotechnical reports. We also reviewed the Golder Associates (2004) "Geology, Soils, and Groundwater Discipline Report" that was prepared for the

I-405 Kirkland Segment Project. In addition, we reviewed "bald earth" LiDAR images of the alignment to aid in assessing geologic hazards.

The second step consisted of field-truthing and defining more accurately the geologic features, sensitive areas and hazard areas identified during the desk-level study. Additionally, sensitive and/or hazard areas observed during the field study that were not mapped or apparent during the desk-level study, were identified and documented. The field geologic reconnaissance was completed by senior level and staff level personnel from our firm.

The mapped sensitive areas are presented in the following table.

Sensitive Areas		
Landslide/Erosion		
Milepost	**Approximate Station**	**Level**
18.66	SB Line 4156+50 (LT)	1
18.84 to 19.05	SB Line 4165+50 to 4176+50 (LT)	1
19.12 to 19.20	SB Line 4180+00 to 4184+00 (LT)	2
19.24 to 19.61	SB Line 4186+50 to 4206+00 (LT)	1
21.64	NB Line 4302+00 (RT)	1
22.7 to 23.40	NB Line 4369+30 to 4403+50 (RT & LT)	2

Notes:

Level 1: Moderate Landslide Hazard consists of areas sloping between 15 and 40 percent and underlain by relatively permeable soils consisting largely of sand and gravel or highly competent glacial till. Generally stable under natural slope conditions but subject to stability problems due to land use activities. Severe Erosion Hazard when slopes are devegetated.

Level 2: High Landslide Hazard consist of areas sloping between 15 and 40 percent with zones of emergent groundwater or underlain by, or interbedded with impermeable silts and clays; areas of known mappable landslides; all areas sloping 40% or greater; and fill of low quality or strength. Relatively unstable under natural slope conditions. Severe to Very Severe Erosion Hazard when slopes are devegetated.

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Seismic
Milepost 20.25 to 20.55 (NB Line 4239+00 to 4256+00 – RT & LT)
Seismic Hazard Areas consists of areas of potential soil liquefaction and differential ground settlement. Areas are generally underlain by loose, sandy soils with a shallow groundwater table. Includes areas of Holocene and recent alluvium, wetlands, areas of fill adjacent to wetlands, and low-lying shoreline areas. Areas mapped as landslide hazards are also subject to increased risk of landsliding during a seismic event.

Based on the results of our geologic reconnaissance, it appears that the sensitive areas along the project alignment have been fairly accurately portrayed by the City of Kirkland, City of Bothell, and King County maps and are consistent with those identified in the Golder Associates (2004) report.

In several locations, it was noted that geologic conditions differ from those presented on the published geologic maps (Figures 4A through 4N). In particular, alluvial soils are mapped as recessional outwash in the Totem Lake area. Also, areas of significant man-made fills are not included on the published geologic maps. This is discussed further in Section 3.2 of this report.

2.3.2 Active And Historic Landslide Activity

An active landslide is present adjacent to the southbound lanes of Interstate 405 in the vicinity of Milepost 23.03 to 23.04, approximately 60 feet west of the pavement edge. Details regarding the landslide and proposed corrective measures are available from the Washington State Department of Transportation (WSDOT) Geotechnical Services Division's Unstable Slope Management System. The design of improvements for Stage 2 of the Kirkland Segment will need to address the presence of this landslide feature.

Steep slopes are present along the Interstate 405 alignment between Mileposts 22.7 and 23.4. This area is classified as a High Landslide Hazard on sensitive areas maps. Previous landslide stabilization work completed in this area is depicted on the plans titled "PSH 1-RE NE 132nd St to JCT. FAI 5, Woodinville Interchange, King County" dated April 15, 1966 and "PSH 1 (SR 405), N.E. 140th St. to Sammamish River, King County" dated May 19, 1967. These plans are available from WSDOT and indicate the work occurred between approximately L-Line Station 840+00 to 850+00. It should be noted that these are NOT as-built plans. A general description of the landslide stabilization work is provided below.

A cut was made into the east (uphill) side of Interstate 405 during construction of the interstate, which initiated slope movement. A riprap buttress was constructed along the cut to stabilize the movement. In addition, three levels of horizontal drains (finger drains) were drilled into the hillside. The horizontal drains range in length from about 100 to 200 feet and were installed with a lateral spacing of approximately 50 feet. The slope of the horizontal drains ranges from 1 to 2 percent. A series of drainage ditches were constructed to collect the groundwater removed from the hillside through the horizontal drains. We understand that WSDOT Maintenance crews periodically remove fine grained soils from these drainage ditches.

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An embankment fill was constructed on the west (downhill) side of Interstate 405. Riprap ribs oriented parallel and perpendicular to the slope were installed below the embankment fill. Perforated pipe was installed in the riprap ribs that run perpendicular to the slope to collect groundwater seepage. The perforated pipes are tightlined into a storm drain system.

2.4 SEISMICITY

2.4.1 Introduction

Seismicity in western Washington is primarily driven by the Cascadia Subduction Zone, which is the zone where the westward advancing North American Plate is overriding the subducting Juan de Fuca Plate. The subduction zone environment results in three potential seismic source zones for western Washington: (1) shallow crustal earthquakes in the North American plate associated with known and/or unknown faults; (2) Cascadia Subduction Zone interface earthquakes (subduction zone earthquakes), which occur along the boundary located between the Juan de Fuca and North American plates; and (3) Cascadia Subduction Zone intraplate earthquakes (deep subcrustal earthquakes), which occur deep within the subducting Juan de Fuca Plate.

2.4.2 Shallow Crustal Earthquakes

Shallow crustal earthquakes occur within the North American Plate to depths up to 15 miles. Shallow earthquakes in western Washington are expected to have durations ranging up to 60 seconds. Four magnitude 7 or greater earthquakes have occurred in the last 1,100 years in the Cascadia region, two of these occurred on Vancouver Island and two in western Washington.

The largest historic earthquake in western Washington occurred in 1872 in the North Cascades and is estimated to have had a magnitude of 6.8 to 7.4 (Bakun et. al., 2002). This earthquake is believed to have occurred at a depth of less than 10 miles. The other magnitude 7+ western Washington earthquake occurred on the Seattle Fault approximately 1,100 years ago (Booth et. al., 2003).

Shallow crustal faults with known or suspected displacements within the general project area include the Seattle Fault Zone and the Southern Whidbey Island Fault. The Seattle Fault Zone is located approximately 3 miles to the south of the State Route 520/I-405 interchange. The Seattle Fault Zone is an east-west trending reverse-slip fault structure extending from near Issaquah in the east to the west side of the Kitsap Peninsula in the west. The average recurrence interval for magnitude 7+ earthquakes along the Seattle Fault Zone is estimated to be on the order of a few thousand to several thousand years (Johnson et. al., 1999).

The Southern Whidbey Island Fault is located approximately 4 miles to the northwest of the State Route 522/I-405 interchange. The Southern Whidbey Island Fault is a northwest trending reverse- and strip-slip fault structure extending from the southern end of Whidbey Island to the Strait of Juan de Fuca. The most recent major earthquake and fault displacement is estimated to have occurred about 3,000 years ago (Kelsey et. al., 2003).

2.4.3 Subduction Zone Earthquakes

Subduction zone earthquakes occur on the boundary between the Juan de Fuca and North American tectonic plates, known as the Cascadia Subduction Zone. The Cascadia Subduction Zone extends from Vancouver Island to Northern California. Interface earthquakes on the Cascadia Subduction Zone are anticipated to have durations ranging up to 4 minutes.

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There is no local, historical evidence of Cascadia Subduction Zone earthquakes. However, paleogeologic evidence of the occurrence of large (magnitude 8 to 9+) earthquakes occurring on the Cascadia Subduction Zone has recently been discovered. The last large interface earthquake is believed to have occurred in the year 1700 based on carbon dating of sunken/buried organic materials and the recording of a rogue tsunami wave in Japan (Atwater, 1987). It is estimated that the average recurrence interval for interface earthquakes on the Cascadia Subduction Zone is about 400 to 1,200 years; however, the interval between earthquakes has been irregular (Rogers et. al., 1991).

2.4.4 Deep Subcrustal Earthquakes

Deep subcrustal earthquakes occur within the subducting Juan de Fuca Plate at depths of 30 to 40 miles within western Washington. Subcrustal earthquakes are expected to have durations ranging up to 45 seconds and magnitudes ranging up to 7.5. The Olympia 1949 (magnitude 7.1), the Seattle 1965 (magnitude 6.5), and the Nisqually 2001 (magnitude 6.8) are considered to be subcrustal earthquakes. The recurrence interval for the maximum magnitude earthquake (magnitude 7.5) is estimated to be about 200 years, with smaller magnitude earthquake events having shorter recurrence intervals (Rogers et. al., 1991).

3.0 SUBSURFACE CONDITIONS

3.1 EXISTING DATA

3.1.1 Historical Explorations

Subsurface conditions along the project alignment were evaluated in-part by reviewing available geotechnical explorations and laboratory data along the Interstate 405 Kirkland Segment alignment completed for previous projects. The exploration logs and laboratory data were provided to us by the Interstate 405 Project Team. Approximately 450 explorations (test pits and borings) were completed by others between the late-1960s to 2003. The locations of the historical explorations are presented on the Site Plans, Figures 3A through 3N. An index to the site plans is provided on Figure 2. The logs of the explorations and laboratory test results are not included in this report but are part of the information available to prospective Design-Build teams from the Interstate 405 Project Team office.

3.1.2 WSDOT I-405 Team Borings Completed As Part Of This Study

Thirteen explorations (KG-1-04, KI-1-04, KJ-1-04, KQ-1-04, KR-1-04, KS-1-04, KT-1-04, KU-1-04, KW-2-04, KX-3-04, KX-4-04, KX-9-04, and KX-10-04) were completed by the WSDOT I-405 team as part of the current study. These borings were drilled using mud rotary techniques with both truck and track mounted drilling equipment. The borings were completed to depths of about 39½ to 51½ feet below the ground surface. The boring locations were selected by the Interstate 405 Project Team and the WSDOT Geotechnical Division.

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Soil samples were obtained from the borings at selected depths using a 1.4-inch-inside-diameter split-barrel sampler (SPT sampler). The split-barrel sampler was driven into the soil using a 140-pound automatic hammer free-falling a vertical distance of 30 inches. The number of hammer blows required to drive the sampler the final 12 inches, or other indicated distance, is recorded on the boring logs. The SPT values presented on the logs are actual field measured SPT values. They have not been corrected for hammer energy, silt content, rod weight and flexure, or overburden pressures.

Laboratory tests were completed by WSDOT on selected samples from the borings. Laboratory testing included moisture content determinations, Atterberg Limits (liquid and plastic limits), and particle size analyses.

The locations of the thirteen borings completed as part of the current study are presented on Figures 3A through 3N. The logs of the borings and results of the laboratory tests are presented in Appendix A.

3.2 SOIL UNITS AND ENGINEERING CHARACTERISTICS

3.2.1 General

Based on our review of explorations along the Interstate 405 Kirkland Segment project alignment, the soil conditions described on the logs are generally consistent with those presented on the geologic maps and our observations during the geologic reconnaissance. Exceptions are discussed in Section 3.2.3 and 3.2.8 of this report.

The subsurface soils along the project alignment generally consist of seven soil units: fill, alluvial deposits, recessional outwash, glacial till, advance outwash, transitional beds and Olympia gravel. These soil units and their typical engineering characteristics are presented below, beginning with the most recently deposited. It is important to note that the engineering properties described are general in nature.

The existing boring logs should be reviewed to assess subsurface conditions and engineering characteristics of the soils at specific locations.

3.2.2 Fill

Fill was encountered in some of the borings along the project alignment. The fill ranges from loose to dense and typically consists of sand, silt and gravel. The fill observed in the explorations varies in thickness. A comparison of the existing finished grade elevations and the boring elevations at some of the structure locations indicates that significant amounts of fill have been placed in and around bridge approaches.

Depending on the relative compaction of the fill, allowable bearing pressures for spread footings varying from 4 ksf (kips per square foot) to 6 ksf were used for the existing bridge structures. This bearing pressure range is typical for other areas of the Puget Sound region.

Portions of the fill have relatively high fines content (material passing the U.S. No. 200 sieve) and will therefore be moisture sensitive. These soils may become muddy and unstable when exposed to moisture. It will also be difficult to operate equipment on or adequately compact these soils during wet weather conditions because of the high fines content. The existing fill soils generally meet the criteria for "Common Borrow" as described in Section 9-03.14(3) of the WSDOT (2004) "Standard Specifications."

Infiltration rates into fill deposits can vary tremendously because of the variable composition and layering of the fill materials. In general, existing fill soils are not considered suitable for infiltration.

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3.2.3 Alluvial Deposits and Recessional Outwash

Alluvial deposits and recessional outwash are combined for discussion in this report because their engineering characteristics are relatively similar. The geologic maps do not differentiate between recessional outwash and alluvial deposits; however, sensitive areas map do discuss the presence of alluvial deposits in the Totem Lake area (milepost 20.25 to milepost 20.55). Recessional outwash was alluvially deposited by glacial meltwater streams while alluvial deposits originate from Holocene period (post-glacial) river flows. Neither of these materials has been glacially consolidated.

Alluvial deposits and recessional outwash typically consists of loose to medium dense, stratified sand and gravel with minor silt and clay layers. The deposits in the Totem Lake area contain large thicknesses of soft silt, organic silt, and peat. In the Puget Sound area, typical allowable bearing capacities for spread footings supported on alluvial deposits and recessional outwash, provided soft or organic soils are not present, range from 2 ksf to 6 ksf. Along the project alignment, existing bridges were either supported on spread footings founded in approach fill placed over alluvial deposits and recessional outwash or on deep foundations.

Alluvial and recessional outwash deposits with relatively high fines content will be moisture sensitive and will become muddy and unstable when the amount of moisture in the soil rises above the optimum moisture content. Provided the material is granular and organic material is separated from these soils or is present in minor amounts, these soils generally meet the requirements for "Common Borrow" as described in Section 9-03.14(3) of the WSDOT (2004) "Standard Specifications." Cleaner deposits may be suitable for use as "Gravel Borrow" or "Select Borrow" as described in Sections 9-03.14(1) and 9-03.14(2), respectively, of the WSDOT (2004) "Standard Specifications."

Infiltration rates into alluvial or recessional outwash deposits typically range from moderate to high (1 inch per hour to greater than 10 inches per hour) depending on the silt content of the sandy soils and the presence of interbedded silt layers. The presence of interbedded organic layers or large thicknesses of organic layers will significantly decrease the rate of infiltration.

3.2.4 Glacial Till

Glacial till consists of a dense to very dense, nonsorted mixture of clay, silt, sand, gravel, cobbles and boulders. The upper 2 to 5 feet is often weathered and typically medium dense to dense. Allowable bearing capacities for spread footing foundations in undisturbed, dense to very dense glacial till typically range from 6 ksf to 16 ksf. The majority of existing bridge spread footings founded on undisturbed dense to very dense glacial till were designed for allowable bearing capacities of 4 ksf to 12 ksf. Notable exceptions include, a pier at the bridge for the 116th Street over crossing that was designed for 16 ksf and the middle piers of the 1989 widening of the 118th Street bridge which were designed for 20 ksf.

It is important to note that cobbles and boulders are often encountered in glacial till soils. Boulders ranging up to 10 to 20 feet in diameter have been observed in glacial till soils within the Puget Sound region.

Glacial till typically contains a significant percentage of fines (silt and clay) and is moisture sensitive. When the moisture content is more than a few percent above the optimum moisture content, glacial till soils become muddy and unstable and operation of equipment on these soils can be difficult. Wet weather construction is generally not recommended for glacial till soils without the use of admixtures to control moisture content. Glacial till soils typically meet the criteria for "Common Borrow."

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Relatively low infiltration rates (less than 0.5 inches per hour) are typically encountered in glacial till soils because of the high fines content and the density of the soils.

3.2.5 Advance Outwash

Advance outwash consists chiefly of dense to very dense, stratified sand with gravel and some cobbles and boulders. Allowable bearing capacities for spread footing foundations in undisturbed dense to very dense advance outwash soils typically range from 6 ksf to 16 ksf. Along the Kirkland Segment, existing bridge spread footings founded on undisturbed dense to very dense advance outwash were designed for allowable bearing capacities ranging between 4 ksf to 12 ksf.

Advance outwash deposits often contain relatively low fines content. Locally, the advance outwash can be silty and contain layers of fine-grained sands and silts. Advance outwash soils are typically less moisture sensitive than glacial till soils. Advance outwash sand and gravel often meet the gradation requirements for "Gravel Borrow" and "Select Borrow." Locally silty lenses typically meet the criteria for "Common Borrow."

Moderate to high infiltration rates (1 inch per hour to greater than 10 inches per hour) are often encountered in advance outwash soils. The infiltration rate is dependent on the silt content of the soil and the presence of interbedded layers with higher silt contents.

3.2.6 Transitional Beds

Transitional beds consist mostly of thick sections of hard clay and silt and dense to very dense fine sand, with some layers of peaty sand. Allowable bearing capacities in the undisturbed transitional beds deposits

typically range from 4 ksf to 12 ksf. An existing bridge spread footing along the Kirkland Segment was founded on undisturbed transitional beds and designed for an allowable bearing capacity of 8 ksf.

The fine grained soils are moisture sensitive and will be susceptible to the same degradation described above when the moisture in the soil rises above the optimum moisture content. Transitional bed deposits are typically not suitable for re-use as fill.

Relatively low infiltration rates (less than 0.5 inches per hour) are typically encountered in transitional beds because of the high fines content.

Transitional bed deposits typically have a high probability of slope instability if present in sloping ground areas. High moisture contents, plasticity and jointing are associated with these deposits. In addition, zones of seepage can occur above these deposits in sloping situations because of the relatively low permeability of the transitional beds.

3.2.7 Olympia Gravel

Olympia gravel generally consists of dense to very dense, stratified sand and gravel and typically underlies the transitional beds. These soils were deposited fluvially before the Fraser glaciation. High allowable bearing capacities are typical in these soils and can be as high as 16 ksf. No existing Kirkland Segment bridge spread foundations are founded on the Olympia Gravel Unit. The soils also are often cemented and stand near-vertical in fresh outcrops. The Olympia gravel deposits generally meet the criteria for "Gravel Borrow" and "Select Borrow."

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Olympia gravel deposits typically contain a relatively low fines content. Moderate to high infiltration rates (1 inch per hour to greater than 10 inches per hour) are often encountered in Olympia gravel. The infiltration rate is dependent on the silt content of the soil, the degree of cementation and the presence of interbedded layers with higher silt contents.

3.2.8 Soil Unit Locations

The following table presents expected surficial soil units along the project alignment, based on the geologic maps and our geologic reconnaissance. The soil unit locations are also depicted on Figures 4A through 4N, Alignment Geology. Figures 4A through 4N also present "bare earth" LiDAR images of the project alignment. An index to the Alignment Geology plans is provided on Figure 2.

Approximate Milepost	Mapped Geologic Unit
15.4 to 16.9	Glacial Till
16.9 to 17.7	Advance Outwash
17.7 to 18.4	Along Boundary Between Advance Outwash and Glacial Till
18.4 to 19.0	Advance Outwash
19.0 to 20.3	Glacial Till
19.4 to 19.7 (west of alignment)	Transitional Beds/Olympia Gravel
20 to 20.5 (west of alignment)	Transitional Beds
20.3 to 20.9	Alluvial Deposits and Recessional Outwash
20.9 to 21.2	Along Boundary Between Advance Outwash and Glacial Till
21.2 to 23.4	Advance Outwash
22.3 to 23.1 (east of alignment)	Glacial till

As previously discussed, notable exceptions to the above table and Figures 4A through 4N exist at several locations, based on review of the exploration logs and our geologic reconnaissance:

- Significant thicknesses of fill, up to 30 feet, have generally been placed at the bridge approach abutments. Minor amounts of fill, generally less than 10 feet, have also been placed along the majority of the interstate alignment.
- Our review of the historical explorations and previous reports indicates the presence of compressible soils consisting of peat, silts and clays along the alignment between about milepost 19.8 (116th Street bridges) to about mile post 20.9 (132nd Street bridges). This area is predominately mapped as recessional outwash but also includes alluvial deposits. It appears that relatively thick layers of silt, clay and peat existed near the surface along this portion of the alignment. However, much of the compressible soils were likely removed as part of the initial construction of Interstate 405 and replaced with embankment fill. It is anticipated that these compressible soils may still be present in the median as well as beyond the outer shoulders of the freeway (RZA-AGRA, 1991).
- Alluvial deposits are likely present at creek/river locations along the project alignment. Four creeks/rivers cross the Interstate 405 alignment, including an unnamed creek at approximately milepost 17.5, Forbes Creek at approximately milepost 19.15, an unnamed creek at approximately milepost 20.85 and Juanita Creek at approximately milepost 21.85.
- In the vicinity of the 116th Street Bridge, located at approximately milepost 19.8, the geologic maps indicate that the near surface soils consist of glacial till. However, several of the historical borings encountered peat and organic silt soil layers on the order of 2 to 4 feet in thickness below the bridge approach fills. Cross sections depicting our interpretation of the subsurface conditions at the 116th Street replacement bridge locations are presented in Figures 5 and 6.
- At the northern end of the alignment, from about milepost 22.7 to milepost 23.1, the historical explorations indicate that there is up to 68 feet of variable density fill overlying transitional beds. Inclinometers were installed in several of the previous borings. Historic and current landslide activity has been observed in this area, as discussed in Section 2.3.2 of this report. The Golder (2004) report refers to this area as a landslide complex, while the geologic mapping (Minard, 1985) indicates that the soils are advance outwash.

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3.3 GROUNDWATER CONDITIONS

Variable groundwater conditions were observed in the historical and the WSDOT I-405 Team borings completed along the Interstate 405 Kirkland Segment project alignment. The depth to groundwater was observed to be as shallow as a few inches below the ground surface to over 30 feet below the ground surface. We anticipate that the groundwater level along the project alignment will fluctuate as a function of season, precipitation and other factors.

Most of the groundwater levels observed have been interpreted by others to be perched groundwater on top of the glacial till or on top of silty layers within the outwash and transitional bed soils. Perched groundwater typically develops where a relatively impermeable soil horizon impedes the vertical infiltration of surface water. It should be noted that multiple perched water levels can form within stratified or interlayered soil deposits.

The following table presents groundwater elevations observed during drilling as well as the measured groundwater elevations in piezometers installed in the WSDOT I-405 Team borings.

Boring	Surface Elevation (ft)	Elevation of Groundwater Observed During Drilling (ft)[1]	Groundwater Measured in Piezometer	
			Date	Elevation (ft)[2]
KG-1-04	186.6	177.0	07/20/04	181.7
			08/31/04	182.0
KI-1-04	154.8	129.8	07/20/04	138.8
			08/31/04	137.25
KJ-1-04	108.3	93.8	07/20/04	99.25
			08/31/04	100.15
KQ-1-04	267.6	247.4	08/04/04	250.85
			08/31/04	251.0
KR-1-04	279.7	260.5	08/04/04	263.25
			08/31/04	262.85
KS-1-04	n/a	(26.0 bgs)[3]	08/04/04	(25.1 bgs)[3]
			08/31/04	(25.35 bgs)[3]
KT-1-04	260.5	251.9	08/04/04	252.8
			08/31/04	253.0
KU-1-04	205.3	182.7	08/04/04	196.25
			08/31/04	196.15
KW-2-04	133.3	121.3		--
KX-10-04	198.0	186.5		--
KX-3-04	166.8	157.8		--
KX-4-04	202.9	187.9		--
KX-9-04	185.2	"Dry hole"		--

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Notes:

[1]The groundwater levels observed during drilling were measured in the drill casing prior to removal. This water level may not truly represent actual groundwater elevation.

[2]The water level measured in a piezometer is representative of a static groundwater condition.

[3]bgs = below ground surface

4.0 EXISTING STRUCTURES (AS-BUILT CONDITIONS) ALONG ALIGNMENT

As part of our services, we completed a detailed review of the available as-built plans for major structures and facilities along the alignment. The structures and facilities included in our review consisted of bridges, retaining walls, sound walls and stormwater facilities. Our review consisted of documenting the structure type and location, pertinent design and construction information (i.e. allowable bearing pressure and footing elevation for shallow foundations), and summarizing representative exploration logs and subsurface conditions. Summary sheets for each of the major existing structures and facilities are presented in Appendix B.

5.0 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS AND CONSIDERATIONS

5.1 EARTHQUAKE ENGINEERING

5.1.1 Design Earthquake Parameters

The seismic design of the Stage 1 Kirkland Segment bridges can be completed using the design criteria presented in the Request for Proposal (RFP) for this project. The design criteria in the RFP references the 1996 USGS National Seismic Hazards Mapping project for determining a peak ground (bedrock) acceleration coefficient for design. A peak ground acceleration of 0.31 is provided in the 1996 USGS mapping project. The acceleration coefficient is based on the expected ground motion at the project site that has a 10 percent probability of exceedence in a 50-year period (475-year return period). The design response spectra presented in the design criteria in the RFP are considered appropriate for seismic design of this project. A Type II Soil Profile response spectrum with a Site Coefficient of 1.2 should be used for seismic design of the Stage 1 improvements.

5.1.2 Liquefaction Potential

Liquefaction is a phenomenon where soils experience a rapid loss of internal strength as a consequence of strong ground shaking. Ground settlement, lateral spreading and/or sand boils may result from liquefaction. Structures supported on liquefied soils could suffer foundation settlement or lateral movement that could be severely damaging to the structures.

Conditions favorable to liquefaction occur in loose to medium dense, clean to moderately silty sand that is below the groundwater level. Based on our evaluation of the subsurface conditions at the site, we conclude that the medium dense to very dense soils located within the project corridor have a low potential for liquefaction during a design earthquake event.

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5.1.3 Lateral Spreading

Lateral spreading involves lateral displacements of large volumes of liquefied soil during an earthquake. Lateral spreading can occur on near-level ground as blocks of surface soils displace relative to adjacent blocks. Lateral spreading also occurs as blocks of surface soils are displaced toward a nearby slope (free face) by movement of the underlying liquefied soil. Due to the low likelihood of liquefaction within the project corridor, we do not anticipate the initiation of lateral spreading during a design earthquake event.

5.1.4 Ground Rupture

Because of the thickness of the non-glacially and glacially consolidated soils below the site and the estimated distance to the closest known fault (in excess of 3 miles), it is our opinion that the potential for surface fault rupture along the alignment is remote.

5.1.5 Landsliding

Based on our geologic reconnaissance, there does not appear to be large-scale active landsliding along the Stage 1 alignment. Thus, earthquake shaking will have a low likelihood of initiating large-scale landsliding, in our opinion.

As with all slopes in western Washington, shallow surficial sliding is possible, particularly when the ground is saturated. Surficial slides typically occur in the upper 2 to 5 feet of soil and movement occurs

episodically, generally in response to heavy rainfall. Earthquake shaking would tend to increase the size of the surficial slide area as well as the frequency of movement.

Steep slopes were observed in the vicinity of Forbes Creek, between approximate milepost 19.1 to 19.6. The steep slopes range up to about 1H:1V (horizontal to vertical). The majority of the slopes are vegetated with brush and trees, however, some unvegetated areas were observed along the steep slopes. These slopes are prone to erosion and surficial landsliding.

While not part of Stage 1, the landslide area north of milepost 22.7, as described in Section 2.3.2, is also prone to landsliding during earthquake shaking.

5.2 BRIDGE FOUNDATION RECOMMENDATIONS

5.2.1 General

We understand that the existing 116th Street bridges (Bridge 405/55E and Bridge 405/55W) will be replaced as part of the current project. The existing bridges are three span structures supported on two abutment piers and two interior piers. Details regarding as-built foundations and subsurface conditions are presented in Appendix B. The southern most pier of each bridge (Pier 1) is supported on a pile foundation system because of the presence of loose embankment approach fill and a 2- to 4-foot-thick layer of organic soils below the fill. The remaining piers for both existing bridges are supported on shallow foundations.

The replacement bridges will be located essentially in the same locations as the existing bridges, between approximately stations NB Line 4217+00 to 4218+50. The bridges will be approximately 150 feet long and 80 feet wide. Each of the bridge designs includes five lanes of traffic with 10-foot wide shoulders on either side of the traffic lanes. Retaining walls with heights on the order of 16 feet may be constructed at the abutments to retain approach fills.

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Cross sections of the proposed east and west replacement bridges are shown in Figures 5 and 6. Subsurface information obtained from borings completed in the vicinity of the proposed bridges is also presented on the cross sections.

Based on the subsurface conditions, it is our opinion that the replacement bridges can be designed using either shallow or deep foundations. Preliminary design criteria for shallow and deep foundations is presented below.

5.2.2 Shallow Foundation Design Criteria

Shallow foundations should be designed in accordance with the design criteria presented in the RFP. These criteria include acceptance requirements for bearing capacity, sliding, and overturning.

Primary and secondary settlement of shallow foundations must not exceed the tolerance of the bridge structure, which generally will be less than 1 inch total. This is of particular importance for the abutment piers of the replacement 116th Street bridges because of the presence of loose fill and soft organic soils at depth. Support of shallow foundations on fill material above this soft silt layer will need to address potential settlement of this layer.

Allowable bearing capacities used for design of the existing bridges varied from 6 to 16 ksf, depending on the soil conditions at the foundation level. See the bridge summary sheet in Appendix B for additional information regarding the as-built conditions for the bridges.

5.2.3 Pile Foundation Design Criteria

Pile capacity and settlement should be evaluated using the design criteria presented in the RFP. It should be specifically understood that WSDOT does not allow or approve the use of augercast piles. Cast-in-place concrete piles may be used provided they are installed within a casing driven to the appropriate acceptance criteria. However, it should be noted that 55-ton (110 kip) HP piles were driven for Pier 1 of the existing 116th Street bridge, most likely because of difficult driving conditions in glacially deposited soils at depth. At least one test pile should be specified for each bridge pier location where piles are used for foundation support.

Lateral load resistance for pile foundations should also be evaluated using the design criteria presented in the RFP. Standard foundation stiffness charts, which are referenced in the RFP design criteria, can be used for this purpose. The standard foundation stiffness charts are for selected combinations of seven standard soil profiles and six typical foundation types for three levels of shaking. Evaluation of the site conditions indicates that standard soil profiles can be used at some of the existing 116th Street bridge piers. These are: Soil Profile S1 for Piers 2 and 3 and Soil Profile S4 for Pier 4. The following table presents a description of the soil profiles presented in the referenced design criteria.

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Standard Soil Profiles

Soil Profile	Brief Description
S1	30 feet of dense glacial till consisting of silty sand with gravel overlying very dense glacial tills (groundwater table at 10 feet).
S2	30 feet of very soft organic silts overlying dense to very dense silty, gravelly sand (groundwater table at surface).
S3	30 feet of medium stiff to very stiff alluvial fills/clays overlying dense to very dense glacial deposits (groundwater table at 5 feet).
S4	30 feet of medium dense to dense alluvial fills/sands overlying dense to very dense glacial deposits (groundwater table at 10 feet).
S5	10 feet of loose sands overlying 50 feet of soft organic silt underlain by dense sand (groundwater table at surface)
S6	70 feet of medium stiff clays overlying dense to very dense glacial deposits (groundwater table at 10 feet).
S7	10 feet of medium dense sand overlying 40 feet of loose, liquefiable sands underlain by dense to very dense glacial deposits (groundwater table at 10 feet).

The soil conditions at Pier 1 of the existing 116th Street bridges cannot be readily correlated to a standard soil profile, and as such, will require more detailed analyses. The lateral loading effects of pile groups should also be included in the analyses.

5.2.4 Drilled Shaft Design Criteria

Drilled shaft capacity and settlement should be evaluated using the design criteria presented in the RFP.

Lateral load resistance for drilled shaft foundations should also be evaluated using the design criteria presented in the RFP. Standard foundation stiffness charts, which are referenced in the RFP design criteria, can be used for this purpose. The standard foundation stiffness charts are for selected combinations of seven standard soil profiles and six typical foundation types for three levels of shaking. Evaluation of the site conditions indicates that standard soil profiles can be used at some of the existing 116th Street bridge piers. These are: Soil Profile S1 for Piers 2 and 3 and Soil Profile S4 for Pier 4. See the table in Section 5.2.3 of this report for a description of the soil profiles.

The soil conditions at Pier 1 of the existing 116th Street bridges cannot be readily correlated to a standard soil profile, and as such, will likely require more detailed analyses. The lateral loading effects of shaft groups should also be included in the analyses.

5.2.5 Bridge Approach Slabs

Approach slabs will be necessary for this project, as referenced in the RFP.

5.3 WALL RECOMMENDATIONS

5.3.1 General

Current plans call for construction of five retaining walls and three noise walls. Additionally, bridge structure abutment walls will also be constructed for the replacement bridges at 116th Street. The locations of the retaining walls (excluding the bridge structure abutment walls) and noise walls are presented in the following table and are shown graphically on the Site Plans, Figures 3A through 3N.

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Wall Type/Number	Location	Begin Station	End Station
Retaining Walls			
3005	NB NE 85th Street On Ramp	4145+68 NB	4154+08 NB
3010	SB NE 116th Street On Ramp	332+62 SB	345+16 SB
3020	NB NE 116th Street Off Ramp	136+44 NB	147+55 NB
3030	NB Infield at NE 116th Street	4214+60 NB	4216+89 NB
3040	SB Infield at NE 116th Street	4210+99 SB	4217+09 SB
Noise Walls			
U4	SB NE 85th Street Off Ramp	4143+12 SB	4147+01 SB
R2	NB NE 85th Street Off Ramp	4144+58 NB	4155+55 NB
N3	SB NE 85th Street to NE 100th Street	4155+85 SB	4165+08 SB

Numerous existing retaining walls and noise walls are present along the Stage 1 alignment. These existing walls are also shown on the Site Plans, Figures 3A and 3N. Details regarding the wall type, foundation conditions, design criteria and subsurface conditions are presented in Appendix B.

5.3.2 Design Considerations

Wall design guidelines are dependant on the relative location of the wall to bridge structures. Criteria and guidelines for design of the various retaining walls and noise walls for the project are presented in the RFP.

In all cases, adequate drainage should be installed behind retaining walls to prevent the build-up of hydrostatic pressures.

Specific design considerations for the walls required for this project are presented below.

5.3.3 Bridge Structure Abutment Walls

Bridge structure abutment walls are required at the 116th Street replacement bridges. Cantilever cast-in-place concrete walls or mechanically stabilized earth (MSE) walls are possible provided requirements for wall settlement and stability are satisfied. The design should take into account sloping conditions in front of and behind the wall, as well as traffic surcharge loading, as appropriate.

Full-height or stub abutment walls founded on shallow foundations may also be considered for support of bridge foundations. If stub abutment walls are chosen, the design of shallow foundations placed within the embankment fill should take into account settlement and bearing capacity on or near a slope.

The presence of the soft organic silt layer noted in the boring at pier 1 of the existing 116th Street bridges should be considered in the design of the bridge structure abutment walls.

5.3.4 Retaining Walls

5.3.4.1 Retaining Wall 3005–Station 4145+68 to 4154 +08 NB–NE 85th Street On Ramp

Retaining Wall 3005 will be constructed to retain the fill embankment placed as part of the lane addition. The wall will either be installed adjacent to Noise Wall U4 or integral with Noise Wall U4 (combination retaining wall/noise wall). Five explorations were completed in the vicinity of this retaining wall including KR-1-04 (Current), KX-4-04 (Current), TP-7 (L-0889), TP-8 (L-0889), and BRZ-7 (L-0889).

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In general, the subsurface soil conditions described on the logs consist of up to 5 feet of fill consisting of silty sand with varying amounts of organics. The fill, where present, is underlain by medium dense to dense sand or gravel with variable silt. The sand and gravel grades to very dense at depths of 1 to 10 feet below the surface. Groundwater was observed in borings KR-1-04 and KX-4-04 during drilling at about 19 and 15 feet below the surface, respectively (this groundwater level was measured in the drill casing prior to removal and may not truly represent actual groundwater elevation). Slow groundwater seepage was observed in TP-7 about 9 feet below the surface. Groundwater was not observed in boring BRZ-7 or test pit TP-8, both of which were completed about 8 feet below the surface.

The geologic maps indicate that the near surface soils consist of advance outwash. In general, the very dense soil conditions near the surface and below the fill are characteristic of advance outwash.

Feasible wall types for consideration include “Standard Plan” walls or pre-approved proprietary MSE walls. Other wall types may also be considered, as discussed in the RFP.

5.3.4.2 Retaining Wall 3010–Station 332+62 to 345+16 SB–NE 116th Street On Ramp

Retaining Wall 3010 will be constructed along the southbound onramp from 116th Street to Interstate 405. The wall will retain fill placed as part of the widening project. At the time this report was prepared it was uncertain whether this wall would be constructed as part of Stage 1 Kirkland Segment, or later as part of Stage 2. The closest borings to the wall alignment are KJ-1-04 (Current), KW-2-04 (Current), B-77 (PSH-1-RE), and B-145 (PSH-1-RE). Borings KJ-1-04 and KW-2-04 were completed on the east side of Interstate 405 about 320 feet east of the proposed retaining wall alignment. Borings B-77 and B-145 were

completed for the NE 116th Street bridge and are located about 420 and 380 feet northeast of the north end of the retaining wall alignment, respectively.

The soil conditions described on the logs are variable. The near surface soil conditions in boring B-145 and KW-2-04 consist of up to 17 feet of loose to medium dense silty sand with gravel characterized as fill in boring B-145. The soils below the fill in boring KW-2-04 and B-145 consist of soft to hard silt and clay and medium dense silty sand. Very dense silty sand with gravel was observed at about 5 feet below the surface in borings KJ-1-04 and B-77 (designated as glacial till on the boring log of B-77). Groundwater was not noted on the log for boring B-145. Groundwater in the remaining borings was observed at depths ranging from about 1 to 14½ feet below the surface. The groundwater level in KW-2-04 may not reflect actual groundwater level as the level was measured in the drill casing prior to removal.

The geologic maps indicate that the near surface soils consist of glacial till. In general, the very dense soil conditions near the surface in borings B-77 and KJ-1-04 are characteristic of glacial till. The near surface soils in borings KW-2-04 and B-145 are characteristic of fill or recessional outwash.

Feasible wall types for consideration include "Standard Plan" walls or pre-approved proprietary MSE walls. Other wall types may also be considered, as discussed in the RFP. The design of the wall may need to take into account the presence of loose to medium dense soil, as encountered in the nearby explorations.

5.3.4.3 Retaining Wall 3020–Station 136+44 to 147+55 NB–NE 116th Street Off Ramp

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Retaining Wall 3020 will be constructed along the east right-of-way of Interstate 405 and will support fill at the southern end of the wall and retain a cut at the northern end of the wall. The subsurface soil conditions near the wall alignment are characterized by the borings KJ-1-04 and KW-2-04, which were completed for the current study. The soil conditions are variable between the two borings. In boring KJ-1-04, the subsurface soils consist of 33 feet of medium dense to very dense silty sand with gravel overlying hard silty clay. In boring KW-2-04, the subsurface soils consist of 8 feet of loose silty sand with gravel, 10 feet of loose to medium dense sand with gravel, 9 feet of hard sandy clay, 12 feet of medium dense silty sand, and 3 feet of silt with sand. Ground water was measured at a depth of 14.5 feet in KJ-1-04 and a depth of 12 feet in KW-2-04. The groundwater level in KW-2-04 may not reflect actual groundwater level as the level was measured in the drill casing prior to removal.

The geologic maps indicate that the near surface soils consist of glacial till. The very dense soil conditions in boring KJ-1-04 are characteristic of glacial till; however, the loose to medium dense soil conditions in boring KW-2-04 are characteristic of fill or recessional outwash.

Feasible wall types in fill areas (southern end of the wall) include "Standard Plan" walls or pre-approved proprietary MSE walls. Soldier pile walls, as discussed below, may also be considered; however, the cost of soldier pile walls is typically much higher. Other wall types may also be considered, as discussed in the RFP. The design of the wall may need to take into account the presence of loose to medium dense soil, as encountered in the nearby explorations.

The northern end of the wall will have a maximum wall height of about 12 feet and will support a cut along the WSDOT right-of-way. These constraints limit the appropriate wall types for this wall. The most likely wall option is a cantilever soldier pile wall because the wall will be situated fully within the right-of-way and temporary construction easements will not be required. Additionally, lagging can be installed immediately after excavation to reduce the risk of caving of the loose soils encountered in boring KJ-1-04. Cantilever soldier pile walls are typically feasible for wall height less than about 15 feet. Other

wall alternatives that may be considered include a "Standard Plan" conventional cast-in-place wall, a tieback soldier pile wall, or a soil nail wall. For each of these wall alternatives, construction easements will be required, either to excavate and install the foundation for a "Standard Plan" wall or to install ground anchors for the tieback soldier pile wall or soil nail wall. Additionally, permanent easements will be required if the foundation or ground anchors are needed for wall stability on a permanent basis.

Typical anchor design values for design of retaining walls supporting cuts are presented below. The design values take into account the variability in soil conditions encountered in the borings:

- Ultimate anchor load transfer of 3 to 10 kips per foot. Typical allowable anchor load transfer values for competent fill and recessional outwash are 1.5 to 2 kips per foot and for glacial till and advance outwash are 3 to 5 kips per foot.
- An allowable anchor load transfer value of 1.5 kips per foot was used for design of the soil nail wall anchors to be installed in existing abutment fills for the Totem Lake/NE 128th Street HOV Direct Access project (WSDOT, 2004). These soil nail walls have not been constructed as of the writing of this report.
- It should be noted that the anchor load transfer value is highly dependant on installation techniques. Lower values are typical of gravity feed grouting (i.e. soil nails). Significantly higher values can be achieved using pressure injection grouting or secondary grouting (i.e. tiebacks).

5.3.4.4 Retaining Wall 3030–Station 4212+60 to 4216+89 NB–Infield at NE 116th Street

Retaining wall 3030 will be constructed in the infield along the northbound off ramp of Interstate 405 at NE 116th Street. This wall will likely retain fill for the majority of the alignment. Boring KW-2-04 was completed in the vicinity of the proposed retaining wall. Boring B-80 (PSH-1-RE) was completed about 140 feet northwest of the north end of the propose wall.

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In boring KW-2-04, the subsurface soils consist of 8 feet of loose silty sand with gravel, 10 feet of loose to medium dense sand with gravel, 9 feet of hard sandy clay, 12 feet of medium dense silty sand, and 3 feet of silt with sand. The subsurface soils in boring B-80 consist of about 2 feet of loose clayey sand underlain by hard sandy silt. Ground water was observed at a depth of 12 feet below the surface in boring KW-2-04. The groundwater level in KW-2-04 may not reflect actual groundwater level as the level was measured in the drill casing prior to removal. The groundwater level in boring B-80 was not noted on the log.

The geologic maps indicate that the near surface soils consist of glacial till. The very dense soil conditions in boring B-80 are characteristic of glacial till; however, the loose to medium dense soil conditions in boring KW-2-04 are characteristic of fill or recessional outwash.

Feasible wall types for consideration include "Standard Plan" walls or pre-approved proprietary MSE walls. Other wall types may also be considered, as discussed in the RFP. The design of the wall may need to take into account the presence of loose to medium dense soil, as encountered in the nearby explorations.

5.3.4.5 Retaining Wall 3040–Station 4210+99 to 4217+09–SB Infield at NE 116th Street

Retaining Wall 3040 will be constructed in the infield along the southbound onramp to Interstate 405 at NE 116th Street. This wall will likely retain fill for the majority of the alignment. The closest borings to the wall alignment are KW-2-04 (Current), B-77 (PSH-1-RE), and B-145 (PSH-1-RE). Boring KW-2-04 was completed on the east side of Interstate 405 about 245 feet east of the proposed retaining wall

alignment. Borings B-77 and B-145 were completed for the NE 116th Street bridge and are located about 100 feet east and northeast of the north end of the retaining wall alignment, respectively.

The soil conditions described on the logs are variable. The near surface soil conditions in boring B-145 and KW-2-04 consist of up to 17 feet of loose to medium dense silty sand with gravel, characterized as fill in boring B-145. The soils below the fill in boring KW-2-04 and B-145 consist of soft to hard silt and clay and medium dense silty sand. Very dense silty sand with gravel, designated as glacial till, was observed at about 5 feet below the surface in boring B-77. Groundwater in borings B-77 and KW-2-04 was observed at depths of 1 to 12 feet below the surface, respectively. Ground water was observed at a depth of 12 feet below the surface in boring KW-2-04. The groundwater level in KW-2-04 may not reflect actual groundwater level as the level was measured in the drill casing prior to removal. Groundwater was not noted on the log for boring B-145.

The geologic maps indicate that the near surface soils consist of glacial till. In general, the very dense soil conditions near the surface in borings B-77 are characteristic of glacial till. The near surface soils in borings KW-2-04 and B-145 are characteristic of fill or recessional outwash.

Feasible wall types for consideration include "Standard Plan" walls or pre-approved proprietary MSE walls. Other wall types may also be considered, as discussed in the RFP. The design of the wall may need to take into account the presence of loose to medium dense soil, as encountered in the nearby explorations.

5.3.5 Noise Walls

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5.3.5.1 Noise Wall U4–Station 4143+12 to 4147+01–SB 85th Off Ramp

Noise Wall U4 will be a replacement wall installed to replace a portion of existing Noise Wall 6 (see Appendix B and Section 5.3.6.4 for information regarding design of the existing noise walls). There are two explorations that were completed in the vicinity of this portion of the noise wall, including KX-10-04 (Current) and BRZ-6 (L-0889).

In general, the subsurface soil conditions described on the logs consist of dense to very dense silty sand with gravel. Groundwater was observed in boring KX-10-04 about 11½ feet below the surface. The groundwater level in KX-10-04 may not reflect actual groundwater level as the level was measured in the drill casing prior to removal. Groundwater was not observed in boring BRZ-6 or KX-9.

The geologic maps indicate that the near surface soils consist of advance outwash. The very dense soil conditions in borings BRZ-6 are designated as glacial till on the boring logs. Boring BRZ-6 was completed near the contact of glacial till and advance outwash shown of the geologic maps. The dense soil conditions observed in boring KX-10-04 are consistent with advance outwash or glacial till.

