Lake Oswego to Portland Transit Project

Geology, Soils, and Seismic Hazards
Technical Report

November 2010

TriMet and Metro

Prepared by Dan Meier, CEG, URS

The preparation of this report was financed in part by the U.S. Department of Transportation, Federal Transit Administration. The opinions, findings and conclusions expressed in this report are not necessarily those of the U.S. Department of Transportation, Federal Transit Administration.
# TABLE OF CONTENTS

1. INTRODUCTION .............................................................................................................................. 1  
   1.1 Project Background ...................................................................................................................... 1  
   1.2 Purpose and Need ......................................................................................................................... 1  
   1.3 Alternatives/Options Considered ................................................................................................. 2  
      1.3.1 Alternatives Analysis ............................................................................................................ 2  
      1.3.2 Scoping/Project Refinement Study ....................................................................................... 3  
   1.4 Description of Alternatives Analyzed in this Technical Report and the DEIS ......................... 4  
      1.4.1 No-Build Alternative ............................................................................................................. 4  
         1.4.1.1 Capital Improvements .................................................................................................... 4  
         1.4.1.2 Transit Operations ........................................................................................................ 10  
      1.4.2 Enhanced Bus Alternative ................................................................................................... 10  
         1.4.2.1 Capital Improvements ...................................................................................................... 11  
         1.4.2.2 Transit Operations ........................................................................................................ 12  
      1.4.3 Streetcar Alternative ............................................................................................................ 12  
         1.4.3.1 Capital Improvements .................................................................................................. 12  
         1.4.3.2 Transit Operations ........................................................................................................ 23  
         1.4.3.3 Construction Phasing Options ...................................................................................... 23  
2. Evaluation Methods ......................................................................................................................... 25  
   2.1 Introduction ................................................................................................................................ 25  
   2.2 Related Laws and Regulations ................................................................................................... 25  
   2.3 Contacts, Coordination and Consultation .................................................................................. 25  
   2.4 Data Collection ........................................................................................................................... 25  
   2.5 Affected Environment Profile .................................................................................................... 25  
   2.6 Impact Assessment Analysis Methods ....................................................................................... 26  
   2.7 Mitigation Measures ................................................................................................................... 26  
   2.8 Documentation ........................................................................................................................... 26  
3. Contacts, Coordination and Consultation ........................................................................................ 26  
   3.1 State Agency Coordination ........................................................................................................ 27  
   3.3 Local Agency Coordination ....................................................................................................... 27  
4. Affected Environment ...................................................................................................................... 27  
   4.1 Geologic, Soil and Groundwater Conditions ............................................................................. 27  
   4.2 Geologic Hazards ....................................................................................................................... 30  
5. Environmental Consequences .......................................................................................................... 35  
6. Potential Mitigation Measures ......................................................................................................... 38  
References ............................................................................................................................................ 39  
List of Preparers ................................................................................................................................... 40  

## Appendices

Appendix A: Select Oregon Water Resources Department Geotechnical Hole Reports with Locations

Appendix B: Peak Ground Acceleration and Probabilistic Seismic Hazard Analyses for South Waterfront and Lake Oswego
List of Tables

Table 1-1 Transit Capital Improvements for the No-Build, Enhanced Bus, and Streetcar Alternatives (2035) ...................................................................................................................................................... 6
Table 1-2 Streetcar and Bus Network Operating Characteristics of No-Build, Enhanced Bus, and Streetcar Alternatives (2035) ........................................................................................................................................ 7
Table 5-1 Estimated Cubic Feet of Cut and Fill and Linear Feet of Retaining Wall for the Streetcar Alternative By Segment and Design Option ........................................................................................................ 36

List of Figures

Figure 1-1 No-Build Alternative Transportation Network and Facilities ............................................... 8
Figure 1-2 Enhanced Bus Alternative Transportation Network ........................................................... 13
Figure 1-3 Streetcar Alternative Transportation Network ...................................................................... 14
Figure 1-4 Streetcar Alternative Design Option Locations ................................................................... 18
Figure 1-5 Streetcar and Enhanced Bus Alternatives and Design Options ........................................... 19
Figure 1-6 Streetcar Alternative Design Option Details ....................................................................... 20
Figure 4-1 Geologic Map ...................................................................................................................... 29
Figure 4-2 Relative Earthquake Hazard ............................................................................................. 32
1. INTRODUCTION

This report contains the detailed analysis and documentation that is the basis for the Chapter 3, Section 3.7 on Geology, Soils, and Seismic Hazards in the Lake Oswego to Portland Transit Project (LOPT) Draft Environmental Impact Statement (DEIS) published by the Federal Transit Administration in December 2010. This chapter of the report includes a summary of the project background, the Purpose and Need, the alternatives/options considered and the description of the alternatives analyzed.

