GEOTECHNICAL DATA REPORT

SR-167 Puyallup River Bridge Replacement (No.167/20E)

XL-4105, MP 6.41 to 6.49

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1. INTRODUCTION

1.1. General

This report presents the results of the geotechnical investigation for the subject project. A vicinity map illustrating the project location is presented as Figure 1. Additional geotechnical information is provided as reference material in the Request for Proposal (RFP).

1.2. Project Overview

The project is located between mile posts 6.41 and 6.49 on SR-167 in Pierce County, Washington. It primarily consists of the replacement of the northbound SR 167 Puyallup River Bridge. The current northbound structure was constructed in 1925 and has reached the end of its life span. The current southbound structure was constructed in 1971, and it is to remain in-place. The scope of project is to construct a new northbound bridge that meets current design standards preserving the structural and functional integrity of the roadway. A project plan view is presented as Figure 2 of this report.

2. REGIONAL SETTING

2.1. Regional Geology

Washington's geology is highly diverse. Rocks of Precambrian age, as well as units from every geologic period, Cambrian to Quaternary, are represented. The state has been subject to continental collisions, metamorphism, and intrusion of igneous rocks, volcanism, mountain-building episodes, erosion, and massive flooding events. As a result of these geologic processes, Washington can be divided into nine physiographic regions, as shown in Figure 3. This project is located in the south-central portion of the Puget Lowland. The geologic setting in this area is a result of multiple glaciations that occurred over the last 10,000 to 2,000,000 years.

The end of the Vashon glaciation period was approximately 13,000 years ago. The Puyallup valley is a relict subglacial meltwater channel cut in advance outwash deposits during the glacial recession. Subsequent alluvial deposits partly filled this valley before burial by the Osceola Mudflow. The Osceola Mudflow is believed to be an enormous mudflow (or lahar) comprised of clay-rich gravel, cobbles and boulders that originated from the northeastern flank Mt. Rainier about 5,700 years ago, and spread widely on a plain of Vashon till and outwash deposits. Deltaic, fluvial, and laharic sediments then filled the lower Puyallup valley after the Osceola Mudflow deposition (Dragovich, Pringle, and Walsh, 1994).

The last glaciation is believed to have filled the regional lowland area with ice up to 1 mile thick, resulting in thick deposits of compacted soil overlying bedrock. After the last glaciation, the surface was modified by erosional and depositional processes such as stream incision and deposition. Bedrock is estimated to be between 1,300 and 1,900 feet below ground surface (Jones, 1996).

The geology generally consists of loose alluvial silts and sands overlying dense glacial sands with silts and gravels. Cobbles and boulders could be encountered at some locations. Figure 4 shows the locations of the primary geologic units to be present at or near the ground surface within the boundaries of the project, as mapped by the Washington State Department of Natural Resources.

2.2. Regional Seismicity

The seismicity of western Washington is predominantly influenced by the oblique subduction of the Juan de Fuca Plate under the North American Plate. The convergence between the plates is estimated to be about 4 cm per year. Within this active tectonic environment, three possible sources for seismic events in western Washington have been identified. The first two sources are intraplate and are related to plate deformations and stress concentrations within the two plates as they are deformed by the subduction process. The first source is near surface within the continental crust of the uplifting North American Plate, and the second source is deeper within the subducting Juan de Fuca plate. The third source is in the vicinity of the Pacific coast near the subduction line between the two plates and is related to movement along the subduction interface. This source has recently been referred to as the Cascadia Subduction Zone. These areas and locations of notable earthquakes are depicted in Figure 5.

Shallow crustal seismicity within the North American plate, until recently, was thought to be limited in magnitude, less than 3 on the Richter scale, and unrelated to specific structures within the Puget Sound Lowland and Portland Basin. Recent evidence suggests that some geologic structural control may be present and that these structures may be capable of producing shallow crustal seismic events with magnitudes greater than 6 on the Richter scale. One such structure is the inferred Seattle Fault. Evidence suggests that relatively recent activity has occurred along this fault, approximately 1,100 years ago. One of the most recent earthquakes of record from a shallow crustal source was the Richardson Point earthquake on January 28, 1995. The earthquake was a magnitude of 5 on the Richter scale and ground accelerations of 0.07g were recorded. Minor damage and some liquefaction were evident as the result of ground shaking.