5.3.5.2 Noise Wall R2–Station 4144+58 to 4155+55 NB–85th Street On Ramp

We understand Noise Wall R2 will replace a portion of existing Noise Wall 7 and will be moved to the east of the existing Noise Wall 7 alignment. There are four explorations that were completed in the vicinity of this portion of the noise wall including KX-4-04 (Current), TP-7 (L-0889), TP-8 (L-0889), and BRZ-7 (L-0889).

In general, the subsurface soil conditions described on the logs consist of up to 5 feet of fill consisting of silty sand with varying amounts of organics. The fill, where present, is underlain by medium dense to dense sand or gravel with variable silt. The sand and gravel grades to very dense at depths of 1 to 10 feet below the surface. Groundwater was observed in boring KX-4 about 15 feet below the surface (may not

reflect actual groundwater level as the level was measured in the drill casing prior to removal). Slow groundwater seepage was observed in TP-7 about 9 feet below the surface. Groundwater was not observed in boring BRZ-7 or test pit TP-8, both of which were completed about 8 feet below the surface.

The geologic maps indicate that the near surface soils consist of advance outwash. In general, the very dense soil conditions near the surface and below the fill are characteristic of advance outwash.

It should be noted that soft subgrade soils and/or unsuitable soils are likely to be encountered during construction along NB 405 Line – Approximate STA 4144 to STA 4146 (70'-80' RT) due to the presence of an existing mapped wetland. The noise wall design should identify the possible presence of soft/unsuitable soils and foundation support options should be developed to take into account the presence of these soils, if necessary.

5.3.5.3 Noise Wall N3–Station 4155+85 to 4165+08 SB–NE 85th Street to NE 100th Street

Noise Wall N3 will be a new wall constructed north of existing Noise Wall 8. The south end of Noise Wall N3 will abut with the north end of existing Noise Wall 8. There are two explorations, BRZ-33 (L-0889) and BH-1 (9807), that were completed near the north and south ends of the proposed noise wall respectively.

In general, the subsurface soil conditions described on the logs indicate up to 7 feet of loose to medium dense fill consisting of sand with variable silt and gravel. The fill is underlain by dense to very dense sand with silt designated advance outwash on the log of boring BH-1. Groundwater was observed in boring BRZ-33 about 16 feet below the surface and about 20 feet below the surface in boring BH-1.

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The geologic maps indicate that the near surface soils consist of advance outwash. The very dense soil conditions observed below the fill are characteristic of advance outwash.

5.3.5.4 Noise Wall Design Considerations

As summarized in Appendix B, the existing noise walls along the Stage 1 alignment consist of either cast-in-place structures supported on 21-foot-long drilled shafts or pre-cast concrete panels installed in a lean concrete filled trench with an embedment depth of 5 to 9 feet. Cast-in-place noise walls were typically used in areas where fill was placed while pre-cast panels were typically used in cut areas. The foundations were designed using the spiral log method assuming an internal soil friction angle of 32 degrees and a soil unit weight of 120 pcf (pounds per cubic foot). The design method is referenced on the "As-Built" plan sheets fore each noise wall, provided in Appendix B.

The design of the existing noise walls was completed prior to development of WSDOT "Standard Plans" for foundations for noise walls. It appears that for the cast-in-place noise walls, the worst case soil and ground surface configuration conditions for this type of noise wall and foundation support were used in design of all similar noise walls along the Interstate 405 Kirkland Segment. Using the current "Standard Plans," the shaft embedment depth would be significantly less than the existing drilled shaft depth.

"Standard Plan" walls may be considered for design of the new noise walls. Depending on the final ground surface configuration, "Standard Plans" may not be allowed and a special design may be required. Special designs are typically used when there is sloping ground adjacent to the wall. Special designs may also be required for other reasons, such as wind speed and type of exposure. If special designs are required, the foundation design should be completed using the guidelines presented in the RFP.

5.4 STORMWATER FACILITY RECOMMENDATIONS

5.4.1 General

Current plans call for construction of three stormwater detention facilities and five ecology embankments. The locations of these facilities are presented in the following table and are shown graphically on the Site Plans, Figures 3A through 3N.

Detention Facilities	Milepost	Station	
B4 Pond	18.22	4132+00 NB	
C Pond	19.10	4179+00 SB	
C Vault	19.35 to 19.50	4192+50 SB	4200+00 SB
Ecology Embankments			
B4.1	18.16 – 18.25	4129+50 NB	4134+50 NB
B4.2	18.34 – 18.58	4139+00 NB	4151+00 NB
C1.1	18.58 – 19.36	4151+50 SB	4192+50 SB
C1.2	19.10 – 19.60	4179+00 NB	4205+00 NB
D1.1	19.85 – 19.95	4219+00 SB	4224+00 SB

5.4.2 Detention Ponds

5.4.2.1 B4 Pond–Station 4132+00 NB

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Explorations completed in the vicinity of the planned B4 Pond include: KQ-1-04 (Current), B-60 (PSH-1-RE), BRZ-49 (L-0889) and BRZ-50 (L-0889). Boring KQ-1-04 was completed in the vicinity of the proposed pond. Boring B-60 was completed approximately 400 feet south of the proposed pond. The other two borings were completed in the median of Interstate 405 approximately 200 feet southwest and 250 feet northwest of the proposed pond.

The log of boring KQ-1-04 indicates the presence of 19½ feet of loose to dense sand with variable silt content underlain by very dense silty sand with gravel. The exploration logs for the borings completed in the median of Interstate 405 indicate the presence of 10 to 24 feet of fill typically consisting of sand with variable silt and gravel. Boring BRZ-49 terminates in the fill at a depth of 24 feet. The log for boring B-60 indicates the presence of approximately 3 to 4 feet of soft sandy silt near the surface. The silt and fill in borings B-60 and BRZ-50 are underlain by dense to very dense silty sand with gravel (described as glacial till on one log).

Based on the geologic maps, advance outwash is likely to be present at the location of the pond. However, the pond bottom will likely be located in embankment fill placed for the NE 85th Street Interchange.

5.4.2.2 C Pond–Station 4179+00 SB

Explorations completed in the vicinity of the planned C Pond include: BRZ-26 (L-0889) and BRZ-13 (L-0889). The borings are located within about 50 feet of the planned C Pond location.

The exploration log for boring BRZ-26 indicates the presence of up to 5 feet of fill consisting of sand with silt and gravel. The fill is underlain by silt. The log for boring B-13 indicates that the near surface soils consist of silty sand, most likely native.

The borings (BRZ-26 and BRZ-13) were completed in areas mapped as glacial till, which is consistent with the soil descriptions on the logs. Based on the geologic maps, the location of the pond is near the contact between advance outwash and glacial till.

5.4.2.3 Design Considerations

The design of the stormwater detention ponds and constructed wetlands should be completed in accordance with guidelines presented in the RFP.

The RFP design guidelines provide recommendations for embankment side slopes, which preferably are not to exceed a slope of 3H:1V. As currently envisioned, the ponds are designed with side slopes of 3H:1V. The guidelines also provide two methods for infiltration design, if applicable: 1) a detailed analysis which considers the site specific hydraulic gradient for the site and 2) a simplified method which considers the estimated infiltration rate of the site soils. The site specific hydraulic gradient in the detailed analysis is estimated using an empirical equation based on several ASTM gradation properties of the soil. For critical designs, in-situ hydraulic gradient values can be obtained through field tests such as packer permeability tests, piezocones, or through the use of a pilot infiltration test (PIT). The infiltration rate using the simplified method is estimated using the ASTM D_{10} gradation value (particle size for which 10 percent of the sample is finer).

Using the simplified method and gradation results from laboratory tests on soil samples from the borings, the estimated long-term infiltration rate of the soils generally cannot be evaluated because the soils contain greater than 10 percent fines (silt and clay). For soils with greater than 10 percent fines, the long-term infiltration rate is less than 1 inch per hour. Additional laboratory testing, including hydrometer analyses, would be required to define the long-term infiltration rate using the ASTM D_{10} gradation methods, as the soils contain more than 10 percent fines (silt and clay).

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An exception is one soil sample from boring KQ-1-04, located in the planned B4 Pond location. The soil sample consists of fill material that has a D_{10} of slightly greater than 0.1 millimeters. At this soil sample location, the estimated long-term infiltration rate is estimated to be about 2.0 inches per hour.

It should be noted that B4 Pond is located in an embankment. Infiltration of stormwater may cause saturation of the fill soils, leading to slope instability. The stability of the embankment, as described in Section 5.6 of this report, should be evaluated as part of the design of the pond.

5.4.3 Detention Vault – Station 4192+50 To 4200+00 SB

Boring KJ-1 (Current) was completed near the planned detention vault. The subsurface conditions observed in boring KJ-1 consist of 18 feet of very dense silty sand with gravel. A layer of medium dense to dense silty sand with larger gravels was observed between about 18 feet and 25 feet below the surface. Very dense silty sand with gravel extends down to about 34 feet below the surface. The silty sand is underlain by hard sandy clay. Groundwater was observed about 14½ feet below the surface at the time of drilling.

We anticipate that the most cost-effective design for the detention vault will be either a pre-cast or cast-in-place concrete structure supported on shallow foundations. The structure should be designed using the guidelines presented in the RFP.

The detention vault will be located near a topographic depression and long-term hydrostatic forces may be present if adequate drainage is not provided. If drainage is not included in the design, the vault walls should be designed for full hydrostatic pressures. Additionally, the vault and structural design of the floor

slab should be designed for buoyancy and uplift. A minimum factor of safety of 1.5 should be used for buoyancy and uplift design.

Soft subgrade soils and/or unsuitable soils are likely to be encountered during construction along SB 405 Line – Approximate STA 4198+00 to STA 4204+00 (100'-180' LT). The detention vault design should identify the presence of soft/unsuitable soils and foundation support options should be developed to take into account the presence of these soils, if present.

5.4.4 Ecology Embankments

5.4.4.1 General

Five ecology embankments are planned along the Stage 1 project alignment. The ecology embankments are essentially long, narrow, stone-filled trenches used for the collection, temporary storage, and infiltration of stormwater runoff. They may also be designed for runoff treatment.

Four of the ecology ditches/embankments are located along the east and west sides of Interstate 405 between NE 85th Street and NE 116th Street. The fifth ecology ditch/embankment is located on the west side of Interstate 405 between NE 116th Street and the BNRR Overcrossing. The facility number and locations of the ecology embankments are presented in the table in Section 5.4.1 of this report and are shown on the Site Plans, Figures 3A through 3N.

5.4.4.2 Ecology Embankment B4.1–Station 4129+50 to 4134+50 NB

Explorations completed along Interstate 405 in the vicinity of the proposed ecology embankment include: B-60 (PSH-1-RE), BRZ-49 (L-0889) and BRZ-50 (L-0889). B-60 was completed on the east side of Interstate 405 near the south end of the proposed embankments. The other two borings were completed in the median of Interstate 405 approximately 110 feet west of the proposed embankment alignment.

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The exploration logs indicate the presence of 10 to 24 feet of fill in the median of Interstate 405 typically consisting of sand with variable silt and gravel. Boring BRZ-49 terminates in the fill at a depth of 24 feet. The log for boring B-60 indicates the presence of approximately 3 to 4 feet of soft sandy silt near the surface. The silt and fill in borings B-60 and BRZ-50 are underlain by dense to very dense silty sand with gravel (described as glacial till on one log).

Based on the geologic maps, advance outwash is mapped along the ecology embankment alignment. However, the ecology embankment, particularly the southern end, will likely be located in embankment fill placed for the NE 85th Street Interchange.

5.4.4.3 Ecology Embankment B4.2–Station 4139+00 to 4151+00 NB

Explorations completed along the east side of Interstate 405 for ecology embankment B4.2 include: KX-9-04 (Current), TP-7 (L-0889) and BRZ-7 (L-0889).

The exploration logs indicate the presence of up to 5 feet of fill typically consisting of silty sand with gravel. The fill observed in the borings is underlain by sand with some gravel in test pit TP-7 and by silty sand with gravel in boring BRZ-7. In boring KX-9-04, where fill is not noted on the log, the near-surface soils generally consist of silty sand with gravel.

Based on the geologic maps, advance outwash is likely to be present along the length of ecology embankment B4.2. Borings TP-7 and BRZ-7 were completed in the area mapped as advance outwash; however, fill is present at the surface these two borings. The soil below the fill in test pit TP-7 is

generally consistent with advance outwash; although, no geologic description is included on the log. However, the soil near the surface or below the fill described on the logs for borings BRZ-7 and KX-9-04 is consistent with glacial till and is described as such on one of the logs.

5.4.4.4 Ecology Embankment C1.1–Station 4151+50 to 4192+50 SB

Explorations completed along the west side of Interstate 405 near ecology embankment C1.1 include: BRZ-33 (L-0889), BH-2 (9807), BRZ-17 (L-0889), BRZ-13 (L-0889), TP-13 (L-0889), and KI-1-04 (Current).

The exploration logs indicate the presence of up to 10 feet of fill typically consisting of silty sand with gravel. In areas where fill is not noted on the logs, the near-surface soils generally consist of silty sand with gravel (described as advance outwash and glacial till on the logs).

Based on the geologic maps, advance outwash is likely to be present from Station 4151+00 to SB 4179+00, and glacial till is likely to be present from about 4179+00 to 4192+50. Borings BRZ-33, BH-2 and BRZ-17 were completed in the area mapped as advance outwash; however, fill is present at the surface in two of these borings. The remainder of the borings were completed in areas mapped as glacial till, which is consistent with the soils described on the boring logs.

5.4.4.5 Ecology Embankment C1.2–Station 4179+00 to 4205+00 SB

Explorations completed in the vicinity of the ecology embankment C1.2 along the east side of Interstate 405 include: KX-3-04 (Current) and KJ-1-04 (Current).

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In general, the near surface soil conditions presented on the log of boring KX-3-04 completed near the south end of the proposed ecology embankment consist of approximately 15 feet of medium dense silty sand with gravel. Wood and trace organic material were observed in two of the samples in the upper 10 feet indicating that this may be fill. Medium dense to dense silty sand with gravel consistent with glacial till was observed about 15 feet below the surface. Very dense silty sand with gravel (consistent with glacial till) was observed near the surface in boring KJ-1-04.

Based on the geologic maps, glacial till will likely be present. The borings (KX-3-04 and KJ-1-04) were completed in areas mapped as glacial till, which is consistent with the soil descriptions on the logs.

5.4.4.6 Ecology Embankment D1.1–Station 4219+00 to 4224+00 SB

The final ecology embankment, D1.1, is located on the west side of Interstate 405 between NE 116th Street and the BNRR Overcrossing. Explorations along the ditch alignment include B-79 (PSH-1-RE), B-147 (PSH-1-RE) and B-171 (PSH-1-RE).

The exploration logs indicate that glacial till or fill was present at the ground surface; however, a significant amount of embankment fill for construction of Interstate 405 was placed following drilling of the borings. The composition and density of this existing embankment fill is not known at this time. The fill will need to be characterized in order to design this facility.

The geologic maps indicate that the proposed ecology embankment will be constructed in an area designated as glacial till. The soil descriptions on the logs are consistent with glacial till.

5.4.4.7 Design Criteria

The design of the ecology embankments should be completed in accordance with guidelines presented in the RFP.

The RFP design guidelines provide two methods for infiltration design, if applicable: 1) a detailed analysis which considers the site specific hydraulic gradient for the site and 2) a simplified method which considers the estimated infiltration rate of the site soils. The site specific hydraulic gradient in the detailed analysis is estimated using an empirical equation based on several ASTM gradation properties of the soil. For critical designs, in-situ hydraulic gradient values can be obtained through field tests such as packer permeability tests, piezocones, or through the use of a pilot infiltration test (PIT). The infiltration rate using the simplified method is estimated using the ASTM D_{10} gradation value.

It should be noted that the RFP design guidelines state that the simplified method described above must not be used for determining short-term infiltration rates for runoff treatment infiltration facilities. The table below presents the anticipated soil conditions along the embankment alignment, available laboratory test results from the explorations, as well as the estimated long-term infiltration rates.

Facility Number	Stationing	Soil Type	Number of Sieve Analyses	Results of Sieve Analyses D_{10} (mm)	Estimated Infiltration Rate
B4.1	4129+50 NB – 4134+50 NB	Advance Outwash/Fill	6	< 0.075	< 1 inch per hour
B4.2	4139+00 NB – 4151+00 NB	Advance Outwash/Glacial Till	4	< 0.075	< 1 inch per hour
C1.1	4151+50 SB – 4175+00 SB	Fill	3	< 0.075	< 1 inch per hour
		Advance Outwash	3	0.1 - 0.2	2 - 3.5
	4175+00 SB – 4192+50 SB	Glacial Till	6	< 0.075	< 1 inch per hour
C1.2	4179+00 NB – 4205+00 NB	Glacial Till/Fill	9	< 0.075	< 1 inch per hour
D1.1	4219+00 SB – 4224+00 SB	Glacial Till/Fill	None	-	-

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The estimated infiltration rates presented in the above table were developed using the ASTM D_{10} gradation results from laboratory tests and the simplified method described above. It should be noted that the bottom elevation of the ecology embankments had not been determined at the time this report was prepared. As such, we included all gradation test results from the explorations completed near the embankment locations. The estimated infiltration rates may be used for preliminary purposes; however, the actual infiltration rate will be highly dependent on the bottom elevation of the embankment.

It should also be noted that several of the ecology embankments are sited in areas where significant thicknesses of fill were placed, namely ecology embankments B4.1 and D1.1. The estimated infiltration rates provided above are typically for the native soils underlying the fill, as most of the borings were completed prior to fill placement. Infiltration of stormwater may cause saturation of the fill soils, leading to slope instability. The stability of the embankment, as described in Section 5.6 of this report, should be evaluated as part of the design of the pond

5.4.5 Facility – Forbes Creek

5.4.5.1 General

It is anticipated that a new culvert will be installed below Interstate 405 at about milepost 19.13. The culvert will be about 60 inches in diameter and approximately 500 feet in length. The culvert will likely be installed with a bore and jack process and will be located up to 30 feet below the existing ground surface. The culvert invert elevation will likely be near the elevation of the old creek bed of Forbes Creek.

Forbes Creek currently crosses under Interstate 405 at about station SB 405 Line 4182+00. Four explorations exist along the west side of Interstate 405 in the vicinity of Forbes Creek including: TP-13 (L-0889), BRZ-13 (L-0889), BRZ-26 (L-0889), and KI-1-04 (Current). In general, the soil conditions presented on the explorations logs consist of 0 to 5 feet of fill consisting of medium dense sand with variable silt and gravel over dense to very dense silty sand with gravel (described as glacial till in several explorations). Hard silt was observed near the bottom of borings BRZ-26 and KI-1-04. Groundwater was observed at about Elevation 130 feet in boring KI-1-04.

5.4.5.2 Design Considerations

Because of the wide variety of installation technique and equipment, the design of bore and jack operations is best left up to the contractor. All culvert pipe should meet the minimum requirements as specified in the RFP design criteria. The design and submittal should include necessary information to ensure that the pipe can be installed along the planned alignment without damage to the culvert pipe or settlement to the adjacent facilities. It is important to note that the bore and jack casing will likely encounter a mixed face condition with dense, native soils near the bottom of the pipe and existing fill soils in the upper portion of the pipe. The lower, native soils will tend to push the casing upward into the fill upon jacking.

5.5 Sign, Sign Bridge and Signal Pole Foundations

The number and location of new signs, sign bridges, and signal poles planned as part of the Stage 1 improvements were not available at the time this report was prepared. However, based on the general soil conditions along the project alignment and previous geotechnical studies, "Standard Plan" foundations have typically been used for the design of these structures.

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A common design value used for these features as described in many of the previous studies is an allowable lateral bearing pressure of 2,500 psf (pounds per square foot). This value was used for the Totem Lake/NE 128th Street HOV Direct Access project (WSDOT, 2004) and for the SR 405, Northup to Bothell HOV project (WSDOT, 1992).

For foundations placed on or near a slope, the foundation depth will need to be increased or special foundation designs will be required. Special designs may also be required for other reasons, such as structure configuration (i.e. cantilever signs with long mast arms). Special foundation designs should be completed using the guidelines presented in the RFP.

5.6 Embankments And Cut Slopes

5.6.1 General

Existing fill embankments and cut slopes into native soils are present along the east and west sides of Interstate 405. The inclinations of the cut slopes and fill embankments are generally sloped at about 2H:1V (horizontal to vertical) or flatter. Based on our observations, in general the embankment and cut slopes appear stable throughout the Stage 1 alignment.

New fill embankments and cut slopes are planned along the Stage 1 alignment. The limits of the fill embankments and cut slopes are shown on the Site Plans, Figures 3A through 3N.

5.6.2 Design Considerations

The design requirements for embankments and cut slopes are dependant on the location along the alignment. Bridge approach embankments require Gravel Borrow material. The factor of safety for

bridge approach embankments should be at least 1.5 for static conditions and 1.1 for seismic conditions if the embankment supports the structure foundation or if an abutment wall supports the embankment.

For all other embankments not defined as bridge approach embankments, Select or Common Borrow may be used for fill embankment construction. Global stability analyses should be completed for each embankment or cut slope, and the factor of safety should be at least 1.3 for static conditions. These embankments or cut slopes generally do not need to be designed for seismic conditions.

If retaining walls are designed to support embankments or cut slopes, the overall stability of the embankments and slopes in the vicinity of the walls shall be considered as part of the design of retaining walls. All embankment design must meet the requirements outlined in the RFP.

Soft subgrade soils and/or unsuitable soils are likely to be encountered during construction in areas adjacent to existing mapped wetlands. Soft/unsuitable soil may also be present in other areas along the project alignment. Soft/unsuitable soils will likely require overexcavation and replacement with suitable borrow materials in order to achieve adequate embankment stability. Alternatively, using staged-construction and preloads may be acceptable techniques for constructing embankments over soft ground. Mapped wetlands present along the alignment are shown on Figures 3A through 3N.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 BRIDGE FOUNDATIONS

6.1.1 General Considerations

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An existing camera pole and other electrical equipment are located south of Pier 1 of the existing 116th Street bridge structure 405/55E. These facilities, as well as other utilities and existing bridge foundation elements within the construction area, will need to be removed prior to construction of the new bridge foundations.

6.1.2 Shallow Foundations

Based on the borings completed for the existing 116th bridge structures, groundwater was present within 4 feet of the original ground surface. Groundwater seepage was expected during foundation excavation for this structure, but the groundwater quantity was not anticipated to be excessive and was expected to be handled by ditching and/or pumped sumps.

Groundwater seepage should be anticipated for shallow foundation excavations for intermediate piers of the new bridges. If not properly controlled, the subgrade soils could become muddy and/or unstable and may require overexcavation. It is prudent to channel groundwater away from the footing subgrade as it's encountered, before saturation and deterioration of the subgrade occurs.

The stability of temporary footing excavations will need to be addressed in order to construct shallow foundations. Open cuts may be completed where space allows. Driven shoring, e.g. sheet piling, should be expected to meet refusal in the dense/hard native soils underlying the fill at the site. Cantilevered shoring may be appropriate for the abutment piers of the new structure, but likely will not be appropriate for interior piers because native soils are near the existing ground surface and penetration of sheets below the base of the excavation may be difficult. Alternative shoring methods, such as crossed-braced sheets or soldier pile and lagging walls, may be more appropriate.

6.1.3 Pile Foundations

Pile driving should be completed in general accordance with the WSDOT (2004) "Standard Specifications." Additionally, at least one test pile should be driven at each bridge pier location prior to driving production piles.

Interstate 405 will likely remain open during construction of the replacement bridges. This will result in a heavily congested work area. Pile installation, movement of pile driving equipment and staging of construction materials will need to be considered in order to maintain operation of Interstate 405.

6.1.4 Drilled Shafts

Groundwater seepage should be expected in drilled shaft excavations, and the contractor should be prepared to deal with these conditions. Control of groundwater may require the use of temporary casing or "wet" construction using drilling slurries to maintain sidewall stability of the drilled hole. Temporary casing may also be required to maintain support of the existing embankment fill material during drilled shaft construction. If "wet" construction methods are used, it will be necessary to use tremie methods for placement of concrete. Nondestructive testing of shafts using Cross Sonic Logging (CSL) is required for all drilled shafts constructed using "wet" methods. Installation of the CSL logging tubes should occur during construction.

Drilled shafts should be drilled with equipment that reduces the amount of loose cuttings or slough at the bottom of the drilled hole. All slough and loose cuttings should be removed from the hole prior to placing the concrete.

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Cobbles and boulders are frequently encountered in glacially deposited soils. The contractor should be prepared to remove cobbles and boulders during drilled shaft construction.

Interstate 405 will likely remain open during construction of the replacement bridges. This will result in a heavily congested work area. Shaft installation, movement of equipment and staging of construction materials will need to be considered in order to maintain operation of Interstate 405.

6.2 WALLS

6.2.1 Walls Supporting Cuts

The construction considerations presented in Section 6.1 for bridge foundations are also appropriate for retaining wall foundations, depending on the type of wall and foundation support option selected during design.

Groundwater seepage should be expected in drilled shaft excavations for soldier piles should a soldier pile wall be selected to support cuts. Soldier pile excavation may require temporary casing, drilling slurry, or a combination of both, in order to maintain stability of the drilled hole. Temporary casing may also be required to maintain support of the loose soils near the ground surface during soldier pile construction.

Face stability and localized caving may occur during installation of soil nail walls (should this method be selected for support cuts) due to the presence of loose soils near the ground surface and shallow groundwater. The soil nail contractor should be prepared to modify their excavation and soil nailing methodology to reduce caving, as excessive caving could impact facilities outside the Interstate 405 right-of-way. Face stability is less of an issue for soldier pile walls but still needs to be considered when installing lagging.

Cobbles and boulders are frequently encountered in glacially deposited soils. The contractor should be prepared to remove cobbles and boulders during drilled shaft construction for soldier piles. The contractor's drilling method for ground anchors (soil nails or tiebacks) should also be capable of dealing with cobbles and boulders, should they be encountered.

6.2.2 Sound Walls and Fill Walls

The construction considerations presented in Section 6.1 for bridge foundations are also appropriate for sound wall and fill wall foundations, depending on the foundation support option selected during design.

As previously stated, soft subgrade soils and/or unsuitable soils are likely to be encountered during construction in areas adjacent to existing mapped wetlands. Soft/unsuitable soils may require overexcavation and replacement with suitable borrow materials, depending on the foundation support option selected for the sound wall.

6.3 STORMWATER FACILITIES

6.3.1 Detention Ponds

Highly variable soils are likely to be encountered during construction because the facilities, particularly Pond B4, are located within an existing roadway fill. Care should be taken by the contractor to reduce the amount of soil disturbance and fill stability during construction.

6.3.2 Detention Vault

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The construction considerations presented in Section 6.1.2 for shallow foundations are also appropriate for construction of the detention vault foundation.

As previously stated, soft subgrade soils and/or unsuitable soils are likely to be encountered during construction in areas adjacent to existing mapped wetlands. Soft/unsuitable soils may require overexcavation and replacement with suitable borrow materials. Care should be taken by the contractor to reduce the amount of soil disturbance in the adjacent wetland during construction.

6.3.3 Ecology Embankments

Initial excavation for ecology embankments designed for infiltration should be completed to within about 1 foot of the finished grade. Final excavation to finish grade should be deferred until all disturbed areas upgradient of the facility have been stabilized or protected; otherwise the infiltration capacity can be significantly decreased. The final phase of excavation should remove all accumulated sediment from the facility.

Infiltration facilities should generally not be used as temporary sediment traps during construction because of the potential for decreasing the long-term infiltration capacity of the soils.

6.3.4 Forbes Creek

We anticipate that the soil conditions along the proposed alignment of the culvert will consist of fill and alluvium overlying dense native soils. It is likely that the drilling will encounter a mixed face condition. Because of the variable density of the soils, the leading edge of the pipe will tend to be deflected into the looser/softer soils. The contractor performing the construction should be prepared to compensate for this condition to maintain the correct pipe alignment and invert profile.

Based on the subsurface soils encountered in the explorations, low to moderate sidewall friction should be anticipated during jacking operations. Problems with side friction can be reduced by injecting bentonite slurry around the perimeter of the pipe.

The jacking and receiving pits may require excavations for equipment access. Depending on the locations of the pits, the excavations may need to be temporarily shored. The decision to shore the temporary jacking or receiving pits will depend on the proximity of improvements. The Contractor should be responsible for the design and maintenance of shoring and for the safety of people and equipment in and near the excavations.

It is likely that the proposed culvert will be installed near the existing culvert for Forbes Creek and that surface water or groundwater associated with the creek will seep into the jacking and receiving pits. Therefore, dewatering in the jacking and receiving pit areas will likely be necessary.

6.4 Sign, Sign Bridge and Signal Pole Foundations

The construction considerations presented in Section 6.1 for bridge foundations are also appropriate for sign, sign bridge, and signal pole foundations.

6.5 Embankments and Cut Slopes

The Golder (2004) "Geology, Soils, and Groundwater Discipline Report" mentions the presence of a Metro Sewer Line between milepost 19.45 and 19.65 at a depth of 15 feet or more below the existing ground surface. Impacts of fill placement over the sewer line will need to be considered during construction.

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The majority of the existing soils at the site contains a high percentage of fines (silt material passing the US No. 200 sieve) and are moisture sensitive. Operation of equipment on the site soils will be difficult if embankment construction is completed during wet weather. Disturbance of shallow subgrade soils should be expected if construction is completed during periods of wet weather.

Gravel Borrow, as defined in WSDOT (2004) "Standard Specification" will likely be required for embankment construction during wet weather. Select and Common Borrow materials, as defined in WSDOT (2004) "Standard Specifications," are not considered to be wet weather construction materials. It should be noted that compaction of borrow materials, even Gravel Borrow, may be difficult during wet weather, unless the fines content is restricted to less than 5 percent. Section 3.2 of this report provides some general guidance regarding the re-use of on-site soils for fill and what gradation criteria (Common Borrow, Select Borrow, or Gravel Borrow) they often meet.

Soft subgrade soils and/or unsuitable soils are likely to be encountered during construction in areas adjacent to existing mapped wetlands, as shown on Figures 3A through 3N of this report. Soft/unsuitable soil may also be present in other areas along the project alignment. Soft/unsuitable soils may require overexcavation and replacement with suitable borrow materials in order to achieve adequate embankment stability. Alternatively, staged construction and/or preloading may be more appropriate depending upon the thickness, composition and total volume of the unsuitable soils that would otherwise be overexcavated.

The contractor should expect limited work and staging areas for embankment and cut slope construction because of right-of-way constraints and the need to maintain operation of Interstate 405 during construction.

7.0 SUPPLEMENTAL SUBSURFACE EXPLORATIONS

The thirteen new explorations for this study were completed to fill-in data gaps along the project alignment and to aid in general site characterization. Since specific borings were not completed for the planned facilities, supplemental geotechnical explorations will be necessary to confirm subsurface conditions and to develop final design criteria for the facilities. The number and location of supplemental explorations should meet the minimum criteria provided in the RFP.

8.0 LIMITATIONS

We have prepared this report for the exclusive use by the Interstate 405 Design Team and other members of the project team for the subject project. The data and report should be provided to prospective contractors for their bidding or estimating purposes, but our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the fields of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

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1 inch equals 3,000 feet

0 1000 2000 4000 6000 8000 10000 Feet

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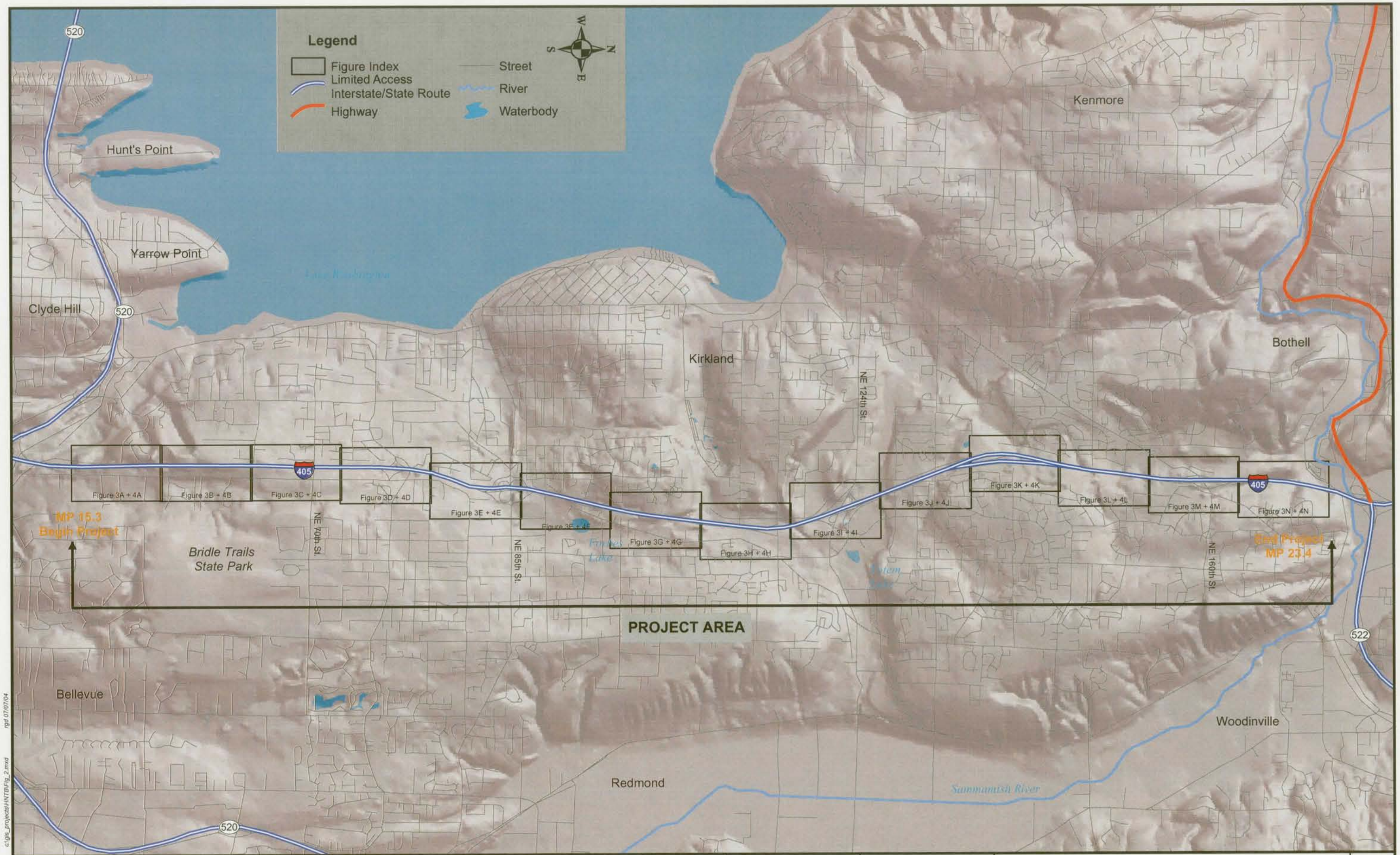
Project Location Plan

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 1



Notes:
Data Sources: Imagery and LiDAR data obtained from King County. Orthophotography is the USGS 2002 coverage and has 15 cm pixel resolution. LiDAR data interpolated to DEM with 9 foot GSD from its native coordinate system which is State Plane Washington North, projected to Horizontal Datum NAD83 (HARN) feet; Vertical Datum is NAVD88. Digital Terrain Model (DTM) created by GeoEngineers from LiDAR DEM using ERDAS ArcGIS CUTG software.

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1 inch equals 3,000 feet

0 1000 2000 4000 6000 8000 10000 Feet

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Index to Site Plans & Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 2

rgd 07/07/04

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Site Plan

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 3A

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WATERSHED PARK

50th

BRZ-38
L0889

NOISE WALL 1

TP-22
L0889

MP. 16

BRZ-11
L0889

NOISE WALL 2

117th

NE 48th Pl

117th

118th

43rd

BRIDLE TRAILS NEIGHBORHOOD

Legend

Borings
- Historical
- WSDOT I-405 Team

- MP. 16.5
- Waterbody
- Wetlands
- Ecology Embankments
- Pond
- Vault

- Cut
- Fill
- Current Lanes
- Project 1 Lanes
- Proposed Wall
- Existing Wall
- Tax Parcels

W S N E

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Notes
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1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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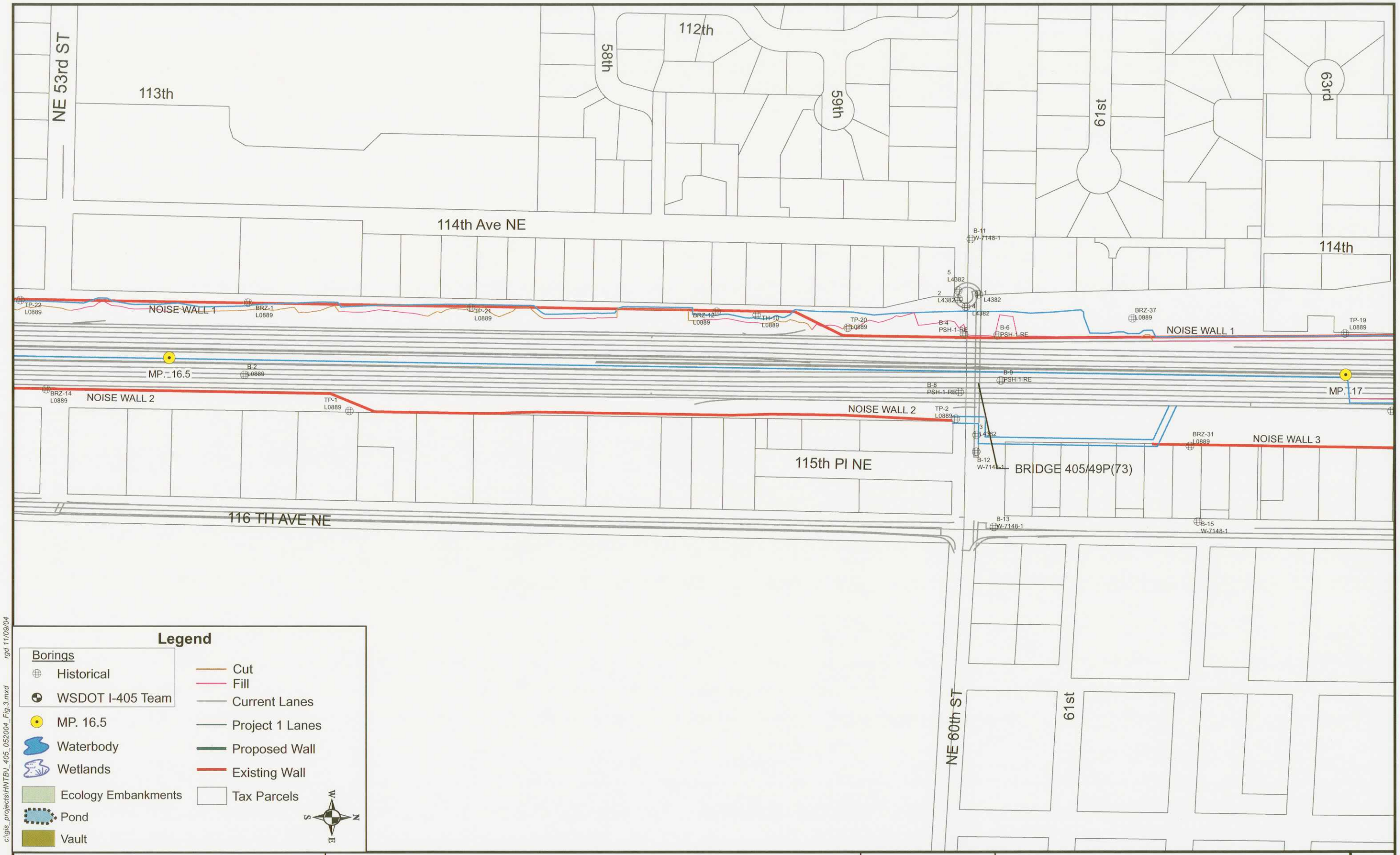
Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE
3B


NE 53rd ST
113th
112th
58th
59th
61st
63rd
114th Ave NE
114th
NOISE WALL 1
NOISE WALL 2
NOISE WALL 3
MP. 16.5
MP. 17
115th Pl NE
116 TH AVE NE
BRIDGE 405/49P(73)
NE 60th ST
61st
Legend
Borings
Historical
WSDOT I-405 Team
MP. 16.5
Waterbody
Wetlands
Ecology Embankments
Pond
Vault
Cut
Fill
Current Lanes
Project 1 Lanes
Proposed Wall
Existing Wall
Tax Parcels
N
W
S
E
1 inch equals 200 feet
0
100
200
400
600
800
1,000
Feet
GEOENGINEERS
Earth Science + Technology
Site Plan
Geotechnical Baseline Report I-405, SR 520 to 522
FIGURE
3C
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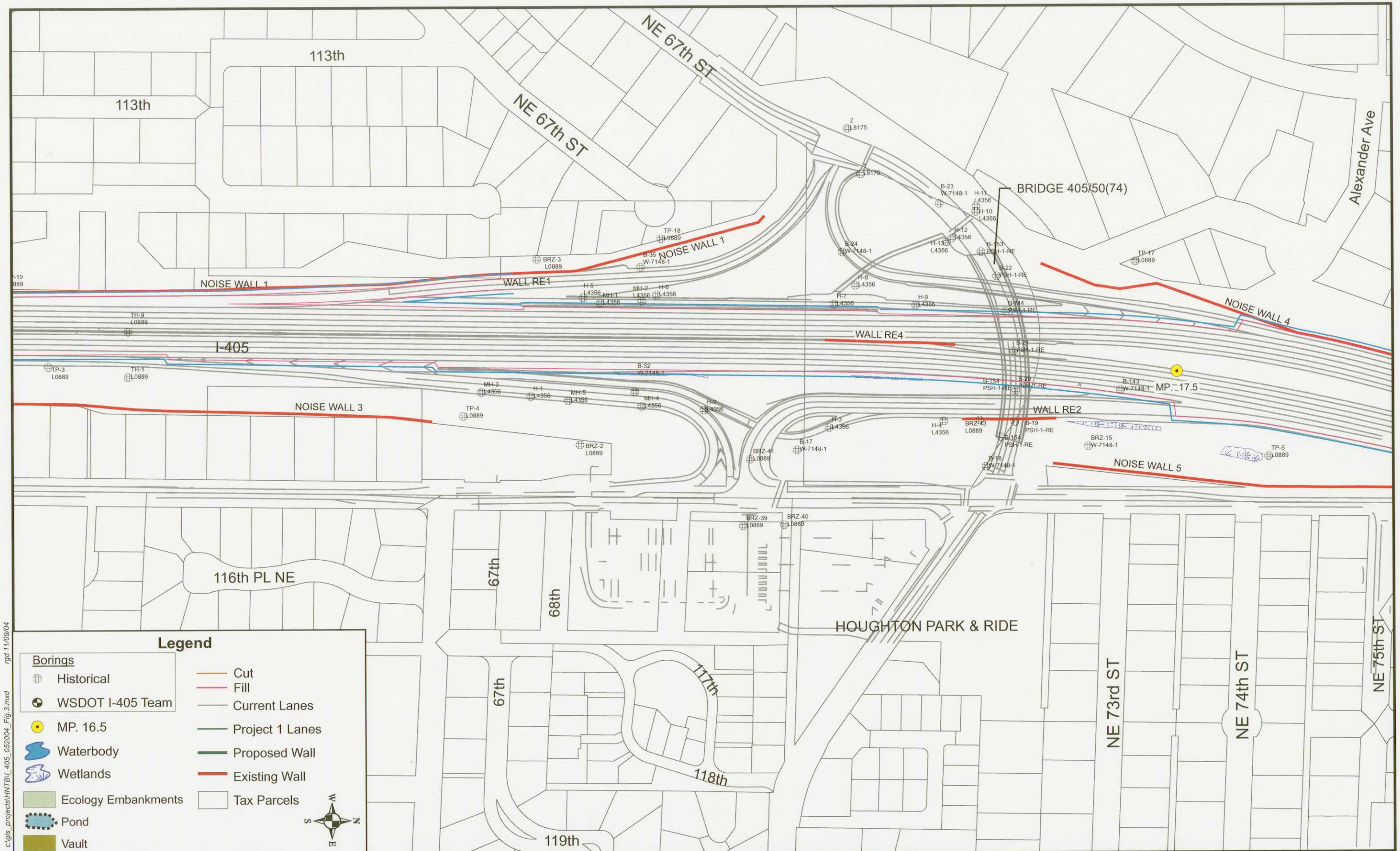