1.1 Project Background

Transit improvements in the Lake Oswego to Portland corridor have been studied several times in recent history. In the 1970s and 80s, a light rail alignment through Johns Landing was studied as part of the Westside Corridor Alternatives Analysis, and in the 1990s potential light rail alignments through Johns Landing were studied as part of the South/North Corridor Study.

The Willamette Shore Line right of way was first established in 1885-1887 as the Portland and Willamette Valley Railroad, which began operation in July 1887. The Southern Pacific Railroad (SPRR) later purchased the railway in 1914. The railroad had a major impact on the development of southwest Portland. Initially, 14 trains operated between Portland and Oswego (as it then was known), and it became the main transportation link for developing residential communities along the route. The line was electrified in 1914 and passenger traffic hit its peak in 1920 with SPRR running 64 daily trains between Portland and Oswego. Passenger service ended on October 5, 1929, while freight service continued until 1983.

In August of 1984, the Interstate Commerce Commission granted SPRR permission to abandon the line. In 1988, the Willamette Shore Line Consortium (the Consortium) purchased the 6.3-mile-long line from SPRR for approximately $2 million. The Consortium, comprised of the City of Lake Oswego, City of Portland, Oregon Department of Transportation (ODOT), Clackamas County, Multnomah County, Metro, and TriMet, purchased the line to preserve it for future passenger rail transit use. TriMet holds title for the Consortium and the City of Lake Oswego provides maintenance services funded by the Consortium.

In 2005, with the endorsement of the Joint Policy Advisory Committee on Transportation, the Metro Council directed staff to initiate the Lake Oswego to Portland Transit and Trail Alternatives Analysis. The alternatives analysis focused on improving the ability to serve travel demand in the corridor through improved transit service and development of a multi-use pathway.

1.2 Purpose and Need

The Purpose of the project is to optimize the regional transit system by improving transit within the Lake Oswego to Portland transit corridor, while being fiscally responsive and supporting regional and local land use goals. The project should maximize, to the extent possible, regional resources and economic development opportunities, and garner broad public support. The project should build on previous corridor transit studies, analyses, and conclusions and should be environmentally sensitive.
The **Need** for the project results from:

- Historic and projected increases in traffic congestion in the Lake Oswego to Portland corridor due to increases in regional and corridor population and employment;
- Lengthy and increasing transit travel times and deteriorating public transportation reliability in the corridor due to growing traffic congestion;
- Increasing operating expenses, combined with increasingly scarce operating resources and the demand for more efficient public transportation operations;
- Local and regional land use and development plans, goals, and objectives that target the corridor for residential, commercial, retail, and mixed-use development to help accommodate forecast regional population and employment growth, and previous corridor transit studies, analyses, and conclusions;
- The region’s growing reliance on public transportation to meet future growth in travel demand in the corridor;
- The topographic, geographic, and built-environment constraints within the corridor that limit the ability of the region to expand the highway and arterial infrastructure in the corridor; and
- Limited options for transportation improvements in the corridor caused by the identification and protection of important natural, built, and socioeconomic environmental resources in the corridor.

### 1.3 Alternatives/Options Considered

Metro’s 2004 Regional Transportation Plan (RTP) identified the need for a refinement plan for a high capacity transit option for the corridor, which included an analysis of several modal alternatives. Metro initiated the corridor refinement plan in July 2005 and issued the *Lake Oswego to Portland Transit and Trail Alternatives Analysis Evaluation Summary Public Review Draft* in June 2007.

On December 13, 2007, after reviewing and considering the alternatives analysis report, public comment, and recommendations from the Lake Oswego to Portland Transit and Trail Project Citizen Advisory Committee (CAC), the Lake Oswego to Portland Transit and Trail Project Management Group (PMG), Steering Committee, and partner jurisdictions and agencies, the Metro Council approved Resolution No. 07-3887A. The resolution adopted the *Lake Oswego to Portland Transit and Trail Alternatives Analysis: Alternatives to be Advanced into a Draft Environmental Impact Statement and Work Program Considerations* (December 13, 2007). (See Section 2.1 for additional detail on the process used to identify and narrow alternatives.) It also selected the No-Build, Enhanced Bus, and Streetcar alternatives to advance into the project’s DEIS for further study, and directed staff to conduct a refinement study to identify design options in the Johns Landing Area and terminus options to advance into the project’s DEIS. The resolution called for further refinement of the trail component to move forward as a separate process.