Other notable earthquakes within the region have generally been attributed to the intraplate seismicity within the Juan de Fuca plate. On April 13, 1949, a magnitude 7.0 earthquake occurred, on April 29, 1965, a magnitude 6.5 earthquake occurred, and on February 28, 2001, a magnitude 6.8 earthquake occurred. These three quakes are believed to be from this source. All of the quakes caused damage and liquefaction within the Seattle/Olympia area.

The Cascadia Subduction Zone has not experienced a known earthquake within the last 165 years of seismic record. However, evidence suggests that in 1700 many coastal estuaries experienced rapid subsidence as the result of seismic activity related to this zone. It is generally believed that this source is capable of producing seismic events as large as magnitude 9.

3. FIELD EXPLORATION

The field exploration program for the project consisted of performing a field reconnaissance of the project site, drilling 7 test borings, conducting 3 cone penetrometer tests (CPTs), geophysical in-situ testing, and installing field instrumentation.

3.1. Subsurface Exploration Program

The subsurface exploration consisted of 7 borings drilled to depths of up to about 250 feet below ground surface (bgs), and 3 CPTs pushed to depths up to about 50 feet bgs. Borings were completed in 2011. Piezometers were installed in three of the borings. Plan locations of the borings and piezometers are shown on Figure 2, and are plotted on a site profile as Figure 6. The piezometer monitoring results are separately discussed below.

The current explorations were located by survey from Olympic Region and/or by the Geotechnical Division using hand-held GPS units and surveyed topographic data supplied by the Region. The explorations were continuously monitored, logs of subsurface conditions were maintained, and representative samples were collected. The soils collected were visually classified using procedures as outlined in the Geotechnical Design Manual (GDM). Logs for the borings, CPTs and test pits including a key for their symbols and further description of the field exploration are contained in Appendix A of this report.

3.2 Geophysical Testing

The geophysical testing conducted at the site included borehole suspension logging in boreholes H-3p-11 and H-5p-11. The objectives of the geophysical investigations were to determine the shear wave velocities of the soil in the vicinity of the bridge foundations. The testing was conducted by Global Geophysics located in Monroe, Washington. Further detail of the testing techniques and results are located in Appendix B of this report.

3.3 Field Instrumentation

The instrumentation consisted of piezometers installed in 3 of the borings across the site. Most of the piezometers were read at least quarterly, and many were read monthly. All of the piezometer readings are presented in Appendix A of this report.

3.4. Laboratory Testing

Laboratory testing was performed on selected samples from the field exploration program. The samples are grouped into two categories, disturbed and undisturbed. Disturbed samples are those that were obtained during the Standard Penetration Test (SPT) while undisturbed samples are those samples that were obtained using the WSDOT sampler or Shelby Tubes. Further description of sample collection techniques is included in Appendix C of this report.

All disturbed soil samples were visually examined and then grouped together based on particle size distribution, consistency, and color. Once groups of samples were established that had similar characteristics, a minimum of one sample per group was tested. The testing consisted of performing particle size analyses, determining the liquid limit if applicable, and determining the plastic limit and plasticity index if applicable. The tests were done in accordance with AASHTO T-88, T-89, and T-90 guide specifications respectively. After the testing was complete, the samples were classified using the Unified Soil Classification System (USCS).

4. REFERENCES

Dragovich, Joe D., Patrick T. Pringle, and Timothy J. Walsh. (1994). "Extent and Geometry of the Mid-Holocene Osceola Mudflow in the Puget Lowland - Implications for Holocene Sedimentation and Paleogeography". Washington Geology. Vol. 22, No. 3. September.

Frankel, A.D., et al., 2002, *Documentation for the 2002 Update of the National Seismic Hazard Maps*. Open-file Report 02-420. U.S. Geological Survey, Denver, CO. (http://pubs.usgs.gov/of/2002/ofr-02-420)