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1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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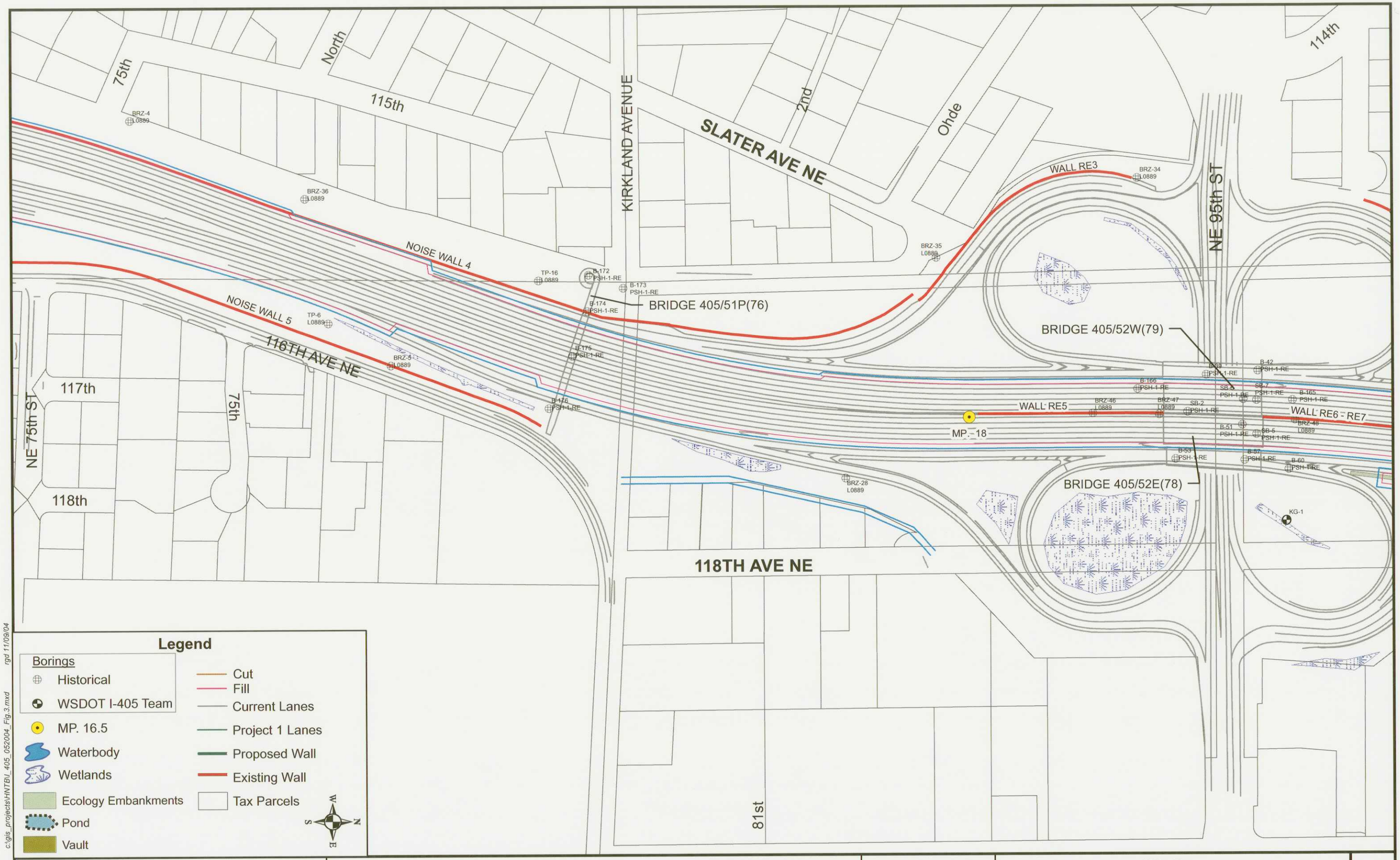
Site Plan

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 3D



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0 100 200 400 600 800 1,000 Feet

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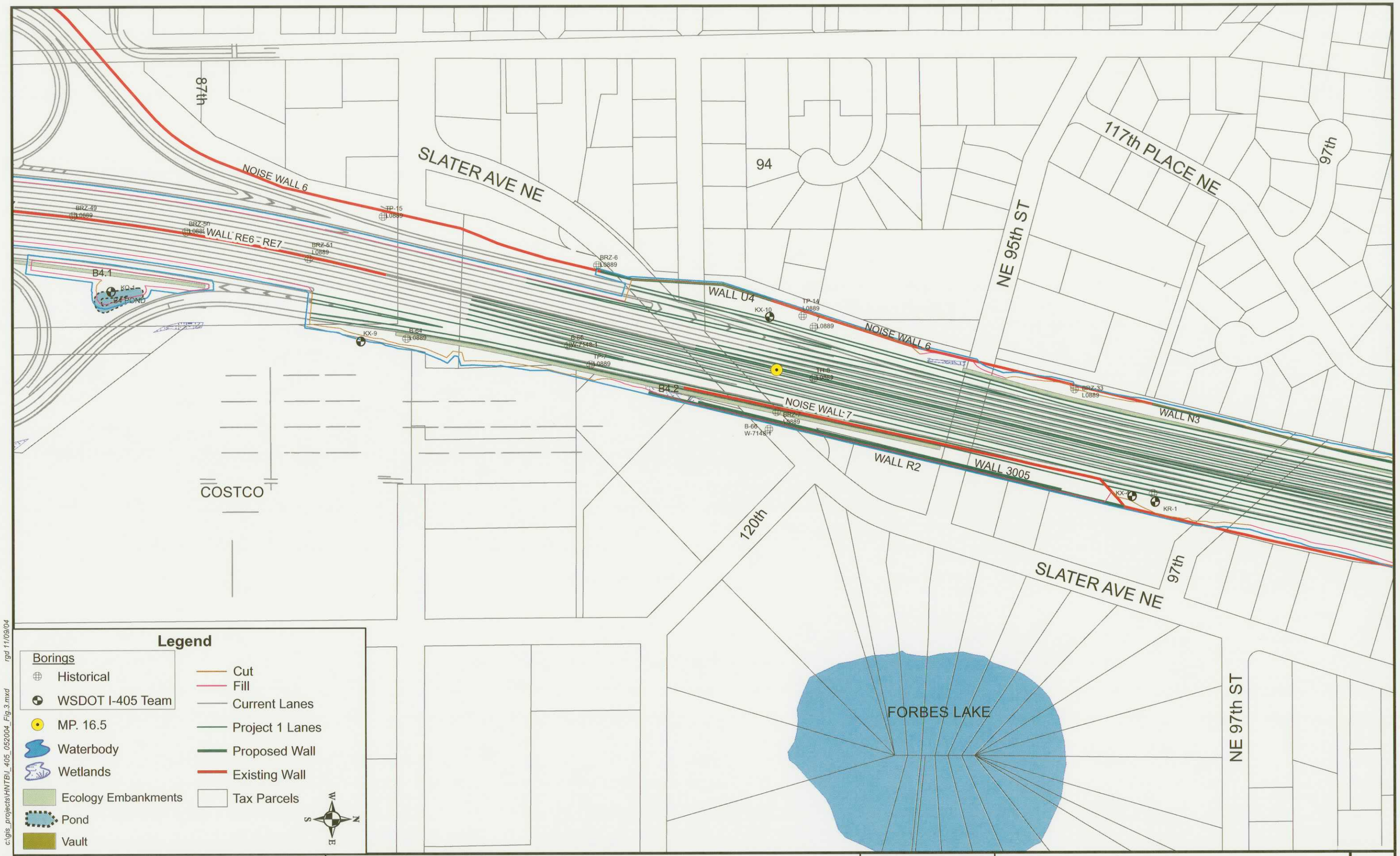
FIGURE 3E



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0 100 200 400 600 800 1,000 Feet

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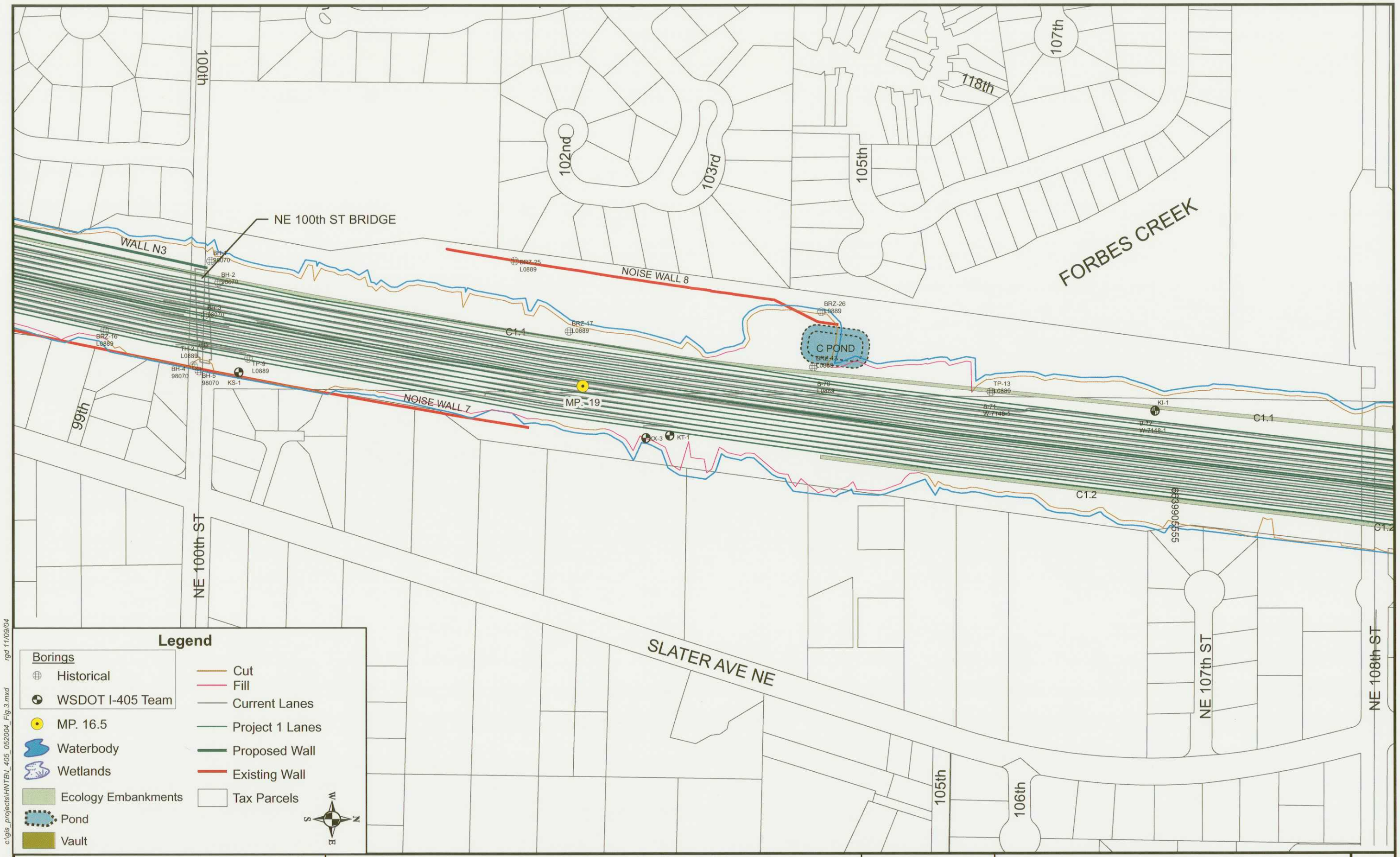
FIGURE
3F



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0 100 200 400 600 800 1,000 Feet

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FIGURE 3G

BNSF

120th AVE NE

C1.1

C VAULT

WALL 3010

C1.2

MP. 19.5

KV-1

KJ-1

WALL 3040

BRIDGE 405/55W(82)

D1.

WALL RE9

WALL RE8

B-77 PSH-1-RE

B-79 PSH-1-RE

B-146 PSH-1-RE

B-147 PSH-1-RE

B-80 PSH-1-RE

B-82 PSH-1-RE

BRIDGE 405/55E(81)

WALL 3030

KW-2

WALL 3020

NE 108th ST

SLATER AVE NE

NE 116TH ST

122nd

115th

123rd LN NE

112th

Legend

Borings

- Historical
- WSDOT I-405 Team
- MP. 16.5
- Waterbody
- Wetlands
- Ecology Embankments
- Pond
- Vault
- Cut
- Fill
- Current Lanes
- Project 1 Lanes
- Proposed Wall
- Existing Wall
- Tax Parcels

W S N E

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Notes:
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1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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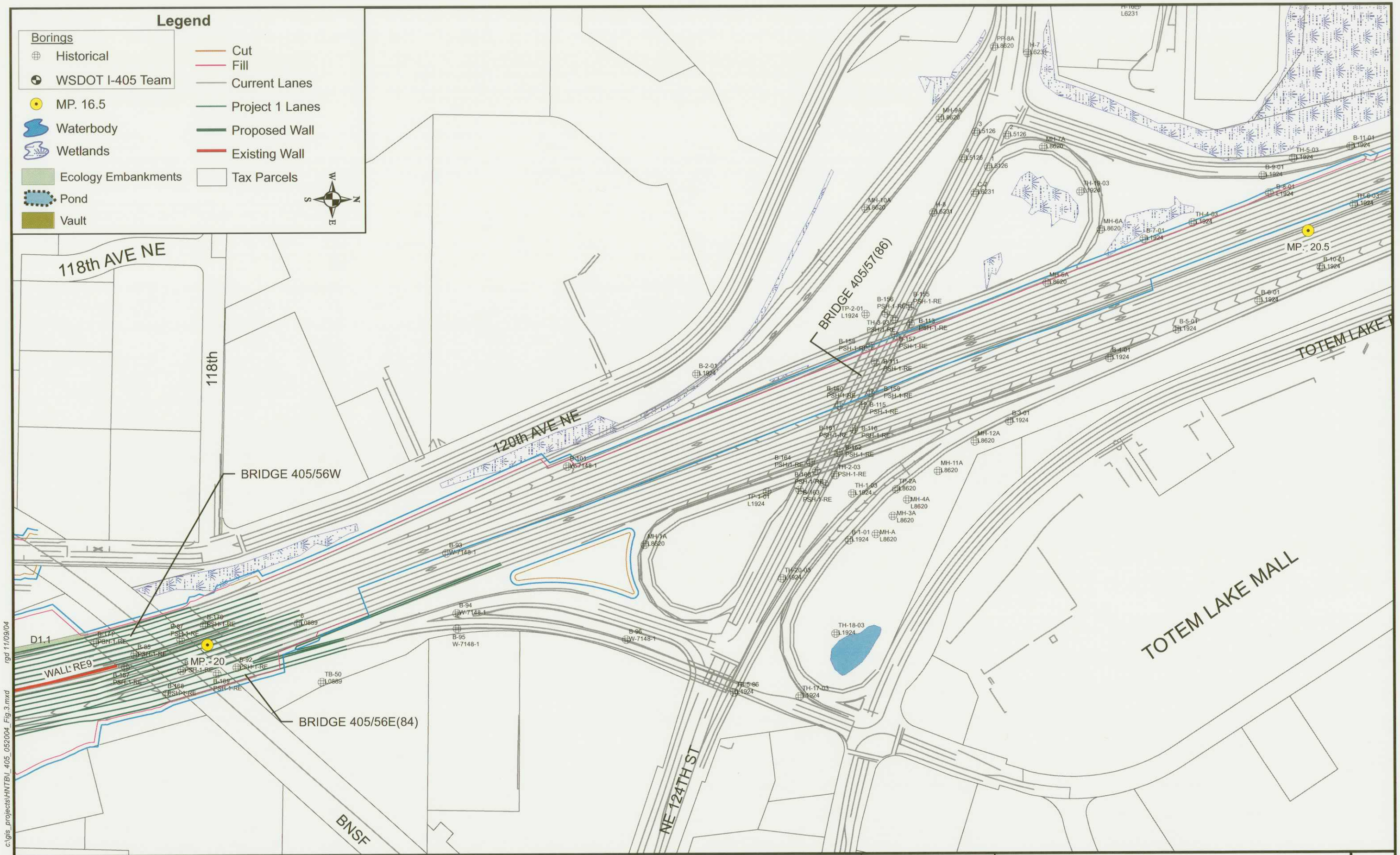
Site Plan

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 3H



Notes:
Data Sources: Imagery and LIDAR data obtained from King County. Orthophotography is the USGS 2002 coverage and has 15 cm pixel resolution. LIDAR data interpolated to DEM with 8 foot GSD from its native coordinate system which is State Plane Washington North, projected to Horizontal Datum NAD83 (HARN) feet, Vertical Datum is NAVD88. Digital Terrain Model (DTM) created by GeoEngineers from LIDAR DEM using ESRI ArcGIS COTS software.

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1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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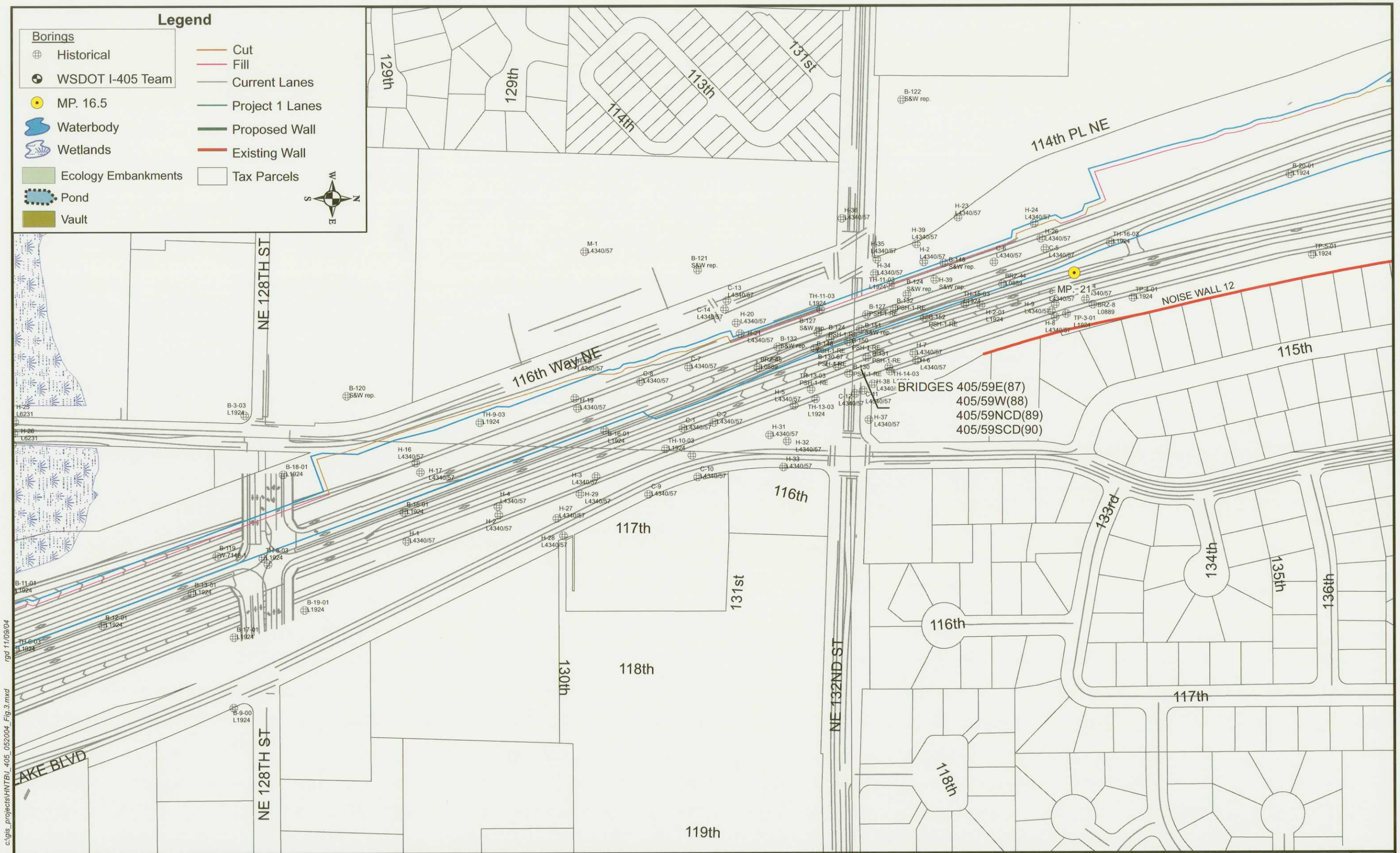
Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE
3I



Notes:
Data Sources: Imagery and LIDAR data obtained from King County. Orthophotography is the USGS 2002 coverage and has 15 cm pixel resolution. LIDAR data interpolated to DEM with 6 foot GSD from its native coordinate system which is State Plane Washington North, projected to Horizontal Datum NAD83 (HARN) feet; Vertical Datum is NAVD88. Digital Terrain Model (DTM) created by GeoEngineers from LIDAR DEM using ESRI ArcGIS COTS software.

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1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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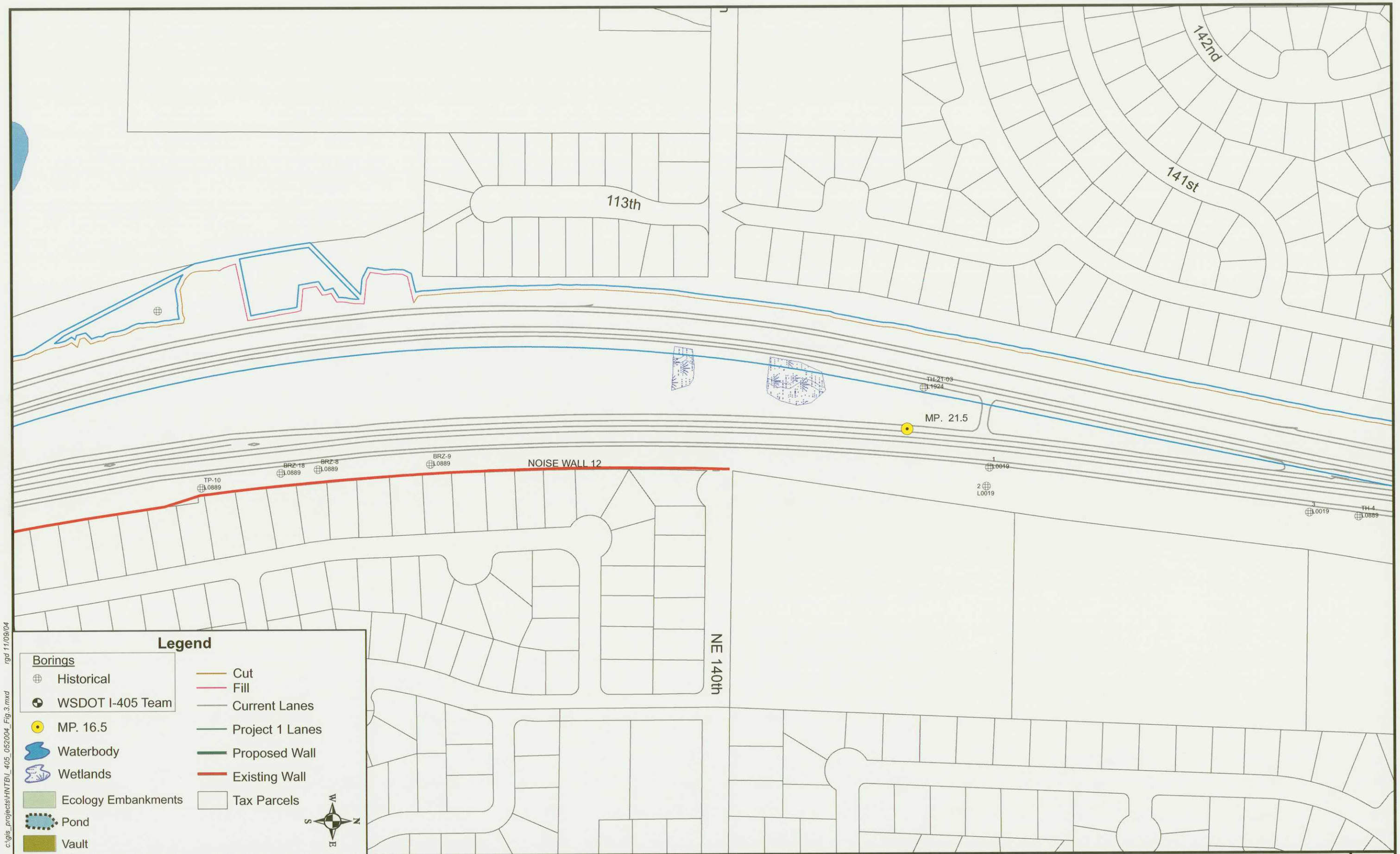
Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 3J

c:\gis_projects\HNTB\I_405_052004_Fig.3.mxd rgd 11/09/04



c:\gis_projects\HNTB\I_405_052004_Fig.3.mxd rgd 11/09/04

Notes:
Data Sources: Imagery and LiDAR data obtained from King County. Orthophotography is the USGS 2002 coverage and has 15 cm pixel resolution. LiDAR data interpolated to DEM with 6 foot GSD from its native coordinate system which is State Plane Washington North, projected to Horizontal Datum NAD83 (HARN) feet; Vertical Datum is NAVD88. Digital Terrain Model (DTM) created by GeoEngineers from LiDAR DEM using ESRI ArcGIS COTS software.

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0 100 200 400 600 800 1,000 Feet

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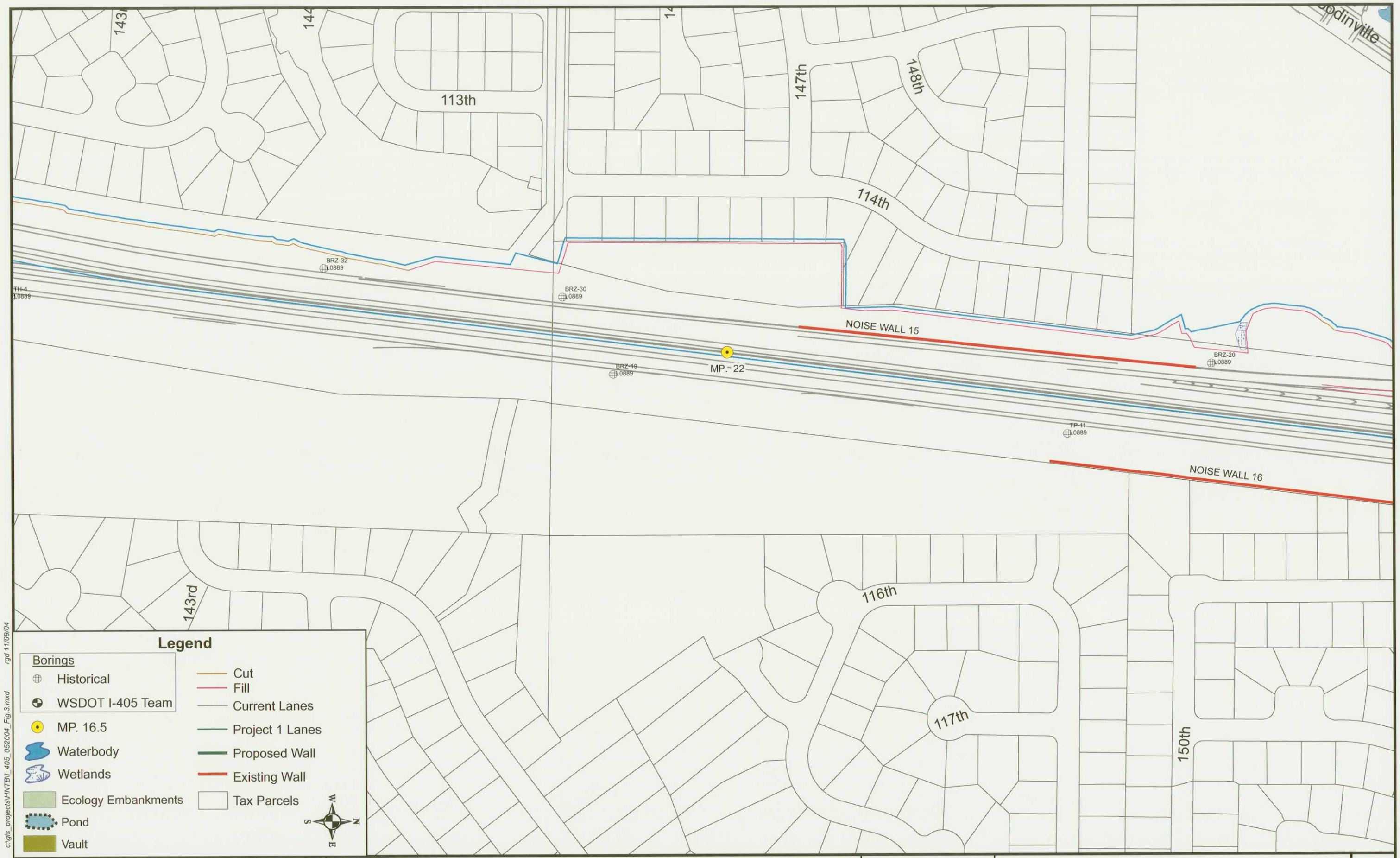
Site Plan

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE
3K



c:\gis_projects\HNTB\I_405_052004_Fig.3.mxd rgd 11/09/04

Notes:
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1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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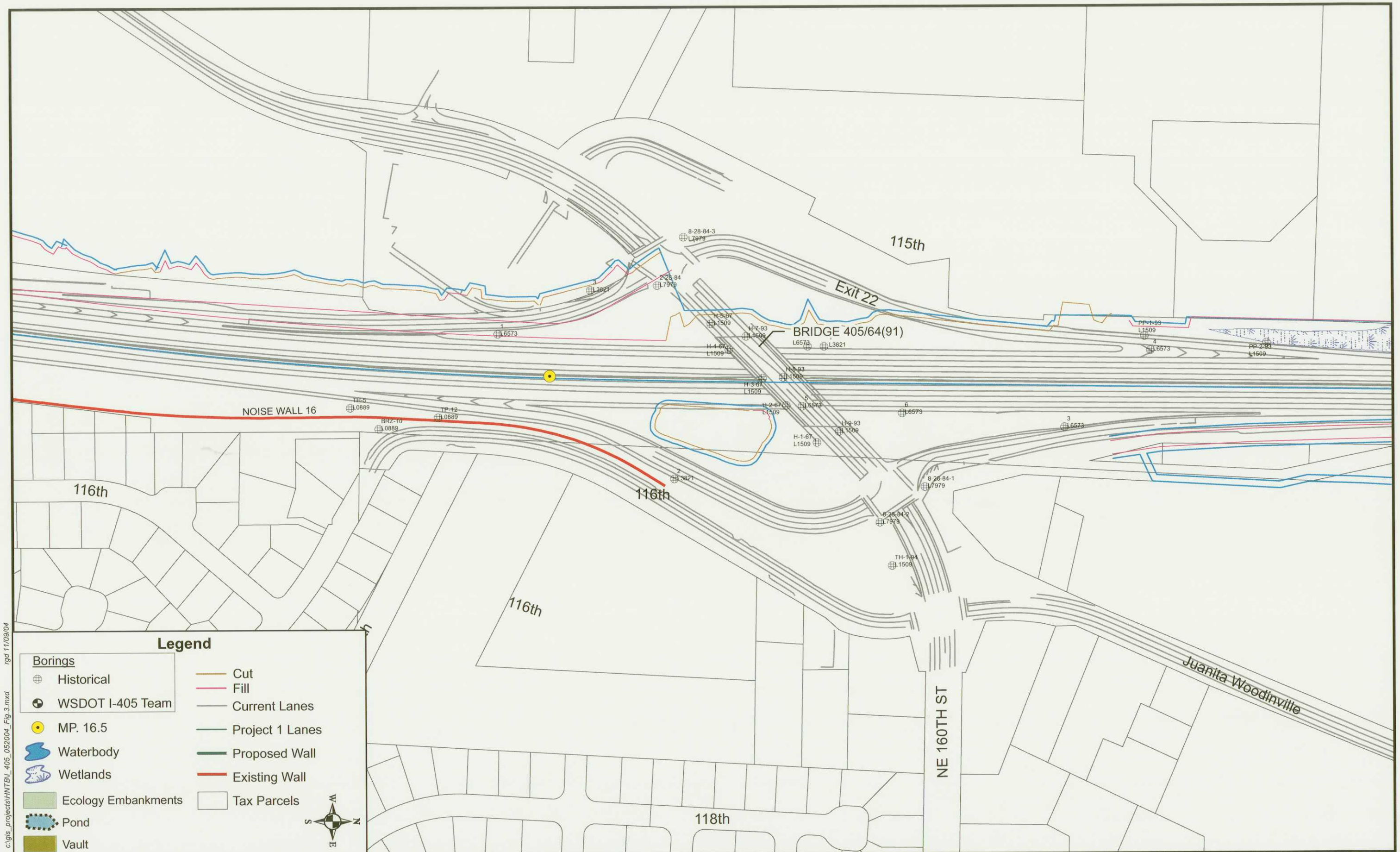
Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE
3L



c:\gis_projects\HNTBU_405_052004_Fig.3.mxd rgd 11/09/04

Notes:
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1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE
3M

c:\gis_projects\HNTBI_405_052004_Fig.3.mxd rgd 11/09/04

Notes:
Data Sources: Imagery and LiDAR data obtained from King County. Orthophotography is the USGS 2002 coverage and has 15 cm pixel resolution. LiDAR data interpolated to DEM with 6 foot GRID from flo-mative coordinate system which is State Plane Washington North, projected to Horizontal Datum NAD83 (NARN) feet; Vertical Datum is NAVD88. Digital Terrain Model (DTM) created by GeoEngineers from LiDAR DEM using ESRI ArcGIS COTS software.

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1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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Site Plan

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE
3N

Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4A

c:\gis_projects\HNTB\Fig 4.mxd rgd 09/03/04

c:\gis_projects\HNTB\Fig 4.mxd rgd 09/03/04

1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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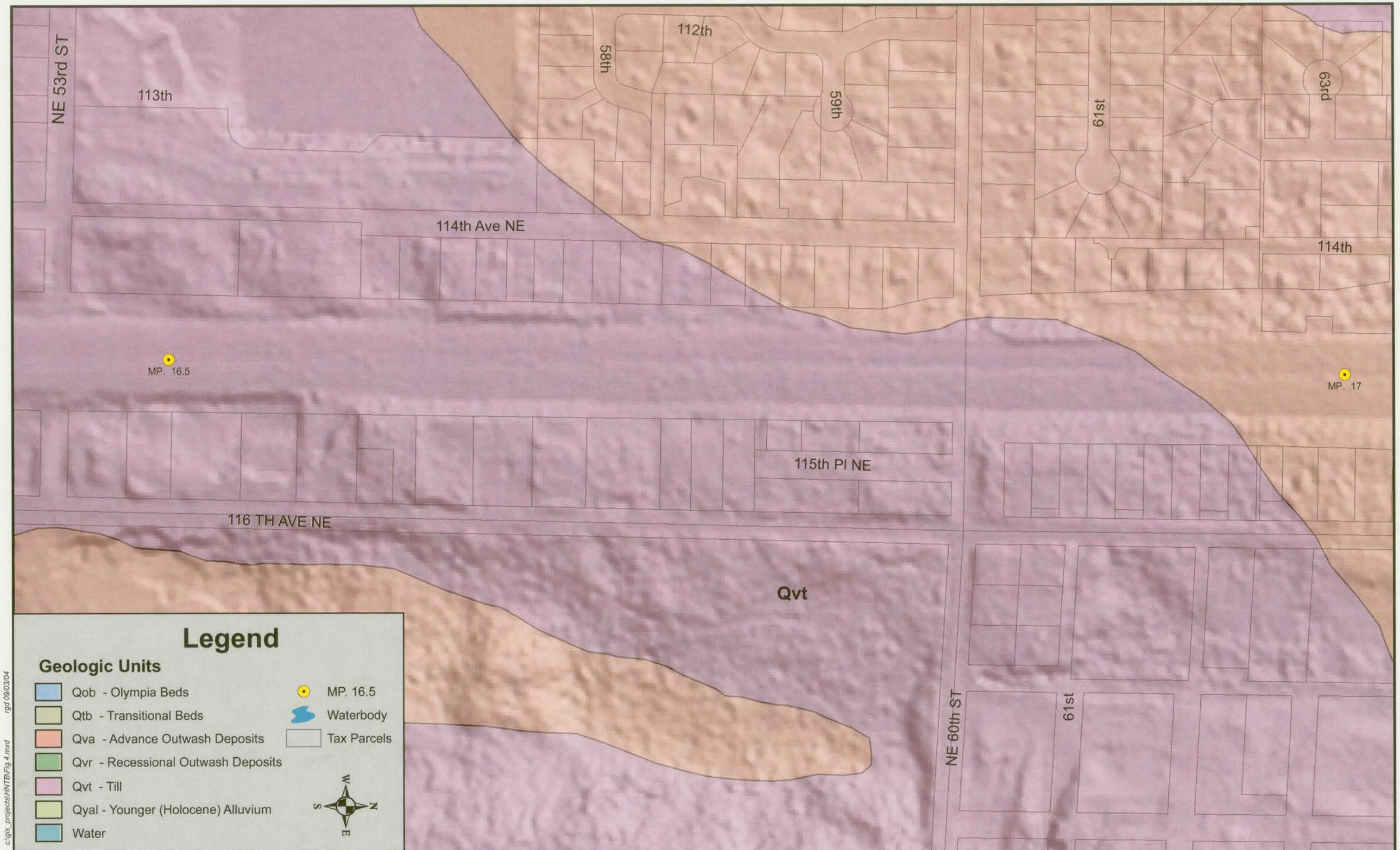
Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4B



1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4C

113th

113th

NE 67th ST

NE 67th ST

Alexander Ave

Qva

I-405

MP. 17.5

116th PL NE

67th

68th

67th

117th

118th

119th

HOUGHTON PARK & RIDE

NE 73rd ST

NE 74th ST

NE 75th ST

Legend

Geologic Units

- Qob - Olympia Beds
- Qtb - Transitional Beds
- Qva - Advance Outwash Deposits
- Qvr - Recessional Outwash Deposits
- Qvt - Till
- Qyal - Younger (Holocene) Alluvium
- Water

- MP. 16.5
- Waterbody
- Tax Parcels

W S N E

c:\gis_projects\HNTB\Fig.4.mxd rgd 09/03/04

1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4D

c:\gis_projects\HNTB\Fig.4.mxd rgd 09/03/04

1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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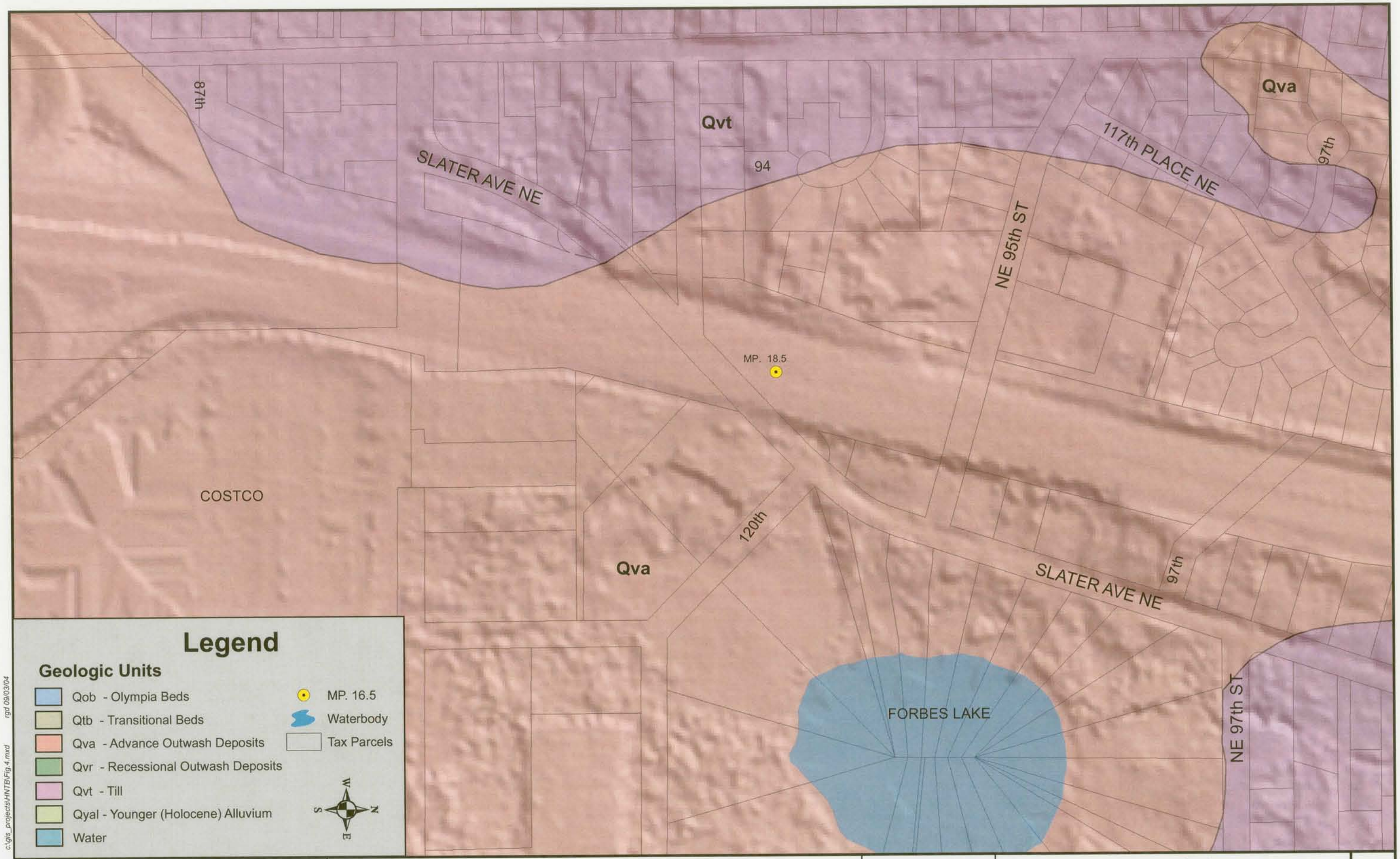
Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4E



c:\gis_projects\HNTB\Fig 4.mxd rgd 09/03/04

1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

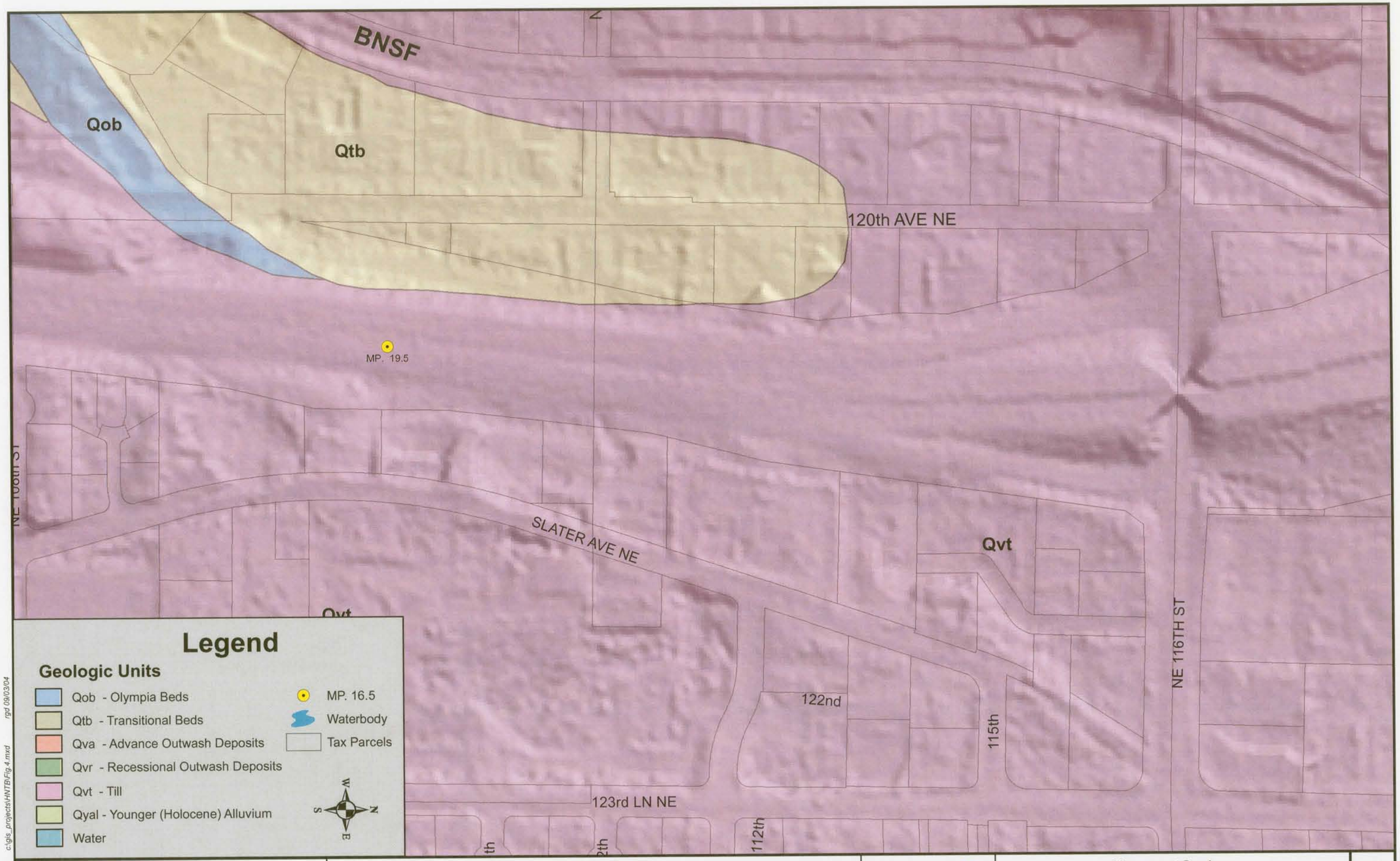
FIGURE 4F

Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4G

c:\gis_projects\HNTB\Fig 4.mxd rgd 09/03/04



c:\gis_projects\HNTB\Fig 4.mxd rgd 09/03/04

1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4H

c:\gis_projects\HNTB\Fig.4.mxd rgd 09/03/04

Notes:
Data Sources: Imagery and LiDAR data obtained from King County. Orthophotography is the USGS 2002 coverage and has 10 cm pixel resolution. LiDAR data interpolated to DEM with 8 foot GSD from its native coordinate system which is State Plane Washington North, projected to Horizontal Datum NAD83 (HARN) feet. Various Datum is NAVD88. Digital Terrain Model (DTM) created by GeoEngineers from LiDAR DEM using ESRI ArcGIS COTS software. Geology obtained from publicly available GIS coverage published by the WA Dept. Natural Resources.