#### 1.3.1 Alternatives Analysis

The project’s alternatives analysis process developed a wide range of alternatives for evaluation and early screening, which included: a no-build alternative, widening of Highway 43, reversible lanes on Highway 43, river transit (three options), bus rapid transit (BRT) (three options), commuter rail, light rail, and streetcar (a wide range of alignment alternatives and terminus alternatives and options).

Through a screening process that assessed the ability of the alternatives to meet the project’s Purpose and Need, the initial range of possible alternatives was narrowed. Appendix C of the DEIS provides a
summary of the technical evaluation of the alternatives and options considered during the alternatives analysis phase.

The following alternatives were selected for further study through the alternatives analysis phase: 1) No-Build Alternative, 2) Bus Rapid Transit Alternative, and 3) Streetcar Alternative. Following is a description of those alternatives as they were studied in the alternatives analysis (see the Lake Oswego to Portland Transit and Trail Study Evaluation Summary Public Review Draft for more information).

- **No-Build Alternative.** Similar to the project’s current No-Build Alternative, described in Section 1.4.1.

- **Bus Rapid Transit Alternative.** The Bus Rapid Transit Alternative would operate frequent bus service with Line 35 on Highway 43 between downtown Portland and downtown Lake Oswego, generally in mixed traffic, with bus station spacing that would be longer than TriMet typically provides for fixed-route bus service. Transit queue bypass lanes would be constructed at congested intersections, where feasible.

- **Streetcar Alternative.** The Streetcar Alternative would extend the existing Portland Streetcar line, which currently operates between NW 23\textsuperscript{rd} Avenue and SW Lowell Street, to downtown Lake Oswego. Study of this alternative includes an evaluation of whether the Willamette Shore Line right of way would be used exclusively of whether it would be used in combination with SW Macadam Avenue or other adjacent roadways.

### 1.3.2 Scoping/Project Refinement Study

This section describes the alignment and terminus options developed, evaluated, and screened in 2009 as a part of the project’s scoping and refinement study phase. In November 2010, Metro published the Lake Oswego to Portland Transit Project Refinement Report, which detailed the study’s results and summarized public comment. This phase focused on refinements in two areas: 1) alignment options for the Johns Landing area; and 2) terminus options in the Lake Oswego area. In summary, the project’s Purpose Statement during the refinement phase was to:

- Optimize the regional transit system;
- Be fiscally responsive and maximize regional resources;
- Maximize the economic development potential of the project;
- Be sensitive to the built and social environments; and
- Be sensitive to the natural environment.

The options, evaluation measures, and results of the Johns Landing streetcar alignment refinement process and the Lake Oswego terminus refinement processes are summarized below.

#### A. Johns Landing Streetcar Alignment Refinement

For the refinement of streetcar design options within the Johns Landing area, the project used the following criteria: streetcar operations, streetcar performance, financial feasibility, traffic operations, accessibility and development potential, neighborhood sustainability, and adverse impacts to the natural environment. Measures for each of the criteria were developed and applied to each of the alignment options studied, which included:
• Hybrid 1: Macadam Avenue In-Street
• Hybrid 2: East Side Exclusive
• Hybrid 3: Macadam Avenue with New Northbound Lane
• Willamette Shore Line
• Full Macadam In-Street

B. Lake Oswego Terminus Option Refinement. For the refinement of terminus options in the Lake Oswego area, the project used the following criteria: expansion potential and regional context, streetcar operations, streetcar performance, financial feasibility, traffic operations, accessibility and development potential, and neighborhood sustainability. Measures for each of the criteria were developed and applied to each of the alignment options studied, which included: a) Safeway Terminus Option; b) Albertsons Terminus Option; and c) Trolley Terminus Option.

On June 1, 2009, in consultation with FTA and based on the findings of the analysis, public and agency comment and recommendations from the Lake Oswego to Portland Transit Project Management Group, the Lake Oswego to Portland Transit Project Steering Committee selected the following options in the Johns Landing area to advance into the DEIS: Willamette Shore Line; Hybrid 1 – Macadam Avenue In Street (Boundary Street to Carolina Street); and Hybrid 3: Macadam Avenue with New Northbound Lane (Boundary Street to Carolina Street).