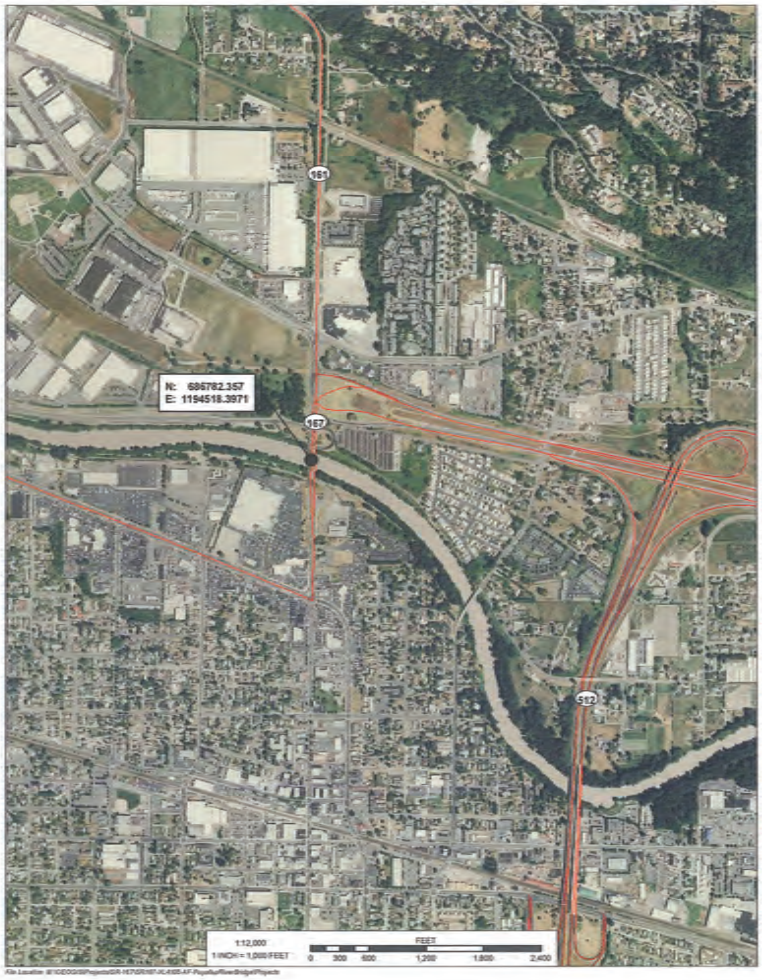
Jones, M.A. (1996). *Thickness of Unconsolidated Deposits in the Puget Lowland, Washington and British Columbia*. Water Resources Investigations Report Number 94-4133, plate 1. U.S. Geological Survey.

Personius, S.F., compiler, 2002, Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/regional/qfaults, accessed 09/03/2009 02:23 PM.

5. CLOSURE

This report presents data assembled for the subject project. If you have questions or require further information, please contact Tony Allen at (360) 709-5450 or Andrew Fiske at (360) 709-5456.

FIGURES



LEGEND

- Site Location
- Milepost Markers
- State Route
- Ramps

N

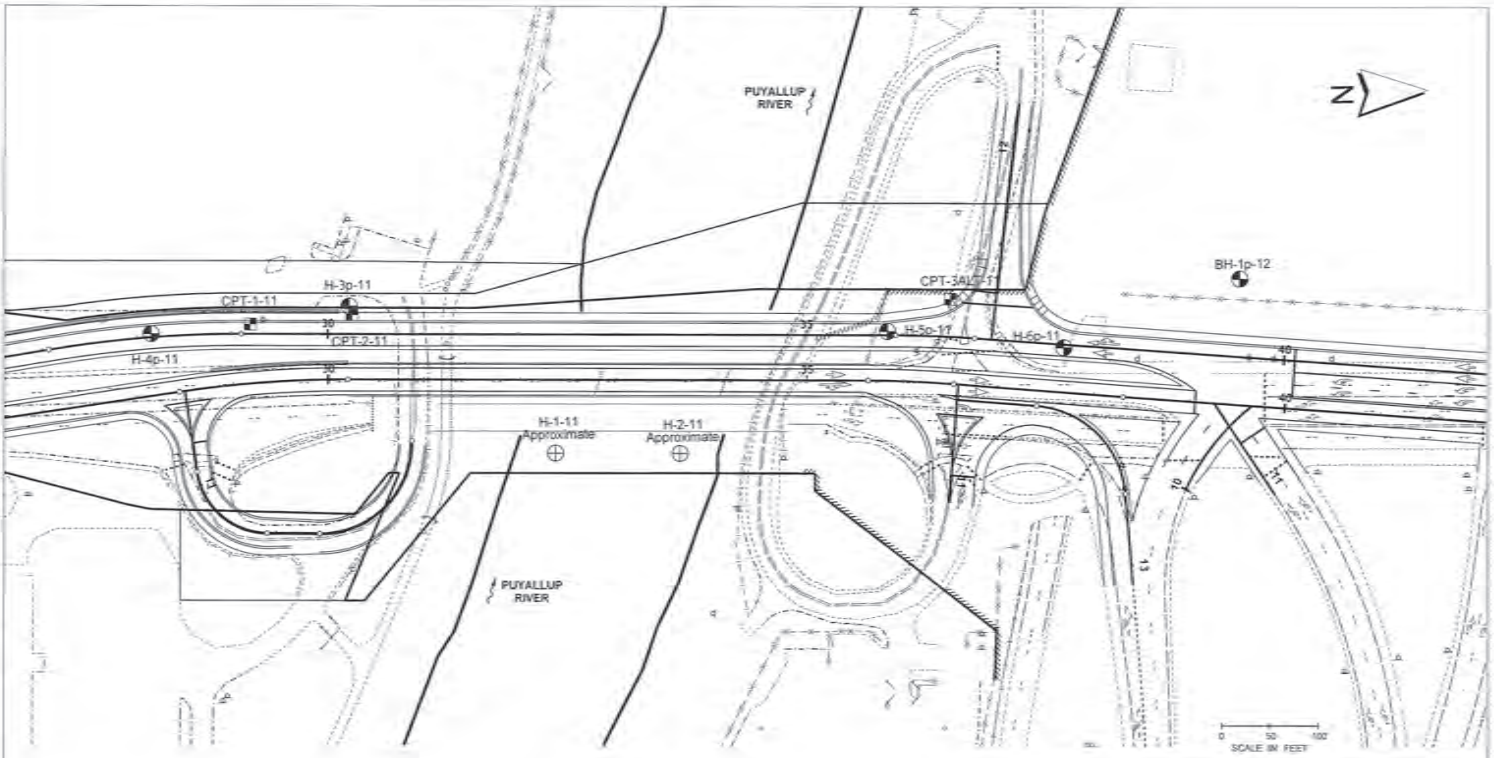
JOB # XL-4105	STATE ROUTE 167	MILEPOST 6.4