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1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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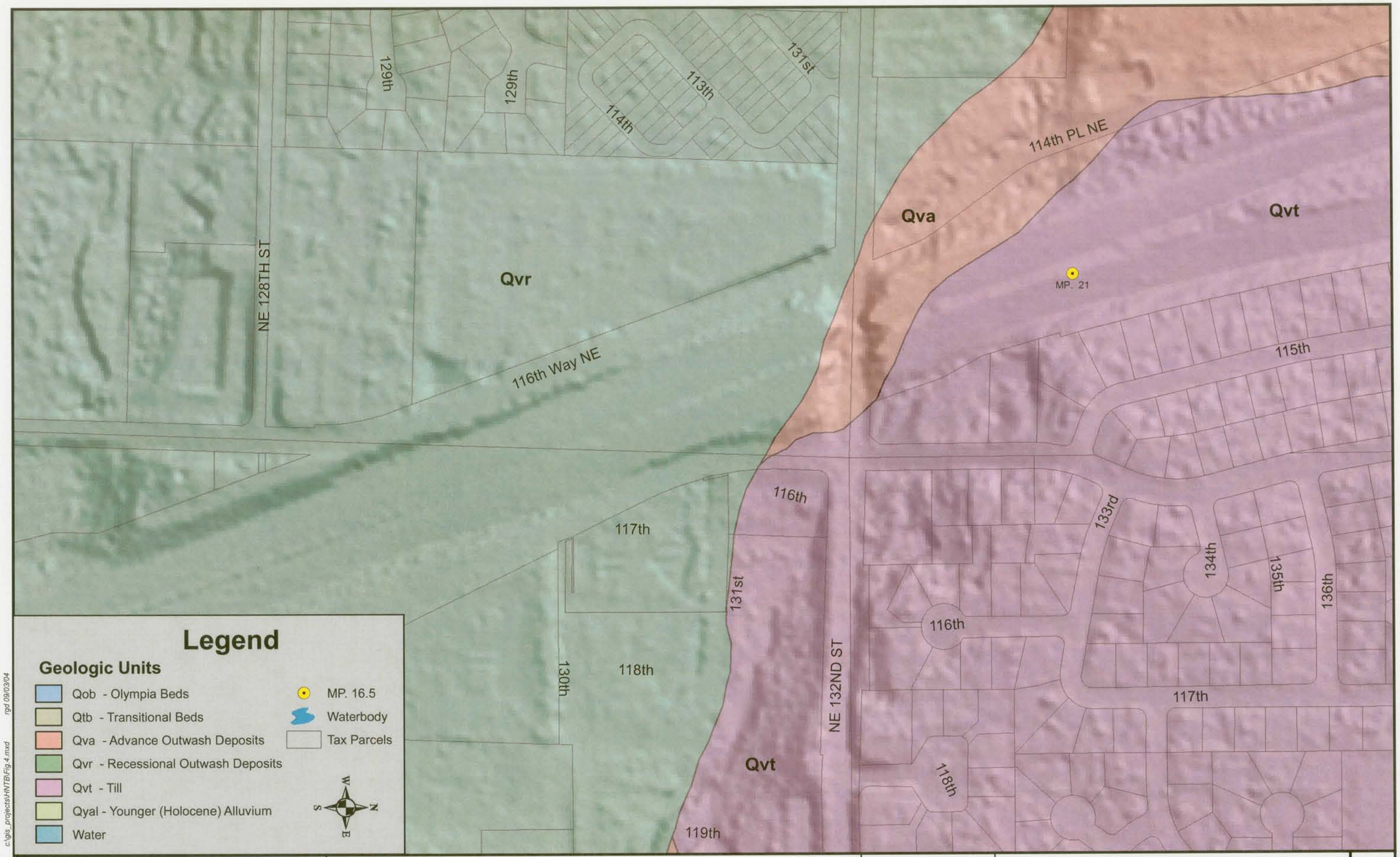
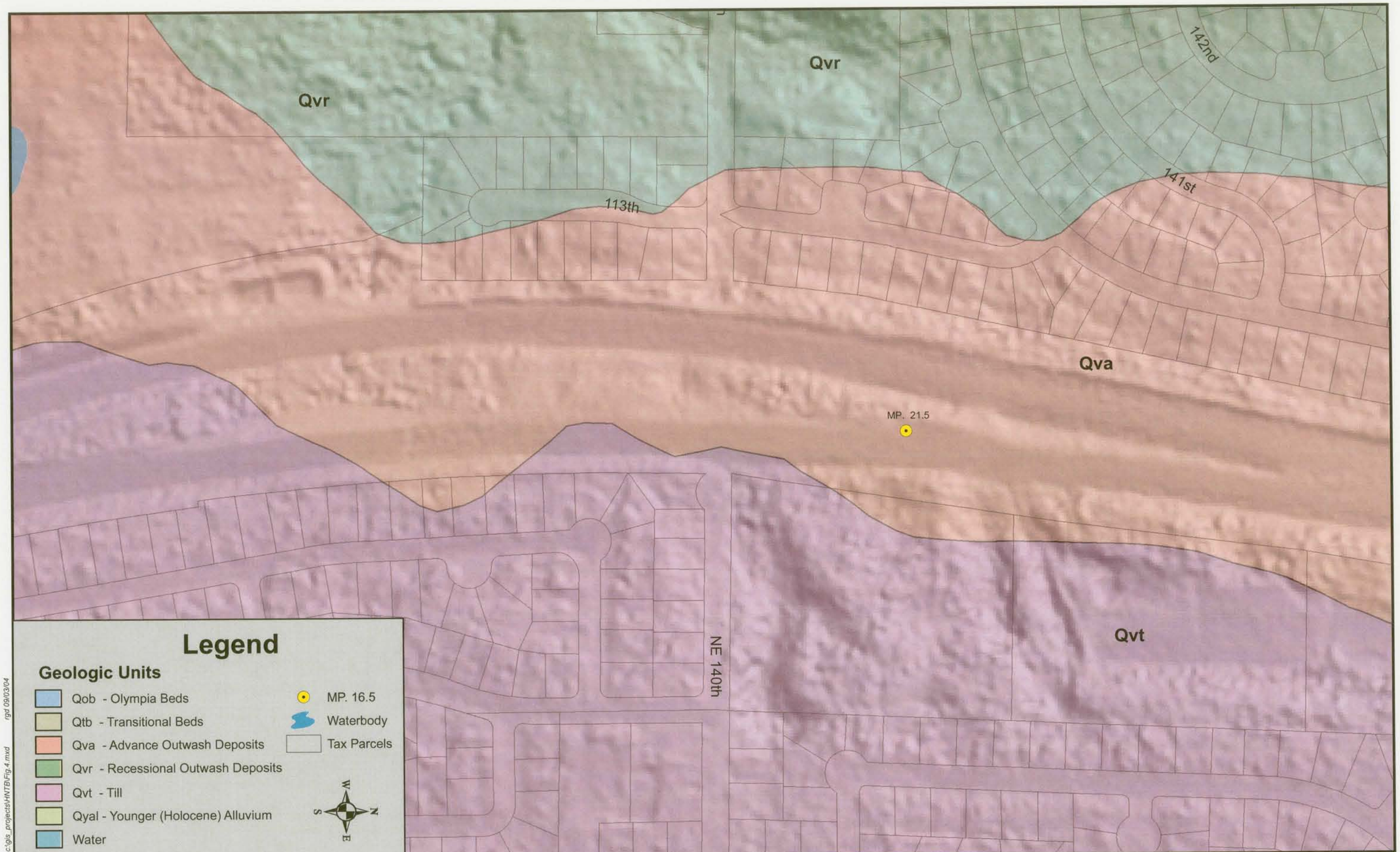
Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4I


129th
129th
114th
113th
131st
114th PL NE
Qva
Qvt
Qvr
NE 128TH ST
MP. 21
116th Way NE
115th
116th
117th
133rd
134th
135th
136th
131st
116th
130th
118th
NE 132ND ST
117th
Qvt
118th
119th
Legend
Geologic Units
Qob - Olympia Beds
Qtb - Transitional Beds
Qva - Advance Outwash Deposits
Qvr - Recessional Outwash Deposits
Qvt - Till
Qyal - Younger (Holocene) Alluvium
Water
MP. 16.5
Waterbody
Tax Parcels
W
S
N
E
1 inch equals 200 feet
0
100
200
400
600
800
1,000
Feet
GEOENGINEERS
Earth Science + Technology
Alignment Geology
Geotechnical Baseline Report I-405, SR 520 to 522
FIGURE
4J
c:\gis_projects\HNTB\Fig 4.mxd
rgd 09/03/04



c:\gis_projects\HNTB\Fig 4.mxd rgd 09/03/04

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Alignment Geology

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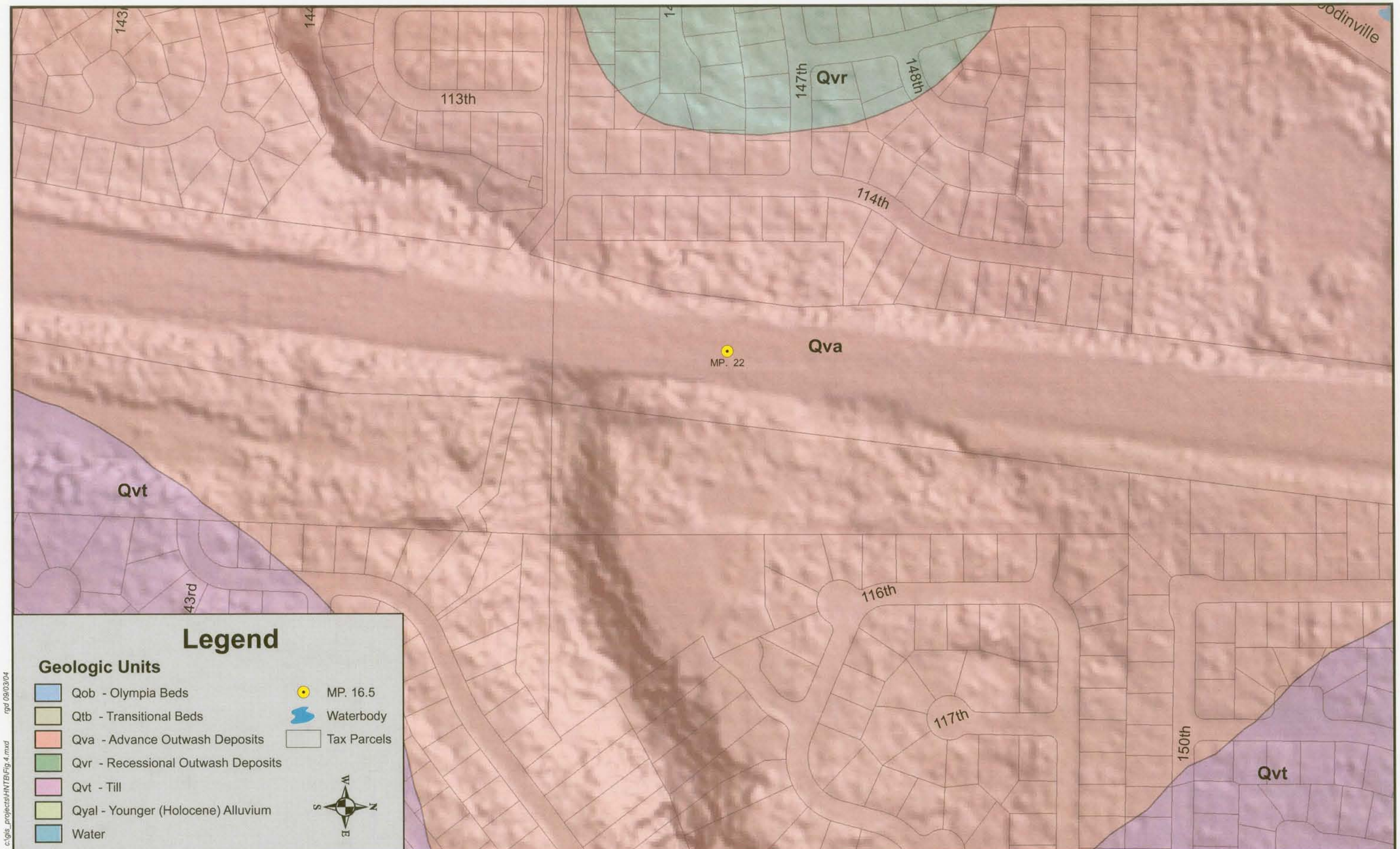
FIGURE 4K



c:\gis_projects\HNTB\Fig 4.mxd rgd 09/03/04

1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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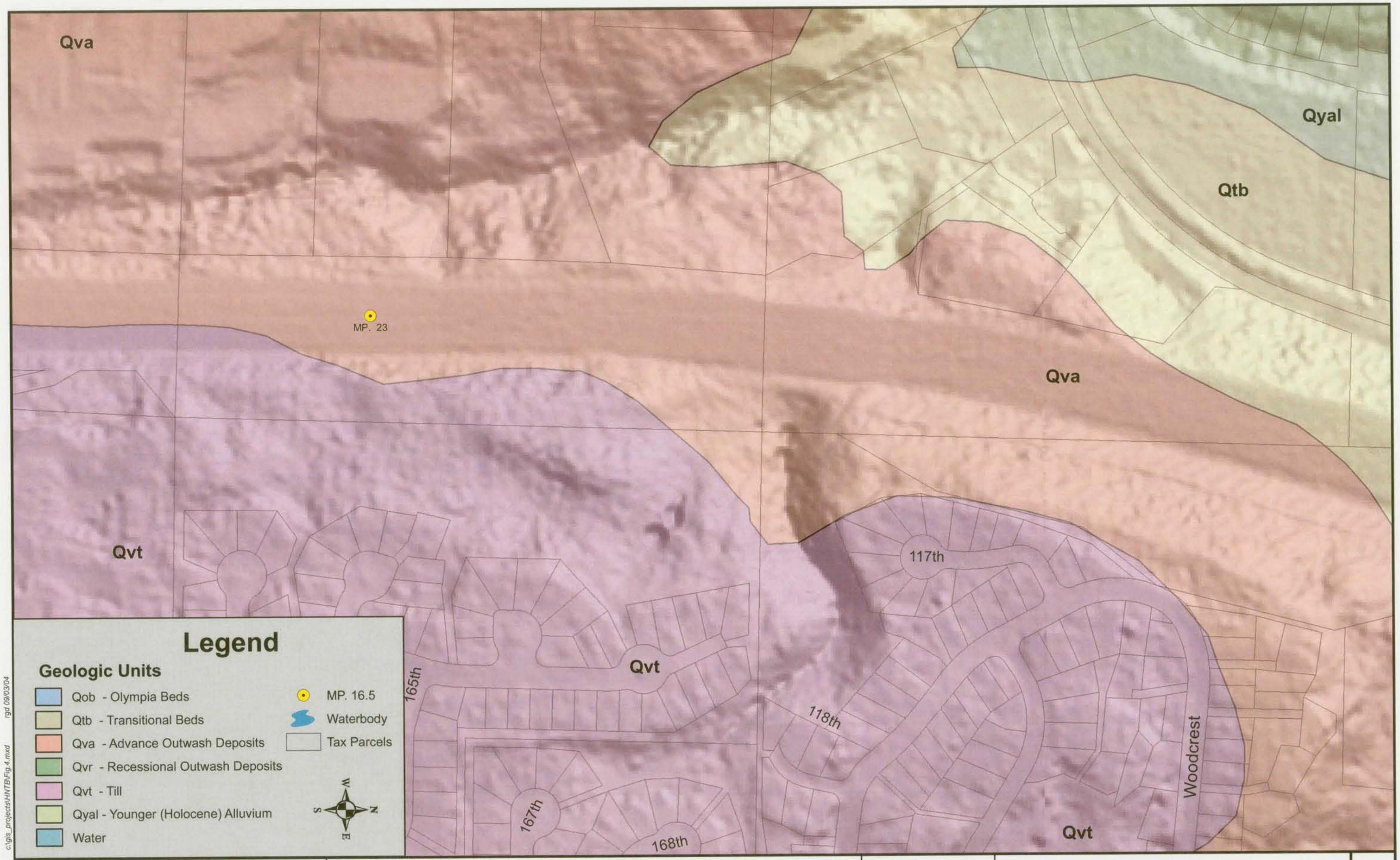
Alignment Geology

Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4L

Qva
115th
Exit 22
Qva
MP. 22.5
116th
Qvt
116th
116th
Qvt
Juanita Woodinville
NE 160TH ST
118th
Legend
Geologic Units
Qob - Olympia Beds
Qtb - Transitional Beds
Qva - Advance Outwash Deposits
Qvr - Recessional Outwash Deposits
Qvt - Till
Qyal - Younger (Holocene) Alluvium
Water
MP. 16.5
Waterbody
Tax Parcels
W
S
N
E
c:\gis_projects\HNTB\Fig 4.mxd
rgd 09/03/04
1 inch equals 200 feet
0
100
200
400
600
800
1,000
Feet
GeoEngineers
Earth Science + Technology
Alignment Geology
Geotechnical Baseline Report I-405, SR 520 to 522
FIGURE
4M



1 inch equals 200 feet

0 100 200 400 600 800 1,000 Feet

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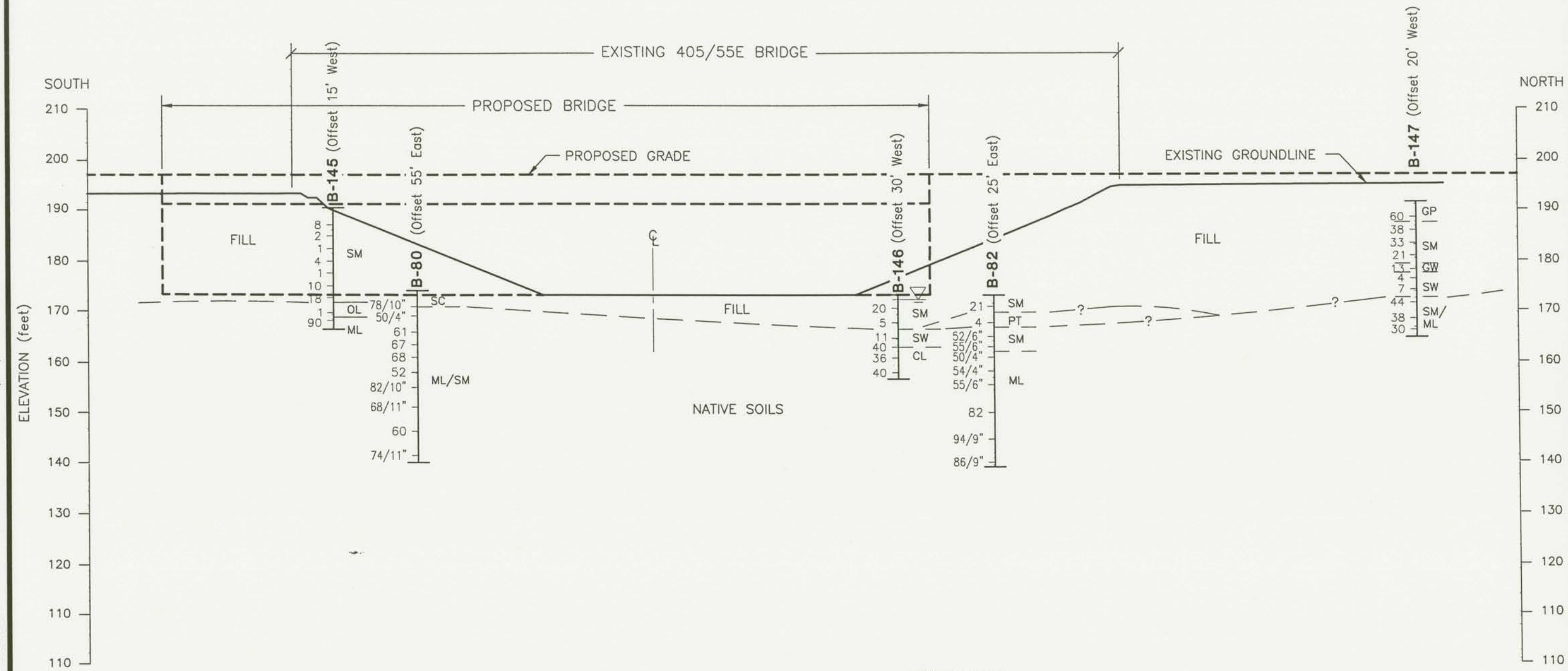
Geotechnical Baseline Report I-405, SR 520 to 522

FIGURE 4N

c:\gis_projects\HNTB\Fig 4.mxd rgd 09/03/04



EXPLANATION:

B-145 Boring

7 Blow Count

Groundwater Level

Soil Contact

DATUM NAVD88

HORIZONTAL & VERTICAL SCALE: 1" = 20'

Notes: 1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate; actual subsurface conditions may vary from those shown.

2. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored by GeoEngineers, Inc. and will serve as the official document of record.

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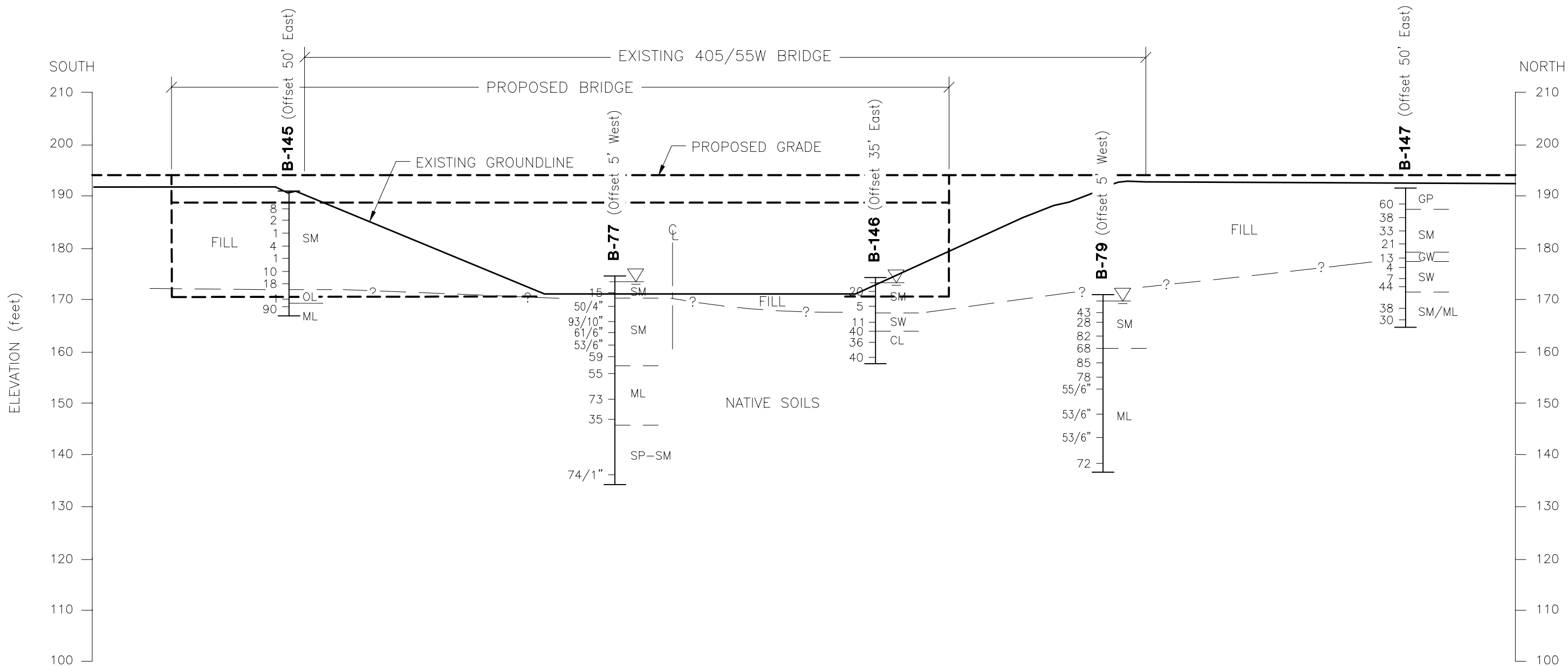
I-405 NE 116TH STREET-EAST BRIDGE

FIGURE 5

08/31/04 KGO:HLA REDM\P:\0180152\00\CAD\01801520OA.DWG



EXPLANATION:

B-145 Boring

7 Blow Count

Groundwater Level

Soil Contact

DATUM NAVD88

HORIZONTAL & VERTICAL SCALE: 1" = 20'

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GEOENGINEERS

I-405 NE 116TH STREET-WEST BRIDGE

FIGURE 6

08/31/04 KGO:HLA REDM\P:\0180152\00\CAD\018015200B.DWG

APPENDIX A

FIELD EXPLORATIONS AND LABORATORY TESTING COMPLETED FOR THIS STUDY

DRAFT

GrfcText\BORLEGSOIL 6/15/2004 8:51:04 AM

Washington State
Department of Transportation

Test Boring Legend

Sampler Symbols

	Standard Penetration Test
	Oversized Penetration Test (Dames & Moore, California)
	Shelby Tube
P	Piston Sample
	Washington Undisturbed
	Vane Shear Test
	Core
	Becker Hammer
B	Bag Sample

Well Symbols

	Cement Surface Seal
	Piezometer Pipe in Granular Bentonite Seal
	Piezometer Pipe in Sand
	Well Screen in Sand
	Granular Bentonite Bottom Seal
	Inclinometer Casing in Concrete Bentonite Grout

Laboratory Testing Codes

UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
UC	Unconfined Compression Test
DS	Direct Shear Test
CN	Consolidation Test
GS	Grain Size Distribution
MC	Moisture Content
SG	Specific Gravity
OR	Organic Content
DN	Density
AL	Atterberg Limits
PT	Point Load Compressive Test
SL	Slake Test
DG	Degradation
LA	LA Abrasion
HT	Hydrometer Test

Soil Density Modifiers

Gravel, Sand & Non-plastic Silt		Elastic Silts and Clay	
SPT Blows/ft	Density	SPT Blows/ft	Consistency
0-4	Very Loose	0-1	Very Soft
5-10	Loose	2-4	Soft
11-24	Medium Dense	5-8	Medium Stiff
25-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very Stiff
		31-60	Hard
		>60	Very Hard

Angularity of Gravel & Cobbles

Angular	Coarse particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Coarse grained particles are similar to angular but have rounded edges.
Subrounded	Coarse grained particles have nearly plane sides but have well rounded corners and edges.
Rounded	Coarse grained particles have smoothly curved sides and no edges.

Soil Moisture Modifiers

Dry	Absence of moisture; dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible free water

Soil Structure

Stratified	Alternating layers of varying material or color at least 6mm thick; note thickness and inclination.
Laminated	Alternating layers of varying material or color less than 6mm thick; note thickness and inclination.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, somtimes striated.
Blocky	Cohesive soil that can be broken down into smaller angular lumps which resist further breakdown.
Disrupted	Soil structure is broken and mixed. Infers that material has moved substantially - landslide debris.
Homogeneous	Same color and appearance throughout.

HCL Reaction

No HCL Reaction	No visible reaction.
Weak HCL Reaction	Some reaction with bubbles forming slowly.
Strong HCL Reaction	Violent reaction with bubbles forming imediately.

Degree of Vesicularity of Pyroclastic Rocks

Slightly Vesicular	5 to 10 percent of total
Moderately Vesicular	10 to 25 percent of total
Highly Vesicular	25 to 50 percent of total
Scoriaceous	Greater than 50 percent of total

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Washington State
Department of Transportation

Test Boring Legend

Grain Size

Fine Grained	< 1mm	Few crystal boundaries/grains are distinguishable in the field or with hand lens.
Medium Grained	1mm to 5mm	Most crystal boundaries/grains are distinguishable with the aid of a hand lens.
Coarse Grained	> 5mm	Most crystal boundaries/grains are distinguishable with the naked eye.

Weathered State

Term	Description	Grade
Fresh	No visible sign of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than its fresh condition.	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as core stones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as core stone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength approx
R1	Very Weak	Specimen crumbles under sharp blow from point of geological hammer, and can be cut with a pocket knife.	150-3500 psi
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3500-7500 psi
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer.	7500-15000 psi
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15000-350000 psi
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 30000 psi

Discontinuities

Spacing	
Very Widely	Greater than 3 m
Widely	1 m to 3 m
Moderately	0.3 m to 1 m
Closely	50 mm to 300 mm
Very Closely	Less than 50 mm

RQD (%)

$$\frac{100(\text{length of core in pieces} > 100\text{mm})}{\text{Length of core run}}$$

Condition	
Excellent	Very rough surfaces, no separation, hard discontinuity wall
Good	Slightly rough surfaces, separation less than 1 mm, hard discontinuity wall.
Fair	Slightly rough surfaces, separation greater than 1 mm, soft discontinuity wall.
Poor	Slickensided surfaces, or soft gouge less than 5 mm thick, or open discontinuities 1 to 5 mm.
Very Poor	Soft gouge greater than 5 mm thick, or open discontinuities greater than 5 mm.

Fracture Frequency (FF) is the average number of fractures per 300 mm of core.
Does not include mechanical breaks caused by drilling or handling.

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62176

HOLE No. KG-1-04

Sheet 1 of 2

Job No. MS-4700 SR 405 Elevation 186.6 (56.9 m)

Project Stage 1 and 2 Kirkland Nickel Project

Driller Joe Judd Lic# 2454

Site Address Vicinity SR-405 and NE 85th Street

Inspector Dave Nelson

Start March 31, 2004 Completion March 31, 2004 Well ID# AHN-809 Equipment CME 850 w/ autohammer

Station Offset Casing 6" x 10.0 & 4" x 39.0 Method Wet Rotary

Northing 250822.65 Easting 1307817.18 Latitude Longitude

County King Subsection NW 1/4 of SW 1/4 Section 4 Range 5 EWM Township 25 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1		>>	15 40 47 (87)		D-1		Silty SAND with gravel, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
	2		>>	26 40 50 (90)		D-2		Silty SAND with gravel, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
10	3		>>	21 23 40 (63)		D-3		Silty SAND with gravel, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft 03/31/2004	▽	
	4		>>	33 61 (61/6")		D-4		Silty SAND with gravel, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
15	5		>>	65 (65/6")		D-5	GS MC	SM, M.C. =13% Silty SAND with gravel, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft		
			>>	65 (65/6")		D-6		Silty SAND with gravel, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft		
20	6		>>	51 45		D-7		Silty SAND, sub rounded, very dense, grey, moist, Homogeneous, HCl reaction not tested		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62176

HOLE No. KG-1-04

Job No. MS-4700 SR 405 Elevation 186.6 (56.9 m)

Sheet 2 of 2

Project Stage 1 and 2 Kirkland Nickel Project

Driller Joe Judd Lic# 2454

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				50 (95/5")				Length Recovered 1.0 ft		
			>>	100 (100/6")		D-8		Silty SAND, sub rounded, very dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft		
	7									
25			>>	100 (100/5")		D-9	GS MC	SM, M.C. =12% Silty SAND, sub rounded, very dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft		
	8		>>	100 (100/5")		D-10		Silty SAND, sub rounded, very dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft		
	9			35 50 (50/6")		D-11		SILT with sand, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
30			>>	26 39 50 (89)		D-12		SILT with sand, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
	10									
35			>>	22 44 44 (88)		D-13	GS MC	ML, M.C. =21%, Non-plastic SILT with sand, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
	11		>>	20 25 38 (63)		D-14		SILT with sand, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
40	12		>>	17 26 28 (54)		D-15		SILT with sand, very dense, grey, wet, Homogeneous, HCl reaction not tested, recharged to 9.6 in 5 mins. Length Recovered 1.0 ft		
	13							Bail test started at 1.0 ended bail test at 13.5 End of test hole boring at 41.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45										

Job No. **MS-4700** Date **August 5, 2004**

Hole No. **KG-1-04** Sheet **1** of **1**

Project **Stage 1 and 2 Kirkland Nickel Project**

Laboratory Summary

Washington State Department of Transportation

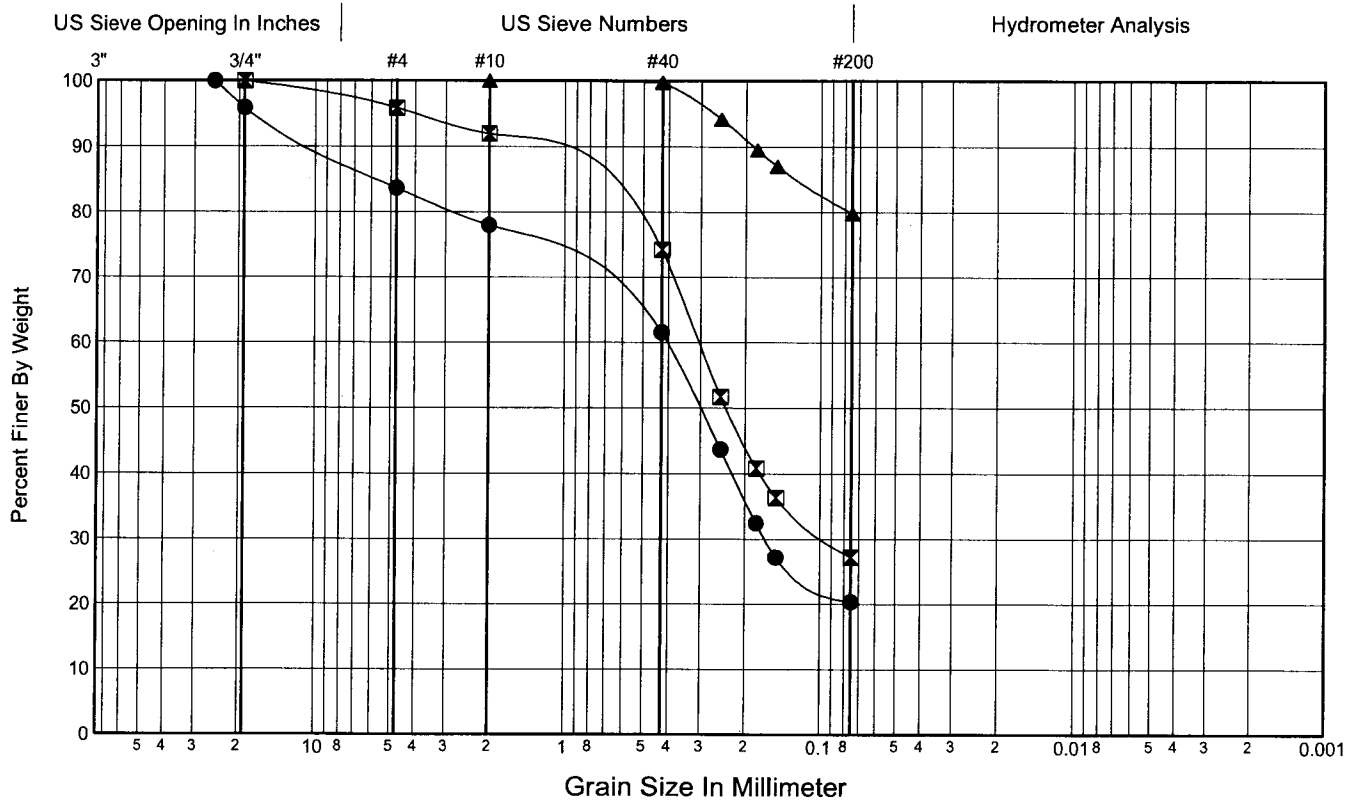
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	14.0	4.27	D-5	SM	See Boring Log	SILTY SAND with GRAVEL	13			
⊠	24.0	7.32	D-9	SM	See Boring Log	SILTY SAND	12			
▲	34.0	10.36	D-13	ML	See Boring Log	SILT with SAND	21			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	16.4	63.3	20.3		
⊠	4.2	68.7	27.2		
▲	0.0	20.2	79.8		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.406	0.30	0.17		
⊠	0.304	0.24	0.09		
▲					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62183

Job No. MS-4700 SR 405 Elevation 154.8 (47.2 m)

HOLE No. KI-1-04

Sheet 1 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Joe Judd Lic# 2454

Site Address Vicinity SR-405 and NE 85th Street

Inspector Dave Nelson

Start March 30, 2004 Completion March 30, 2004 Well ID# AHN-816 Equipment CME 850 w/ autohammer

Station Offset Casing 6" x 10.0 & 4" x 50.0 Method Wet Rotary

Northing 256599.2 Easting 1308573.09 Latitude Longitude

County King Subsection SW 1/4 of NW 1/4 Section 33 Range 5 EWM Township 26 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1, 2		>>	12 24 29 60 (53)		D-1	GS MC	SM, M.C. =9% Silty SAND, sub rounded, very dense, brown, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
10	3		>>	23 33 66 (99)		D-2		Silty SAND, sub rounded, very dense, brown, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
			>>	38 55 (55/6")		D-3		Silty SAND, sub rounded, very dense, brown, moist, Homogeneous, HCl reaction not tested Length Recovered 0.9 ft		
15	4		>>	39 65 (65/6")		D-4		Silty SAND, sub rounded, very dense, brown, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
	5		>>	20 38 40 (78)		D-5		Silty SAND, sub rounded, very dense, reddish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
20	6			50 50 (50/6")		D-6	GS MC	SM, M.C. =11% Silty SAND, sub rounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62183

HOLE No. KI-1-04

Job No. MS-4700 SR 405 Elevation 154.8 (47.2 m)

Sheet 2 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Joe Judd Lic# 2454

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				15 19 20 (39)		D-7	GS MC	SP-SM, M.C. =19% Poorly graded SAND with silt, dense, reddish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
	7			38 50 (50/6")		D-8		Silty SAND with gravel, sub rounded, very dense, brown, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
25			>>	20 30 38 (68)		D-9		Silty SAND with gravel	03/30/2004	
	8									
			>>	23 36 41 (77)		D-10	GS MC	SM, M.C. =10% Silty SAND with gravel, sub rounded, very dense, brown, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
	9									
30			>>	18 24 44 (68)		D-11		Silty SAND with gravel, sub rounded, very dense, brown, moist, Homogeneous, HCl reaction not tested, color change at 33.5 Length Recovered 1.0 ft		
	10									
				44 50 (50/6")		D-12		Silty SAND, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
35			>>	70 (70/6")		D-13		Silty SAND, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft		
	11									
			>>	78 (78/6")		D-14		Silty SAND, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft		
	12									
40			>>	32 35 78 (113)		D-15	GS MC	SM, M.C. =9% Silty SAND, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
	13									
			>>	33 34 60 (94)		D-16		Silty SAND, sub rounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
45			>>							

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-62183

HOLE No. KI-1-04

Job No. MS-4700 SR 405 Elevation 154.8 (47.2 m)

Sheet 3 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Joe Judd Lic# 2454

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14		>>	18 37 59 (96)		D-17		SILT with sand, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
	15		>>	17 40 58 (98)		D-18	GS MC	ML, M.C. =24%, Non-plastic SILT with sand, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
50			>>	18 33 50 (83)		D-19		SILT with sand, very dense, grey, wet, Homogeneous, HCl reaction not tested, bail test started @ 9.0 bail test ended @ 23.2 after 5 mins. 23.2 after 10 mins. 23.2 Length Recovered 1.0 ft		
	16							End of test hole boring at 51.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
55	17									
60	18									
65	19									
	20									
	21									
70										

Job No.	**MS-4700**	Date	**August 5, 2004**
Hole No.	**KI-1-04**	Sheet	**1** of **2**
Project	**Stage 1 and 2 Kirkland Nickel Project**		

Laboratory Summary

Washington State Department of Transportation

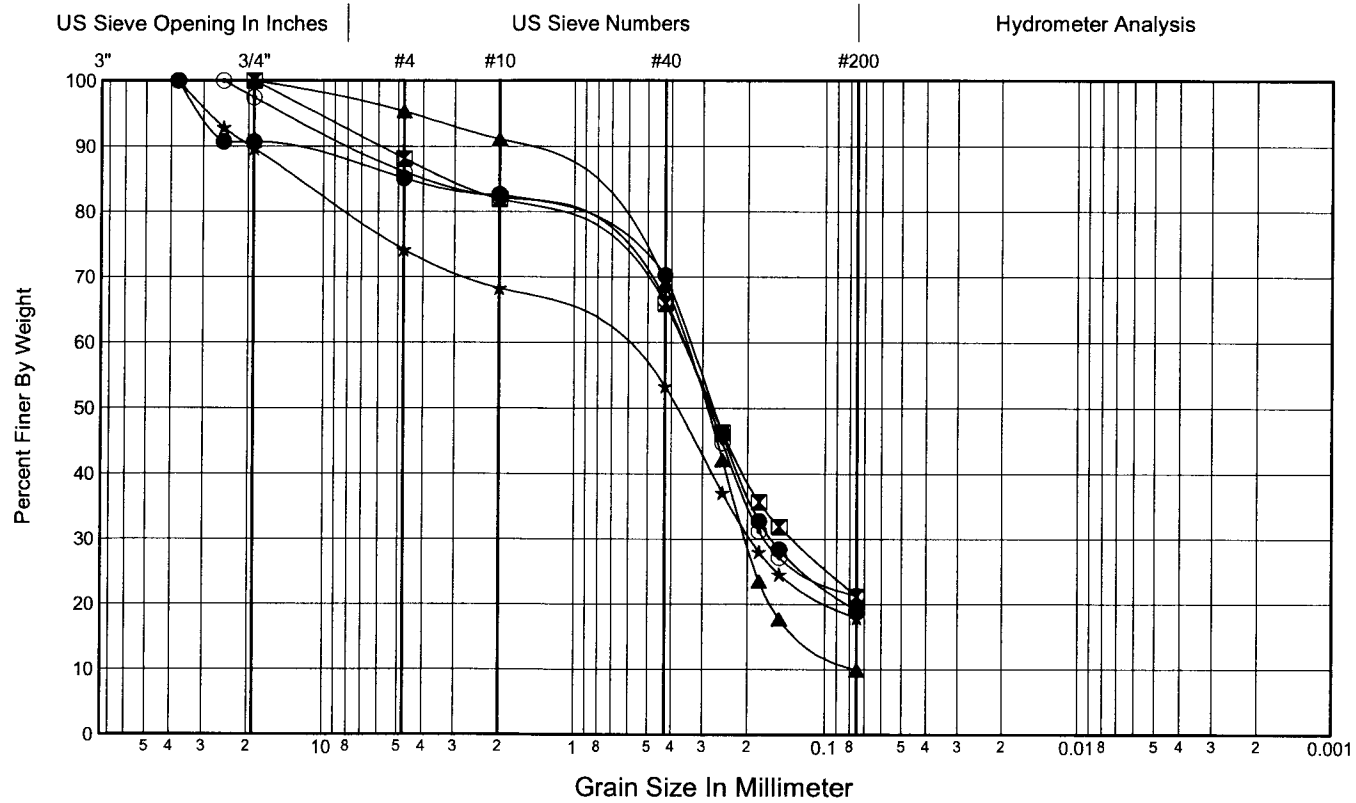
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	**3.5**	**1.07**	**D-1**	**SM**	**See Boring Log**	**SILTY SAND**	**9**			
⊠	**18.5**	**5.64**	**D-6**	**SM**	**See Boring Log**	**SILTY SAND**	**11**			
▲	**20.0**	**6.10**	**D-7**	**SP-SM**	**See Boring Log**	**POORLY GRADED SAND with SILT**	**19**			
★	**28.5**	**8.69**	**D-10**	**SM**	**See Boring Log**	**SILTY SAND with GRAVEL**	**10**			
⊙	**40.0**	**12.19**	**D-15**	**SM**	**See Boring Log**	**SILTY SAND**	**9**			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	**14.9**	**66.1**	**19.0**		
⊠	**11.9**	**67.0**	**21.2**		
▲	**4.7**	**85.4**	**9.9**	**1.5**	**4.7**
★	**25.8**	**56.3**	**17.9**		
⊙	**13.9**	**64.8**	**21.3**		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	**0.340**	**0.27**	**0.16**	**0.08**	
⊠	**0.362**	**0.28**	**0.13**		
▲	**0.356**	**0.29**	**0.20**	**0.16**	**0.076**
★	**0.849**	**0.38**	**0.19**	**0.09**	
⊙	**0.363**	**0.28**	**0.17**		



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **MS-4700** Date **August 5, 2004**

Hole No. **KI-1-04** Sheet **2** of **2**

Project **Stage 1 and 2 Kirkland Nickel Project**

Laboratory Summary

Washington State Department of Transportation

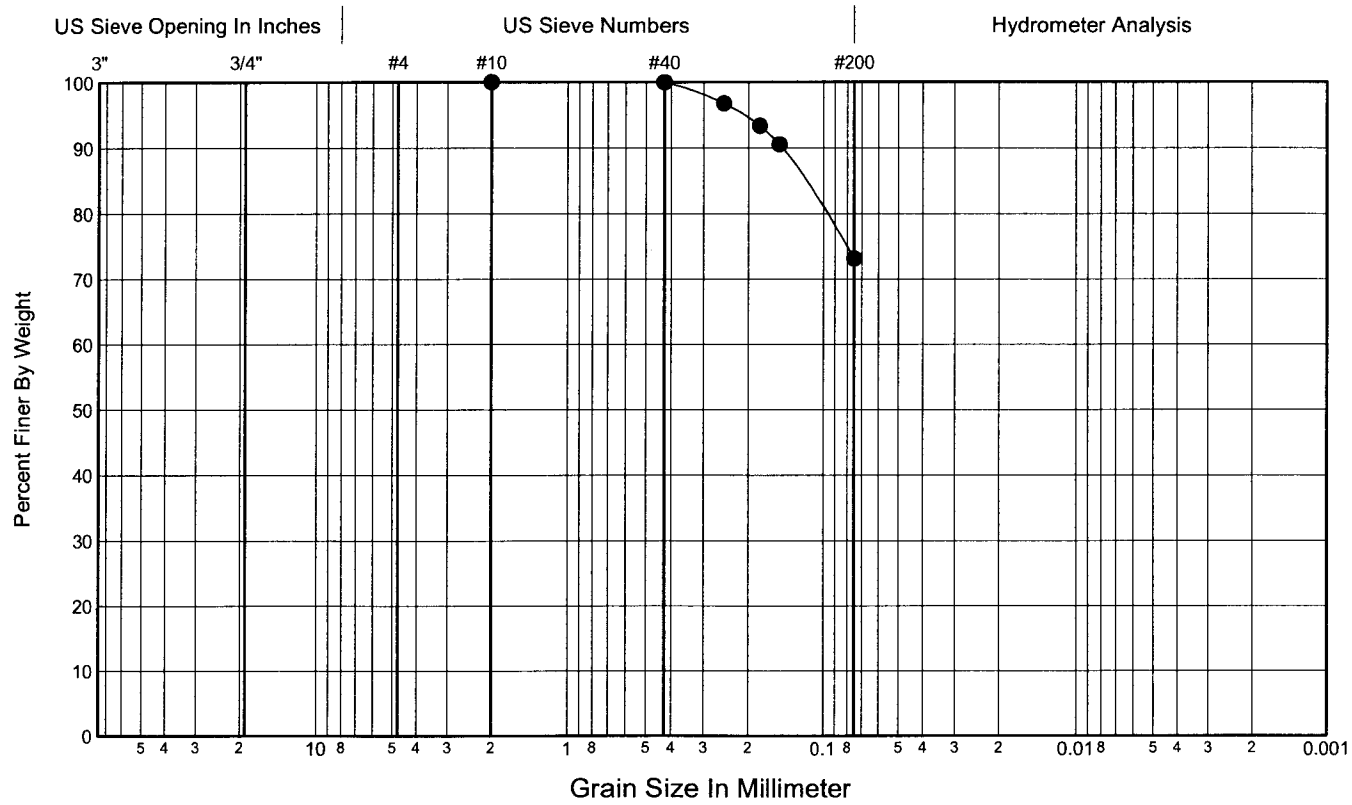
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	**48.5**	**14.78**	**D-18**	**ML**	**See Boring Log**	**SILT with SAND**	**24**			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	**0.0**	**26.9**	**73.1**		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62177