1.4 Description of Alternatives Analyzed in this Technical Report and the DEIS

This section summarizes the roadway and transit capital improvements and transit operating characteristics for the No-Build, Enhanced Bus, and Streetcar alternatives. Table 1-1 provides a summary of the transit capital improvements associated with the three alternatives, and Table 1-2 summarizes the operating characteristics of the alternatives. A more detailed description of the alternatives may be found in the Lake Oswego to Portland Transit Project Detailed Definition of Alternatives Report (Metro/TriMet: January 2010). Detailed drawings of the Streetcar Alternative, including the various design options, can be found in the Streetcar Plan Set, November 2009.

1.4.1 No-Build Alternative

This section describes the No-Build Alternative, which serves as a reference point to gauge the benefits, costs, and effects of the Enhanced Bus and Streetcar alternatives. In describing the No-Build Alternative, this section focuses on: 1) the alternative’s roadway, bicycle and pedestrian, and transit capital improvements; and 2) the alternative’s transit operating characteristics. This description of the No-Build Alternative is based on conditions in 2035, the project’s environmental forecast year.

1.4.1.1 Capital Improvements

Following is a brief description of the roadway, bicycle and pedestrian, and transit capital improvements that would occur under the No-Build Alternative (see Table 1-1). Figure 1-1 illustrates the location of those improvements.
• **Roadway Capital Improvements.** The No-Build Alternative includes the existing roadway network in the corridor, with the addition of roadway capital improvements that are listed in the financially constrained road network of Metro’s 2035 RTP. Following is a list of the roadway projects that would occur within the corridor by 2035.

  o *Moody/Bond Avenue Couplet* (create couplet with two lanes northbound on SW Bond Avenue and two lanes southbound on SW Moody Avenue);
  o *South Portal* (Phases I and II to extend the SW Moody Avenue/SW Bond Avenue couplet to SW Hamilton Street and realign SW Hood Avenue to connect with SW Macadam Avenue at SW Hamilton Street);
  o *I-5 North Macadam* (construct improvements in the South Waterfront District to improve safety and access); and
  o *Macadam Intelligent Transportation Systems* (install system and devices in the SW Macadam Avenue corridor to improve traffic flow).

---

Table 1-1 Transit Capital Improvements for the
No-Build, Enhanced Bus, and Streetcar Alternatives (2035)

<table>
<thead>
<tr>
<th>Capital Improvements</th>
<th>No-Build</th>
<th>Enhanced Bus</th>
<th>Streetcar¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Streetcar Alignment Length²</td>
<td>N/A</td>
<td>N/A</td>
<td>5.9 to 6.0</td>
</tr>
<tr>
<td>One-Way Streetcar Track Miles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland Streetcar System</td>
<td>15.7</td>
<td>15.7</td>
<td>26.2 to 27.0</td>
</tr>
<tr>
<td>Proposed Lake Oswego to Portland Project</td>
<td>0</td>
<td>0</td>
<td>10.5 to 11.3</td>
</tr>
<tr>
<td>Streetcar Stations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland Streetcar System</td>
<td>69</td>
<td>69</td>
<td>79</td>
</tr>
<tr>
<td>Proposed Lake Oswego to Portland Project</td>
<td>0</td>
<td>0</td>
<td>10³</td>
</tr>
<tr>
<td>Streetcars (in service/spares/total)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland Streetcar System</td>
<td>17/5/22</td>
<td>17/5/22</td>
<td>27/6/33</td>
</tr>
<tr>
<td>Proposed Lake Oswego to Portland Project</td>
<td>N/A</td>
<td>N/A</td>
<td>10/1/11</td>
</tr>
<tr>
<td>Streetcar Operations and Maintenance (O&amp;M) Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Facilities</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Maintenance Capacity (number of Streetcars)</td>
<td>36</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Storage Capacity (number of Streetcars)</td>
<td>25</td>
<td>25</td>
<td>33</td>
</tr>
<tr>
<td>Line 35 Bus Stops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line 35 Bus Stops (Lake Oswego to SW Bancroft St.)</td>
<td>26</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Buses (in service/spares)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TriMet Systemwide</td>
<td>607/712</td>
<td>619/725</td>
<td>601/704</td>
</tr>
<tr>
<td>Difference from No-Build Alternative</td>
<td>N/A</td>
<td>13</td>
<td>- 8</td>
</tr>
<tr>
<td>Transit Centers</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Park-and-Ride Facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joint Use Surface – Lots/Spaces</td>
<td>3/76</td>
<td>3/76</td>
<td>3/76</td>
</tr>
<tr>
<td>Surface – Lots/Spaces</td>
<td>0/0</td>
<td>0/0</td>
<td>1/100</td>
</tr>
<tr>
<td>Structured – Lots/Spaces</td>
<td>0/0</td>
<td>1/300</td>
<td>1/300</td>
</tr>
</tbody>
</table>

Note: LO = Lake Oswego; O&M = operating and maintenance.