FIGURE 1: SITE VICINITY MAP

Puyallup River Bridge
East Bound Replacement

Washington State Department of Transportation
GEOTECHNICAL DIVISION

PREPARED BY Tracy Tisdale DATE June 12, 2012



H-2-11 Approximate Drilled Boring Locations

H-3-11 Surveyed Drilled Boring Locations

CPT-1-11 Surveyed Cone Penetrometer Boring Locations

JOB# XL-4105 STATE ROUTE 0167 MILEPOST(S) 8.41 - 8.49

FIGURE 2:
SITE PLAN

SR 167/PUYALLUP RIVER BRIDGE
BRIDGE REPLACEMENT (NO. 167/20E)

Washington State Department of Transportation
GEOTECHNICAL OFFICE

PREPARED BY William Montgomery DATE June, 2012

File Location: I:\Projects\XL-4105 SR 167\Puyallup River Bridge_Bridge Replacement (No. 167/20E)\XL4105_SHEET BASE 8-23-12.dgn

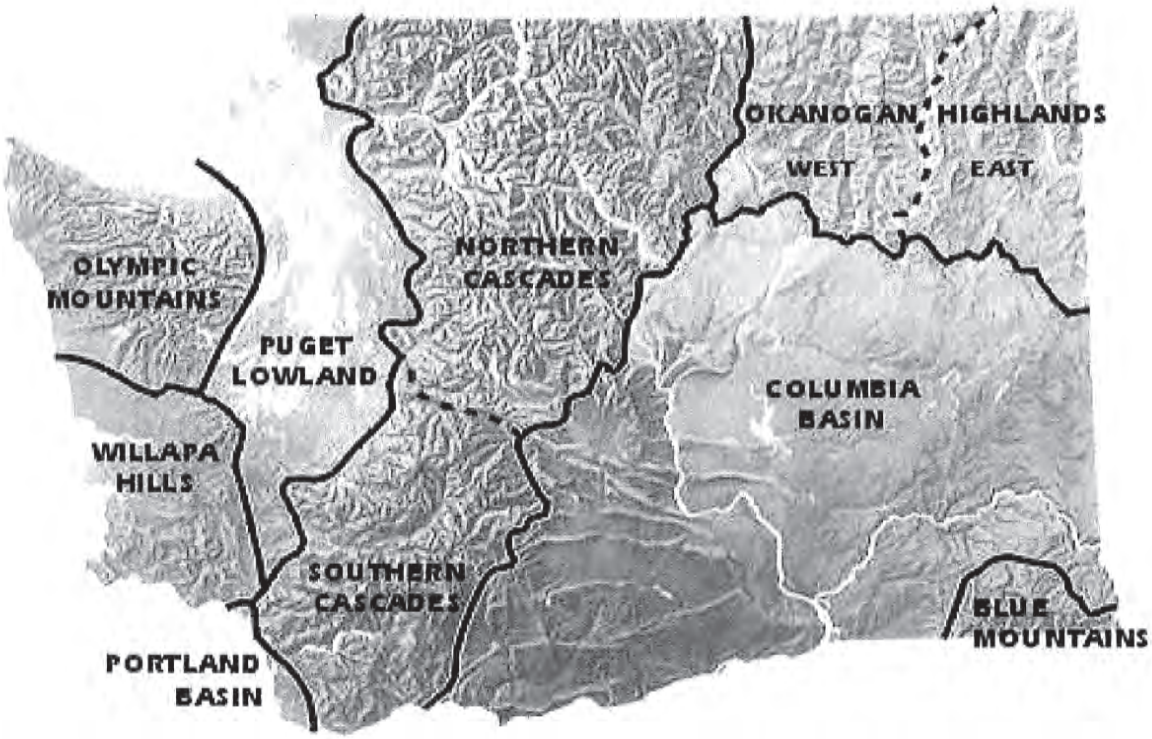


Figure 3: Depicting the Physiographic Regions (Courtesy of the Washington State Dept. of Natural Resources)

LEGEND

- Site Location
- Milepost Markers
- State Route
- Ramps
- Road Network

Geologic Units (100K)

Holocene-Pleistocene

- Qa — alluvium

Pleistocene

- Qgd — continental glacial drift, Fraser-age, mostly Vashon Stade in western WA
- Qgt — continental glacial till, Fraser-age, mostly Vashon Stade in western WA