HOLE No. KJ-1-04

Sheet 1 of 2

Job No. MS-4700 SR 405 Elevation 108.3 (33.0 m)

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Site Address Vicinity SR-405 and NE 85th Street

Inspector Dan Reed

Start March 30, 2004 Completion March 30, 2004 Well ID# AHN-810

Equipment CME 45 w/ autohammer

Station Offset Casing HW 4.5/HQ 3.5

Method Wet Rotary

Northing 257995.39 Easting 1308959.73 Latitude Longitude

County King Subsection NE 1/4 of the NW 1/4 Section 33 Range 5 EWM Township 26N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			28 38 50/2 (50/2")		D-1		Silty SAND with gravel, Subangular, very dense, Gray, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft,		
	2			35 50/3 (50/3")		D-2		Silty SAND with gravel, Subangular, very dense, Gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 0.8 ft,		
10	3		>>	28 38 50 (88)		D-3	GS MC	SM, M.C. =8% Silty SAND with gravel, angular, very dense, Gray, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft,		
	4			36 50 (50/6")		D-4		Silty SAND with gravel, subangular, very dense, Gray, moist, Homogeneous, no HCl reaction, Moisture tin retained in sample bag. Length Recovered 0.8 ft,	03/30/2004	
15	5		>>	23 26 29 (55)		D-5	GS MC	SM, M.C. =9% Silty SAND with gravel, subangular, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.5 ft, Length Retained 1.2 ft		
			>>	25 30 39 (69)		D-6		Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.3 ft,		
20	6									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62177

HOLE No. KJ-1-04

Job No. MS-4700 SR 405 Elevation 108.3 (33.0 m)

Sheet 2 of 2

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				11 10 9 (19)		D-7	GS MC	SM, M.C. =16% Silty SAND, angular, medium dense, Lt. Brown, wet, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.0 ft,		
	7			10 13 12 (25)		D-8		Silty SAND, angular, dense, Lt. Brown, wet, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.1 ft,		
25	8		>>	18 23 30 (53)		D-9		Silty SAND with gravel, subangular, dense, gray, moist, Homogeneous, no HCl reaction, Silt lenses. Length Recovered 1.2 ft,		
	9			15 21 26 (47)		D-10	GS MC	SM, M.C. =14% Silty SAND with gravel, subangular, dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.3 ft,		
30			>>	18 29 31 (60)		D-11		Silty SAND with gravel, subangular, very dense, gray, moist, Homogeneous, no HCl reaction, Moisture tin retained in sample bag. Length Recovered 1.2 ft,		
	10		>>	55 (55/6")		D-12		Silty SAND with gravel, subrounded, very dense, gray, moist, Homogeneous, no HCl reaction, Drove large gravel into sampler bit. With large gravel as indicated by drilling process. Length Recovered 0.5 ft,		
35	11		>>	20 32 39 (71)		D-13		Sandy silty CLAY, very dense, gray, moist, Homogeneous, no HCl reaction, Moisture tin retained in sample bag. Length Recovered 1.5 ft,		
	12		>>	25 34 43 (67)		D-14		Sandy silty CLAY, very dense, gray, moist, Homogeneous, no HCl reaction, Fine gray sand. Length Recovered 1.5 ft, Length Retained 1.5 ft		
40	13		>>	29 31 39 (70)		D-15	GS MC AL	CL-ML, M.C. =23%, PI =6 Sandy silty CLAY, very dense, gray, moist, Homogeneous, no HCl reaction, Length Recovered 1.5 ft, Moisture tin retained in sample bag. Water level before bailing 7.0, after bailed 19.0', after 5 minutes 16.1', after 10 minutes 15.8', after 15 minutes 15.0', water table stabilized at 14.5'.		
45								End of test hole boring at 41.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		

Job No. **MS-4700** Date **August 5, 2004**

Hole No. **KJ-1-04** Sheet **1** of **1**

Project **Stage 1 and 2 Kirkland Nickel Project**

Laboratory Summary

Washington State Department of Transportation

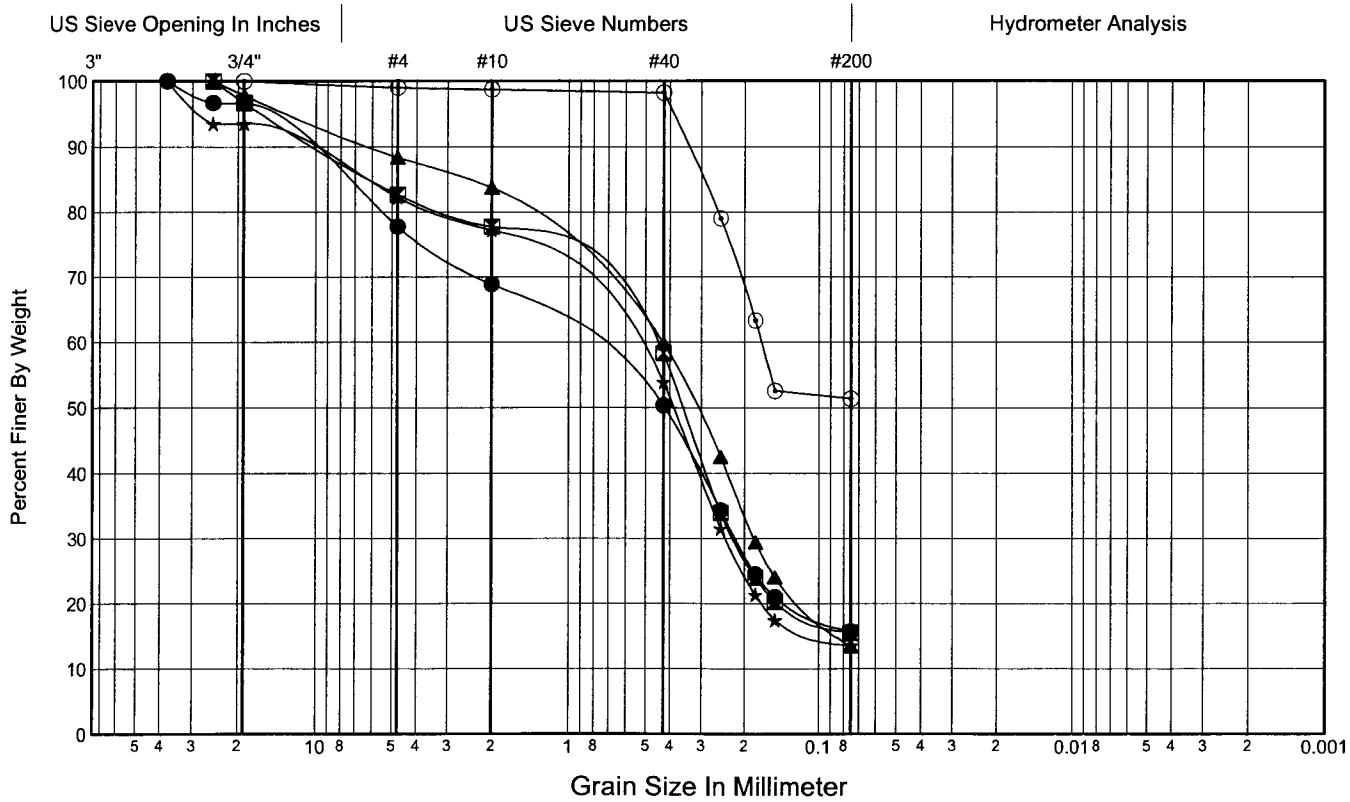
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	10.0	3.05	D-3	SM	See Boring Log	SILTY SAND with GRAVEL	8			
⊠	15.0	4.57	D-5	SM	See Boring Log	SILTY SAND with GRAVEL	9			
▲	20.0	6.10	D-7	SM	See Boring Log	SILTY SAND	16			
★	27.5	8.38	D-10	SM	See Boring Log	SILTY SAND with GRAVEL	14			
⊙	40.0	12.19	D-15	CL-ML	See Boring Log	SANDY SILTY CLAY	23	28	22	6

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	22.3	62.0	15.7		
⊠	17.4	67.1	15.5		
▲	11.6	74.9	13.4		
★	17.8	68.7	13.5		
⊙	1.0	47.7	51.3		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.954	0.42	0.22	0.13	
⊠	0.487	0.35	0.22	0.14	
▲	0.430	0.31	0.18	0.12	
★	0.638	0.39	0.24	0.17	
⊙	0.170				



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-62195

HOLE No. KQ-1-04

Sheet 1 of 2

Job No. XL-2068 SR 405 Elevation 267.6 ft (81.6 m)

Project Stage 1 Kirkland Driller Sean Verlo Lic# 2615

Site Address Vic. SR 405 + NE 85th ST. Inspector Don Henderson

Start July 23, 2004 Completion July 23, 2004 Well ID# AHN-837 Equipment CME 45 w/ autohammer

Station Offset Casing HW-4.5/HQ-3.5 Method Wet Rotary

Northing 251223.1 Easting 1307781.1 Latitude Longitude

County King Subsection NW 1/4 of the SW 1/4 Section 4 Range 5 EWM Township 25N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				17 22 16 (38)		D-1		Silty SAND, dense, Lt. Brown, dry, Homogeneous, no HCl reaction, Trace organics, With large gravel as indicated by drilling process. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	1			13 14 15 (29)		D-2	GS MC	SM, MC=10% Silty SAND, dense, Lt. Brown, dry, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.5 ft, Length Retained 1.5 ft		
5				7 11 13 (24)		D-3		Well graded SAND with silt, medium dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft		
	2			14 11 12 (23)		D-4	GS MC	SW-SM, MC=9% Well graded SAND with silt, medium dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 1.4 ft, Length Retained 1.4 ft		
10	3			14 15 13 (28)		D-5		Well graded SAND with silt, dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	4			11 12 8 (20)		D-6		Silty SAND, medium dense, gray, wet, Homogeneous, no HCl reaction, Hit wet zone at 12.5. Length Recovered 1.1 ft, Length Retained 1.1 ft		
15	5			5 4 3 (7)		D-7	GS MC	SM, MC=20% Silty SAND, loose, brown, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
	6			3 3 4 (7)		D-8	GS MC	SW-SM, MC=18% Well graded SAND with silt and gravel, loose, gray, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
20				18		D-9		Silty SAND, dense, gray, moist, Homogeneous, no HCl		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62195

HOLE No. KQ-1-04

Job No. XL-2068 SR 405 Elevation 267.6 ft (81.6 m)

Sheet 2 of 2

Project Stage 1 Kirkland Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				15 20 (35)				reaction Length Recovered 0.9 ft, Length Retained 0.9 ft 07/23/2004 07/23/2004		
	7									
25			>>	21 25 32 (57)		D-10		Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.2 ft, Length Retained 1.2 ft		
	8									
	9			37 50/4 (50/4")		D-11	GS MC	SM, MC=11% Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 0.9 ft, Length Retained 0.9 ft		
30										
	10									
35				50/6 (50/6")		D-12		Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 0.5 ft, Length Retained 0.5 ft		
	11									
	12			40 50/3 (50/3")		D-13	GS MC	SP-SM, MC=13% Poorly graded SAND with silt and gravel, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 0.8 ft, Length Retained 0.8 ft		
40								End of test hole boring at 40.3 ft below ground elevation.		
	13							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45								Bore hole water level before bailing 7.0', after bailed 37.0', after 10 minutes 27.2', after 20 minutes 25.1', after 30 minutes 23.7', water table stabilized at 20.2'.		

Job No. **XL-2068**
Hole No. **KQ-1-04**
Project **Stage 1 Kirkland**

Date **August 12, 2004**
Sheet **1** of **2**

Laboratory Summary

Washington State Department of Transportation

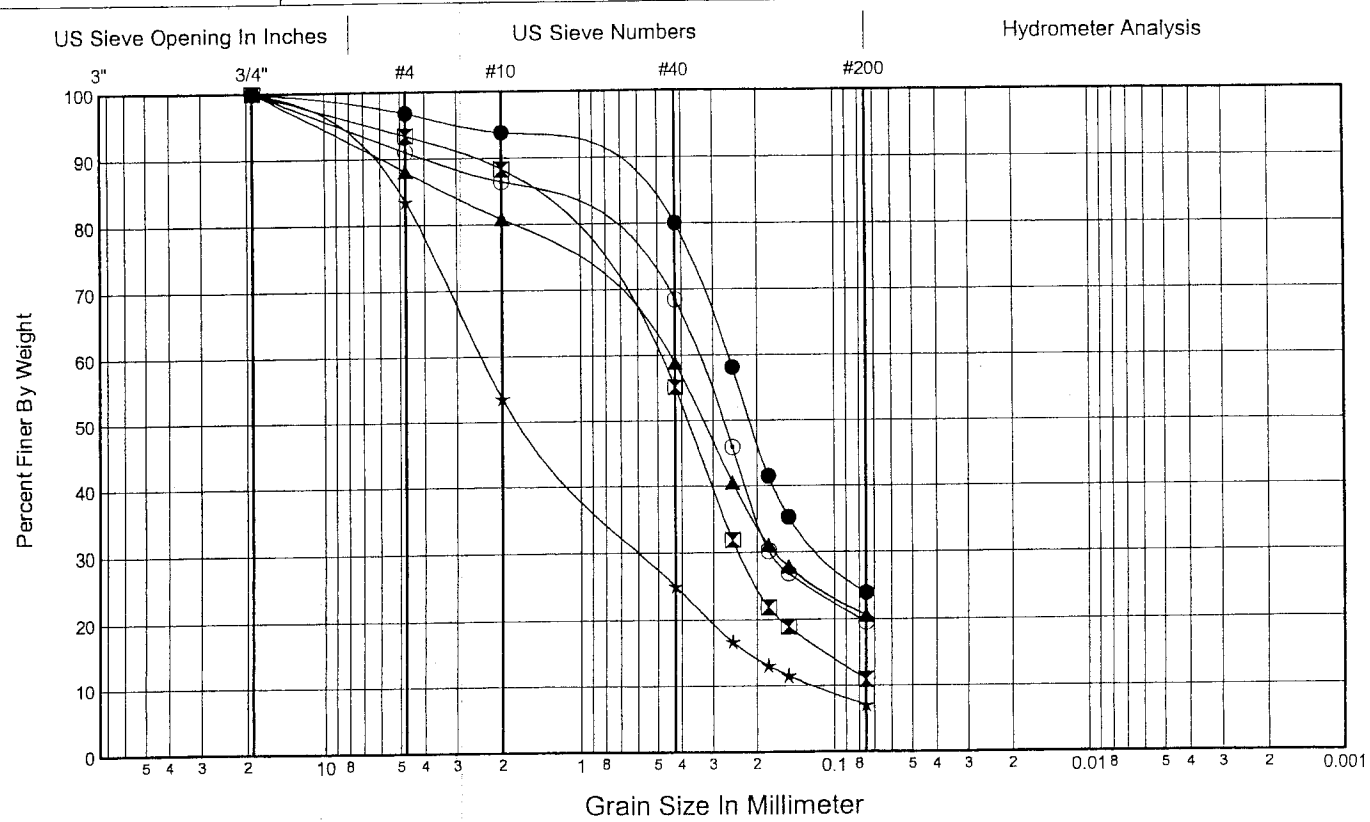
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	3.0	0.91	D-2	SM	See Boring Log	SILTY SAND	10			
⧗	8.0	2.44	D-4	SW-SM	See Boring Log	WELL-GRADED SAND with SILT	9			
▲	14.5	4.42	D-7	SM	See Boring Log	SILTY SAND	20			
★	18.0	5.49	D-8	SW-SM	See Boring Log	WELL-GRADED SAND with SILT and GRAVEL	18			
⊙	29.5	8.99	D-11	SM	See Boring Log	SILTY SAND	11			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	3.2	72.9	23.9		
⧗	6.6	82.5	10.9	1.5	7.7
▲	11.9	67.5	20.5		
★	16.5	76.5	7.0	1.1	20.2
⊙	9.0	71.4	19.6		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.262	0.21	0.11		
⧗	0.534	0.38	0.24	0.16	
▲	0.462	0.33	0.17		
★	2.411	1.65	0.56	0.31	0.119
⊙	0.348	0.28	0.18	0.08	



Job No. **XL-2068**
Hole No. **KQ-1-04**
Project **Stage 1 Kirkland**

Date **August 17, 2004**
Sheet **2** of **2**

Laboratory Summary

Washington State Department of Transportation

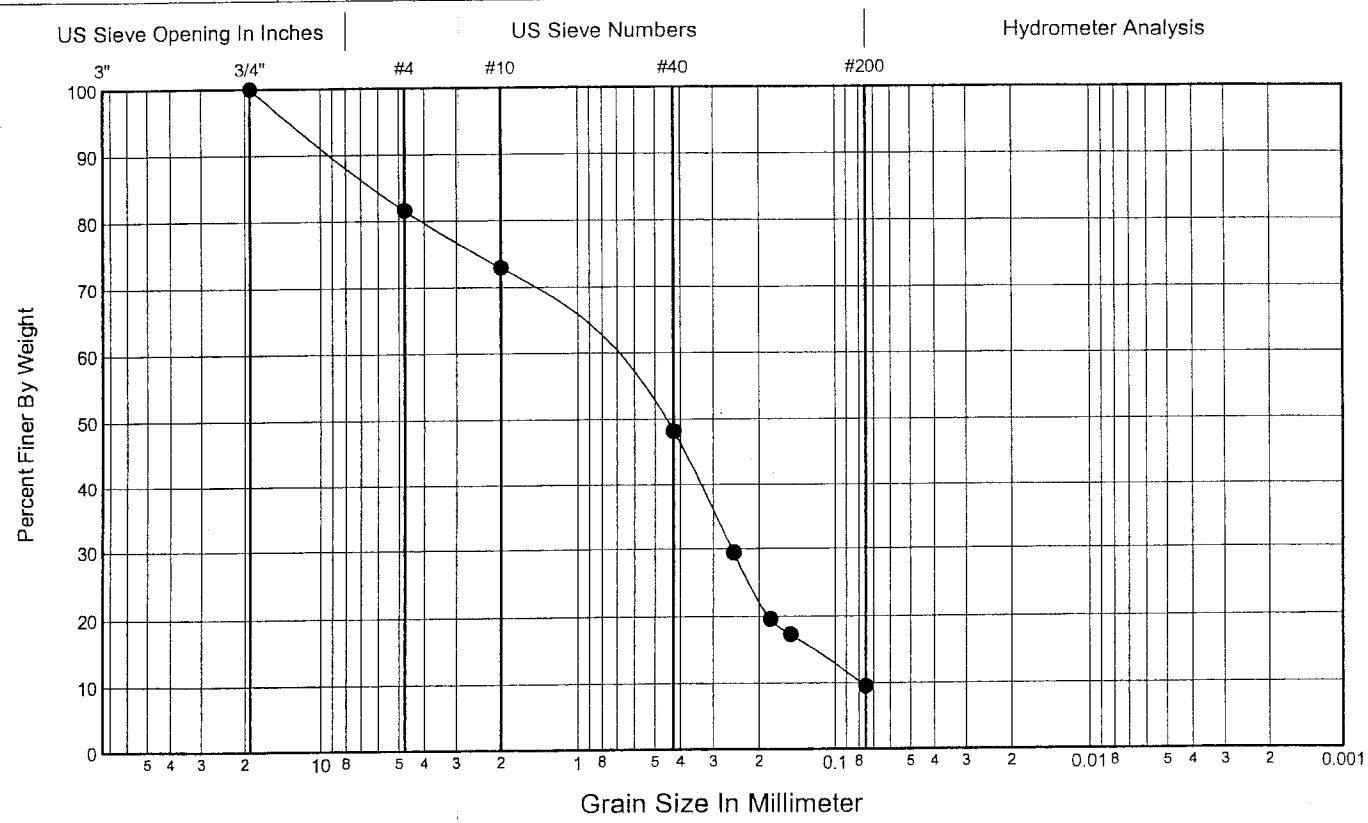
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	39.5	12.04	D-13	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	13			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	18.4	72.1	9.5	0.9	11.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.890	0.48	0.25	0.18	0.078



Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-62197

HOLE No. KR-1-04

Sheet 1 of 2

Job No. XL-2068 SR 405 Elevation 279.7 ft (85.3 m)

Project Stage 1 Kirkland

Driller Sean Verlo Lic# 2615

Site Address Vic. SR 405 + NE 85rd ST.

Inspector Don Henderson

Start July 26, 2004 Completion July 26, 2004 Well ID# AHN-838

Equipment CME 45 w/ autohammer

Station Offset Casing HW-4.5/HQ-3.5

Method Wet Rotary

Northing 253565.3 Easting 1308257.4 Latitude Longitude

County King Subsection SW 1/4 of the NW 1/4 Section 4 Range 5 EWM Township 25N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				4 9 14 (23)		D-1		Silty SAND, medium dense, Lt. Brown, dry, Homogeneous, no HCl reaction, Trace organics (roots). Length Recovered 1.3 ft, Length Retained 1.3 ft		
	1			13 15 16 (31)		D-2		Silty SAND with gravel, dense, Lt. Brown, dry, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
5				7 12 16 (28)		D-3		Silty SAND with gravel, dense, Lt. Brown, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.2 ft, Length Retained 1.2 ft		
	2			24 50/6 (50/6")		D-4	GS MC	SM, MC=13% Silty SAND, very dense, light brown, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.0 ft, Length Retained 1.0 ft		
10	3			44 50/6 (50/6")		D-5		Poorly graded SAND with gravel, very dense, light brown, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	4			50/6 (50/6")		D-6	GS MC	SP, MC=11% Poorly graded SAND with gravel, very dense, light brown, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 0.5 ft, Length Retained 0.5 ft		
15	5		>>	57/6 (57/6")		D-7		Poorly graded SAND with gravel, very dense, light brown, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 0.4 ft, Length Retained 0.4 ft		
20	6			9 13 22 (35) 18		D-8 D-9	GS	Poorly graded SAND with gravel, dense, light brown, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.0 ft, Length Retained 1.0 ft 07/26/2004		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62197

HOLE No. KR-1-04

Job No. XL-2068 SR 405 Elevation 279.7 ft (85.3 m)

Sheet 2 of 2

Project Stage 1 Kirkland Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				19 20 (39)			MC	07/26/2004 SM, MC=23% Silty SAND, dense, gray, wet, Homogeneous, no HCl reaction, Silt from 20.3 to 21.0. Length Recovered 1.3 ft, Length Retained 1.3 ft		
	7									
25				11 16 21 (37)		D-10		Clayey SAND, dense, gray, moist, Stratified, no HCl reaction, Sand lenses throughout, Moisture tin retained in sample bag. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	8									
	9			12 19 25 (44)		D-11	GS MC AL	SC, MC=24%, PI=15		
30								Clayey SAND, dense, gray, moist, Homogeneous, no HCl reaction, Moisture tin retained in sample bag. Length Recovered 1.5 ft, Length Retained 1.5 ft		
						U-12 A		Clayey SAND, dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 0.4 ft, Length Retained 0.4 ft		
	10									
35				9 14 17 (31)		D-13		Clayey SAND, dense, gray, moist, Homogeneous, no HCl reaction, Moisture tin retained in sample bag. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	11					U-14 A B C D		Clayey SAND, dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	12			15 20 25 (45)		D-15		Clayey SAND, dense, gray, moist, Homogeneous, no HCl reaction, Length Recovered 1.0 ft, Length Retained 1.0 ft		
	13							End of test hole boring at 41 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Bore hole water level before bailing 10.0', after bailed 25.5', after 10 minutes 24.5', after 20 minutes 21.4', after 30 minutes 19.6', water table stabilized at 19.2'.		
45										

Job No. **XL-2068**
Hole No. **KR-1-04**
Project **Stage 1 Kirkland**

Date **August 12, 2004**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

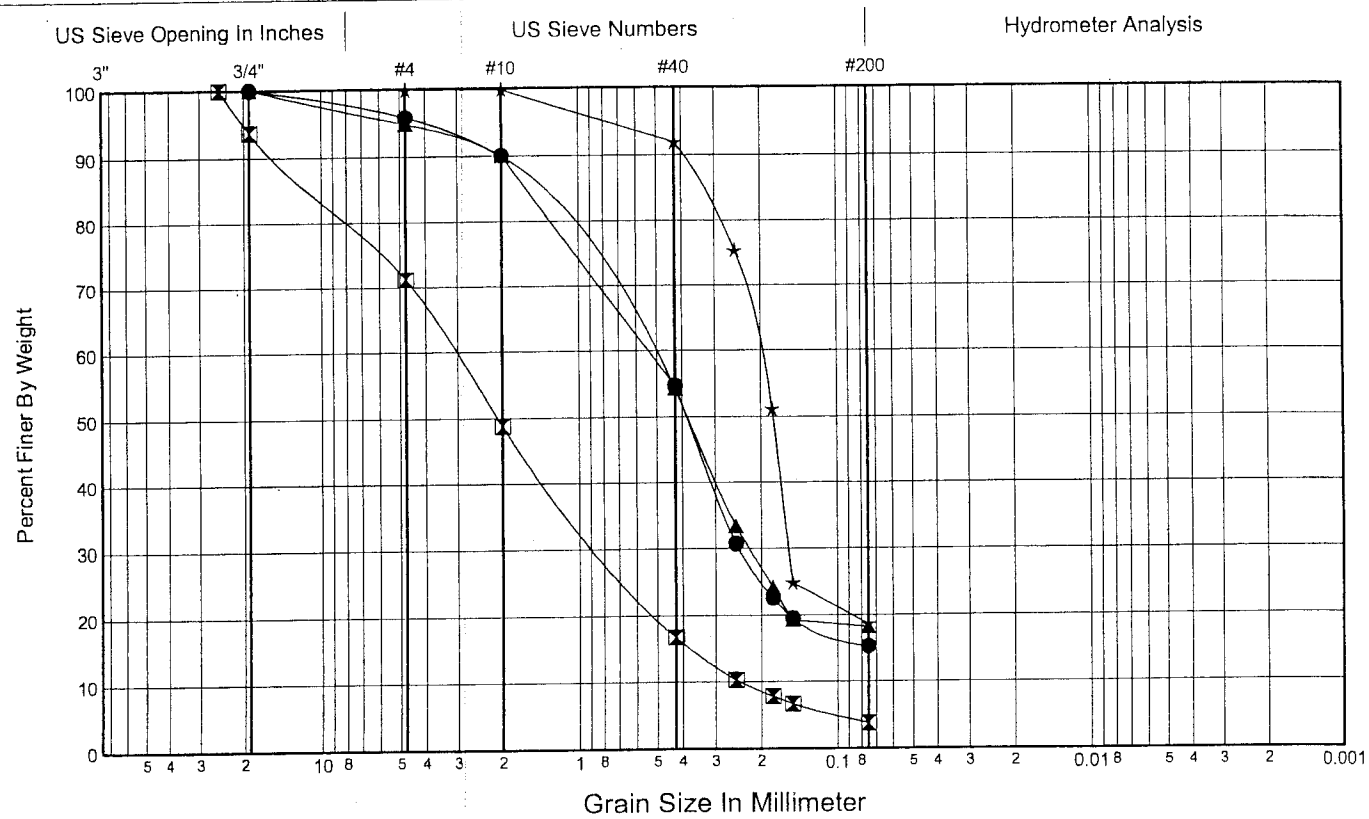
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	8.0	2.44	D-4	SM	See Boring Log	SILTY SAND	13			
⊠	13.0	3.96	D-6	SP	See Boring Log	POORLY GRADED SAND with GRAVEL	11			
▲	19.5	5.94	D-9	SM	See Boring Log	SILTY SAND	23			
★	29.5	8.99	D-11	SC	See Boring Log	CLAYEY SAND	24	40	25	15

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	4.2	80.6	15.2		
⊠	28.8	67.4	3.8	0.9	12.8
▲	5.2	76.7	18.1		
★	0.1	81.3	18.6		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.538	0.38	0.24	0.15	
⊠	3.086	2.10	0.81	0.50	0.242
▲	0.547	0.38	0.22	0.15	
★	0.203	0.18	0.16	0.09	



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62197

HOLE No. KS-1-04

Job No. XL-2068 SR 405 Elevation ft (m)

Sheet 1 of 2

Project Stage 1 Kirkland

Driller Sean Verlo Lic# 2615

Site Address Vic. SR 405 + NE 85rd ST.

Inspector Don Henderson

Start July 21, 2004 Completion July 21, 2004 Well ID# AHN-839

Equipment CME 45 w/ autohammer

Station Offset Casing HW-4.5/HQ-3.5

Method Wet Rotary

Northing 254525.5 Easting 1308481.7 Latitude Longitude

County King Subsection SW 1/4 of the NW 1/4 Section 4 Range 5 EWM Township 25N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				8 13 23 (36)		D-1		Silty SAND with gravel, dense, light brown, dry, Homogeneous, no HCl reaction, Trace organics, (roots). Length Recovered 1.2 ft, Length Retained 1.2 ft		
			>>	31 38 33 (68)		D-2		Silty SAND with gravel, very dense, light brown, dry, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	1					C-3		Silty SAND with gravel, very dense, light brown, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
5			>>	18 21 36 (57)		D-4	GS MC	SM, MC=10% Silty SAND with gravel, very dense, gray, moist, Homogeneous, no HCl reaction, Trace organics. With large gravel as indicated by drilling process. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	2		>>	20 25 28 (53)		D-5		Silty SAND with gravel, very dense, light brown, dry, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
				15 17 20 (37)		D-6		Poorly graded SAND with silt, dense, light brown, moist, Homogeneous, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft		
10	3			15 16 18 (34)		D-7	GS MC	SP-SM, MC=17% Poorly graded SAND with silt, dense, light brown, moist, Homogeneous, no HCl reaction Length Recovered 1.4 ft, Length Retained 1.4 ft		
	4									
				13 16 25 (41)		D-8		Poorly graded SAND with silt, dense, light brown, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
15			>>	22 26 31 (57)		D-9		Poorly graded SAND with silt, very dense, light brown, moist, Homogeneous, no HCl reaction Length Recovered 1.1 ft, Length Retained 1.1 ft		
	5									
				16 23		D-10		Poorly graded SAND with silt, dense, light brown moist, Homogeneous, no HCl reaction		
20	6									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62197

HOLE No. KS-1-04

Job No. XL-2068 SR 405 Elevation ft (m)

Sheet 2 of 2

Project Stage 1 Kirkland

Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				26 (49)				Length Recovered 1.4 ft, Length Retained 1.4 ft		
	7									
25				18 23 25 (48)		D-11		Poorly graded SAND with silt, dense, light brown, moist, Homogeneous, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft		
	8								07/21/2004 07/21/2004	
	9		>>	17 23 28 (51)		D-12		Poorly graded SAND with silt, very dense, light brown, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
30										
	10									
35			>>	21 24 31 (55)		D-13		Poorly graded SAND with silt, very dense, light brown, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
	11									
	12		>>	24 26 41 (67)		D-14		Poorly graded SAND with silt, very dense, light brown, moist, Homogeneous, no HCl reaction, Length Recovered 1.5 ft, Length Retained 1.5 ft		
40								End of test hole boring at 40.5 ft below ground elevation.		
	13							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Bore hole water level before bailing 9.5', water level after bailed 28.5', water level after 10 minutes 28.0', after 20 minutes 27.5', after 30 minutes 26.8', water table stabilized at 26.0'.		
45										

Job No. **XL-2068**
Hole No. **KS-1-04**
Project **Stage 1 Kirkland**

Date **August 12, 2004**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

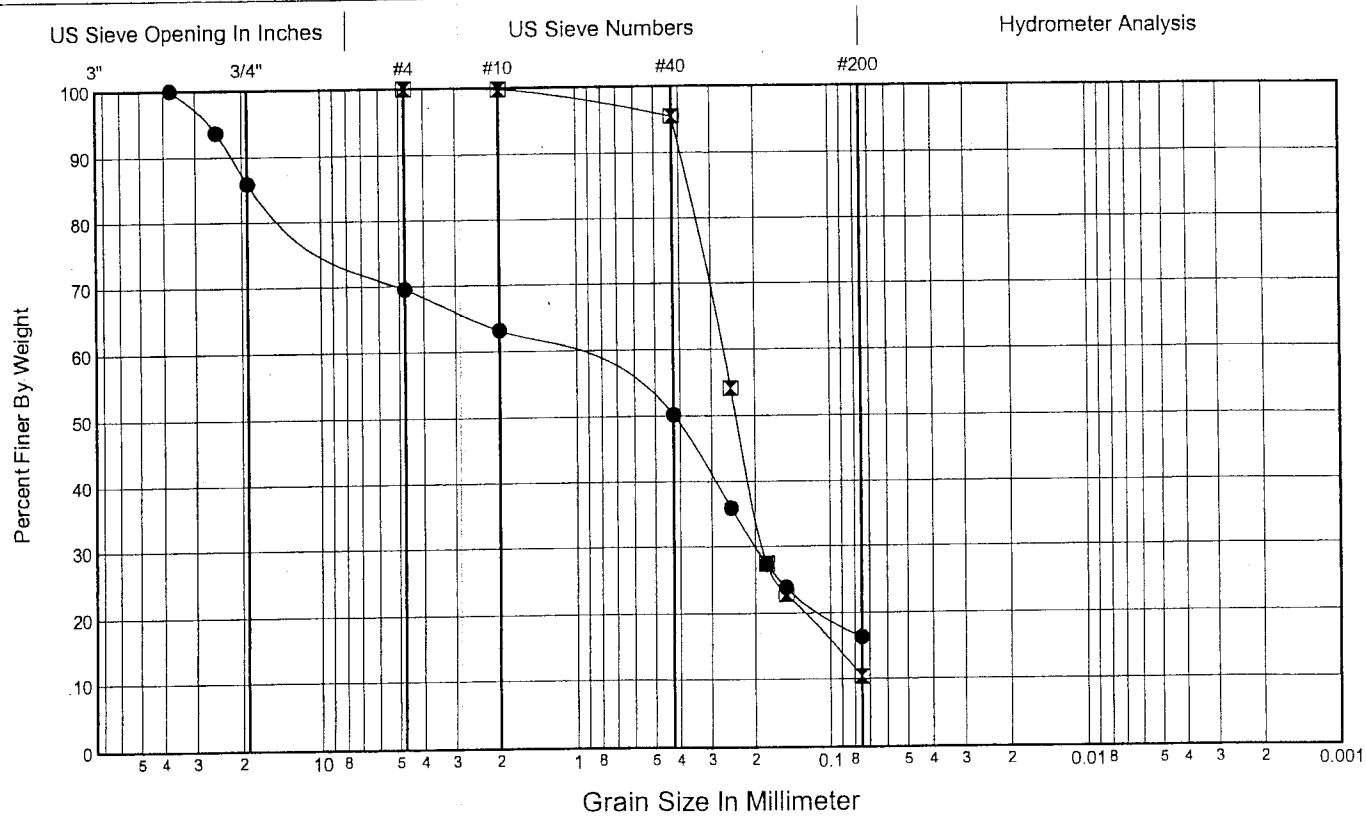
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-4	SM	See Boring Log	SILTY SAND with GRAVEL	10			
⊠	10.5	3.20	D-7	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	17			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	30.5	53.2	16.3		
⊠	0.0	89.6	10.4	1.7	3.7

GRADATION VALUES

	D60	D50	D30	D20	D10
●	1.377	0.42	0.20	0.11	
⊠	0.270	0.24	0.19	0.13	



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-62199

HOLE No. KT-1-04

Sheet 1 of 2

Job No. XL-2068 SR 405 Elevation 260.5 ft (79.4 m)

Project Stage 1 Kirkland Driller Joe Judd Lic# 2454

Site Address SR 405 & NE 85 th. St. Inspector Dave Nelson

Start August 2, 2004 Completion August 3, 2004 Well ID# AHN-841 Equipment CME 850 w/ autohammer

Station Offset Casing 6" x 8' & 4" x 38.0 Method Wet Rotary

Northing 255491 Easting 1308624 Latitude Longitude

County King Subsection SW 1/4 of SW 1/4 Section 33 Range 5 EWM Township 26 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	1			4 4 5 (9)		D-1		Well graded SAND with silt, with wood, loose, grey, dry, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
5	2			5 6 6 (12)		D-2		Well graded SAND with silt, medium dense, greyish green, moist, Stratified, HCl reaction not tested, stratified with well graded sand Length Recovered 1.0 ft		
				14 22 25 (47)		D-3		Well graded SAND with silt, dense, brown, moist, Stratified, HCl reaction not tested, stratified with silt Length Recovered 1.0 ft 08/03/2004	▽	
10	3		>>	21 26 30 (56)		D-4	GS MC	SW-SM, MC=16% Well graded SAND with silt, very dense, brown, moist, Stratified, HCl reaction not tested, stratified with silt Length Recovered 1.0 ft		
	4			11 19 24 (43)		D-5		Well graded SAND with silt, dense, brown, wet, Stratified, HCl reaction not tested, stratified with silt Length Recovered 1.0 ft		
15	5			24 21 26 (47)		D-6		Silty SAND, dense, grey, wet, Stratified, HCl reaction not tested, stratified with silt Length Recovered 1.0 ft		
			>>	14 38 32 (70)		D-7		Silty SAND, very dense, greyish green, wet, Stratified, HCl reaction not tested, stratified with silt Length Recovered 1.0 ft		
20	6									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62199

HOLE No. KT-1-04

Job No. XL-2068 SR 405 Elevation 260.5 ft (79.4 m)

Sheet 2 of 2

Project Stage 1 Kirkland

Driller Joe Judd Lic# 2454

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	7			11 19 28 (47)		D-8	GS MC	SM, MC=21% Silty SAND, dense, greyish green, moist, Laminated,Fissured, HCl reaction not tested, poorly graded sand Length Recovered 1.0 ft		
25	8			10 13 16 (29)		D-9		Silty SAND, dense, greyish green, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
30	9									
	10			12 17 19 (36)		D-10		Silty SAND, dense, greyish green, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft		
35	11									
	12			8 13 20 (33)		D-11		Silty SAND, dense, greyish green, moist, Laminated,Fissured, HCl reaction not tested, laminated with silt and sand Length Recovered 1.0 ft		
40	13							End of test hole boring at 39.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45										

Job No. **XL-2068**
Hole No. **KT-1-04**
Project **Stage 1 Kirkland**

Date **August 12, 2004**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

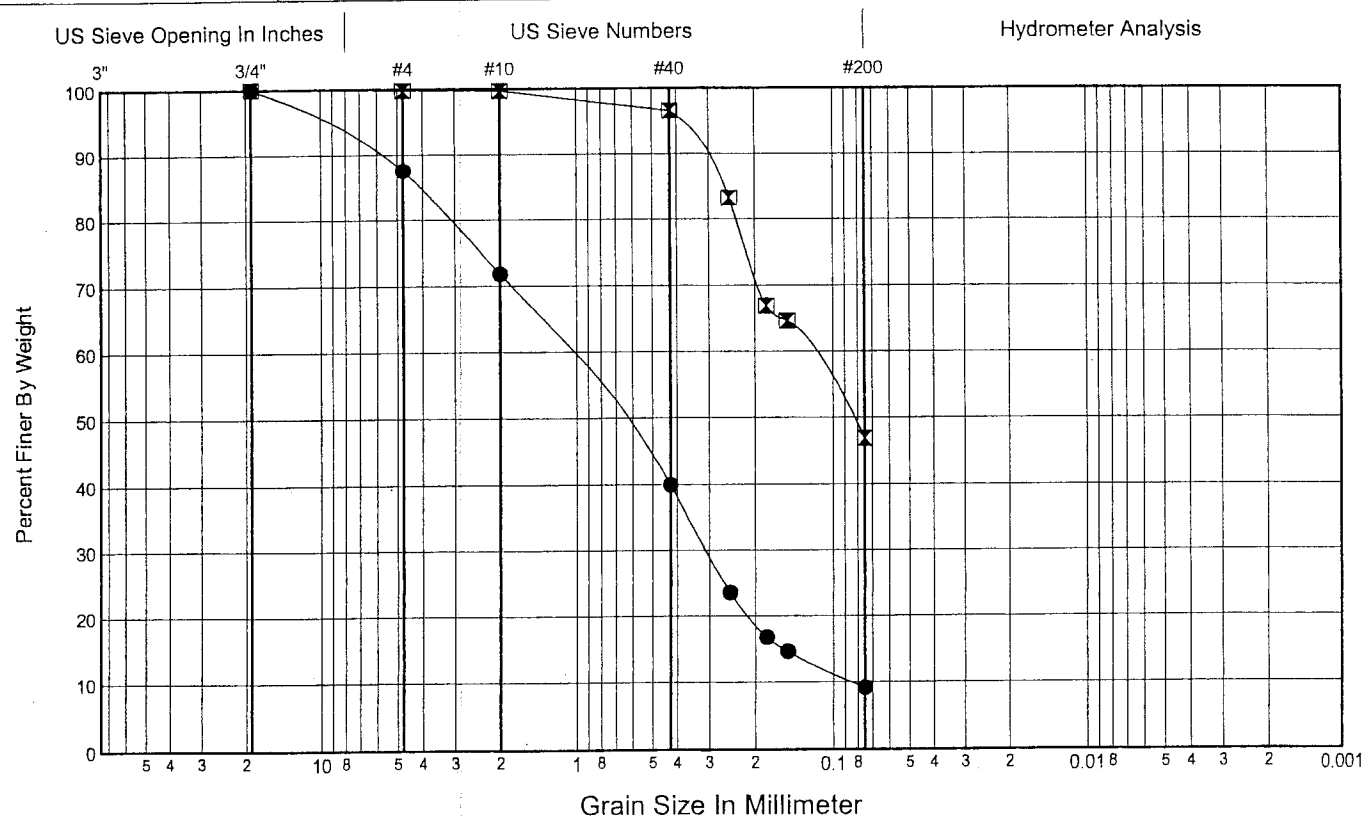
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	10.5	3.20	D-4	SW-SM	See Boring Log	WELL-GRADED SAND with SILT	16			
⊠	23.0	7.01	D-8	SM	See Boring Log	SILTY SAND	21			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	12.5	78.4	9.1	1.0	13.4
⊠	0.2	52.9	46.9		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	1.128	0.69	0.31	0.21	0.084
⊠	0.125	0.08			



Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-62198

HOLE No. KU-1-04

Job No. XL-2068 SR 405 Elevation 205.3 ft (62.6 m)

Sheet 1 of 2

Project Stage 1 Kirkland

Driller Sean Verlo Lic# 2615

Site Address Vic. SR 405 + NE 116th ST.