¹ The transit capital improvements of the Streetcar Alternative summarized in this table would not vary by design option, except when shown as a range and as noted for new streetcar alignment length and one-way track miles. The first number listed is under the Willamette Shore Line design option and the second number listed is under the Macadam design options (in the Johns Landing Segment).

² Under the No-Build and Enhanced Bus alternatives, the Portland Streetcar System would include two streetcar lines: a) the existing Portland Streetcar Line, between NW 23rd Avenue and SW Bancroft Street, and b) the Portland Streetcar Loop, which is currently under construction and will be completed when the Milwaukie Light Rail and Streetcar Close the Loop project are constructed. The Streetcar Alternative would extend the existing Portland Streetcar line south, from SW Bancroft Street to Lake Oswego. One-way track miles are calculated by multiplying the mileage of double-tracked sections and adding that to the mileage of single-track sections. Alignment length and one-way track miles are presented as a range, because they would vary by design option. The number of streetcar stations, streetcars in service or as spares and the number and size of streetcar O&M facilities would not change by streetcar design option.

³ Two optional stations are also being considered for inclusion in the Streetcar Alternative (see Figure 1-5 and Figure 1-6): 1) the Pendleton Station under the Macadam In-Street and Macadam Additional Lane design options in the Johns Landing Segment; and the E Avenue Station in the Lake Oswego Segment.

⁴ There is an existing streetcar operations and maintenance (O&M) facility at NW 16th Avenue, between NW Marshall and NW Northrup streets; under the Streetcar Alternative, additional storage for eight vehicles would be provided along the streetcar alignment under the Marquam Bridge. There would be no change in the number or size of bus O&M facilities under any of the alternatives or design options. Bus stops are those that would be served exclusively by Line 35 between Lake Oswego and SW Bancroft Street.

⁵ Under the No-Build and Enhanced Bus alternative, the Lake Oswego Transit Center would remain at its current location (on 4th Street, between A and B avenues); under the Streetcar Alternative, the transit center would be moved to be adjacent to the Lake Oswego Terminus Station.

Source: TriMet, January 2010.
### Table 1-2 Streetcar and Bus Network Operating Characteristics of No-Build, Enhanced Bus, and Streetcar Alternatives (2035)

<table>
<thead>
<tr>
<th>Operating Characteristics by Vehicle Mode</th>
<th>No-Build</th>
<th>Enhanced Bus</th>
<th>Streetcar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Streetcar Network Operating Characteristics</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekday Streetcar Vehicle Miles Traveled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systemwide</td>
<td>2,180</td>
<td>2,180</td>
<td>3,200 or 3,230</td>
</tr>
<tr>
<td>Difference from No-Build Alternative</td>
<td>N/A</td>
<td>0</td>
<td>1,020 or 1,050</td>
</tr>
<tr>
<td>Weekday Streetcar Revenue Hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systemwide</td>
<td>267</td>
<td>267</td>
<td>326 or 332</td>
</tr>
<tr>
<td>Difference from No-Build Alternative</td>
<td>N/A</td>
<td>0</td>
<td>59 or 65</td>
</tr>
<tr>
<td>Corridor Weekday Streetcar Place Miles&lt;sup&gt;2&lt;/sup&gt;</td>
<td>N/A</td>
<td>N/A</td>
<td>89,000 or 91,320</td>
</tr>
<tr>
<td>Corridor Streetcar Round-Trip Time&lt;sup&gt;3&lt;/sup&gt;</td>
<td>N/A</td>
<td>N/A</td>
<td>37 or 44 minutes</td>
</tr>
<tr>
<td>Corridor Streetcar Headways&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Lake Oswego to PSU</td>
<td>N/A</td>
<td>7.5 / 7.5 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bus Network Operating Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekday Bus Miles Traveled</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systemwide</td>
<td>76,560</td>
<td>77,560</td>
<td>75,520</td>
</tr>
<tr>
<td>Difference from No-Build Alternative</td>
<td>N/A</td>
<td>1,000</td>
<td>-1,040</td>
</tr>
<tr>
<td>Weekday Bus Revenue Hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systemwide</td>
<td>5,300</td>
<td>5,400</td>
<td>5,210</td>
</tr>
<tr>
<td>Difference from No-Build Alternative</td>
<td>N/A</td>
<td>100</td>
<td>-90</td>
</tr>
<tr>
<td>Line 35 (bus) Weekday Place Miles&lt;sup&gt;2&lt;/sup&gt;</td>
<td>37,000</td>
<td>57,840</td>
<td>0</td>
</tr>
<tr>
<td>Line 35 (bus) Headways&lt;sup&gt;4&lt;/sup&gt;</td>
<td>Lake Oswego to Downtown Portland</td>
<td>15 / 15 min.</td>
<td>6 / 15 min.</td>
</tr>
<tr>
<td></td>
<td>Oregon City to Lake Oswego</td>
<td>15/15 min.</td>
<td>15/15 min.</td>
</tr>
</tbody>
</table>