Other

- wtr — water

N

FEET
0 250 500 1,000 1,500 2,000
1:12,000
1 INCH = 1,000 FEET

JOB # XL-4105 STATE ROUTE 167 MILEPOST(S) 6.4

FIGURE 4: GEOLOGY

Puyallup River Bridge
East Bound Replacement

Washington State Department of Transportation
GEOTECHNICAL DIVISION

PREPARED BY First Last DATE August 30, 2011

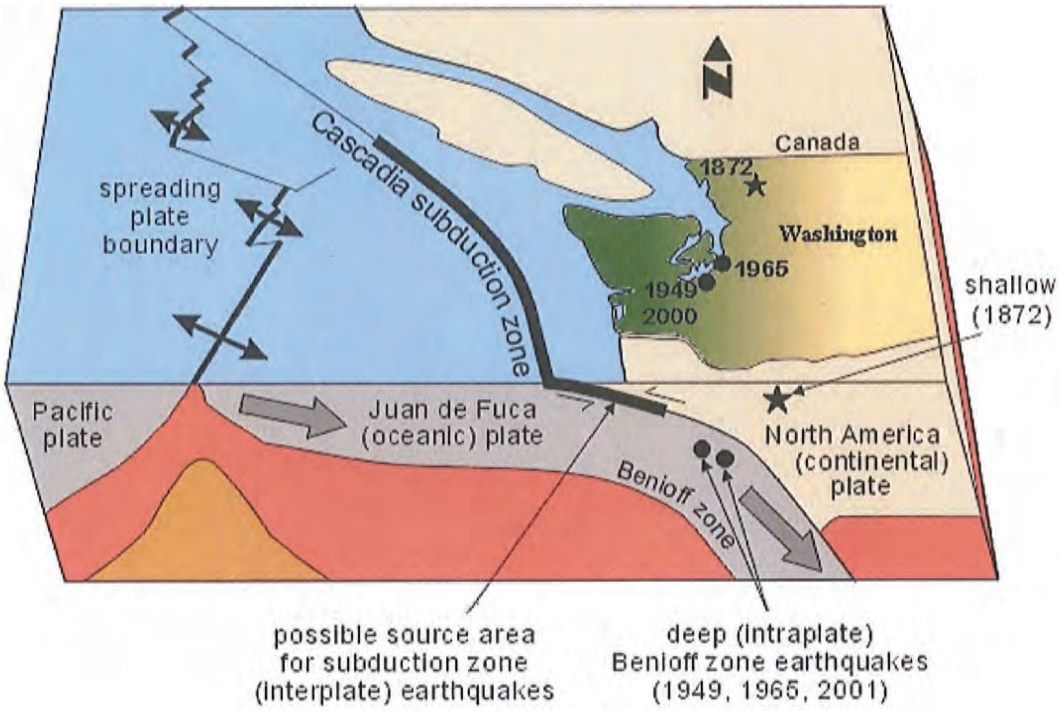
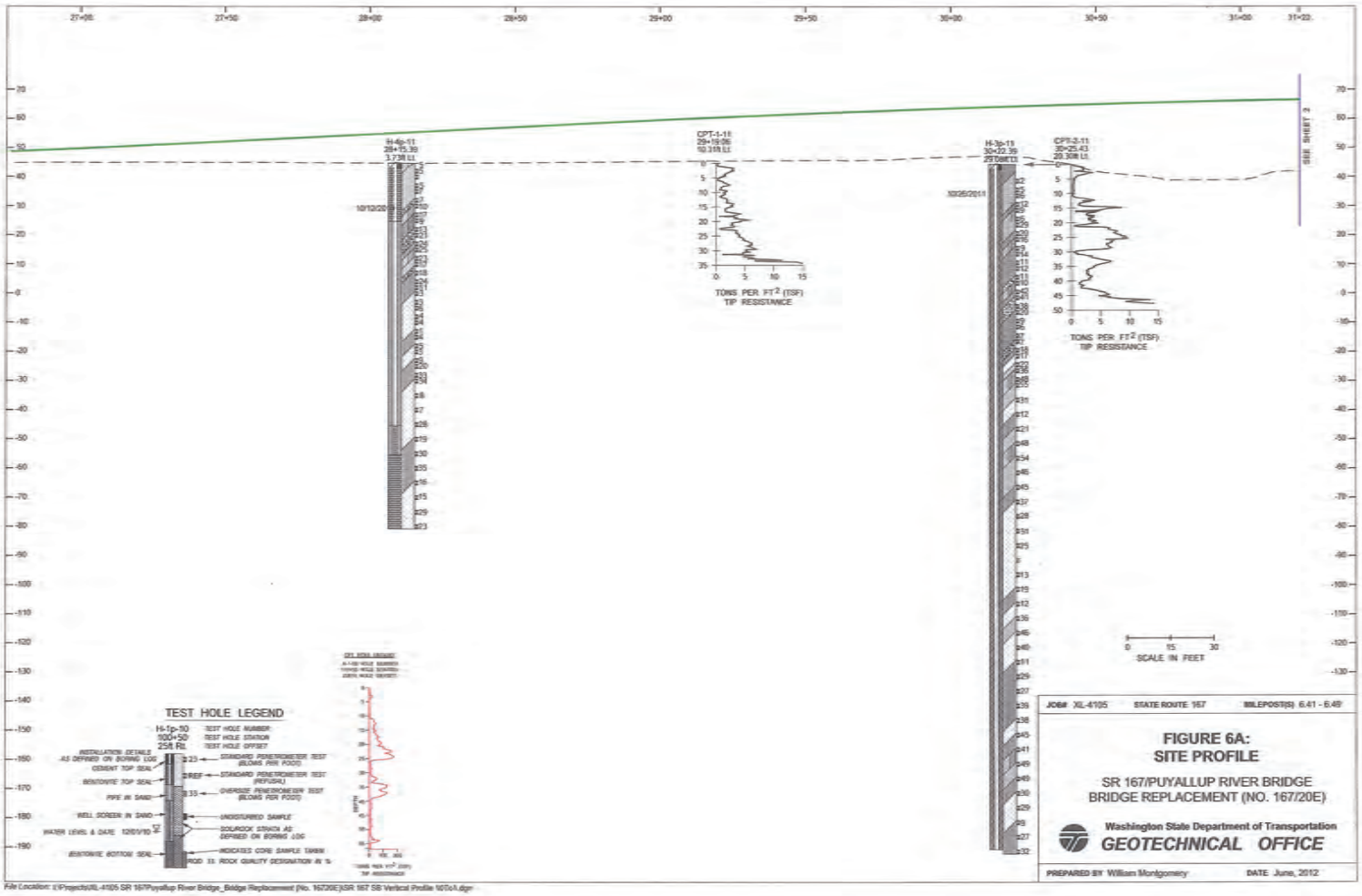


Figure 5: Seismicity of Western Washington (Courtesy of the Washington State Dept. of Natural Resources)



JOB# XL-4105 STATE ROUTE 167 MILEPOST(S) 6.41 - 6.49

FIGURE 6A:
SITE PROFILE

SR 167/PUYALLUP RIVER BRIDGE
BRIDGE REPLACEMENT (NO. 167/20E)