Inspector Don Henderson

Start July 22, 2004 Completion July 22, 2004 Well ID# AHN-840

Equipment CME 45 w/ autohammer

Station Offset Casing HW-4.5/HQ-3.5

Method Wet Rotary

Northing 257512.2 Easting 1308900.5 Latitude Longitude

County King Subsection SE 1/4 of the NW 1/4 Section 33 Range 5 EWM Township 26N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				2 4 4 (8)		D-1		Silty SAND with gravel, loose, Lt. Brown, dry, Homogeneous, no HCl reaction, Trace organics (roots). Length Recovered 1.5 ft, Length Retained 1.5 ft		
	1			2 4 14 (18)		D-2	GS MC	SM, MC=15% Silty SAND with gravel, medium dense, Lt. Brown, moist, Homogeneous, no HCl reaction, trace organics (roots) Length Recovered 1.0 ft, Length Retained 1.0 ft		
5			>>	22 50/3 (50/3") 34 60/6 (60/6")		D-3 D-4		Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 0.8 ft, Length Retained 0.8 ft Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	2									
10	3		>>	20 34 40 (74)		D-5	GS MC	SM, MC=14% Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process., trace organics. Length Recovered 1.2 ft, Length Retained 1.2 ft		
	4		>>	32 34 40 (74)		D-6		Silty SAND, very dense, gray, wet, Stratified, no HCl reaction, With large gravel as indicated by drilling process. Wet layer at approx. 13.0'. Length Recovered 1.5 ft, Length Retained 1.5 ft		
15			>>	34 60/6 (60/6")		D-7	GS MC	SM, MC=14% Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
	5			50/2 (50/2")		D-8		Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 0.2 ft, Length Retained 0.2 ft		
20	6		>>	23		D-9		Silty SAND, very dense, gray, moist, Homogeneous, no		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62198

HOLE No. KU-1-04

Job No. XL-2068 SR 405 Elevation 205.3 ft (62.6 m)

Sheet 2 of 2

Project Stage 1 Kirkland

Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				32 50 (82)				HCl reaction Length Recovered 1.3 ft, Length Retained 1.3 ft	07/22/2004 07/22/2004	
25	7			40 50/4 (50/4")		D-10	GS MC	SP, MC=10% Poorly graded SAND with gravel, very dense, gray, wet, Homogeneous, no HCl reaction, drilling changed at 23.5'. Length Recovered 0.9 ft, Length Retained 0.9 ft		
30	8			>> 24 19 32 (51)		D-11		Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.5 ft, Length Retained 1.5 ft		
35	9			>> 22 27 36 (63)		D-12	GS MC	SP-SM, MC=22% Poorly graded SAND with silt, very dense, gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
40	10			>> 22 31 49 (80)		D-13		Poorly graded SAND with silt, very dense, gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	11							End of test hole boring at 41 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Bore hole water level before bailing 8.0', after bailed 25.2', after 10 minutes 24.9', after 20 minutes 23.4', after 30 minutes 23.0', Water table stabilized at 22.6'.		
	12									
	13									

Job No. **XL-2068**
Hole No. **KU-1-04**
Project **Stage 1 Kirkland**

Date **August 12, 2004**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

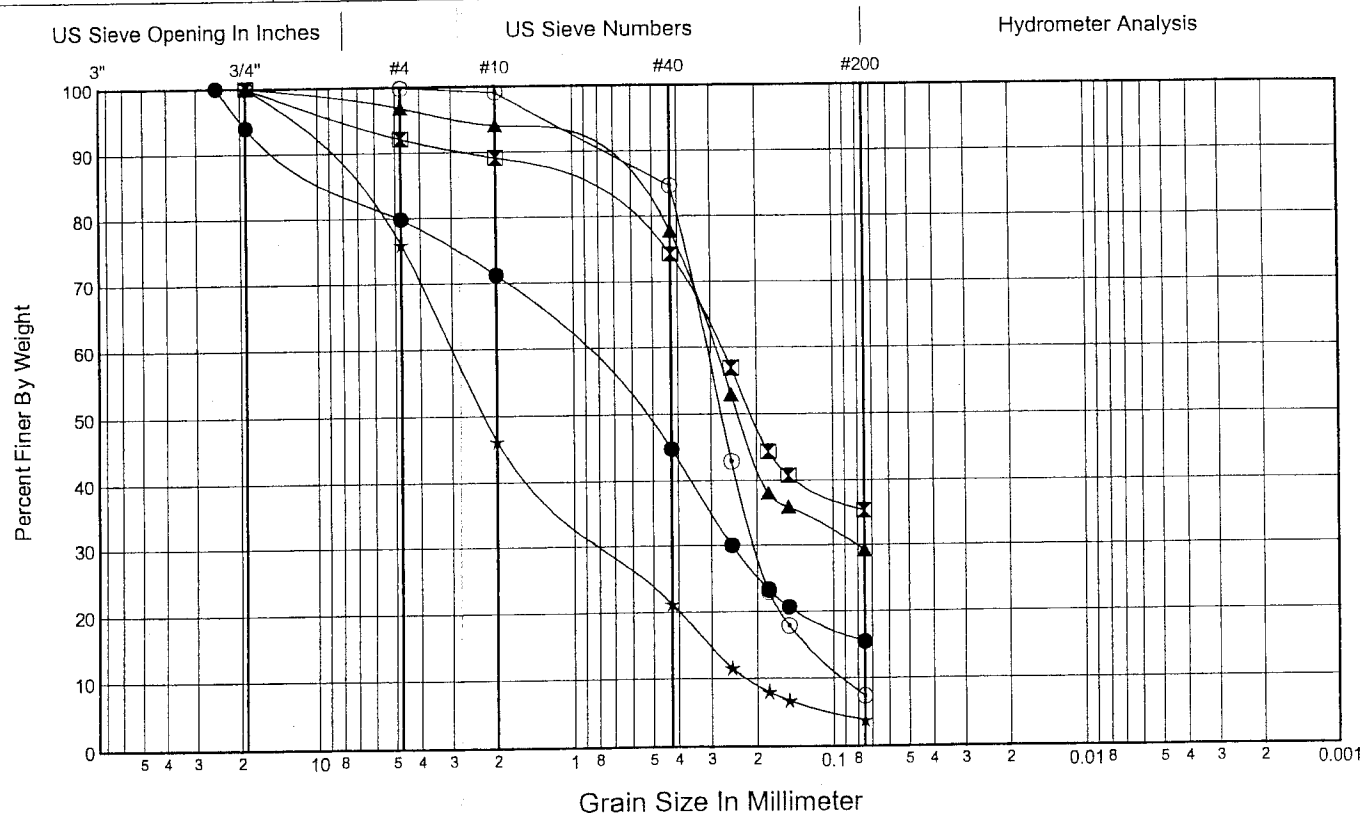
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	3.0	0.91	D-2	SM	See Boring Log	SILTY SAND with GRAVEL	15			
⧗	9.5	2.90	D-5	SM	See Boring Log	SILTY SAND	14			
▲	14.5	4.42	D-7	SM	See Boring Log	SILTY SAND	14			
★	24.5	7.47	D-10	SP	See Boring Log	POORLY GRADED SAND with GRAVEL	10			
⊙	34.5	10.52	D-12	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	22			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	20.2	64.4	15.4		
⧗	7.9	56.8	35.3		
▲	3.2	67.6	29.2		
★	24.1	72.2	3.8	0.8	13.8
⊙	0.2	92.5	7.4	1.5	3.5

GRADATION VALUES

	D60	D50	D30	D20	D10
●	1.037	0.58	0.25	0.14	
⧗	0.275	0.21			
▲	0.291	0.23	0.08		
★	2.989	2.23	0.73	0.40	0.217
⊙	0.311	0.27	0.20	0.16	0.089



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-23934

Job No. MS-4700 SR 405 Elevation 133.3 (40.6 m)

HOLE No. KW-2-04

Sheet 1 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Site Address Vicinity SR-405 and NE 85th Street

Inspector Dan Reed

Start March 31, 2004 Completion March 31, 2004 Well ID# Equipment CME 45 w/ autohammer

Station Offset Casing HW 4.5/ HQ 3.5 Method Wet Rotary

Northing 259105.75 Easting 1309114.05 Latitude Longitude

County King Subsection SW 1/4 of the SW 1/4 Section 28 Range 5 EWM Township 26N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1, 2			3 5 5 (10)		D-1	GS MC	SM, M.C. =27% Silty SAND with gravel, Subrounded, loose, Lt. Brown, wet, Disrupted, no HCl reaction, Moisture tin retained in sample bag. Length Recovered 1.1 ft,		
10	3, 4			4 5 10 (15)		D-2		Well graded SAND with gravel, Slightly silty, subangular, medium dense, Lt. Brown, wet, Disrupted, no HCl reaction Length Recovered 0.8 ft,	03/31/2004	
15	5, 6			5 4 5 (9)		D-3	GS MC	SW, M.C. =9% Well graded SAND with gravel, subangular, loose, gray, wet, Homogeneous, no HCl reaction Length Recovered 0.9 ft,		
20										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-23934

HOLE No. KW-2-04

Job No. MS-4700 SR 405 Elevation 133.3 (40.6 m)

Sheet 2 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				17 16 36 (52)		D-4		Sandy lean CLAY, very dense, gray, moist, Stratified, no HCl reaction, With silty sand lenses. Moisture tin retained in sample bag. Contact with Sandy lean clay at 18.0' as indicated by drilling process. Length Recovered 1.5 ft,		
25	7			12 16 18 (34)		D-5	GS MC AL	CL, M.C. =17%, PI =11 Sandy lean CLAY, very dense, gray, moist, Disrupted, no HCl reaction, Mixed soil colors. Moisture tin retained in sample bag. Length Recovered 1.5 ft,		
30	8 9			7 9 10 (19)		D-6	GS MC	SM, M.C. =24% Silty SAND, medium dense, Lt. Brown, moist, Homogeneous, no HCl reaction, Contact with light brown fine sand at 30.1 Length Recovered 1.2 ft,		
35	10 11			5 6 6 (12)		D-7		Silty SAND, medium dense, gray, wet, Homogeneous, no HCl reaction, Fine gray sand. Moisture tin retained in sample bag. Length Recovered 1.5 ft,		
40	12			27 37 50 (50)		D-8	GS MC	ML, M.C. =24% SILT with sand, angular, very dense, gray, moist, Stratified, no HCl reaction, Length Recovered 1.5 ft, Moisture tin retained in sample bag.		
45	13							End of test hole boring at 41.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. This test boring was not instrumented with a piezometer. Prior to removal, a bail test was performed within the drill		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-23934

Job No. MS-4700 SR 405 Elevation 133.3 (40.6 m)

HOLE No. KW-2-04

Sheet 3 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								casing. The water level observed from this may not truly reflect the actual groundwater conditions present at the site. Water level before bailing 11.0', after bailed 18.0', after 5 minutes 17.3', after 10 minutes 16.0', after 15 minutes 15.1', water table stabilized at 12.0'.		
	14									
	15									
50										
	16									
55										
	17									
	18									
60										
	19									
65										
	20									
	21									
70										

Job No. **MS-4700** Date **August 5, 2004**

Hole No. **KW-2-04** Sheet **1** of **1**

Project **Stage 1 and 2 Kirkland Nickel Project**

Laboratory Summary

Washington State Department of Transportation

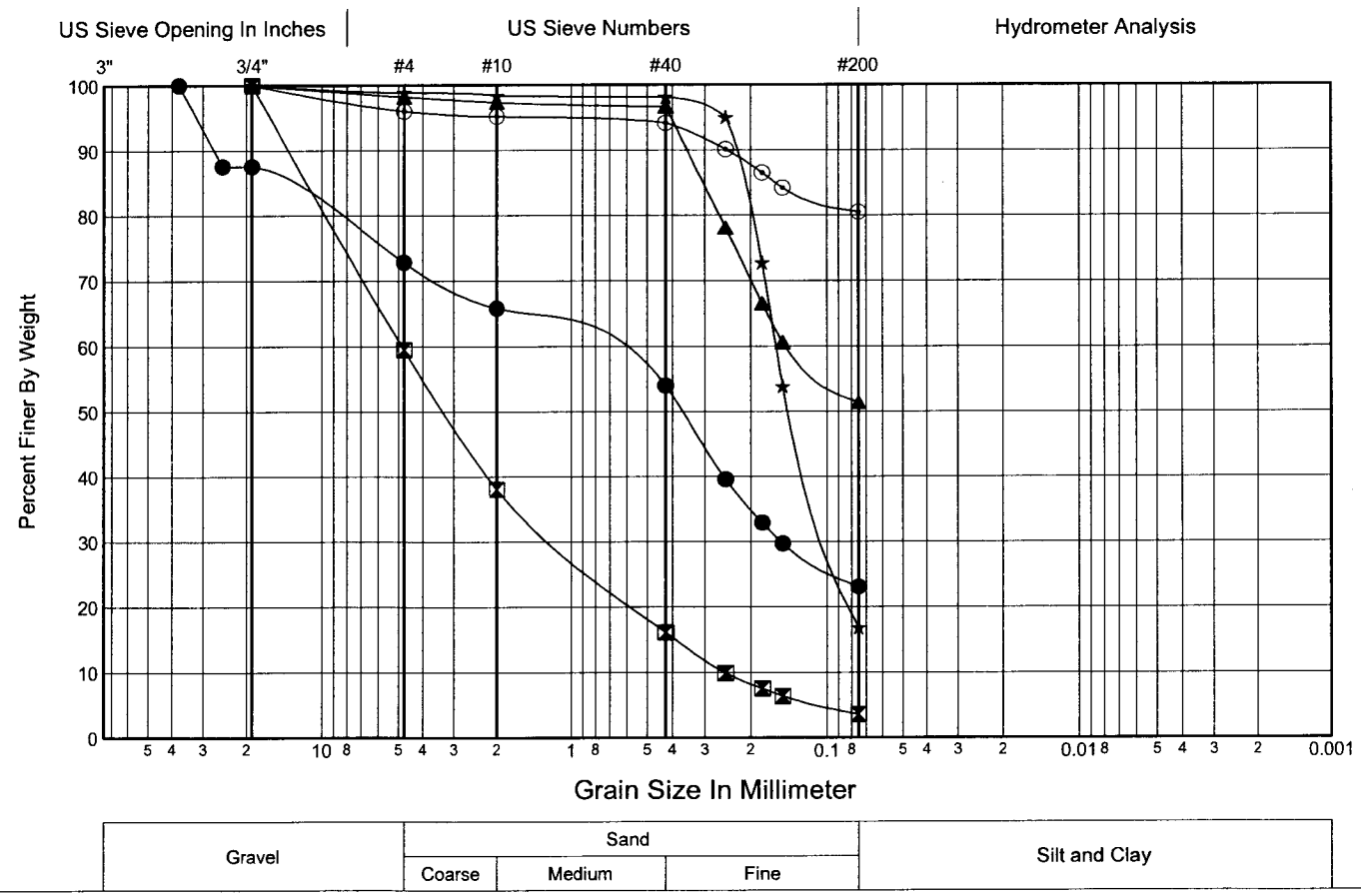
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-1	SM	See Boring Log	SILTY SAND with GRAVEL	27			
⊠	15.0	4.57	D-3	SW	See Boring Log	WELL-GRADED SAND with GRAVEL	9			
▲	25.0	7.62	D-5	CL	See Boring Log	SANDY LEAN CLAY	17	33	22	11
★	30.0	9.14	D-6	SM	See Boring Log	SILTY SAND	24			
⊙	40.0	12.19	D-8	ML	See Boring Log	SILT with SAND	24			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	27.2	49.8	23.0		
⊠	40.5	55.9	3.6	1.1	19.1
▲	1.8	46.8	51.4		
★	1.1	82.0	16.8		
⊙	4.0	15.5	80.5		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.938	0.37	0.15		
⊠	4.832	3.24	1.13	0.56	0.252
▲	0.144				
★	0.159	0.14	0.10	0.08	
⊙					



Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-23933

HOLE No. KX-3-04

Sheet 1 of 3

Job No. MS-4700 SR 405 Elevation 166.8 (50.8 m)

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Site Address Vicinity SR-405 and NE 85th Street

Inspector Dan Reed

Start March 25, 2004 Completion March 25, 2004 Well ID# Equipment CME 45 w/ autohammer

Station Offset Casing HW 4.5"/HQ 3.5" Method Wet Rotary

Northing 255429.44 Easting 1308620.57 Latitude Longitude

County King Subsection SE 1/4 of the SW 1/4 Section 33 Range 5 EWM Township 26 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			5 11 13 (24)		D-1	GS MC	SM, M.C. =23% Silty SAND, trace of organics, wood, medium dense, gray, moist, Stratified, no HCl reaction Length Recovered 5.0 ft,		
	2								3/25/04	
10	3			7 8 9 (17)		D-2		Silty SAND, medium dense, gray, moist, Stratified, no HCl reaction, trace of organic black bark Length Recovered 1.5 ft,		
	4									
15	5			9 11 10 (21)		D-3	GS MC	SM, M.C. =21% Silty SAND, medium dense, gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft,		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-23933

HOLE No. KX-3-04

Job No. MS-4700 SR 405 Elevation 166.8 (50.8 m)

Sheet 2 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				9 11 33 (44)		D-4		Silty SAND, dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft,		
	7									
25				10 10 10 (20)		D-5		Silty SAND, medium dense, gray, moist, Stratified, no HCl reaction, fine, medium, coarse sand lenses Length Recovered 1.2 ft,		
	8									
	9									
30				9 12 15 (27)		D-6	GS MC	SM, M.C. =31% Silty SAND, medium dense, gray, moist, Stratified, no HCl reaction, fine, medium, coarse sand lenses Length Recovered 1.3 ft,		
	10									
35				13 15 15 (30)		D-7		Silty SAND, dense, gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft,		
	11									
	12									
40				15 17 19 (36)		D-8	GS MC	ML, M.C. =24% Sandy SILT, fine grained, dense, gray, wet, Homogeneous, no HCl reaction, Length Recovered 1.5 ft,		
	13							End of test hole boring at 41.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. This test boring was not instrumented with a piezometer. Prior to removal, a bail test was performed within the drill casing. The water level observed from this may not truly reflect the actual groundwater conditions present at the		
45										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-23933

HOLE No. KX-3-04

Job No. MS-4700 SR 405 Elevation 166.8 (50.8 m)

Sheet 3 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								site. Water level before bailing 6.5', bailed bore hole water level to 20.0',water level after 5 minutes 18.1', after 10 minutes 14.0', after 15 minutes 12.8', water table stabilized at 9.0'		
	14									
	15									
50										
	16									
55										
	17									
	18									
60										
	19									
65										
	20									
	21									
70										

Job No. **MS-4700** Date **August 5, 2004**

Hole No. **KX-3-04** Sheet **1** of **1**

Project **Stage 1 and 2 Kirkland Nickel Project**

Laboratory Summary

Washington State Department of Transportation

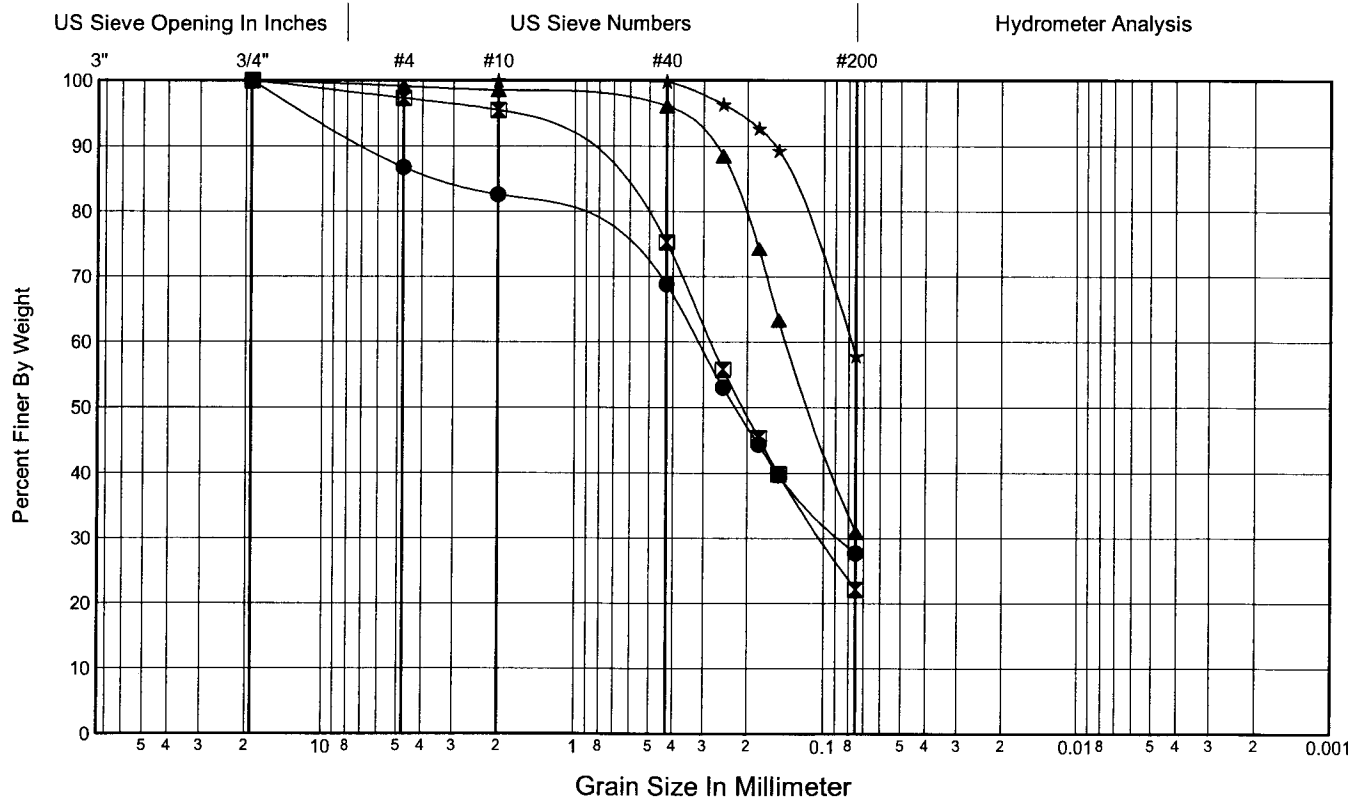
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-1	SM	See Boring Log	SILTY SAND	23			
⊠	15.0	4.57	D-3	SM	See Boring Log	SILTY SAND	21			
▲	30.0	9.14	D-6	SM	See Boring Log	SILTY SAND	31			
★	40.0	12.19	D-8	ML	See Boring Log	SANDY SILT	24			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	13.3	59.0	27.7		
⊠	2.7	75.2	22.1		
▲	0.9	68.2	30.9		
★	0.0	42.2	57.8		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.316	0.22	0.09		
⊠	0.280	0.21	0.10		
▲	0.140	0.11			
★	0.079				



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-23932

HOLE No. KX-4-04

Sheet 1 of 3

Job No. MS-4700 SR 405 Elevation 202.9 (61.8 m)

Project Stage 1 and 2 Kirkland Nickel Project

Driller Donny Henderson Lic# 2598

Site Address Vicinity SR-405 and NE 85th Street

Inspector Dan Reed

Start March 17, 2004 Completion March 18, 2004 Well ID# Equipment BK-81 w/ autohammer

Station Offset Casing HW-4.5/HQ-3.5 Method Wet Rotary

Northing 253513.47 Easting 1308251.8 Latitude Longitude

County King Subsection NW 1/4 of the NW 1/4 Section 4 Range 5 EWM Township 25 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1			9 10 9 (19)		D-1		Poorly graded GRAVEL with sand, Subrounded, medium dense, light brown, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	2			10 12 13 (25)		D-2	GS MC	SW, M.C. =10% Well graded SAND with gravel, angular, dense, gray, wet, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.5 ft, Length Retained 1.5 ft		
10	3		>>	36 55 (55)		D-3		Well graded SAND with gravel, angular, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	4		>>	55/3 (55)		D-4		Poorly graded GRAVEL with sand, very dense, gray, moist, Homogeneous, no HCl reaction, with large gravel as indicated by drilling process. Length Recovered 0.3 ft, Length Retained 0.3 ft		
15	5		>>	18 34 40 (74)		D-5		03/18/2004 Poorly graded GRAVEL with sand very dense, gray, moist, Homogeneous, no HCl reaction, with large gravel as indicated by drilling process. Length Recovered 0.3 ft, Length Retained 0.3 ft		
				31 50 (50)		D-6	GS MC	03/17/2004 GP, M.C. =9% Poorly graded GRAVEL with sand, very dense, gray, moist, Homogeneous, no HCl reaction, with large gravel as indicated by drilling progress. Length Recovered 1.0 ft, Length Retained 1.0 ft		
20	6		>>							

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-23932

HOLE No. KX-4-04

Job No. MS-4700 SR 405 Elevation 202.9 (61.8 m)

Sheet 2 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Donny Henderson Lic# 2598

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			>>	16 25 36 (61)		D-7		Poorly graded GRAVEL with sand, subangular, very dense, gray, moist, Homogeneous, no HCl reaction, with large gravel as indicated by drilling process. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	7			41 50 (50)		D-8		Poorly graded GRAVEL with sand, subangular, very dense, gray, wet, Homogeneous, no HCl reaction, with large gravel as indicated by drilling process. Length Recovered 1.0 ft, Length Retained 1.0 ft		
25			>>	39 56 (56)		D-9		Poorly graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction, with large gravel as indicated by drilling process. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	8									
			>>	18 23 34 (57)		D-10	GS MC	SP, M.C. =22% Poorly graded SAND, subangular, very dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	9									
30			>>	24 33 41 (74)		D-11		Poorly graded SAND, very dense, gray, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	10									
35				12 18 24 (42)		D-12		SILT and sand, dense, gray, moist, Homogeneous, no HCl reaction, Moisture tin in sample bag. Material change at 34.0' attempted shelby tube no penetration and no recovery. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	11			14 17 27 (44)		D-13	GS MC AL	ML, M.C. =23%, LL =27 SILT and sand, dense, gray, moist, Homogeneous, no HCl reaction, Moisture tin retained in sample bag. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	12									
40				18 23 25 (48)		D-14		SILT with sand, fine grained sand, dense, gray, moist, Stratified, no HCl reaction, Moisture tin retained in sample bag. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	13							End of test hole boring at 41.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. This test boring was not instrumented with a piezometer. Prior to removal, a bail test was performed within the drill		
45										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-23932

HOLE No. KX-4-04

Job No. MS-4700 SR 405 Elevation 202.9 (61.8 m)

Sheet 3 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Donny Henderson Lic# 2598

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								casing. The water level observed from this may not truly reflect the actual groundwater conditions present at the site. Water level before bailing 6.1', after bailed 35.0', after 5 minutes 27.0', after 10 minutes 19.0', after 15 minutes 16.0', water table stabilized at 15.1'.		
	14									
	15									
50										
	16									
55										
	17									
	18									
60										
	19									
65										
	20									
	21									
70										

Job No. **MS-4700** Date **August 5, 2004**

Hole No. **KX-4-04** Sheet **1** of **1**

Project **Stage 1 and 2 Kirkland Nickel Project**

Laboratory Summary

Washington State Department of Transportation

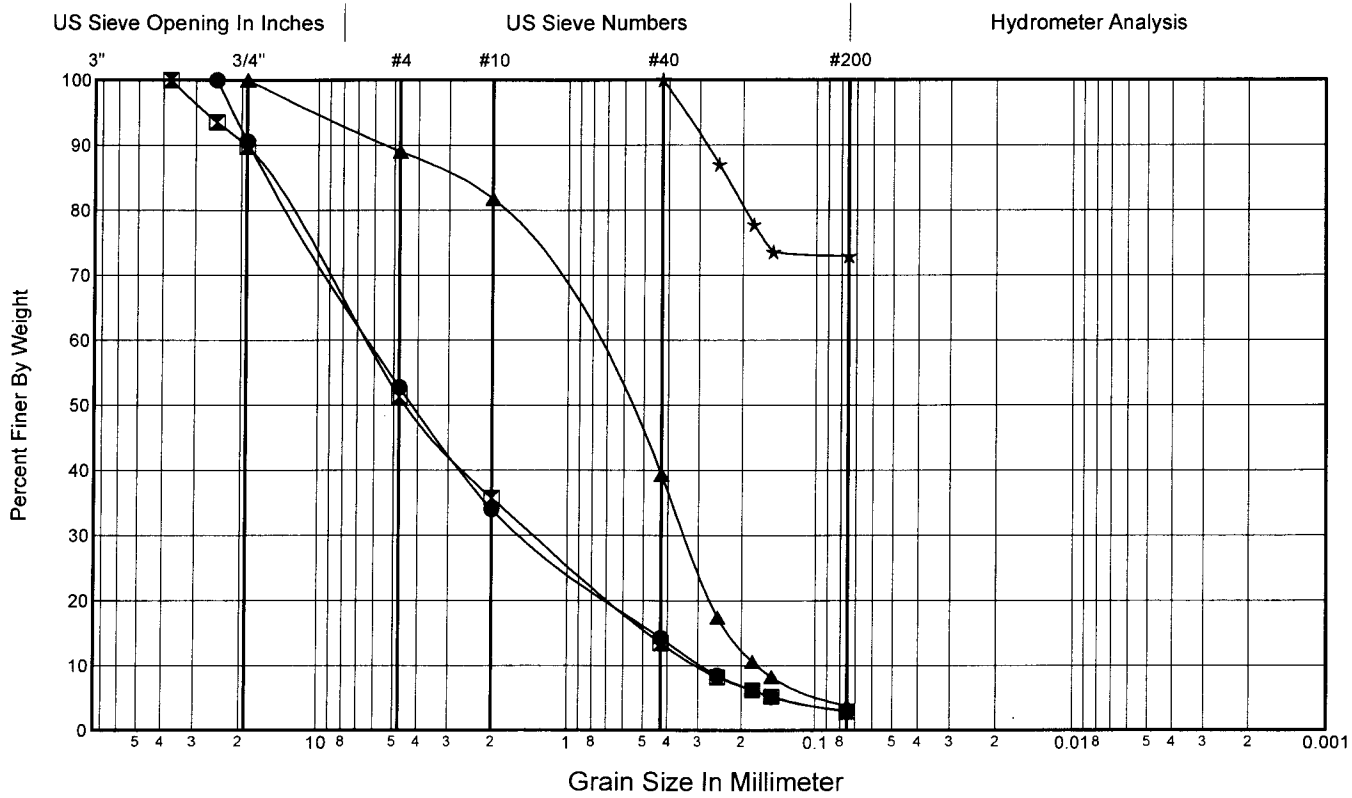
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	7.5	2.29	D-2	SW	See Boring Log	WELL-GRADED SAND with GRAVEL	10			
⊠	17.5	5.33	D-6	GP	See Boring Log	POORLY GRADED GRAVEL with SAND	9			
▲	27.5	8.38	D-10	SP	See Boring Log	POORLY GRADED SAND	22			
★	37.5	11.43	D-13	ML	See Boring Log	SILT with SAND	23	27		

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	47.2	49.7	3.0	1.2	21.6
⊠	48.7	48.4	2.9	0.9	21.8
▲	11.0	85.3	3.8	0.7	5.3
★	0.0	27.1	72.9		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	6.193	4.18	1.46	0.67	0.287
⊠	6.506	4.43	1.34	0.67	0.299
▲	0.904	0.63	0.34	0.27	0.172
★					



Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S 23931

HOLE No. KX-9-04

Sheet 1 of 2

Job No. MS-4700 SR 405 Elevation 185.2 (56.4 m)

Project Stage 1 and 2 Kirkland Nickel Project

Driller Kerry Cooper Lic# 2552

Site Address Vicinity SR-405 and NE 85th Street

Inspector Cleo Andrews

Start March 17, 2004 Completion March 17, 2004 Well ID# Equipment CME 45 w/ autohammer

Station Offset Casing HQ 3" OD x 45.0' Method Wet Rotary

Northing 251791.27 Easting 1307882.34 Latitude Longitude

County 17-King Subsection SW 1/4 of the NW 1/4 Section 4 Range 5 EWM Township 25 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				3 8 20 (28)		D-1		Silty SAND, with root hairs and organic, dense, brown, moist, Stratified,Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
	1		>>	29 40 34 (74)		D-2		Silty SAND, very dense, grayish brown, moist, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.0 ft		
5	2		>>	17 25 28 (53)		D-3	GS MC	SM, M.C. =12% Silty SAND, very dense, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.0 ft		
				9 9 14 (23)		D-4		Silty SAND, medium dense, grayish brown, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
10	3		>>	7 22 38 (60)		D-5		Silty SAND, very dense, grayish brown, moist, Homogeneous, HCl reaction not tested, (100% drilling fluid return) Length Recovered 1.2 ft, Length Retained 1.0 ft		
	4			22 36 50/3 (50)		D-6		Silty SAND, very dense, grayish brown, moist, Homogeneous, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.0 ft		
15	5		>>	63/6 (63)		D-7		Silty SAND, very dense, grayish brown, moist, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft		
20	6									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S 23931

HOLE No. KX-9-04

Job No. MS-4700 SR 405 Elevation 185.2 (56.4 m)

Sheet 2 of 2

Project Stage 1 and 2 Kirkland Nickel Project

Driller Kerry Cooper Lic# 2552

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				33 50/3 (50)		D-8	GS MC	ML, M.C. =14% Sandy SILT, very dense, grayish brown, moist, Homogeneous, HCl reaction not tested Length Recovered 0.7 ft, Length Retained 0.7 ft		
	7									
25			>>	100/5 (100)		D-9		Silty SAND, very dense, olive gray, moist, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft		
	8									
	9									
30			>>	80/6 (80)		D-10		Silty SAND, very dense, gray, moist, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft		
	10									
35			>>	33 94/6 (94)		D-11		SILT and sand, with fine grained with gravel, very dense, gray, moist, Laminated, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
	11									
	12									
40				26 42 50/3 (50)		D-12	GS MC	ML, M.C. =23% SILT and sand, very dense, dark gray, moist, Homogeneous, HCl reaction not tested, (Note : Changed at 38.0' to Silt as indicated by water pressure and by drilling. (Took moisture can MC-12a from same depth, retained 6"). Ended and abandoned test hole at 41.2' below ground elevation. (Dry hole). Length Recovered 1.2 ft, Length Retained 1.2 ft End of test hole boring at 41.2 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	13									
45										

Job No. **MS-4700** Date **August 5, 2004**

Hole No. **KX-9-04** Sheet **1** of **1**

Project **Stage 1 and 2 Kirkland Nickel Project**

Laboratory Summary

Washington State Department of Transportation

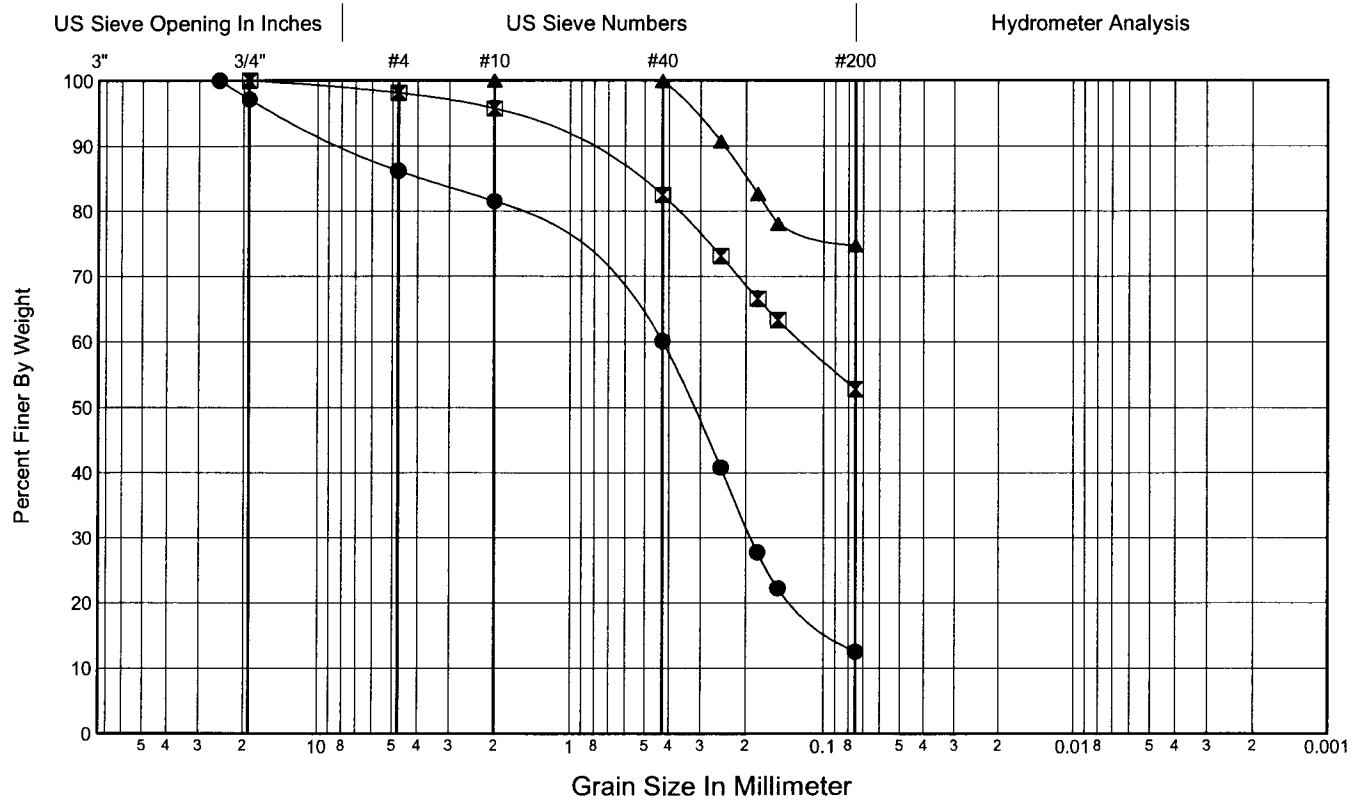
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-3	SM	See Boring Log	SILTY SAND	12			
⊠	20.0	6.10	D-8	ML	See Boring Log	SANDY SILT Non Plastic	14			
▲	40.0	12.19	D-12	ML	See Boring Log	SILT with SAND Non Plastic	23			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	13.8	73.7	12.5	1.4	6.7
⊠	1.9	45.3	52.8		
▲	0.0	25.3	74.7		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.424	0.32	0.19	0.13	
⊠	0.121				
▲					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-23941

HOLE No. KX-10-04

Sheet 1 of 3

Job No. MS-4700 SR 405 Elevation 198.0 (60.4 m)

Project Stage 1 and 2 Kirkland Nickel Project Driller Sean Verlo Lic# 2615

Site Address Vicinity SR-405 and NE 85th Street Inspector Dan Reed

Start March 24, 2004 Completion March 24, 2004 Well ID# Equipment CME 45 w/ autohammer

Station Offset Casing HW 4.5"/HQ3.5" Method Wet Rotary

Northing 252692.15 Easting 1307854.22 Latitude Longitude

County King Subsection NE 1/4 of the SE 1/4 Section 5 Range 5 EWM Township 25 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1, 2			7 12 15 (27)		D-1	GS MC	SM, M.C. =19% Silty SAND, dense, gray, wet, Stratified, no HCl reaction, coarse sand lenses Length Recovered 1.5 ft,		
10	3, 4		>>	24 40 52 (92)		D-2	GS MC	SM, M.C. =15% Silty SAND, silt lenses, very dense, gray, moist, Stratified, no HCl reaction Length Recovered 1.5 ft,	▽ 03/24/2004	
15	5, 6			26 45 50/3 (50/3")		D-3		Silty SAND, very dense, gray, moist, Stratified, no HCl reaction, moisture tin retained in sample bag Length Recovered 1.3 ft,		
20										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-23941

HOLE No. KX-10-04

Job No. MS-4700 SR 405 Elevation 198.0 (60.4 m)

Sheet 2 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				36 50 (50/6")		D-4	GS MC	SM, M.C. =20% Silty SAND, slightly silty, very dense, gray, moist, Stratified, no HCl reaction, fine, medium, coarse sand lenses Length Recovered 1.0 ft,		
	7									
25			>>	38 56 (56/6")		D-5		Silty SAND, very dense, gray, moist, Homogeneous, no HCl reaction, w/large gravel as indicated by drilling process material color change at 25.5' to light gray moisture tin retained in sample bag Length Recovered 1.0 ft,		
	8									
	9									
30			>>	26 41 50 (91)		D-6		Sandy SILT, sand lenses, very dense, gray, moist, Laminated, no HCl reaction, moisture tin retained in sample bag Length Recovered 1.5 ft,		
	10									
35			>>	14 25 35 (60)		D-7	GS MC AL	ML, M.C. =20%, LL =33, Non-plastic Sandy SILT, very dense, gray, moist, Laminated, no HCl reaction, w/fine grained sand lenses within soil unit moisture tin retained in sample bag Length Recovered 1.5 ft,		
	11									
	12									
40			>>	21 41 49 (90)		D-8		Sandy SILT, slightly silty, very dense, gray, wet, Homogeneous, no HCl reaction, Length Recovered 1.5 ft, moisture tin retained in sample bag		
	13							End of test hole boring at 41.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. This test boring was not instrumented with a piezometer. Prior to removal, a bail test was performed within the drill casing. The water level observed from this may not truly reflect the actual groundwater conditions present at the		
45										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-23941

HOLE No. KX-10-04

Job No. MS-4700 SR 405 Elevation 198.0 (60.4 m)

Sheet 3 of 3

Project Stage 1 and 2 Kirkland Nickel Project

Driller Sean Verlo Lic# 2615

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								site. Bore hole water level at 5.5', bailed to 18.0', water level after 5 minutes 16.1', after 10 minutes 13.8', after 15 minutes 12.5', water table stabilized at 11.5'		
	14									
	15									
50										
	16									
55										
	17									
	18									
60										
	19									
65										
	20									
	21									
70										

Job No. **MS-4700** Date **August 5, 2004**

Hole No. **KX-10-04** Sheet **1** of **1**

Project **Stage 1 and 2 Kirkland Nickel Project**

Laboratory Summary

Washington State Department of Transportation

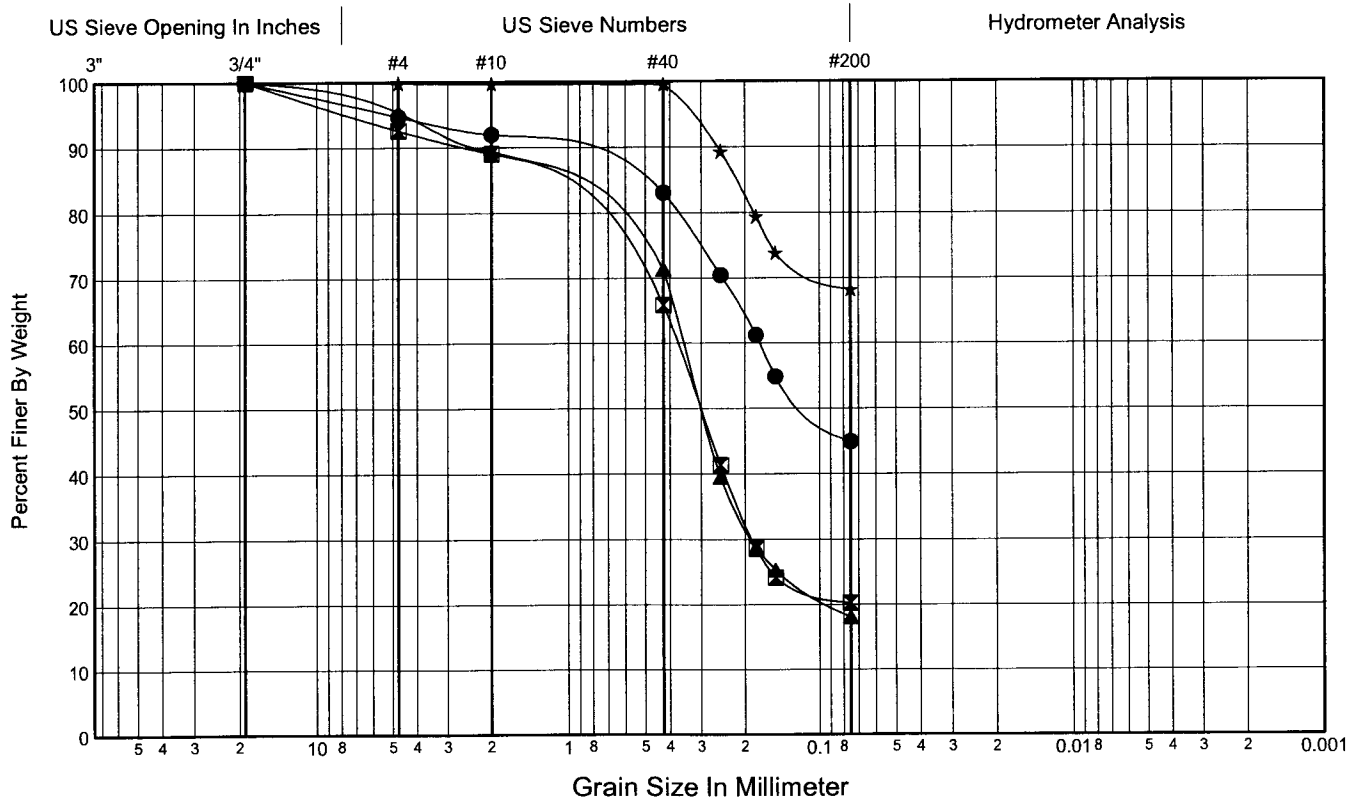
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-1	SM	See Boring Log	SILTY SAND	19			
⊠	10.0	3.05	D-2	SM	See Boring Log	SILTY SAND	15			
▲	20.0	6.10	D-4	SM	See Boring Log	SILTY SAND	20			
★	35.0	10.67	D-7	ML	See Boring Log	SANDY SILT	20	33		

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	5.3	49.8	44.9		
⊠	7.5	72.3	20.2		
▲	4.6	77.3	18.0		
★	0.2	31.6	68.2		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.174	0.11			
⊠	0.375	0.30	0.19		
▲	0.352	0.30	0.19	0.09	
★					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

APPENDIX B

EXISTING STRUCTURES (AS-BUILT CONDITIONS) ALONG PROJECT ALIGNMENT

DRAFT

Bridge No.	405/49P (73)
Bridge Location	NE 60th Street
As-Built Plan	Sheet 9 "SR 405 MP 16.85, South Kirkland Trail Crossing, King County, N.E. 60th Street Pedestrian Crossing" dated November 4, 1977.
Number of Piers	8
Datum	NGVD 1929, unless noted below

Pier No.	1	2	3	4	5	6	7	8	East Wall Ramp
Spread Footings									
Bottom of Footing Elevation (ft)	380	383	376	379	387	397	397	413	416
Approximate Footing Width (ft)	†	†	†	†	†	†	†	†	†
Allowable Bearing Pressure (ksf)	4	4	4	4	6	6	6	8	8

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L 4382	4	31		1	388.5**	383	Sand (medium dense)
PSH-1-RE shan&wilson	B-4	34	Grain Size	1	396**	No Information	Silty sand (medium dense to very dense)
L 4382	5	31.5		2	388**	383	Sand (dense)
L 4382	2	31.5		3	383.7**	378.7	Sand (medium dense)
L 4382	1	26		4	386**	381	Sand (medium dense)
PSH-1-RE shan&wilson	B-6	38		5	395**	392	Sand and gravel (medium dense to very dense)
PSH-1-RE shan&wilson	B-9	33.5		6	No Information	No Information	Silty sand with gravel. (very dense)
PSH-1-RE shan&wilson	B-9	33.5		7	No Information	No Information	Silty sand with gravel. (very dense)
L 0889	TP-2	10		7	409**	None	Silty sand with gravel (dense)
L 4382	3	21.5		8	419.5**	None	Silty sand with gravel (very dense)
L 4382	3	21.5		East Wall Ramp	419.5**	None	Silty sand with gravel (very dense)
PSH-1-RE shan&wilson	B-8	34	Grain Size	South of Pier 7			
W-7148-1	B-11	9	Grain Size	114th and 60th	392**		
W-7148-1	B-12	9		East Abutment	402**		
W-7148-1	B-13	9		116th and 60th	229?**		

Embankment Slopes

Follows existing ground slope

**Datum: City of Seattle

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/50 (74)
Bridge Location	NE 70th Street
As-Built Plan	Sheet 137, "SR 450 MP 16.47 to MP 18.87, N.E. 53rd ST to N.E. 100th St., King County, N.E. 72nd Place Undercrossing", dated May 29, 1969
Number of Piers	5
Datum	City of Seattle, unless noted below

Pier No.	1N	1S	2N	2S	3N	3S	4N	4S
Spread Footings								
Bottom of Footing Elevation (ft)	340.06	337.87	325.00	325.30	323.70	325.00	327.70	328.70
Approximate Footing Width (ft)	†	†	†	†	†	†	†	†
Allowable Bearing Pressure (ksf)	6	6	8	8	8	8	8	8

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE shan&wilson	B-22	34		1	352	None	Sandy silty/silty sand (dense to very dense)
PSH-1-RE shan&wilson	B-153	24		1	348	No Information	Sand (dense to very dense)
PSH-1-RE shan&wilson	B-144	34		2	334	None	Sand (very dense)
PSH-1-RE shan&wilson	B-21	34		3	334	None	Sand (very dense)
L-0889	BRZ-43	32.8	Grain Size	4	344	None	Sand and gravel (very dense)
PSH-1-RE shan&wilson	B-19	39	Grain Size	4	356	None	Sand (very dense)
PSH-1-RE shan&wilson	B-20	34		4	335	None	Sand (very dense)
PSH-1-RE shan&wilson	B-154	25		5	358.5	None	Sand (medium dense)
W-7148-1	B-18	21.5	Grain Size	East abutment	--	6 ft	
L-4356	H-10	5		West abutment	--	None	
L-4356	H-11	5.5		West abutment	--	3 to 4½ feet	
L-4356	H-12	4		West abutment	--	None	
L-4356	H-13	4		West abutment	--	None	
W-7148-1	B-23	33.4	Grain Size	West abutment	--	27 ft	
L-8175	1	8		West of W abutment	--	None	
L-8175	2	10		West of W abutment	--	None	
W-7148-1	BRZ-15	23.3	Grain Size	North of alignment	350	None	
L-4356	H-4	3		South of alignment	--	1½ feet	

Embankment Slopes

2H:1V to 4H:1V for the East and West Ramps

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/51P (76)
Bridge Location	NE 80th Street
As-Built Plan	Sheet 188, SR 405 MP 16.47 to MP 18.87, N.E. 53rd St. to N.E. 100th St., King County, N.E. 80th St. Pedestrian Undercrossing", dated May 29, 1969
Number of Piers	1
Number of Arch Abutments	2
Datum	City of Seattle

Pier No.	1	West Arch Abutment	East Arch Abutment
Spread Footings			
Bottom of Footing Elevation (ft)	293.5	293.0	W Edge 316, E edge 321
Approximate Footing Width (ft)	†	†	†
Allowable Bearing Pressure (ksf)	9	4	4

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE	B-172	17	none	1	298.5	None	Silty sand with gravel (very dense) (glacial till)
PSH-1-RE	B-174	16	none	West abutment	302.5	None	Silty sand with gravel (very dense) (glacial till)
PSH-1-RE	B-176	14	none	East Abutment	322	None	Silty sand with gravel (very dense) (glacial till)
PSH-1-RE	B-175	16	none	Mid span	312.5	None	
PSH-1-RE	B-173	17	none	West approach	298.5	286	
L0889	TP-16	6.5	none	South of Alignment	313	None	

Embankment Slopes

Variable, 2H:1V at west and east ends
and 4 to 5.5 percent slopes in between

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/52 and 405/52 NCD (77)
Bridge Location	NE 85th Street
As-Built Plan	Sheet 157, " SR 405 MP 16.47 to MP 18.87, N.E. 53rd St. to N.E. 100th St., King County, SR 901 Overcrossing", dated May 29, 1969
Number of Piers	4
Datum	City of Seattle, unless noted below

Pier No.	1	2	3	4
Spread Footings				
Bottom of Footing Elevation (ft)		250.05**	246.75**	
Approximate Footing Width (ft)		†	†	
Allowable Bearing Pressure (ksf)		No Info.	No Info.	
12BP53 Piles				
Top of Pile Elevation (ft)	270.92**			265.48**
Approximate Embedment Depth (ft)	†			†
Allowable Pile Capacity (kips)	No Info.			No Info.