Note: N/A = not applicable; LO = Lake Oswego; O&M = operating and maintenance; PSU = Portland State University.

<sup>1</sup> The operating characteristics of the Streetcar Alternative summarized in this table would not vary by design option, except when shown as a range and as noted for streetcar vehicle miles traveled, place miles, and round-trip time. The first number listed is under the Willamette Shore Line Design Option and the second number listed is under the Macadam design options (in the Johns Landing Segment).

<sup>2</sup> Place miles are a measure of the passenger carrying capacities of the alternatives, similar to airline seat miles. Place miles = transit vehicle capacity (seated and standing) of a vehicle type, multiplied by the number vehicle miles traveled for that vehicle type, summed across all vehicle types. The No-Build Alternative bus place miles are based on lines 35 and 36.

<sup>3</sup> Round-trip run time for the proposed streetcar line would include in-vehicle running time from SW Bancroft Street to the Lake Oswego Terminus Station and back to SW Bancroft Street; it does not include layover time at the terminus.

<sup>4</sup> Headways are the average time between transit vehicles per hour within the given time period that would pass by a given point in the same direction, which is inversely related to frequency (the average number of vehicles per hour in the given time period that would pass by a given point in the same direction). Weekday peak is generally defined as 7:00 to 9:00 a.m. and 4:00 to 6:00 p.m.; weekday off-peak is generally defined as 5:00 to 7:00 a.m., 9:00 a.m. to 4:00 p.m. and 6:00 p.m. to 1:00 a.m. There would be streetcar service every 12 minutes between SW Bancroft Street and the Pearl District (via PSU) under the No-Build and Enhanced Bus alternatives. The peak headways shown for the No-Build Alternative are the composite headways for Lines 35 and 36.

FIGURE 1-1 NO-BUILD ALTERNATIVE TRANSPORTATION NETWORK AND FACILITIES
Bicycle and Pedestrian Improvements. The No-Build Alternative includes the existing bicycle and pedestrian network in the corridor, with the addition of bicycle and pedestrian capital improvements that are listed in the financially constrained road network of Metro’s 2035 RTP. Following is a list of the bicycle and pedestrian projects that are proposed to occur within the corridor by 2035.

- **Lake Oswego to Portland Trail** (extension of a multiuse path between Lake Oswego and Portland);
- **I-5 at Gibbs Pedestrian/Bicycle Overcrossing** (construct a bicycle and pedestrian bridge over I-5 in the vicinity of SW Gibbs Street); and
- **Tryon Creek Bridge** (construct a new pedestrian/bicycle bridge near the mouth of Tryon Creek).

Bus Capital Improvements. There are currently two primary bus capital facilities in the corridor: **Lake Oswego Transit Center** (on 4th Street, between A and B avenues); and **Portland Mall** (bus and light rail lanes and shelters on NW/SW 5th and 6th avenues between NW Glisan Street and SW Jackson Street). These bus facilities would remain as-is under the No-Build Alternative. (The financially constrained transit project list of the RTP includes relocation of the Lake Oswego Transit Center to be adjacent to the Lake Oswego to Portland Streetcar alignment, which is also in the financially constrained project list. Neither would occur under the No-Build Alternative.) No additional bus capital improvements are planned for the corridor under the No-Build Alternative by 2035.

Light Rail Capital Improvements. Under the No-Build Alternative, TriMet’s existing Yellow Line light rail service would continue to operate on the Portland Mall (with a station at PSU added), across the Steel Bridge and into North Portland. Yellow Line facilities and service would be extended north from the existing Expo Center Station, across the Columbia River into Vancouver, Washington, and south from the Portland Mall, generally via SW Lincoln Street, across the Willamette River to Milwaukie, Oregon. In addition, downtown Portland would be served by the following TriMet light rail lines: Blue Line (Gresham to Hillsboro); Red Line (Beaverton to Portland International Airport); and Green Line (downtown Portland to Clackamas Town Center).