Washington State Department of Transportation
GEOTECHNICAL OFFICE

PREPARED BY William Montgomery DATE June, 2012

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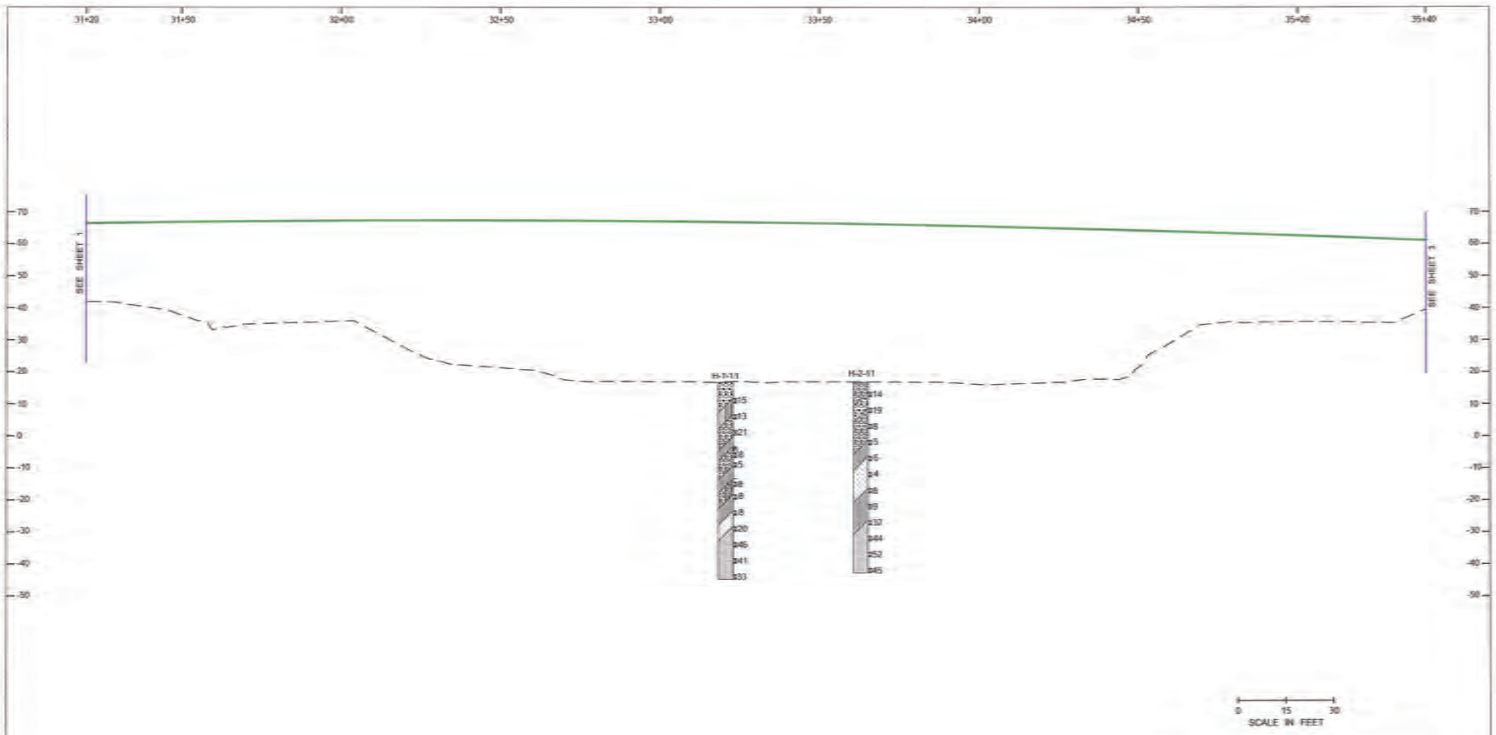
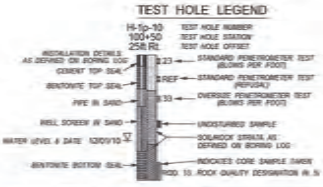


TEST HOLE LEGEND



JOB# XL-4105 STATE ROUTE 167 MILEPOST(S) 6.41 - 6.49

FIGURE 6B:
SITE PROFILE

SR 167/PUYALLUP RIVER BRIDGE
BRIDGE REPLACEMENT (NO. 167/20E)