**Datum unknown for bridge piers

Note: Extensive fill placed at abutments (Piers 1 and 4)

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE shan&wilson	B-53	33		1	265	none	33ft Silty sand with gravel (very dense)
PSH-1-RE shan&wilson	B-57	34		2	255	252	Silty sand with gravel (very dense)
PSH-1-RE shan&wilson	B-57	34		3	255	252	Silty sand with gravel (very dense)
PSH-1-RE shan&wilson	B-57	34		4	255	252	18ft Silty sand with gravel (very dense), 7ft very dense glacial till 9ft Silty sand (very dense)
PSH-1-RE shan&wilson	B-60	9		North Approach	254.5	None	

Embankment Slopes

2H:1V to 3H:1V

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/52E (78) East Bridge (Northbound)
Bridge Location	NE 85th Street (SR 908)
As-Built Plan	Sheet 329 and 1 other sheet whose number is not visible, "SR 405, Northup to Bothel, HOV and SC&DI-Stage 1, SR 908 Overcrossing 405/52", dated September 22, 1992
Number of Piers	4
Datum	City of Seattle

Pier No.	1	2	3	4
Spread Footings				
Bottom of Footing Elevation (ft)		246.0	245.5	
Approximate Footing Width (ft)		†	†	
Allowable Bearing Pressure (ksf)		12	12	
H Piles				
Top of Pile Elevation (ft)	270.17			264.64
Approxiamte Embedment Depth (ft)	†			†
Allowable Pile Capacity (kips)	140			140

Note: Extensive fill placed at abutments (Piers 1 and 4)

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE shan&wilson	SB-2	21		1	257	250	11ft Sand and gravel (very dense), 5ft cemented gravel (very dense) (glacial till), 5ft sandy gravel (very dense)
PSH-1-RE shan&wilson	B-51	34		2	254	250	Silty sand (very dense)
PSH-1-RE shan&wilson	B-51	34		3	254	250	Silty sand (very dense)
PSH-1-RE shan&wilson	SB-5	12		4	254	244	3ft Silty sand, 9ft clayey sand with gravel (very dense)
L-0889	BRZ-46	28		South Approach	290	265	16ft Silty sand with gravel (fill) (dense to very dense) over (glacial till)
L-0889	BRZ-47	25.5		South Approach	286	None	18ft Sand and gravel (loose to medium dense) (fill) over (glacial till)
L-0889	BRZ-48	25.5	Grain Size	North Approach	272	None	Silty sand with gravel (fill) (medium dense to dense)

Embankment Slopes

2H:1V max slopes under approaches

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/52W (79) (West Bridge)
Bridge Location	NE 85th Street (SR 908)
As-Built Plan	Sheet 329 and 1 other sheet whose number is not visible, "SR 405, Northup to Bothel, HOV and SC&DI-Stage 1, SR 908 Overcrossing 405/52", dated September 22, 1992
Number of Piers	4
Datum	City of Seattle

Pier No.	1	2	3	4
Spread Footings				
Bottom of Footing Elevation (ft)		246.0	245.5	
Approximate Footing Width (ft)		†	†	
Allowable Bearing Pressure (ksf)		12	12	
H Piles				
Top of Pile Elevation (ft)	266.55			260.14
Approxiamte Embedment Depth (ft)	†			†
Allowable Pile Capacity (kips)	140			140

Note: Extensive fill placed at abutments (Piers 1 and 4)

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE shan&wilson	SB-2	21		1	257	250	11ft Sand and gravel (very dense), 5ft cemented gravel (very dense) (glacial till), 5ft sandy gravel (very dense)
PSH-1-RE shan&wilson	B-39	33		2	244	None	Silty sand with gravel (very dense)
PSH-1-RE shan&wilson	SB-6	16		3	249	None	Clayey sand with gravel (very dense) (glacial till)
PSH-1-RE shan&wilson	SB-7	12		4	246	None	Clayey sand with gravel (very dense) (glacial till)
PSH-1-RE shan&wilson	B-165	34		4	269	None	14ft Silty sand with gravel and organics (loose to dense) (fill), 5ft silt and clay (medium dense) (fill), 5ft silt and silty sand (medium stiff, loose), 10ft silty sand with gravel (dense to very dense) (glacial till)
PSH-1-RE shan&wilson	B-42	33		4	238	237	4ft Silty sand (loose) (fill), 11ft silty sand with gravel (medium dense to very dense), 18ft silty sand with gravel (very dense) (glacial till)
L-0889	BRZ-47	25.5		South approach	290	265	16ft Silty sand with gravel (dense to very dense) (fill) over (glacial till)
L-0889	BRZ-48	25.5	Grain Size	South approach	286	None	Silty sand with gravel (loose to medium dense) (fill)
PSH-1-RE shan&wilson	B-166	28		South approach	278	None	19ft Sand and gravel (loose to medium dense) (fill) over (glacial till)

Embankment Slopes

2H:1V max slopes under approaches

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	Not available on provided plans
Bridge Location	NE 100th Street
As-Built Plan	"NE 100th Street Bridge" dated January 2, 2001
Number of Piers	3
Datum	Unknown, unless noted below

Pier No.	1	2	3
Spread Footings			
Bottom of Footing Elevation (ft)	261	260	262.5
Approximate Footing Width (ft)	16	14	16
Allowable Bearing Pressure (ksf)	8	8	8

Note: Allowable bearing pressure from "Geotechnical Report, NE 100th Street Bridge, Kirkland Washington" dated January 20, 2000, revised March 15, 2000

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
9807	BH-1	26.5		1	277	257	Sand (medium dense to dense) (advancd outwash)
9807	BH-2	56.5		1	269	256	Silty sand (dense) (advancd outwash)
9807	BH-3	60.5		2	267	249	Clay (very stiff to hard) (lacustrine)
9807	BH-4	56		3	273	260	Silty sand (very dense) (advancd outwash)
9807	BH-6	26.5		3	260	253	Boring below foundation elevation
L-0889	TH-2	3.5		3	258**	None	Boring below foundation elevation
L-0889	BRZ-16	23		South of alignment	270**		
9807	BH-5	41.5		South of alignment	273		
L-0889	TP-9	9		North of alignment	267**		

Embankment Slopes

Not available on plans

**Datum: City of Seattle for L-0889 borings

Bridge No.	405/55E (81)
Bridge Location	NE 116th Street
Original As-Built Plan	Sheets 118, 119, 124 "SR 405 MP 18.87 to MP 21.83 NE 100th Street to NE 145th Street, King County, NE 116th Street Overcrossing" dated February 27, 1969
Widening As-Built Plan	Sheets 337, 338, 341, 348 "SR 405 Northup to Bothel, HOV and SC&DI-Stage 1, NE 116th Street 405/55" dated September 8, 1992
Number of Piers	4
Datum	City fo Seattle

Pier No.	1	2	3	4
Spread Footings (Original)				
Bottom of Footing Elevation (ft)	171.22 - 174.16	155	155	171.82 - 174.72
Approximate Footing Width (ft)	6	9	9	6
Allowable Bearing Pressure (ksf)	4	6	6	4
Spread Footings (Widening)				
Bottom of Footing Elevation (ft)		155	155	171.24
Approximate Footing Width (ft)		14	14	6
Allowable Bearing Pressure (ksf)		16	6	6
HP 12x53 Piles (Widening)				
Approx. Top of Pile Elevation (ft)	†			
Approxiamte Embedment Depth (ft)	†			
Allowable Pile Capacity (kips)	110			

Note: Extensive fill placed at abutments (Piers 1 and 4)

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE shan&wilson	B-145	24		1	181	None	19ft silty sand with gravel (loose to medium dense) (fill), 2ft organic silt (soft), 2ft sandy silt with gravel (hard)
PSH-1-RE shan&wilson	B-77	39		2	164	163	Silty sand (very dense) (glacial till)
PSH-1-RE shan&wilson	B-80	34		2	165	None	Sandy, clayey silt (hard) (glacial till)
PSH-1-RE shan&wilson	B-82	34		3	165	164	Silty sand with gravel (very dense)
PSH-1-RE shan&wilson	B-146	16.5		3	164	164	Sand (medium dense to dense)
PSH-1-RE shan&wilson	B-79	34		4	161	161	10 ft silty sand (medium dense to very dense) 24 feet sandy silt (hard)
PSH-1-RE shan&wilson	B-147	26.5		North approach	182	None	14ft Sandy gravel (dense to very dense) (fill), 5ft sand (loose), 7½ ft dense sand and hard silt

Embankment Slopes

2H:1V maximum slope

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/55W (82)
Bridge Location	NE 116th Street
Original As-Built Plan	Sheets 118, 119, 124 "SR 405 MP 18.87 to MP 21.83 NE 100th Street to NE 145th Street, King County, NE 116th Street Overcrossing" dated Februar
Widening As-Built Plan	Sheets 337, 338, 341, 348 "SR 405 Northup to Bothel, HOV and SC&DI-Stage 1, NE 116th Street 405/55" dated September 8, 1992
Number of Piers	4
Datum	City fo Seattle

Pier No.	1	2	3	4
Spread Footings (Original)				
Bottom of Footing Elevation (ft)	170.6 - 173.51	155	155	171.79 - 174.68
Approximate Footing Width (ft)	6	9	9	6
Allowable Bearing Pressure (ksf)	4	6	6	4
Spread Footings (Widening)				
Bottom of Footing Elevation (ft)		155	155	171.24
Approximate Footing Width (ft)		14	14	6
Allowable Bearing Pressure (ksf)		16	6	6
HP 12x53 Piles (Widening)				
Approx. Top of Pile Elevation (ft)	†			
Approxiamte Embedment Depth (ft)	†			
Allowable Pile Capacity (kips)	110			

Note: Extensive fill placed at abutments (Piers 1 and 4)

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE shan&wilson	B-145	24		1	181	None	19ft silty sand with gravel (loose to medium dense) (fill), 2ft organic silt (soft), 2ft sandy silt with gravel (hard)
PSH-1-RE shan&wilson	B-77	39		2	164	163	Silty sand (very dense) (glacial till)
PSH-1-RE shan&wilson	B-80	34		2	165	None	Sandy, clayey silt (hard) (glacial till)
PSH-1-RE shan&wilson	B-82	34		3	165	164	Silty sand with gravel (very dense)
PSH-1-RE shan&wilson	B-146	16.5		3	164	164	Sand (medium dense to dense)
PSH-1-RE shan&wilson	B-79	34		4	161	161	10 ft silty sand (medium dense to very dense) 24 feet sandy silt (hard)
PSH-1-RE shan&wilson	B-147	26.5		North approach	182	None	14ft Sandy gravel (dense to very dense) (fill), 5ft sand (loose), 7½ ft dense sand and hard silt

Embankment Slopes

2H:1V maximum slope

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/56W (83) (West Bridge)
Bridge Location	NE 118th Street over RR Tracks
Widening As-Built Plan	Sheets 380, 381, 348, and 385 "SR 405 Northup to Bothel, HOV and SC&DI-Stage 1, BNR Overcrossing 405/56W" dated September 8, 1992
Original As-Built Plan	Sheets 130 and 131 "SR 405 MP 18.87 to MP 21.83, NE 100th Street to NE 145th Street, King County, NP RY. Overcrossing" dated February 27, 1969
Number of Piers	4
Datum	City of Seattle

Pier No.	1	2	3	4
Spread Footings (Original)				
Bottom of Footing Elevation (ft)	156.78	141.33	141.33	153
Approximate Footing Width (ft)	12.67	9.5	9.5	12.67
Allowable Bearing Pressure (ksf)	6	8	8	6
Spread Footings (Widening)				
Bottom of Footing Elevation (ft)		141	141	
Approximate Footing Width (ft)		13	13	
Allowable Bearing Pressure (ksf)		10	10	
Cast-In-Place Piles (Widening)				
Approx. Top of Pile Elevation (ft)	173.5			169.5
Approxiamte Embedment Depth (ft)	†			†
Allowable Pile Capacity (kips)	140			140

Note: Extensive fill placed at abutments (Piers 1 and 4)

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE shan&wilson	B-171	33.5		1	159.5	None	3ft Silt with gravel (stiff), 1ft sand (very dense), 14ft clay and silt (very stiff to hard), 2ft silty sand (very dense), 13ft sandy silt (hard) (glacial till)
PSH-1-RE shan&wilson	B-85	38	Consolidation	2	160.5	157	Silty sand and sandy silt (very dense or hard) (glacial till)
PSH-1-RE shan&wilson	B-87	44	Consolidation	3	158	155	Sandy silt with gravel (very dense) (glacial till)
PSH-1-RE shan&wilson	B-170	23		4	160.5	147	6ft silty sand and sandy silt (medium dense, medium stiff), 10ft sand with gravel (dense to very dense), 3ft sandy silt with gravel (hard) (glacial till), 7ft silty sand and sandy silty (very dense, hard)

Embankment Slopes

2H:1V maximum slope

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/56E (84) (East Bridge)
Bridge Location	NE 118th Street over RR Tracks
1992 Widening As-Built Plan	Sheets 364-369 "SR 405 Northup to Bothel, HOV and SC&DI-Stage 1, BNR Overcrossing 405/56W" dated September 8, 1992
1989 Widening As-Built Plan	Sheets 80-84 "SR 405 Totem Lake/NE 124th Street Interchange, BNRR O'xing 405/56E Widening" dated September 1 1989
1969 Widening As-Built Plan	Sheets 130, 131A, 138-140 "SR 405 MP 18.87 to MP 21.83, NE 100th Street to NE 145th Street, King County, NP RY. Overcrossing" dated February 27, 1969
Original As-Built Plan	Sheets 6, 9, 10A "Secondary State Highway No 2-A N.P. RY. Overcrossing" dated May 4, 1955
Number of Piers	4
Datum	City of Seattle

Pier No.	1	2	3	4
Spread Footings (1955 Original)				
Bottom of Footing Elevation (ft)	156	142	142	152
Approximate Footing Width (ft)	5.5	10	10	5.5
Allowable Bearing Pressure (ksf)	6	6	6	6
Spread Footings (1969 Widening)				
Bottom of Footing Elevation (ft)	151 - 156	140.5-141	140-140.5	149 - 152
Approximate Footing Width (ft)	5.5	9 and 11.5	10 and 11.5	5.5
Allowable Bearing Pressure (ksf)	4	8	8	8
Cast-In-Place Piles (1989 Widening)				
Top of CIP Pile Elevation (ft)	†			†
Approximate Embedment Elev. (ft)	150			148
Allowable CIP Pile Capacity (kips)	140			140
Spread Footings (1989 Widening)				
Bottom of Footing Elevation (ft)		141	140.5	
Approximate Footing Width (ft)		10	10	
Allowable Bearing Pressure (ksf)		20	20	
Spread Footings (1992 Widening)				
Bottom of Footing Elevation (ft)		142	142	
Approximate Footing Width (ft)		18	18	
Allowable Bearing Pressure (ksf)		10	10	
Cast-In-Place Piles (1992 Widening)				
Approx. Top of Pile Elevation (ft)	†			†
Approxiamte Embedment Depth (ft)	†			†
Allowable Pile Capacity (kips)	140			140

Note: Extensive fill placed at abutments (Piers 1 and 4)

Bridge No. 405/56E (84) (East Bridge)
Bridge Location NE 118th Street over RR Tracks

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE shan&wilson	B-167	48	Consolidation	1	180	None	20ft Silty sand with gravel (loose to medium dense) (fill), 18ft clayey/sandy silt (stiff to very stiff), 10ft sandy silt with gravel (hard) (glacial till)
PSH-1-RE shan&wilson	B-168	23		1	159	None	14ft silt (soft to very stiff), 8ft silty sand with gravel (very dense) (glacial till)
PSH-1-RE shan&wilson	B-90	44	Consolidation Grain Size	2	160	147	Silty sand with gravel (very dense) (glacial till)
PSH-1-RE shan&wilson	B-169	18		3	158	None	Sandy silt with gravel (hard) (glacial till)
PSH-1-RE shan&wilson	B-92	34	Consolidation	4	158.5	155	8ft silt and clay (hard), 17ft silty sand (very dense) (glacial till), 9ft sandy silt (hard) (glacial till)
PSH-1-RE shan&wilson	B-170	23		4	160.5	150	6ft silty sand and sandy silt (medium dense, medium stiff), 10ft sand with gravel (dense to very dense), 3ft sandy silt with gravel (hard) (glacial till), 7ft silty sand and sandy silty (very dense, hard)

Embankment Slopes

1½H:1V Maximum slope

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/57 (86)
Bridge Location	NE 124th Street
As-Built Plan	Sheet 148, "SR 405 MP 18.87 to MP 21.83, NE 100th Street to NE 145ht Street, King County, NE 124th Streeet Undercrossing" dated February 27, 1969
Number of Piers	5
Datum	City of Seattle, unless noted below

Pier No.	1N	1S	2N	2S	3N	3S	4N	4S	5N	5S
Spread Footings										
Bottom of Footing Elevation (ft)	105	105	104	108	115	117	120	122	125	130
Approximate Footing Width (ft)	†	†	†	†	†	†	†	†	†	†
Allowable Bearing Pressure (ksf)	8	8	8	8	8	8	8	8	8	8

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L-1924	TH-2-01	11.5	Atterberg Limits	1	153**	148	Boring doesn't go deep enough
L-1924	TH-3-03	70		1	157**	133	Silty sand (very dense)
PSH-1-RE shan&wilson	B-113	40		1	117	116	Silty sand with gravel (very dense) (glacial till)
PSH-1-RE shan&wilson	B-155	10		1	115	114	Silty sand with gravel (very dense)
PSH-1-RE shan&wilson	B-156	26.5		1	116.5	None	Sandy silt with gravel (very dense) (glacial till)
PSH-1-RE shan&wilson	B-111	39	Consolidation, Atterberg Limits, Torvane	2	119	117	Sand with silt and gravel (dense to very dense)
PSH-1-RE shan&wilson	B-157	24.5		2	117.5	117	Silty sand with gravel (dense) (Elev 104 ft)
PSH-1-RE shan&wilson	B-158	24.5		2	125	117	Sand with silt and gravel (med. dense to very dense)
PSH-1-RE shan&wilson	B-115	34		3	130	118	Sandy silt/silty sand (hard, dense to very dense)
PSH-1-RE shan&wilson	B-159	24		3	124	119	Silt (hard)
PSH-1-RE shan&wilson	B-160	24		3	128	None	Sand (very dense, wet)
PSH-1-RE shan&wilson	B-116	44	Atterberg Limits, Unconfined Compression	4	132	None	Sandy silt (stiff to hard)
PSH-1-RE shan&wilson	B-161	24		4	130	None	Sandy silt (hard)
PSH-1-RE shan&wilson	B-162	24		4	132	None	Silt (hard)
L-1924	TH-2-03	59.5	Grain Size	5	162.8**	153	Silty sand (dense to very dense)
PSH-1-RE shan&wilson	B-108	35	Consolidation, Atterberg Limits, Unconfined Compression	5	133	131	Sandy silt (soft to hard)
PSH-1-RE shan&wilson	B-163	24		5	133.5	none	Silt (very stiff to hard)
PSH-1-RE shan&wilson	B-164	23.5		5	137	none	Sandy silt (hard)

Embankment Slopes

Varies: 2H:1V to 6H:1V

**Datum:Unknown for L-1924 borings

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/59E (87)
Bridge Location	NE 132nd Street
Widening As-Built Plan	Sheet 396 and 1 other sheet whose number is not visible "SR 405 Northup to Bothel, HOV and SC&DI-Stage 1, NE 132nd Street 405/59", dated Sept. 8, 1992
Original As-Built Plan	Sheet 158, 61-64, "SR 405 MP 18.87 to MP 21.83, NE 100th Street to NE 145ht Street, King County, NE 132nd Streeet Overcrossing" dated Feb. 27, 1969
Number of Piers	4
Datum	City of Seattle, unless noted below

Pier No.	1	2	3	4
Spread Footings (Original)				
Bottom of Footing Elevation (ft)	Varies	146	146	Varies
Approximate Footing Width (ft)	†	†	†	†
Allowable Bearing Pressure (ksf)	4.5	4.5	4.5	4.5
Cast-In-Place Piles (Widening)				
Top of CIP Pile Elevation (ft)	167.6	146	146	169
Approximate Embedment Depth (ft)	†	†	†	†
Allowable CIP Pile Capacity (kips)	110	110	110	110

Note: Extensive fill placed at abutments (Piers 1 and 4)

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE S&W	B-149	39		1	176	152	14ft silt (stiff to very stiff) (fill), 5ft silty sand with gravel (medium dense to dense) (fill), 5ft silt with gravel (very stiff), 10ft sand (dense, wet), 5ft clay (stiff)
PSH-1-RE S&W	B-148	21		1	156	150	4ft silty sand (loose) (fill), 2ft peat (soft), 10ft sand with gravel (medium dense to very dense), 5ft layered sand silt and clay (stiff to very stiff)
PSH-1-RE S&W	B-130	59	Atterberg Limits, Grain Size, Unconfined Compression	2	158	150	4ft sandy silt (soft) (fill), 3ft silt (stiff), 16ft sand and gravel (dense to very dense), 21ft silt (very stiff), 15ft sand and gravel (dense to very dense)
PSH-1-RE S&W	B-150	29	Torvane, Unconfined Compression	2	156	152	4ft Sand (soft), 14ft sand with gravel (medium dense to dense), 11ft silt/sandy silt (stiff)
L-1924	B-130	59		2	157.9**	150	4ft silt with sand and gravel (soft) (fill), 3ft silt (stiff), 16ft sand (dense to very dense), 21ft silt (stiff to very stiff), 15ft sand with silt and gravel (dense to very dense)
L-1924	B-131	69		3	160**	No Information	6ft Silty sand (loose) (fill), 1ft silt (soft), 16ft silty sand (dense), 21ft clay, silt and silty sand (stiff to very stiff), 17ft silty sand (dense), 8ft sand and gravel (dense to very dense)
PSH-1-RE S&W	B-131	69	Atterberg Limits, Unconfined Compression, Consolidation	3	160	149	6ft silty sand with gravel (loose) (fill), 4ft sandy silt(soft), 13ft silty sand (dense),21ft silt, clay and silty sand (stiff to very stiff, medium dense), 17ft silty sand (dense), 8ft sand with gravel (dense to very dense)
PSH-1-RE S&W	B-132	53	Atterberg Limits, Grain Size	4	152	147	22ft silty sand (medium dense to very dense), 15ft silt and clay (stiff to very stiff), 15ft silty sand (medium dense to very dense)

Embankment Slopes

2H:1V to 3H:1V

**Datum:Unknown for borings L-1924

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/59W (88)
Bridge Location	NE 132nd Street
Widening As-Built Plan	Sheet 396 and 1 other sheet whose number is not visible "SR 405 Northup to Bothel, HOV and SC&DI-Stage 1, NE 132nd Street 405/59", dated September 8, 1992
Original As Built Plan	Sheet 158, 61-64, "SR 405 MP 18.87 to MP 21.83, NE 100th Street to NE 145ht Street, King County, NE 132nd Streeet Overcrossing" dated February 27, 1969
Number of Piers	4
Datum	City of Seattle

Pier No.	1	2	3	4
Spread Footings (Original)				
Bottom of Footing Elevation (ft)	Varies	144	144	Varies
Approximate Footing Width (ft)	†	†	†	†
Allowable Bearing Pressure (ksf)	4.5	4.5	4.5	4.5
Cast-In-Place Piles (Widening)				
Top of CIP Pile Elevation (ft)	162.6	144	144	164
Approximate Embedment Depth (ft)	†	†	†	†
Allowable CIP Pile Capacity (kips)	110	110	110	110

Note: Unsuitable soils excavated from below Pier 1 original footing

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
PSH-1-RE S&W	B-148	21		1	156	150	4ft silty sand (loose) (fill), 2ft peat (soft), 10ft sand with gravel (medium dense to very dense), 5ft layered sand silt and clay (stiff to very stiff)
PSH-1-RE S&W	B-124	54.5	Atterberg Limits	2	154.5	145	4ft peat (soft), 11ft silty sand (dense to very dense), 8ft sandy silt (medium stiff), 13ft sand with gravel (dense), 3ft silt (hard), 5ft sandy silt (hard), 10ft silt, sand and gravel layers (dense to very dense)
PSH-1-RE S&W	B-150	29		2	156	152	4ft Sand (loose), 14ft sand with gravel (medium dense to dense), 11ft silt/sandy silt (stiff)
PSH-1-RE S&W	B-127	53.5	Atterberg Limits, Torvane	3	153	147	2ft silty sand/sandy silt (loose, soft) (fill), 13ft silty sand (dense to very dense) 22ft silt and clay (stiff), 12ft sand with silt and gravel (medium dense), 4ft silty sand with gravel (medium dense), 5ft silt with silty gravel layers (hard, dense),2ft peat (hard), 6ft silty sand with gravel (dense to very dense)
PSH-1-RE S&W	B-132	53	Atterberg Limits, Grain Size	4	152	147	22ft silty sand (medium dense to very dense), 15ft silt and clay (stiff to very stiff),15ft silty sand (medium dense to very dense)

Embankment Slopes
2H:1V to 3H:1V

† Not provided on as-built plans listed above. Information available from WSDOT.

Bridge No.	405/59 NCD (89) (Southbound - BW Line)
Bridge Location	NE 132nd Street
As-Built Plan	Sheets 28 - 31 "SR 405 MP 20.42 to MP 21.25, N.E. 132nd Street Flyer Stop, King County, BE Line and BW Line Overcrossings" dated September 15, 1978
Number of Piers	4
Datum	City of Seattle, unless noted below

Pier No.	1	2	3	4
Piles				
Type	Concrete	Concrete	Concrete	BP 12x53
Top of Pile Elevation (ft)	165.4	145	145	166.6
Approximate Embedment Depth (ft)	Driven to minimum Elevation of 120 feet			
Allowable Pile Capacity (kips)	110	110	110	130

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L-1924**	TH-11-03	100.5	Atterberg Limits, Grain Size	1	181.5**	155.5	7ft gravel (medium dense to dense) (fill), 20ft sand and gravel (loose to medium dense) (fill), 11ft silt with sand (medium stiff to stiff), 3ft silty gravel with sand (medium dense), 31ft sand with gravel (medium dense to dense), 10ft gravel with sand (medium dense), 18ft sand (very dense)
L-1924**	TH-12-03	70.5		4	182.6**	163	17ft sand with gravel (medium dense) (fill), 21ft silty sand (dense to very dense), 32ft silt (medium stiff to hard): Original ground at 27 feet
L-4357**	H-34	32		3	--**	2.5	4ft silty sand with gravel (medium dense to dense) (fill), 6ft sand with clay lenses (medium dense to very dense), 15ft clay (medium stiff), 7ft silty sand with clay lenses (very loose to medium dense)

See Bridge 405/59 W (88) for nearby subsurface information

Embankment Slopes
2H:1V

**Datum:Unknown for L-1924 and L-4357 borings

Bridge No.	405/59 SCD (90) (Northbound - BE Line)
Bridge Location	NE 132nd Street
As-Built Plan	Sheets 28 - 31 "SR 405 MP 20.42 to MP 21.25, N.E. 132nd Street Flyer Stop, King County, BE Line and BW Line Overcrossings" dated September 15, 1978
Number of Piers	4
Datum	City of Seattle

Pier No.	1	2	3	4
Piles				
Type	BP 12x53	Concrete	Concrete	Concrete
Top of Pile Elevation (ft)	168.8	150	150	170.2
Approximate Embedment Depth (ft)	Driven to minimum Elevation of 120 feet			
Allowable Pile Capacity (kips)	130	110	110	110

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L-1924**	TH-13-03	90.5		1	186.5**	160.5	13ft gravel with sand (very loose to medium dense) (fill), 25ft sand with gravel (medium dense to dense, 21ft silt with sand lenses (medium stiff to stiff), 32ft sand and gravel (medium dense to very dense)
PSH-1-RE S&W	B-149	39		1	176	152	14ft silt (stiff to very stiff) (fill), 5ft silty sand with gravel (medium dense to dense) (fill), 5ft silt (very stiff),10ft sand (dense), 5ft clay (stiff)
PSH-1-RE S&W	B-130	59	Atterberg Limits, Grain Size	2	158	150	4ft sandy silt (soft) (fill), 3ft silt (stiff), 16ft sand and gravel (dense to very dense), 21ft silt (very stiff), 15ft sand and gravel (dense to very dense)
L-4357**	H-38	16.5		3	--**	14.5	10ft silty sand with gravel (medium dense) (fill), 6ft silty sand with gravel (loose to dense)
L-1924**	TH-14-03	68.4		4	187.5**	161	17ft sand with gravel (loose to medium dense), 3ft silty gravel with sand (medium dense), 16ft sand (medium dense to dense), 6ft silt (stiff), 24ft sand with gravel (medium dense to very dense)
PSH-1-RE S&W	B-131	69		4	160	148	7ft silty sand with gravel (loose) (fill), 4ft sandy silt (soft), 12ft silty sand (dense), 21ft clay,silt, silty sand (stiff to very stiff, medium dense), 17ft silty sand (dense), 8ft sand with gravel (dense to very dense)

See Bridge 405/59 E(87) for nearby subsurface information

Embankment Slopes

2H:1V

**Datum:Unknown for L-1924 and L-4357 borings

Bridge No.	405/64 (91)
Bridge Location	NE 160th Street
Widening As-Built Plan	Sheets 71-114 "SR 405 NE 160th Interchange, Bridge Widening, Br. No 405/64 Dated April 4, 1995
Original As-Built Plan	Sheets 33 - 41"SR 405 MP 22.61, Brickyard Road Interchange, King County, Brickyard Road Undercrossing" dated January 2, 1969
Number of Piers	3

	Pier No.	1	2	3
	Spread Footings (Original)			
*Datum USC & GS	Bottom of Footing Elevation (ft)	276*	264*	274.5*
	Approximate Footing Width (ft)	8.75	19	8.75
	Allowable Bearing Pressure (ksf)	6	6	6
	Spread Footings (Widening)			
**Datum City of Seattle	Bottom of Footing Elevation (ft)	267 (N) and 268.3 (S)**	258**	267.5**
	Footing Width (ft) from Plan Dimensions	13.25	23	12
	Allowable Bearing Pressure (ksf)	6	6	6

* Letter to Mr. M. Lwin dated February 17, 1994 indicates that the difference in datums is approximately "0.61 meters (6.0 ft)". The two values are not consistent. It is our understanding that the datums differ by about 6 feet.

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Pier No.	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L-1509**	H-4-67	37		1 (original)	271.1*	266.2	Boring completed below footing elevation
L-1509**	H-5-67	37.5		1 (original)	286.4*	262.2	Sand (dense)
L-1509**	H-7-93	31.5	Grain Size	1 (existing)	270**	259	Silty sand with gravel (very dense)
L-1509**	H-3-67	36.5		2 (original)	274*	267.4	Sand with silt and gravel (dense)
L-1509**	H-8-93	81	Grain Size	2 (existing)	265**	237	Silty sand (loose) over sandy silt (hard) at Elev. 256 ft
L-1509**	H-1-67	31		3 (original)	273.5*	266.7	Silt, sand and gravel (loose) (fill)
L-1509**	H-2-67	Incomplete		3 (original)	270.6*	265.8	Sand and gravel (loose)
L-1509**	H-6-67	37.5		3 (existing)	291.7*	273.3	Silt and sand (very stiff, medium dense)
L-1509**	H-9-93	36.5	Grain Size	3 (existing)	270**	No Information	Silty sand with gravel (dense)
L-6573**	5	8		3 (original)	--***	4.5	

Embankment Slopes

2H:1V slopes

***Datum:USC&GS for L-1509 H-#-67 borings;City of Seattle H-#-93; Unknown for L-6573

Wall No.	Retaining Wall - Sheet RE1 (see Noise Wall 1)
Wall Location	South of NE 70th Street
As-Built Plan	Sheets 139 through 143, 169, and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Standard Reinforced Concrete Retaining Wall Type 6 with Traffic and Noise Barriers
Wall Stationing	STA 0+00 (72-S STA 8+46.71 - 21.58' LT) to 1+20 (72-S STA 9+66.42 - 21.58' LT)
Wall Match	Match Noise Wall 1
Wall Height (ft)	14 to 18 feet Note: Plans suggest that a significant amount of fill was placed for wall construction
Datum:	City of Seattle

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	TP-18	8	Grain Size	353	None	Up to 1.5 ft of loose sand with silt overlying stiff sandy
L-0889	BRZ-3	14	-	368	None	silt and medium dense to very dense silty sand

Wall No.	Retaining Wall - Sheet RE2
Wall Location	South of NE 72nd Place
As-Built Plan	Sheets 170 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Standard Reinforced Concrete Retaining Wall Type 4
Wall Stationing	STA 0+00 (116A-N Line STA 6+54- 33.25' RT) to STA 1+92 (116A-N Line STA 8+45.95- 29.51' RT)
Wall Height (ft)	8 to 10 feet
Datum:	City of Seattle, Unless noted below

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-43	30	Grain Size	344	None	Between 5 to 10 feet of loose to medium dense silty sand overlying very dense sand with silt and gravel and stiff to hard silt
PSH-1-RE	B-19	39	Grain Size	355.5	None	
L-4356	H-4	3	--	unavailable	None	

Wall No.	Retaining Wall - Sheet RE3
Wall Location	Southbound on-ramp from NE 85th St
As-Built Plan	Sheets 171 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Standard Reinforced Concrete Retaining Wall Type 2
Wall Stationing	STA 0+00 (E-S Sta. 5+00 (24.22' LT) to STA 4+21.68 (E-S Sta. 8+94.72 (25.86' LT)
Wall Height (ft)	8 to 15 feet
Datum:	City of Seattle

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-34	37.8	Grain Size	246	230	Up to 3 feet of silty sand (fill) overlying very dense sand
L-0889	BRZ-35	27.9	Grain Size	268	258	with variable silt (glacial till)

Wall No.	Retaining Wall - Sheet RE4
Wall Location	In Median at NE 72nd Place
As-Built Plan	Sheets 172 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Reinforced Concrete Retaining Wall Type 2 with Traffic Barrier
Wall Stationing	STA LE 524+78.33 (32' LT) to STA LE 527+35.49 (34' LT)
Wall Height (ft)	7 to 8 feet
Datum:	City of Seattle, Unless noted below

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-4356	H-7	3.5	-	Illegible**	None	Medium dense to dense sand with variable silt and gravel
L-4356	H-8	3.5	-	Illegible**	None	
L-4356	H-9	3	-	343**	None	

**Datum: Unknown for L-4356 borings

Wall No.	Retaining Wall - Sheet RE5
Wall Location	In Median South of NE 85th Street
As-Built Plan	Sheets 173 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Reinforced Concrete Retaining Wall Type 2 with Traffic Barrier
Wall Stationing	STA L 559+42.37 (1' RT) to STA L 563+60.65 (2' RT)
Wall Height (ft)	8 to 13 feet
Datum:	City of Seattle

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-46	27.8	-	290	265	Loose to very dense sand with variable silt and gravel (Fill)
L-0889	BRZ-47	25.4	-	286	None	
PSH-1-RE S&W	SB-2	21	-	254	None	

Wall No.	Retaining Wall - Sheet RE6 - RE7
Wall Location	North of NE 85th Street
As-Built Plan	Sheets 174, 175 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Reinforced Concrete Retaining Wall Type 2 with Traffic Barrier
Wall Stationing	STA L 565+83.28 (2' LT) to STA L 576+19.18 (1' LT)
Wall Height (ft)	7 to 14 feet
Datum:	City of Seattle

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-48	25.5	Grain Size	272	None	Loose to dense silty sand with gravel (Fill), north end may be founded on very dense silty sand with gravel (native) below the fill
L-0889	BRZ-49	24	Grain Size	265	None	
L-0889	BRZ-50	26.5	Grain Size	260	246	
L-0889	BRZ-51	15	Grain Size	256	246	

Wall No.	Retaining Wall - Sheet RE8
Wall Location	In Median South of NE 116th Street
As-Built Plan	Sheets 176 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Reinforced Concrete Retaining Wall Type 2 with Traffic Barrier
Wall Stationing	STA L 653+20.59 (1' RT) to STA LW 655+35.60 (30' RT)
Wall Height (ft)	7 to 8 feet
Datum:	City of Seattle

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
PSH-1-RE S&W	B-145	24	-	181	None	Very loose to medium dense silty sand with gravel (Fill)

Wall No.	Retaining Wall - Sheet RE9
Wall Location	In Median North of NE 116th Street
As-Built Plan	Sheets 177 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Reinforced Concrete Retaining Wall Type 2 with Traffic Barrier
Wall Stationing	STA LW 657+00.10 (30' RT) to STA LW 662+59.19 (34' RT)
Wall Height (ft)	7 to 9 feet
Datum:	City of Seattle

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
PSH-1-RE S&W	B-147	27	-	182	None	
PSH-1-RE S&W	B-167	48	-	180	None	Loose to very dense silty sand with gravel (Fill)
PSH-1-RE S&W	B-85	38	Consol, Atterberg Limits	161	157	

Wall No.	Retaining Wall - Sheet RE10
Wall Location	In Median South of NE 132nd Street
As-Built Plan	Sheets 178 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Reinforced Concrete Retaining Wall Type 2 with Traffic Barrier
Wall Stationing	STA L 707+50 (10.94' RT) to STA LE 711+53.45 (43' LT)
Wall Height (ft)	8 to 10 feet
Datum:	City of Seattle, Unless noted below

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-1924	B-16-01	16.5	-	177**	None	Dense gravel with sand (recessional outwash) near south end and loose to medium dense silty sand with gravel (fill) near north end.
L-0889	BRZ-45	32.5	-	165	139	
PSH-1-RE S&W	B-148	21	-	156	None	
S&W Report	B-132	Unavailable				

**Datum: Unknown for L-1924 borings

Wall No.	Noise Wall 1
Wall Location	South of NE 72 Place
As-Built Plan	Sheets 139-143, 166-169 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Type	Varies (see below)
Wall Stationing	STA 0+00 (L Line STA 469- 135' LT) to STA 54+80 (72-S Line STA 14+76.20- 48.4' LT)
Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf

Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 to STA 26+08; STA 50+32 to STA 54+80

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	5 to 8.75
Panel Thickness (in)	5
Precast Panel Height (ft)	6 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-38	21.5	Grain Size	415	402	Medium dense to very dense sand with variable silt and gravel. Some of the very dense silty sand with gravel was designated as glacial till.
L-0889	TP-22	7.5	-	395	None	
L-0889	BRZ-1	9	-	397	None	
L-0889	TP-21	8	-	398	None	
L-0889	BRZ-12	9	-	402	None	
L-0889	TH-10	2.5	-	402	None	
L-0889	TP-20	9	-	400	None	
L-0889	TP-18	8	Grain Size	353	None	

Wall No. Noise Wall 1 (cont.)
Wall Location South of NE 72 Place
As-Built Plan Sheets 139-143, 166-169 and 179 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number 92W070

Wall Type Cast-In-Place Concrete with Barrier
Wall Stationing STA 26+08 to STA 48+64; STA 49+84 to STA 50+32

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	8 to 14

Note: large embedment depth appears to be due to extensive fill placement

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	TP-20	9	-	400	None	Up to 6 ft of fill consisting of loose to dense silty sand with gravel overlying loose to very dense sand with variable silt and gravel. Some of the very dense sand deposits are designated glacial till
PSH-1-RE S&W	B-4	33	Grain Size	396	No Information	
PSH-1-RE S&W	B-6	39	-	395	393	
L-0889	BRZ-37	23.5	Grain Size	292	None	
L-0889	TP-19	8	-	396	None	
L-0889	BRZ-3	14	-	368	None	

Wall Type Retaining/Noise Wall (see Retaining Wall - Sheet RE1)
Wall Stationing STA 48+64 to STA 49+84

Datum: City of Seattle

Foundation	
Shaft Spacing (ft)	Unavailable
Shaft Diameter	Unavailable
Embedment Depth (ft)	Unavailable
Allowable Shaft Capacity (kips)	Unavailable
Retaining Wall Height (ft)	Unavailable

Note: Plans suggest that a significant amount of fill was placed for wall construction

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	TP-18	8	Grainsize	353	None	Up to 1.5 ft of loose sand with silt overlying stiff sandy silt and medium dense to very dense silty sand
L-0889	BRZ-3	14	-	368	None	

Wall No.	Noise Wall 2
Wall Location	South of NE 72 Place
As-Built Plan	Sheets 144-146 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Wall Stationing	STA 0+00 (L Line STA 471+66- 79.58' RT) to STA 25+92 (L Line STA 497+50.15- 120' RT)
Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf

Wall Type: Cast-In-Place Concrete with Barrier
Wall Stationing: STA 0+00 to STA 11+92

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	8 to 16

Note: large embedment depth appears to be due to fill placement

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-11	9	Grain Size	392	None	Up to 8 ft of fill consisting of silty sand with gravel over dense to very dense sand with variable silt and gravel
L-0889	BRZ-14	23.5	Grain Size	394	None	

Wall Type: Precast Concrete Panels
Wall Stationing: STA 11+92 to STA 25+92

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	5.5 to 8.25
Panel Thickness (in)	5
Precast Panel Height (ft)	8 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	TP-1	10	None	402	None	
L-0889	TP-2	10	None	409	None	Medium dense to very dense silty sand and silt with variable gravel

Wall No.	Noise Wall 3
Wall Location	South of NE 72 Place
As-Built Plan	Sheets 146-147 and 166-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 502- 165' RT) to STA 14+00 (L Line STA 515+95.57- 195.48' RT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	5.5 to 7.75
Panel Thickness (in)	5
Precast Panel Height (ft)	8 to 16

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-31	21.5	Grain Size	418	410	
L-0889	TP-3	9	None	410	None	Dense to very dense sand with variable silt
L-0889	TP-4	11.5	Grain Size	395	Seepage 384	

Wall No.	Noise Wall 4
Wall Location	Between NE 72nd Place and NE 85th Street
As-Built Plan	Sheets 148-151 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Stationing	STA 0+00 (L Line STA 529+60.26- 179.51' LT) to STA 28+80 (E-S Line STA 3+78.58- 43.47' LT)

Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 to STA 6+09; 23+04 to STA 28+80

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	5.5 to 8.25
Panel Thickness (in)	5
Precast Panel Height (ft)	8 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	TP-17	8	Grain Size	339	None	Up to 8 ft of fill consisting of medium dense silty sand underlain by medium dense to very dense sand with variable silt (glacial till)
L-0889	BRZ-28	14.5	Grain Size	295	None	
L-0889	BRZ-35	27.9	Grain Size	268	258.5	

Wall Type	Cast-In-Place Concrete with Barrier
Wall Stationing	STA 6+09 to STA 23+04

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	12 to 16

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-4	14	Grain Size	321	None	Up to 6.5 feet of fill consisting of medium dense to dense sand with gravel underlain by medium dense to very dense sand with variable silt and gravel
L-0889	BRZ-36	23.4	Grain Size	320	None	
L-0889	TP-16	6.5	-	313	None	

Wall No.	Noise Wall 5
Wall Location	Between NE 72 Place and NE 85th Street
As-Built Plan	Sheets 152-153 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992 (Sheet 153 not available)
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (LE Line STA 530+19.25- 210.27' RT) to approx. STA 14+00 (approx. L Line STA 550+00 RT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	5 to 9
Panel Thickness (in)	5
Precast Panel Height (ft)	8 to 16

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
W-7148	BRZ-15	23.3	-	350	None	Medium dense to very dense sand with variable silt and gravel (glacial till)
L-0889	TP-5	9	-	338	None	
L-0889	TP-6	6	-	322	None	
L-0889	BRZ-5	13	-	332	None	

Wall No.	Noise Wall 6
Wall Location	North of NE 85th Street
As-Built Plan	Sheets 154-156 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992 (Sheet 154 not available)
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (approx. L Line STA 568, LT) to STA 27+84 (L Line STA 594+00.05 - 119.93' LT)

Datum: City of Seattle, unless noted below

	Foundation	Trench Footing
Trench Width (ft)		Unavailable-filled with lean concrete
Footing Width (ft)		Same as panel thickness
Embedment Depth (ft)		4 to 8
Panel Thickness (in)		5
Precast Panel Height (ft)		8 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-27	22.9	Grain Size	245	237.5	Medium dense to very dense sand with variable silt and gravel (glacial till)
L-0889	TP-15	9	-	251	None	
L-0889	BRZ-6	8.5	-	260	None	
Current	KX-10	41.5	Grain Size, Atterberg Limits	198**	187.5	
L-0889	TP-14	10	Grain Size	271	None	
L-0889	BRZ-33	22.7	Grain Size	272	256	

** Datum: NAVD 88 for current KX-10 boring

Wall No.	Noise Wall 7
Wall Location	Between NE 85th Street and NE 116th Street
As-Built Plan	Sheets 157-159 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Stationing	STA 0+00 (L Line STA 583+69.4- 90.45' RT) to STA 27+52 (L Line STA 610+97.26- 120' RT)

Wall Type	Cast-In-Place Concrete with Barrier
Wall Stationing	STA 0+00 to STA 9+60

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	8 to 12

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-7	8	Grain Size	254	None	Up to 5 feet of fill consisting of medium dense silty sand with organics. Dense to very dense sand with gravel and variable silt. One of the boring logs designates the dense sands as glacial till
L-0889	TP-7	10	-	258	Seepage 249	

Wall Type	Precast Concrete Panels
Wall Stationing	STA 9+60 to STA 27+52

Datum: City of Seattle, unless noted below

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	5.5 to 8.75
Panel Thickness (in)	5
Precast Panel Height (ft)	8 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	TP-8	8	Grain Size	262	None	
Current	KX-4	41.5	Grain Size	203**	188	
L-0889	BRZ-16	23.3	Grain Size	270	263	Up to 10 feet of fill consisting of loose to very dense silty sand with gravel over dense to very dense sand with variable silt and gravel. Some of the boring logs designate the dense to very dense material as glacial till or advance outwash
9807	BH-4	56	Grain Size	273**	260	
9807	BH-5	41.5	Grain Size	273**	None	
L-0889	TP-9	9	-	267	None	
Current	KR-1-04	41	Grain Size, Atterberg Limits	279.7	260.5	
Current	KS-1-04	40.5	Grain Size	n/a	26 ft bgs	

**Datum: Unknown for 9807 borings, NAVD 88 for Current borings

Wall No.	Noise Wall 8
Wall Location	Between NE 85th Street and NE 116th Street
As-Built Plan	Sheets 160 and 166-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 608+50- 245' LT) to STA 8+96 (L Line STA 617+49.46- 210' LT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	6.75 to 8.25
Panel Thickness (in)	5
Precast Panel Height (ft)	12 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-25	23	Grain Size	277	None	Up to 5 ft of fill consisting of medium dense to dense sand with silt underlain by hard silt and dense to very dense silty sand with gravel (glacial till)
L-0889	BRZ-26	20.4	Grain Size	239	None	

Wall No.	Noise Wall 12
Wall Location	North of 132nd Street
As-Built Plan	Sheets 161-163 and 166-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 715+00- 75' RT) to STA 24+80 (LE Line STA 740+03.47- 70' RT)

Datum: City of Seattle, unless noted below

	Foundation	Trench Footing
	Trench Width (ft)	Unavailable-filled with lean concrete
	Footing Width (ft)	Same as panel thickness
	Embedment Depth (ft)	6.25 to 8.25
	Panel Thickness (in)	5
	Precast Panel Height (ft)	10 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-4340/57	H-8	1	-	Unavailable	None	
L-0889	BRZ-8	14	-	185	None	
L-1924	TP-4-01	4	-	199**	None	
L-1924	TP-5-01	6	-	203**	None	Up to 3 ft of fill consisting of sand, organics, or quarry spalls over dense to very dense silty sand with gravel. The dense to very dense soils are designated glacial till on some of the logs.
L-0889	BRZ-29	21.5	Grain Size	195	194	
L-0889	TP-10	8	-	197	None	
L-0889	BRZ-18	21.5	Grain Size	202	195.5	
L-0889	BRZ-9	14	-	No Information	11.5 feet below surface	

**Datum: Unknown for L-4340 and L-1924 borings

Wall No.	Noise Wall 15
Wall Location	South of Brick Yard Road
As-Built Plan	Sheets 163 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Cast-In-Place Concrete with Barrier
Wall Stationing	STA 0+00 (L Line STA 772+00- 67.58' LT) to STA 8+96 (L Line STA 780+95.82- 85.5' LT)

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	6 to 8

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
	BRZ-30	36.5	Atterberg Limits,	245	233	Up to 20 ft of fill consisting of medium dense silty sand
L-0889			Grain Size			with gravel underlain by medium dense to very dense
L-0889	BRZ-32	40	Grain Size	235	216	sand with variable silt and gravel (designated as glacial till on log for BRZ-30).