Excursion Trolley Capital Facilities. Under the No-Build Alternative there would be no changes to the existing excursion trolley capital facilities that are located or operate within the corridor. Those excursion trolley capital facilities include approximately six miles of single-tracked Willamette Shore Line tracks and related facilities; stations at SW Bancroft and Moody streets and at N State Street at A Avenue; a trolley barn at approximately N State Street at A Avenue; and typically one vintage and/or other trolley vehicle propelled by externally attached diesel units.

Streetcar Improvements and Vehicles. Under the No-Build Alternative, the existing Portland Streetcar Line would continue to operate between NW 23rd Avenue and SW Lowell Street. In addition, the No-Build Alternative includes the Eastside Streetcar Project (currently under construction), which would extend streetcar tracks and stations across the Broadway Bridge, serving NE and SE Portland on N and NE Broadway and NE and SE Martin Luther King Boulevard and Grand Avenue to OMSI. With the Close the Loop Project, the Eastside Streetcar will be extended across the Willamette River, to complete the planned Streetcar Loop, via a new transit, bicycle, and pedestrian bridge to be constructed under the Milwaukie Light Rail Project, connecting to the Streetcar line in the South Waterfront District. Under the No-Build Alternative
in 2035, there would be 22 streetcars in the transit system (including spares), an increase of 11 compared to existing conditions.

- **Park-and-Ride Facilities.** Under the No-Build Alternative, the park-and-ride facilities in the corridor would be those that currently exist: a shared-use 30-space park-and-ride lot at Christ Church (1060 SW Chandler Road); a shared-use 34-space park-and-ride lot at Lake Oswego United Methodist Church (1855 South Shore Boulevard); and a shared use 12-space park-and-ride lot at Hope Church (14790 SW Boones Ferry Road).

- **Operations and Maintenance Facilities.** Under the No-Build Alternative, there would be one operations and maintenance facility within the corridor, which would be the existing streetcar maintenance building and storage yard on NW 16th Avenue under I-405. With the Streetcar Loop and Close the Loop Projects, the storage yard could accommodate 25 streetcars and the maintenance facility would have the capacity to service 36 streetcars (an increase in capacity of 13 and 18 vehicles, compared to existing conditions, respectively).

### 1.4.1.2 Transit Operations

This section summarizes the transit operating characteristics that would occur under the No-Build Alternative, focusing on bus and streetcar operations (see Table 1-2). Figure 1-1 illustrates the transit network for the No-Build Alternative in the vicinity of the corridor.

- **Bus Operations.** Bus operations under the No-Build Alternative would be similar to TriMet’s existing fixed-route bus network with the addition of improvements included in the 2035 RTP’s 20-year financially constrained transportation system (see Figure 1-1). Transit service improvements within the No-Build Alternative would be limited to those that could be funded using existing and readily-foreseeable revenue sources. Systemwide, those bus operations improvements would include: 1) increases in TriMet bus route frequency to avoid peak overloads and/or maintain schedule reliability; 2) increases in run times to maintain schedule reliability; and 3) incremental increases in TriMet systemwide bus service hours consistent with available revenue sources and consistent with the 2035 RTP’s 20-year financially-constrained transit network, resulting in annual increases in service hours of approximately 0.5 percent per year. Specifically, the No-Build Alternative would include the operation of the TriMet bus route Line 35 between downtown Portland and Lake Oswego (continuing south to Oregon City).

- **Streetcar Operating Characteristics.** Under the No-Build Alternative, the City of Portland, through an operating agreement with the Portland Streetcar, Inc. (PSI), would continue to operate the existing Portland Streetcar line between Northwest Portland and the South Waterfront District, via downtown Portland (see Figure 1-1). On average weekdays in 2035, the Streetcar line would operate every 12 minutes during the peak and off-peak periods. Further, the City of Portland would operate the Streetcar Loop Project, serving downtown Portland, the Pearl District, northeast and southeast Portland, OMSI and the South Waterfront District. Frequency on the line for an average weekday in 2035 would be every 12 minutes during the peak and off-peak periods.

### 1.4.2 Enhanced Bus Alternative

This section describes the roadway, bicycle and pedestrian, and transit capital improvements and transit operating characteristics under the Enhanced Bus Alternative, generally compared to the No-
Build Alternative. The intent of the Enhanced Bus Alternative is to address the project’s Purpose and Need without a major transit capital investment.