Washington State Department of Transportation
GEOTECHNICAL OFFICE

PREPARED BY William Montgomery DATE June, 2012

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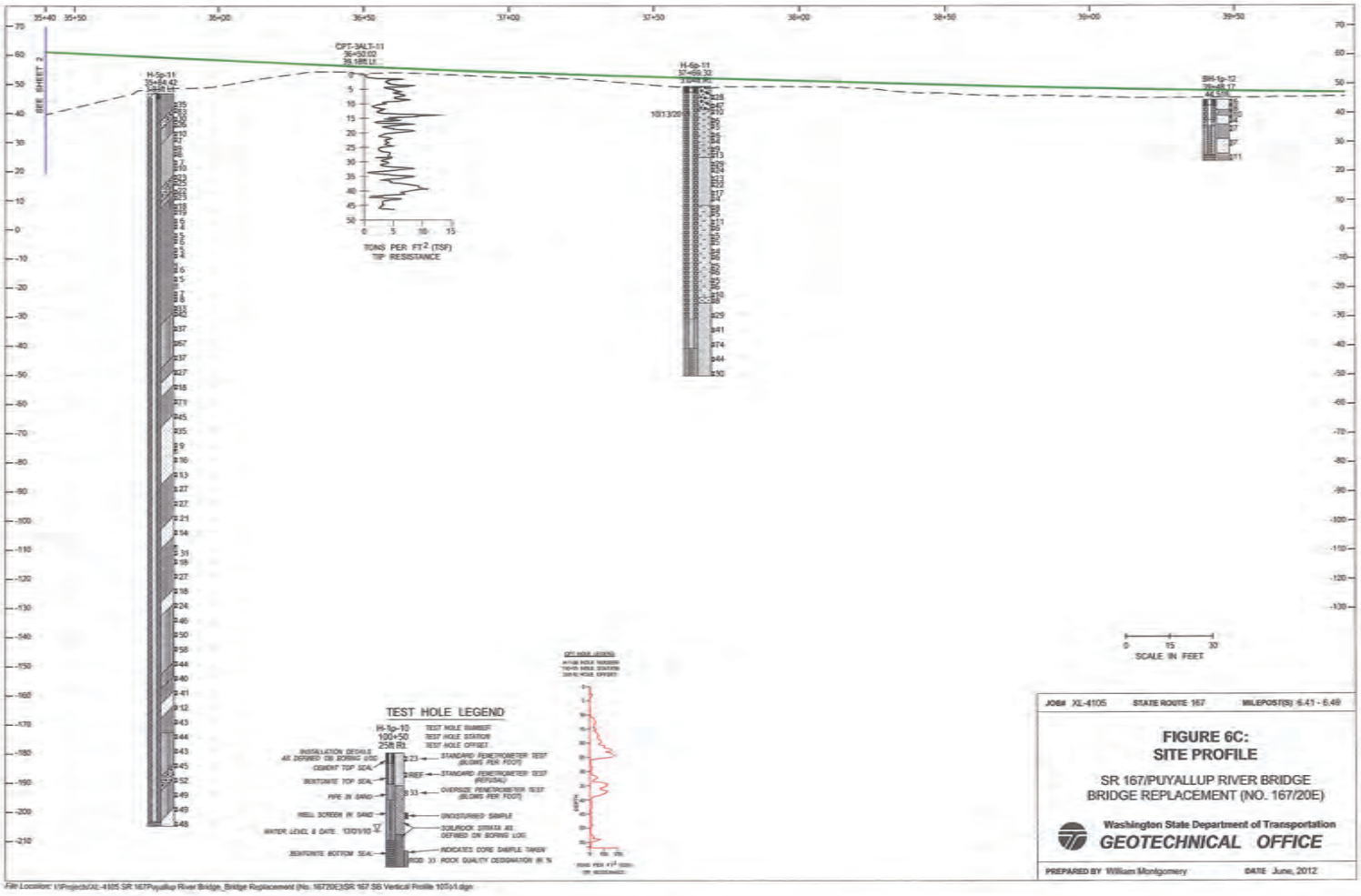

JOB# XL-4105 STATE ROUTE 167 MILEPOST(S) 6.41 - 6.49

FIGURE 6C:
SITE PROFILE

SR 167/PUYALLUP RIVER BRIDGE
BRIDGE REPLACEMENT (NO. 167/20E)

Washington State Department of Transportation
GEOTECHNICAL OFFICE

PREPARED BY William Montgomery DATE June, 2012

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