Wall No.	Noise Wall 16 - Stage 1
Wall Location	South of Brick Yard Road
As-Built Plan	Sheets 164-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 778+05- 155' RT) to STA 15+20 (L Line STA 793+15.42- 114.05' RT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	6.25 to 8.75
Panel Thickness (in)	5
Precast Panel Height (ft)	10 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-19	16	Grain Size	248	None	Up to 2½ ft of fill consisting of loose silty sand with gravel underlain by loose to very dense silty sand with gravel (designated as glacial till on some of the logs).
L-0889	TP-11	12	-	255	None	
L-0889	BRZ-20	20.8	Grain Size	275	267.5	
L-0889	TH-5	1	-	275	None	
L-0889	BRZ-10	8	-	275	None	

Wall No.	Noise Wall 16 - Stage 2
Wall Location	Northbound offramp to NE 160th Street
As-Built Plan	Sheet 57-59 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2" dated July 24, 1993
Project Number	93W103

Wall Type	Precast Concrete Panels
Wall Stationing	STA 15+24.29 (L STA 793+20.62 - 114' RT) to STA 21+96.62

Datum: City of Seattle, unless noted below

Foundation	Drilled Shafts
Shaft Spacing (ft)	12
Shaft Diameter	2'-4"
Embedment Depth (ft)	11.1 to 13.2
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	16 to 19

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
W-7148	BRZ-10	8		275	None	
L-3821	2			**		Up to 5 feet of medium dense silty sand (fill) over very dense silty sand with gravel (glacial till)
W-7148	TP-12	8		274	None	

**Datum:Unknown for L-3821 boring

Wall No.	Noise Wall 6
Wall Location	North of NE 85th Street
As-Built Plan	Sheets 154-156 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992 (Sheet 154 not available)
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (approx. L Line STA 568, LT) to STA 27+84 (L Line STA 594+00.05 - 119.93' LT)

Datum: City of Seattle, unless noted below

	Foundation	Trench Footing
Trench Width (ft)		Unavailable-filled with lean concrete
Footing Width (ft)		Same as panel thickness
Embedment Depth (ft)		4 to 8
Panel Thickness (in)		5
Precast Panel Height (ft)		8 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-27	22.9	Grain Size	245	237.5	Medium dense to very dense sand with variable silt and gravel (glacial till)
L-0889	TP-15	9	-	251	None	
L-0889	BRZ-6	8.5	-	260	None	
Current	KX-10	41.5	Grain Size, Atterberg Limits	198**	187.5	
L-0889	TP-14	10	Grain Size	271	None	
L-0889	BRZ-33	22.7	Grain Size	272	256	

** Datum: NAVD 88 for current KX-10 boring

Wall No.	Noise Wall 7
Wall Location	Between NE 85th Street and NE 116th Street
As-Built Plan	Sheets 157-159 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Stationing	STA 0+00 (L Line STA 583+69.4- 90.45' RT) to STA 27+52 (L Line STA 610+97.26- 120' RT)

Wall Type	Cast-In-Place Concrete with Barrier
Wall Stationing	STA 0+00 to STA 9+60

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	8 to 12

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-7	8	Grain Size	254	None	Up to 5 feet of fill consisting of medium dense silty sand with organics. Dense to very dense sand with gravel and variable silt. One of the boring logs designates the dense sands as glacial till
L-0889	TP-7	10	-	258	Seepage 249	

Wall Type	Precast Concrete Panels
Wall Stationing	STA 9+60 to STA 27+52

Datum: City of Seattle, unless noted below

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	5.5 to 8.75
Panel Thickness (in)	5
Precast Panel Height (ft)	8 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	TP-8	8	Grain Size	262	None	
Current	KX-4	41.5	Grain Size	203**	188	
L-0889	BRZ-16	23.3	Grain Size	270	263	Up to 10 feet of fill consisting of loose to very dense silty sand with gravel over dense to very dense sand with variable silt and gravel. Some of the boring logs designate the dense to very dense material as glacial till or advance outwash
9807	BH-4	56	Grain Size	273**	260	
9807	BH-5	41.5	Grain Size	273**	None	
L-0889	TP-9	9	-	267	None	
Current	KR-1-04	41	Grain Size, Atterberg Limits	279.7	260.5	
Current	KS-1-04	40.5	Grain Size	n/a	26 ft bgs	

**Datum: Unknown for 9807 borings, NAVD 88 for Current borings

Wall No.	Noise Wall 8
Wall Location	Between NE 85th Street and NE 116th Street
As-Built Plan	Sheets 160 and 166-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 608+50- 245' LT) to STA 8+96 (L Line STA 617+49.46- 210' LT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	6.75 to 8.25
Panel Thickness (in)	5
Precast Panel Height (ft)	12 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-25	23	Grain Size	277	None	Up to 5 ft of fill consisting of medium dense to dense sand with silt underlain by hard silt and dense to very dense silty sand with gravel (glacial till)
L-0889	BRZ-26	20.4	Grain Size	239	None	

Wall No.	Noise Wall 12
Wall Location	North of 132nd Street
As-Built Plan	Sheets 161-163 and 166-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 715+00- 75' RT) to STA 24+80 (LE Line STA 740+03.47- 70' RT)

Datum: City of Seattle, unless noted below

	Foundation	Trench Footing
	Trench Width (ft)	Unavailable-filled with lean concrete
	Footing Width (ft)	Same as panel thickness
	Embedment Depth (ft)	6.25 to 8.25
	Panel Thickness (in)	5
	Precast Panel Height (ft)	10 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-4340/57	H-8	1	-	Unavailable	None	
L-0889	BRZ-8	14	-	185	None	
L-1924	TP-4-01	4	-	199**	None	
L-1924	TP-5-01	6	-	203**	None	Up to 3 ft of fill consisting of sand, organics, or quarry spalls over dense to very dense silty sand with gravel. The dense to very dense soils are designated glacial till on some of the logs.
L-0889	BRZ-29	21.5	Grain Size	195	194	
L-0889	TP-10	8	-	197	None	
L-0889	BRZ-18	21.5	Grain Size	202	195.5	
L-0889	BRZ-9	14	-	No Information	11.5 feet below surface	

**Datum: Unknown for L-4340 and L-1924 borings

Wall No.	Noise Wall 15
Wall Location	South of Brick Yard Road
As-Built Plan	Sheets 163 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Cast-In-Place Concrete with Barrier
Wall Stationing	STA 0+00 (L Line STA 772+00- 67.58' LT) to STA 8+96 (L Line STA 780+95.82- 85.5' LT)

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	6 to 8

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
	BRZ-30	36.5	Atterberg Limits,	245	233	Up to 20 ft of fill consisting of medium dense silty sand
L-0889			Grain Size			with gravel underlain by medium dense to very dense
L-0889	BRZ-32	40	Grain Size	235	216	sand with variable silt and gravel (designated as glacial till on log for BRZ-30).

Wall No.	Noise Wall 16 - Stage 1
Wall Location	South of Brick Yard Road
As-Built Plan	Sheets 164-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 778+05- 155' RT) to STA 15+20 (L Line STA 793+15.42- 114.05' RT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	6.25 to 8.75
Panel Thickness (in)	5
Precast Panel Height (ft)	10 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-19	16	Grain Size	248	None	Up to 2½ ft of fill consisting of loose silty sand with gravel underlain by loose to very dense silty sand with gravel (designated as glacial till on some of the logs).
L-0889	TP-11	12	-	255	None	
L-0889	BRZ-20	20.8	Grain Size	275	267.5	
L-0889	TH-5	1	-	275	None	
L-0889	BRZ-10	8	-	275	None	

Wall No.	Noise Wall 16 - Stage 2
Wall Location	Northbound offramp to NE 160th Street
As-Built Plan	Sheet 57-59 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2" dated July 24, 1993
Project Number	93W103

Wall Type	Precast Concrete Panels
Wall Stationing	STA 15+24.29 (L STA 793+20.62 - 114' RT) to STA 21+96.62

Datum: City of Seattle, unless noted below

Foundation	Drilled Shafts
Shaft Spacing (ft)	12
Shaft Diameter	2'-4"
Embedment Depth (ft)	11.1 to 13.2
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	16 to 19

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
W-7148	BRZ-10	8		275	None	
L-3821	2			**		Up to 5 feet of medium dense silty sand (fill) over very dense silty sand with gravel (glacial till)
W-7148	TP-12	8		274	None	

**Datum:Unknown for L-3821 boring

Wall No.	Retaining Wall 1
Wall Location	North of 160th St NE
As-Built Plan	Sheet 60 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2, Retaining Wall 1" dated December 1, 1993
Project Number	93W103

Wall Type	Reinforced Concrete Retaining Wall Type 3; Type 4B Barrier
Wall Stationing	STA L 807+43 (70.58' RT) to STA L 812+83 (67.08' RT)

Datum: City of Seattle, unless noted below

Foundation	Shallow Footing
Wall Height (ft)	5 to 8
Approximate Footing Width (ft)	3 to 4.25
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-6573	3	2		--**	None	1 ft of gravel borrow over dense silty sand

**Datum: Unknown for L-6537 boring

Wall No.	Retaining Wall 1
Wall Location	North of 160th St NE
As-Built Plan	Sheet 60 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2, Retaining Wall 1" dated December 1, 1993
Project Number	93W103

Wall Type	Reinforced Concrete Retaining Wall Type 3; Type 4B Barrier
Wall Stationing	STA L 807+43 (70.58' RT) to STA L 812+83 (67.08' RT)

Datum: City of Seattle, unless noted below

Foundation	Shallow Footing
Wall Height (ft)	5 to 8
Approximate Footing Width (ft)	3 to 4.25
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-6573	3	2		--**	None	1 ft of gravel borrow over dense silty sand

**Datum: Unknown for L-6537 boring

Wall No.	Retaining Wall 2
Wall Location (milepost)	North of 160th St NE
As-Built Plan	Sheet 61 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2" dated July 21, 1993
Project Number	93W103

Wall Type	Reinforced Concrete Retaining Wall Type 3; Type 4B Barrier
Wall Stationing	STA BKYD-N 8+53.66 - 27' RT (App. STA L 812+67) to STA L 816+28 - 92' RT

Datum: City of Seattle, unless noted below

Foundation	Shallow Footing
Wall Height (ft)	6 to 9
Approximate Footing Width (ft)	3 to 4.75
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-6573	3	2		--**	None	1 ft of gravel borrow over dense silty sand

**Datum: Unknown for L-6537 boring

Wall No.	Noise Wall 6
Wall Location	North of NE 85th Street
As-Built Plan	Sheets 154-156 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992 (Sheet 154 not available)
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (approx. L Line STA 568, LT) to STA 27+84 (L Line STA 594+00.05 - 119.93' LT)

Datum: City of Seattle, unless noted below

	Foundation	Trench Footing
Trench Width (ft)		Unavailable-filled with lean concrete
Footing Width (ft)		Same as panel thickness
Embedment Depth (ft)		4 to 8
Panel Thickness (in)		5
Precast Panel Height (ft)		8 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-27	22.9	Grain Size	245	237.5	Medium dense to very dense sand with variable silt and gravel (glacial till)
L-0889	TP-15	9	-	251	None	
L-0889	BRZ-6	8.5	-	260	None	
Current	KX-10	41.5	Grain Size, Atterberg Limits	198**	187.5	
L-0889	TP-14	10	Grain Size	271	None	
L-0889	BRZ-33	22.7	Grain Size	272	256	

** Datum: NAVD 88 for current KX-10 boring

Wall No.	Noise Wall 7
Wall Location	Between NE 85th Street and NE 116th Street
As-Built Plan	Sheets 157-159 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Stationing	STA 0+00 (L Line STA 583+69.4- 90.45' RT) to STA 27+52 (L Line STA 610+97.26- 120' RT)

Wall Type	Cast-In-Place Concrete with Barrier
Wall Stationing	STA 0+00 to STA 9+60

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	8 to 12

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-7	8	Grain Size	254	None	Up to 5 feet of fill consisting of medium dense silty sand with organics. Dense to very dense sand with gravel and variable silt. One of the boring logs designates the dense sands as glacial till
L-0889	TP-7	10	-	258	Seepage 249	

Wall Type	Precast Concrete Panels
Wall Stationing	STA 9+60 to STA 27+52

Datum: City of Seattle, unless noted below

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	5.5 to 8.75
Panel Thickness (in)	5
Precast Panel Height (ft)	8 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	TP-8	8	Grain Size	262	None	
Current	KX-4	41.5	Grain Size	203**	188	
L-0889	BRZ-16	23.3	Grain Size	270	263	Up to 10 feet of fill consisting of loose to very dense silty sand with gravel over dense to very dense sand with variable silt and gravel. Some of the boring logs designate the dense to very dense material as glacial till or advance outwash
9807	BH-4	56	Grain Size	273**	260	
9807	BH-5	41.5	Grain Size	273**	None	
L-0889	TP-9	9	-	267	None	
Current	KR-1-04	41	Grain Size, Atterberg Limits	279.7	260.5	
Current	KS-1-04	40.5	Grain Size	n/a	26 ft bgs	

**Datum: Unknown for 9807 borings, NAVD 88 for Current borings

Wall No.	Noise Wall 8
Wall Location	Between NE 85th Street and NE 116th Street
As-Built Plan	Sheets 160 and 166-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 608+50- 245' LT) to STA 8+96 (L Line STA 617+49.46- 210' LT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	6.75 to 8.25
Panel Thickness (in)	5
Precast Panel Height (ft)	12 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-25	23	Grain Size	277	None	Up to 5 ft of fill consisting of medium dense to dense sand with silt underlain by hard silt and dense to very dense silty sand with gravel (glacial till)
L-0889	BRZ-26	20.4	Grain Size	239	None	

Wall No.	Noise Wall 12
Wall Location	North of 132nd Street
As-Built Plan	Sheets 161-163 and 166-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 715+00- 75' RT) to STA 24+80 (LE Line STA 740+03.47- 70' RT)

Datum: City of Seattle, unless noted below

	Foundation	Trench Footing
	Trench Width (ft)	Unavailable-filled with lean concrete
	Footing Width (ft)	Same as panel thickness
	Embedment Depth (ft)	6.25 to 8.25
	Panel Thickness (in)	5
	Precast Panel Height (ft)	10 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-4340/57	H-8	1	-	Unavailable	None	
L-0889	BRZ-8	14	-	185	None	
L-1924	TP-4-01	4	-	199**	None	
L-1924	TP-5-01	6	-	203**	None	Up to 3 ft of fill consisting of sand, organics, or quarry spalls over dense to very dense silty sand with gravel. The dense to very dense soils are designated glacial till on some of the logs.
L-0889	BRZ-29	21.5	Grain Size	195	194	
L-0889	TP-10	8	-	197	None	
L-0889	BRZ-18	21.5	Grain Size	202	195.5	
L-0889	BRZ-9	14	-	No Information	11.5 feet below surface	

**Datum: Unknown for L-4340 and L-1924 borings

Wall No.	Noise Wall 15
Wall Location	South of Brick Yard Road
As-Built Plan	Sheets 163 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Cast-In-Place Concrete with Barrier
Wall Stationing	STA 0+00 (L Line STA 772+00- 67.58' LT) to STA 8+96 (L Line STA 780+95.82- 85.5' LT)

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	6 to 8

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
	BRZ-30	36.5	Atterberg Limits,	245	233	Up to 20 ft of fill consisting of medium dense silty sand
L-0889			Grain Size			with gravel underlain by medium dense to very dense
L-0889	BRZ-32	40	Grain Size	235	216	sand with variable silt and gravel (designated as glacial till on log for BRZ-30).

Wall No.	Noise Wall 16 - Stage 1
Wall Location	South of Brick Yard Road
As-Built Plan	Sheets 164-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 778+05- 155' RT) to STA 15+20 (L Line STA 793+15.42- 114.05' RT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	6.25 to 8.75
Panel Thickness (in)	5
Precast Panel Height (ft)	10 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-19	16	Grain Size	248	None	Up to 2½ ft of fill consisting of loose silty sand with gravel underlain by loose to very dense silty sand with gravel (designated as glacial till on some of the logs).
L-0889	TP-11	12	-	255	None	
L-0889	BRZ-20	20.8	Grain Size	275	267.5	
L-0889	TH-5	1	-	275	None	
L-0889	BRZ-10	8	-	275	None	

Wall No.	Noise Wall 16 - Stage 2
Wall Location	Northbound offramp to NE 160th Street
As-Built Plan	Sheet 57-59 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2" dated July 24, 1993
Project Number	93W103

Wall Type	Precast Concrete Panels
Wall Stationing	STA 15+24.29 (L STA 793+20.62 - 114' RT) to STA 21+96.62

Datum: City of Seattle, unless noted below

Foundation	Drilled Shafts
Shaft Spacing (ft)	12
Shaft Diameter	2'-4"
Embedment Depth (ft)	11.1 to 13.2
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	16 to 19

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
W-7148	BRZ-10	8		275	None	
L-3821	2			**		Up to 5 feet of medium dense silty sand (fill) over very dense silty sand with gravel (glacial till)
W-7148	TP-12	8		274	None	

**Datum:Unknown for L-3821 boring

Wall No.	Retaining Wall 1
Wall Location	North of 160th St NE
As-Built Plan	Sheet 60 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2, Retaining Wall 1" dated December 1, 1993
Project Number	93W103

Wall Type	Reinforced Concrete Retaining Wall Type 3; Type 4B Barrier
Wall Stationing	STA L 807+43 (70.58' RT) to STA L 812+83 (67.08' RT)

Datum: City of Seattle, unless noted below

Foundation	Shallow Footing
Wall Height (ft)	5 to 8
Approximate Footing Width (ft)	3 to 4.25
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-6573	3	2		--**	None	1 ft of gravel borrow over dense silty sand

**Datum: Unknown for L-6537 boring

Wall No.	Retaining Wall 1
Wall Location	North of 160th St NE
As-Built Plan	Sheet 60 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2, Retaining Wall 1" dated December 1, 1993
Project Number	93W103

Wall Type	Reinforced Concrete Retaining Wall Type 3; Type 4B Barrier
Wall Stationing	STA L 807+43 (70.58' RT) to STA L 812+83 (67.08' RT)

Datum: City of Seattle, unless noted below

Foundation	Shallow Footing
Wall Height (ft)	5 to 8
Approximate Footing Width (ft)	3 to 4.25
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-6573	3	2		--**	None	1 ft of gravel borrow over dense silty sand

**Datum: Unknown for L-6537 boring

Wall No.	Retaining Wall 2
Wall Location (milepost)	North of 160th St NE
As-Built Plan	Sheet 61 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2" dated July 21, 1993
Project Number	93W103

Wall Type	Reinforced Concrete Retaining Wall Type 3; Type 4B Barrier
Wall Stationing	STA BKYD-N 8+53.66 - 27' RT (App. STA L 812+67) to STA L 816+28 - 92' RT

Datum: City of Seattle, unless noted below

Foundation	Shallow Footing
Wall Height (ft)	6 to 9
Approximate Footing Width (ft)	3 to 4.75
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-6573	3	2		--**	None	1 ft of gravel borrow over dense silty sand

**Datum: Unknown for L-6537 boring

Wall No.	Noise Wall 6
Wall Location	North of NE 85th Street
As-Built Plan	Sheets 154-156 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992 (Sheet 154 not available)
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (approx. L Line STA 568, LT) to STA 27+84 (L Line STA 594+00.05 - 119.93' LT)

Datum: City of Seattle, unless noted below

	Foundation	Trench Footing
Trench Width (ft)		Unavailable-filled with lean concrete
Footing Width (ft)		Same as panel thickness
Embedment Depth (ft)		4 to 8
Panel Thickness (in)		5
Precast Panel Height (ft)		8 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-27	22.9	Grain Size	245	237.5	Medium dense to very dense sand with variable silt and gravel (glacial till)
L-0889	TP-15	9	-	251	None	
L-0889	BRZ-6	8.5	-	260	None	
Current	KX-10	41.5	Grain Size, Atterberg Limits	198**	187.5	
L-0889	TP-14	10	Grain Size	271	None	
L-0889	BRZ-33	22.7	Grain Size	272	256	

** Datum: NAVD 88 for current KX-10 boring

Wall No.	Noise Wall 7
Wall Location	Between NE 85th Street and NE 116th Street
As-Built Plan	Sheets 157-159 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Stationing	STA 0+00 (L Line STA 583+69.4- 90.45' RT) to STA 27+52 (L Line STA 610+97.26- 120' RT)

Wall Type	Cast-In-Place Concrete with Barrier
Wall Stationing	STA 0+00 to STA 9+60

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	8 to 12

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-7	8	Grain Size	254	None	Up to 5 feet of fill consisting of medium dense silty sand with organics. Dense to very dense sand with gravel and variable silt. One of the boring logs designates the dense sands as glacial till
L-0889	TP-7	10	-	258	Seepage 249	

Wall Type	Precast Concrete Panels
Wall Stationing	STA 9+60 to STA 27+52

Datum: City of Seattle, unless noted below

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	5.5 to 8.75
Panel Thickness (in)	5
Precast Panel Height (ft)	8 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	TP-8	8	Grain Size	262	None	
Current	KX-4	41.5	Grain Size	203**	188	
L-0889	BRZ-16	23.3	Grain Size	270	263	Up to 10 feet of fill consisting of loose to very dense silty sand with gravel over dense to very dense sand with variable silt and gravel. Some of the boring logs designate the dense to very dense material as glacial till or advance outwash
9807	BH-4	56	Grain Size	273**	260	
9807	BH-5	41.5	Grain Size	273**	None	
L-0889	TP-9	9	-	267	None	
Current	KR-1-04	41	Grain Size, Atterberg Limits	279.7	260.5	
Current	KS-1-04	40.5	Grain Size	n/a	26 ft bgs	

**Datum: Unknown for 9807 borings, NAVD 88 for Current borings

Wall No.	Noise Wall 8
Wall Location	Between NE 85th Street and NE 116th Street
As-Built Plan	Sheets 160 and 166-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 608+50- 245' LT) to STA 8+96 (L Line STA 617+49.46- 210' LT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	6.75 to 8.25
Panel Thickness (in)	5
Precast Panel Height (ft)	12 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-25	23	Grain Size	277	None	Up to 5 ft of fill consisting of medium dense to dense sand with silt underlain by hard silt and dense to very dense silty sand with gravel (glacial till)
L-0889	BRZ-26	20.4	Grain Size	239	None	

Wall No.	Noise Wall 12
Wall Location	North of 132nd Street
As-Built Plan	Sheets 161-163 and 166-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 715+00- 75' RT) to STA 24+80 (LE Line STA 740+03.47- 70' RT)

Datum: City of Seattle, unless noted below

	Foundation	Trench Footing
	Trench Width (ft)	Unavailable-filled with lean concrete
	Footing Width (ft)	Same as panel thickness
	Embedment Depth (ft)	6.25 to 8.25
	Panel Thickness (in)	5
	Precast Panel Height (ft)	10 to 18

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-4340/57	H-8	1	-	Unavailable	None	
L-0889	BRZ-8	14	-	185	None	
L-1924	TP-4-01	4	-	199**	None	
L-1924	TP-5-01	6	-	203**	None	Up to 3 ft of fill consisting of sand, organics, or quarry spalls over dense to very dense silty sand with gravel. The dense to very dense soils are designated glacial till on some of the logs.
L-0889	BRZ-29	21.5	Grain Size	195	194	
L-0889	TP-10	8	-	197	None	
L-0889	BRZ-18	21.5	Grain Size	202	195.5	
L-0889	BRZ-9	14	-	No Information	11.5 feet below surface	

**Datum: Unknown for L-4340 and L-1924 borings

Wall No.	Noise Wall 15
Wall Location	South of Brick Yard Road
As-Built Plan	Sheets 163 and 166-168 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Cast-In-Place Concrete with Barrier
Wall Stationing	STA 0+00 (L Line STA 772+00- 67.58' LT) to STA 8+96 (L Line STA 780+95.82- 85.5' LT)

Datum: City of Seattle

Foundation	Drilled Shafts
Shaft Spacing (ft)	10
Shaft Diameter	2'-0"
Embedment Depth (ft)	21
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	6 to 8

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
	BRZ-30	36.5	Atterberg Limits,	245	233	Up to 20 ft of fill consisting of medium dense silty sand
L-0889			Grain Size			with gravel underlain by medium dense to very dense
L-0889	BRZ-32	40	Grain Size	235	216	sand with variable silt and gravel (designated as glacial till on log for BRZ-30).

Wall No.	Noise Wall 16 - Stage 1
Wall Location	South of Brick Yard Road
As-Built Plan	Sheets 164-167 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 1" dated July 9, 1992
Project Number	92W070

Design Methods	Spiral log method using internal soil friction angle of 32 degrees and unit weight of 120 pcf
Wall Type	Precast Concrete Panels
Wall Stationing	STA 0+00 (L Line STA 778+05- 155' RT) to STA 15+20 (L Line STA 793+15.42- 114.05' RT)

Datum: City of Seattle

Foundation	Trench Footing
Trench Width (ft)	Unavailable-filled with lean concrete
Footing Width (ft)	Same as panel thickness
Embedment Depth (ft)	6.25 to 8.75
Panel Thickness (in)	5
Precast Panel Height (ft)	10 to 20

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-0889	BRZ-19	16	Grain Size	248	None	Up to 2½ ft of fill consisting of loose silty sand with gravel underlain by loose to very dense silty sand with gravel (designated as glacial till on some of the logs).
L-0889	TP-11	12	-	255	None	
L-0889	BRZ-20	20.8	Grain Size	275	267.5	
L-0889	TH-5	1	-	275	None	
L-0889	BRZ-10	8	-	275	None	

Wall No.	Noise Wall 16 - Stage 2
Wall Location	Northbound offramp to NE 160th Street
As-Built Plan	Sheet 57-59 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2" dated July 24, 1993
Project Number	93W103

Wall Type	Precast Concrete Panels
Wall Stationing	STA 15+24.29 (L STA 793+20.62 - 114' RT) to STA 21+96.62

Datum: City of Seattle, unless noted below

Foundation	Drilled Shafts
Shaft Spacing (ft)	12
Shaft Diameter	2'-4"
Embedment Depth (ft)	11.1 to 13.2
Allowable Shaft Capacity (kips)	Unavailable
Precast Panel Height (ft)	16 to 19

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
W-7148	BRZ-10	8		275	None	
L-3821	2			**		Up to 5 feet of medium dense silty sand (fill) over very dense silty sand with gravel (glacial till)
W-7148	TP-12	8		274	None	

**Datum:Unknown for L-3821 boring

Wall No.	Retaining Wall 1
Wall Location	North of 160th St NE
As-Built Plan	Sheet 60 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2, Retaining Wall 1" dated December 1, 1993
Project Number	93W103

Wall Type	Reinforced Concrete Retaining Wall Type 3; Type 4B Barrier
Wall Stationing	STA L 807+43 (70.58' RT) to STA L 812+83 (67.08' RT)

Datum: City of Seattle, unless noted below

Foundation	Shallow Footing
Wall Height (ft)	5 to 8
Approximate Footing Width (ft)	3 to 4.25
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-6573	3	2		--**	None	1 ft of gravel borrow over dense silty sand

**Datum: Unknown for L-6537 boring

Wall No.	Retaining Wall 2
Wall Location (milepost)	North of 160th St NE
As-Built Plan	Sheet 61 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2" dated July 21, 1993
Project Number	93W103

Wall Type	Reinforced Concrete Retaining Wall Type 3; Type 4B Barrier
Wall Stationing	STA BKYD-N 8+53.66 - 27' RT (App. STA L 812+67) to STA L 816+28 - 92' RT

Datum: City of Seattle, unless noted below

Foundation	Shallow Footing
Wall Height (ft)	6 to 9
Approximate Footing Width (ft)	3 to 4.75
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
L-6573	3	2		--**	None	1 ft of gravel borrow over dense silty sand

**Datum: Unknown for L-6537 boring

Wall No.	Retaining Wall 3
Wall Location (milepost)	Northbound offramp to NE 160th Street
As-Built Plan	Sheet 62 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2, Retaining Wall 3" dated July 21, 1993
Project Number	93W103

Wall Type	Gabion Wall
Wall Stationing	STA BKYD-N 1+63 (65' RT) to STA BKYD-N 5+54 (41' RT)

Datum: City of Seattle

Foundation	Gabion Baskets
Individual Baskets	3' x 3' x 9'
Wall Height (f)	9
Approximate Bottom Layer Width (ft)	9 (3 baskets)
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
W-7148	BRZ-10	8		275	None	Up to 5 feet of medium dense silty sand (fill) over very dense silty sand with gravel (glacial till)
L-3821	2	Not Available				
W-7148	TP-12	8		274	None	

Wall No.	Retaining Wall 3
Wall Location (milepost)	Northbound offramp to NE 160th Street
As-Built Plan	Sheet 62 of "SR 405, Northup to Bothell, HOV and SC&DI - Stage 2, Retaining Wall 3" dated July 21, 1993
Project Number	93W103

Wall Type	Gabion Wall
Wall Stationing	STA BKYD-N 1+63 (65' RT) to STA BKYD-N 5+54 (41' RT)

Datum: City of Seattle

Foundation	Gabion Baskets
Individual Baskets	3' x 3' x 9'
Wall Height (f)	9
Approximate Bottom Layer Width (ft)	9 (3 baskets)
Allowable Bearing Pressure (ksf)	Unavailable

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	General Soil Conditions Provided on Log(s)
W-7148	BRZ-10	8		275	None	Up to 5 feet of medium dense silty sand (fill) over very dense silty sand with gravel (glacial till)
L-3821	2	Not Available				
W-7148	TP-12	8		274	None	

General Information	
Stormwater Facility	Detention Pond
Approximate Location	L STA 534+75 (182' RT) - North of NE 70th Street
Approximate Mile Post	17.51
As-Built Plan	Sheets 64, 65, 100 of "SR 405 Northup to Bothell HOV and SD&DI-Stage 1, dated 1992
Datum	City of Seattle, Unless noted below

Detention Pond	
Approximate Bottom Elevation (ft)	320
Approximate Bottom Size (ft)	82 x 6.5
Side Slopes (H:V)	4:1

Outflow Control System	
Type	CB Type 2, 72" with flow restrictor oil seperator
Inlet	18" CMP at Elevation 321 ft
Outlet	18" CMP at Elevation 321 ft

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L0889	TP-5	9	-	338	None	Sand (dense) Boring only goes to Elevation 329
W-7148	BRZ-15	23.3	-	350	None	Sand (very dense) Boring only goes to Elevation 326.7
Current	KX-5					Will be drilled during Stage 2 Nickel Package

General Information	
Stormwater Facility	Detention Pond
Approximate Location	SBCD STA 64+50 (280' LT) South of NE 85th Street
Approximate Mile Post	18.2
As-Built Plan	Sheets 67, 100 of "SR 405 Northup to Bothell HOV and SD&DI-Stage 1, dated 1992
Datum	City of Seattle

Detention Pond	
Approximate Bottom Elevation (ft)	245
Approximate Bottom Size (ft)	55 x 35 (ellipse)
Side Slopes (H:V)	4:1

Outflow Control System	
Type	CB Type 2, 72" with flow restrictor oil seperator
Inlet	18" CMP at Elevation 246 ft
Outlet	18" CMP at Elevation 246 ft

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L0889	BRZ-34	37.8	Grain Size	246	230	Silty sand (very dense) (glacial till)
L0889	BRZ-35	27.9	Grain Size	268	258.5, 252	Silty sand (very dense) (glacial till)

General Information	
Stormwater Facility	Detention Pond
Approximate Location	L STA 634+15 (120' RT) South of NE 116th Street
Approximate Mile Post	19.43
As-Built Plan	Sheets 72, 102 of "SR 405 Northup to Bothell HOV and SD&DI-Stage 1, dated 1992
Datum	City of Seattle

Detention Pond	
Approximate Bottom Elevation (ft)	176
Approximate Bottom Size (ft)	100 x 8
Side Slopes (H:V)	2.5:1 to 4:1

Outflow Control System	
Type	CB Type 2, 72" with flow restrictor oil seperator
Inlet	18" CMP at Elevation 177 ft
Outlet	18" CMP at Elevation 177 ft

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log

General Information	
Stormwater Facility	Detention Vault
Approximate Location	L STA 693+00 (192' LT) - North of NE 124th Street
Approximate Mile Post	20.51
As-Built Plan	Sheet 76, 77, 103E of "SR 405 Northup to Bothell HOV and SD&DI-Stage 1, dated 1992
Datum	City of Seattle, Unless noted below

Detention Pond	Note: Pond replaced with Vault
Approximate Bottom Elevation (ft)	127.64
Approximate Bottom Size (ft)	52 x 10
Side Slopes (H:V)	NA

Outflow Control System	
Type	CB Type 2, 72" with flow restrictor oil seperator
Inlet	12" at Elevation 129.31 ft
Outlet	12" at Elevation 128.64 ft

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L1924**	B-9-1	21.5	Grain Size	131	121	Silty sand and gravel (alluvium) (loose)
L1924**	B-11-01	21.5	Grain Size	141	123	Sand (medium dense)
L1924**	TH-5-03	40.5	Grain Size Atterberg Limits	122.2	121.7	Boring starts below bottom of pond elevation

**Datum unknown for L-1924 borings

General Information

Stormwater Facility	Detention Pond
Approximate Location	L STA 686+00 (200' LT) - NE 124th Street
Approximate Mile Post	20.41
As-Built Plan	Partial Plan "Totem Lake/124th Street" SR 405 MP 20.02 to 20.46
Datum	Unknown

Detention Pond

Approximate Bottom Elevation (ft)	?
Approximate Bottom Size (ft)	?
Side Slopes (H:V)	?

Outflow Control System

Type	?
Inlet	?
Outlet	?

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L8620	MH-6A	17	Atterberg Limits	122.5	Seepage 121.5	
L8620	MH-7A	27	Atterberg Limits	128.5	None	
L1924	TH-19-03	36.5	Grain Size Atterberg Limits	126.6	123	

General Information

Stormwater Facility	Detention Pond
Approximate Location	L STA 678+00 (600 ft RT) - NE 124th Street
Approximate Mile Post	20.26
As-Built Plan	Partial Plan "Totem Lake/124th Street" SR 405 MP 20.02 to 20.46
Datum	Unknown

Detention Pond

Approximate Bottom Elevation (ft)	?
Approximate Bottom Size (ft)	?
Side Slopes (H:V)	?

Outflow Control System

Type	?
Inlet	?
Outlet	?

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L1924	TH-17-03	41	Atterberg Limits	133	123.5	
L1924	TH-18-03	25.3	-	131	129	

General Information	
Stormwater Facility	Detention Pond
Approximate Location	LW STA 730+78 (115' LT) - North of NE 132nd Street
Approximate Mile Post	21.26
As-Built Plan	Sheets 79, 101 of "SR 405 Northup to Bothell HOV and SD&DI-Stage 1, dated 1992
Datum	City of Seattle

Detention Pond	
Approximate Bottom Elevation (ft)	159
Approximate Bottom Size (ft)	72 x 7
Side Slopes (H:V)	4:1

Outflow Control System	Note: Unknow Current Outflow Structure
Type	CB Type 2, 72" with flow restrictor oil seperator
Inlet	161
Outlet	160

Nearby Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L-0889	BRZ-18	21.5	Grain Size	202	195.5	Silty sand (glacial till) (very dense) Boring only extends to Elevation 180 ft
L-0889	TP-10	8	-	197	191	Silty sand (glacial till) (very dense) Boring only extends to Elevation 189 ft
Current	KL-1					Will be drilled during Stage 2 Nickel Package

General Information	
Stormwater Facility	Detention Pond
Approximate Location	LW STA 1730+00 - North of NE 132nd Street
Approximate Mile Post	21.26
As-Built Plan	Sheet DD1 of SR405 Coal CR PKWY TO SR522, dated Feb, 2001
Datum	NAVD 88, unless noted below

Detention Pond	
Approximate Bottom Elevation (ft)	171
Approximate Bottom Size (ft)	76.5(2) x 38
Side Slopes (H:V)	2:1 to 3:1

Outflow Control System	Note: Unknow Current Outflow Structure
Type	?
Inlet	?
Outlet	?

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L-0889	BRZ-18	21.5	Grain Size	202**	195.5	Silty sand (glacial till) (very dense) Boring only extends to Elevation 180 ft
L-0889	TP-10	8	-	197**	191	Silty sand (glacial till) (very dense) Boring only extends to Elevation 189 ft
Current	KL-1					Will be drilled during Stage 2 Nickel Package

**Datum: City of Seattle for L-0889 borings

General Information	
Stormwater Facility	Flow Control Facility
Approximate Location	L STA 767+00 (? RT) - Juanita Creek
Approximate Mile Post	21.95
As-Built Plan	Partial "King County Department of Public Works, Juanita Creek Flow Control Facilities High Woodlands Detention Pond."
Datum	King County (KCAS), unless noted below

Detention Pond	
Approximate Bottom Elevation (ft)	220
Approximate Bottom Size (ft)	?
Side Slopes (H:V)	?

Outflow Control System	Note: Unknow Current Outflow Structure
Type	?
Inlet	?
Outlet	?

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L0889	BRZ-19	16	Grain Size	248**	None	

** Datum:City of Seattle for L-0889 boring

General Information

Stormwater Facility	Detention Pond
Approximate Location	L STA 774+38 (98'RT) - South of Brickyard Road
Approximate Mile Post	22.09
As-Built Plan	Sheets 101, 103 A-C of "SR 405 Northup to Bothell HOV and SD&DI-Stage 1, dated 1992
Datum	City of Seattle

Detention Pond

Approximate Bottom Elevation (ft)	229
Approximate Bottom Size (ft)	60 x 8
Side Slopes (H:V)	2:1 to 4:1

Outflow Control System

Type	CB Type 2, 72" with flow restrictor oil seperator
Inlet	18" CMP at Elevation 230 ft
Outlet	18" CMP at Elevation 230 ft

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L0889	BRZ-19	16	Grain Size	248	None	Silty sand (glacial till) (very dense) Boring only goes to Elev. 232 ft
L0889	TP-11	12		255	None	Sand with interbedded silt (dense), Boring only goes to Elev. 243 ft

General Information

Stormwater Facility	Detention Pond
Approximate Location	L STA 800+00 (450' LT) - Brickyard Road West
Approximate Mile Post	22.56
As-Built Plan	Partial Sheets DR1, DD1 of "Northup to Bothell NE 160th Street Bridge Widening", SR 405 MP 22.49 to MP 22.88 undated
Datum	City of Seattle, unless noted below

Detention Pond

Approximate Bottom Elevation (ft)	250.5
Approximate Bottom Size (ft)	140 x 7.5
Side Slopes (H:V)	2:1

Outflow Control System

Type	Type 2 CB
Inlet	18" at Elevation 255 ft
Outlet	18" at Elevation 255 ft

Nearby Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L7979	8-28-84-3 borings	5	-	285 to 288**	None	Sand and gravel (medium dense to very dense) Borings only extend to about Elevatio 280 ft.
L3821	3					Boring Log not available

**Datum unknown for L-7979 and L-3821 borings

General Information	
Stormwater Facility	Detention Pond
Approximate Location	L STA 803+00 (400' RT) -Brickyard Road East
Approximate Mile Post	22.65
As-Built Plan	Partial Sheets DR4, DD3 of "Northup to Bothell NE 160th Street Bridge Widening", SR 405 MP 22.49 to MP 22.88undated
Datum	City of Seattle, unless noted below

Detention Pond	
Approximate Bottom Elevation (ft)	266.5
Approximate Bottom Size (ft)	Irregular shape with intermediate berms
Side Slopes (H:V)	2:1

Outflow Control System	
Type	Type 2 CB with flow restrictor oil seperator
Inlet	12" concrete
Outlet	18" steel

Explorations

Job Number	Boring ID	Depth (ft)	Lab Data	Approx. Boring Elevation (ft)	Groundwater Elevation (ft)	Foundation Soil Conditions Provided on Log
L1509	H-1-67	31	-	273.5**	266.7	Sand (dense)
L7979	8-28-84-2	5	-	--**	None	Sand and gravel (medium dense to dense)
Current	KO-1					Will be drilled during Stage 2 Nickel package

** Datum USC&GS for L-1509 boring; unknown for L-7979 boring