1.4.2.1 Capital Improvements

This section summarizes the transit, bicycle and pedestrian, and transit capital improvements that would occur under the Enhanced Bus Alternative, compared to the No-Build Alternative (see Table 1-1 and Figure 1-2).

- **Roadway Capital Improvements.** Except for the addition of a two-way roadway connection between the proposed 300-space park-and-ride lot and Foothills Road, there would be no change in roadway improvements under the Enhanced Bus Alternative, compared to the No-Build Alternative.

- **Bicycle and Pedestrian Improvements.** There would be no change in bicycle and pedestrian improvements under the Enhanced Bus Alternative, compared to the No-Build Alternative.

- **Bus Capital Improvements.** Under the Enhanced Bus Alternative, the 26 bus stops that would be served by Line 35 between downtown Lake Oswego and SW Bancroft under the No-Build Alternative would be consolidated into 13 bus stops, which would continue to be served by the Line 35 (the other 13 bus stops would be removed). The bus stops served by Line 35 between Lake Oswego and Oregon City would be unchanged under the Enhanced Bus Alternative, compared to the No-Build Alternative.

- **Light Rail Capital Improvements.** There would be no change in light rail capital improvements under the Enhanced Bus Alternative, compared to the No-Build Alternative.

- **Excursion Trolley Capital Improvements.** There would be no change in excursion trolley capital improvements under the Enhanced Bus Alternative, compared to the No-Build Alternative.

- **Streetcar Improvements and Vehicles.** There would be no change in streetcar improvements and vehicles under the Enhanced Bus Alternative, compared to the No-Build Alternative.

- **Park-and-Ride Facilities.** In addition to the park-and-ride facilities included under the No-Build Alternative, the Enhanced Bus Alternative would include a 300-space structured park-and-ride lot that would be located at Oswego Village Shopping Center on Highway 43 in downtown Lake Oswego. The park-and-ride lot would be served by Lines 35 and 36.

- **Operations and Maintenance Facilities.** There would be no changes to the region’s operations and maintenance facilities under the Enhanced Bus Alternative, compared to the No-Build Alternative, except that the capacity of TriMet’s bus operating and maintenance facilities at either the Center or Powell facility would be expanded to accommodate the additional 13 buses under the Enhanced Bus Alternative (see the *Detailed Definition of Alternatives Report* for additional information).
1.4.2.2 Transit Operations

This section summarizes the corridor’s transit operations under the Enhanced Bus Alternative, focusing on bus and streetcar operations. Figure 1-2 illustrates the transit network for the Enhanced Bus Alternative in the vicinity of the corridor.

- **Bus Operations.** Except for changes to the routing, frequency, and number of stops of Line 35 and the elimination of Line 36 service between downtown Portland and downtown Lake Oswego, bus operations under the Enhanced Bus Alternative would be identical to the bus operations under the No-Build Alternative. Under the Enhanced Bus Alternative, Line 35’s routing between Oregon City and Lake Oswego would remain unchanged relative to the No-Build Alternative. Further, between Lake Oswego and downtown Portland there would be two routing changes to Line 35, compared to the No-Build Alternative: 1) the bus would be rerouted to serve the new park-and-ride lot at the Oswego Village Shopping Center; and, 2) in downtown Portland, Line 35 would be rerouted to serve SW and NW 10th and 11th avenues, generally between SW Market and Clay streets and NW Lovejoy Street/Union Station to address the travel markets.

- **Streetcar Operating Characteristics.** Under the Enhanced Bus Alternative, there would be no change in streetcar operating characteristics, compared to the No-Build Alternative.

1.4.3 Streetcar Alternative

This section describes the roadway, bicycle and pedestrian, and transit capital improvements and transit operating characteristics under the Streetcar Alternative, generally compared to the No-Build Alternative.

1.4.3.1 Capital Improvements

This section summarizes the transit, bicycle and pedestrian, and transit capital improvements that would occur under the Streetcar Alternative, generally compared to the No-Build Alternative (see Table 1-1 and Figure 1-3). This section provides a general description of the capital improvements that would occur under the Streetcar Alternative, independent of design option, and it highlights the differences between design options within three of the corridor’s segments.
FIGURE 1-2 ENHANCED BUS ALTERNATIVE TRANSPORTATION NETWORK
Figure 1-3 STREETCAR ALTERNATIVE TRANSPORTATION NETWORK

FIGURE 1-3 STREETCAR ALTERNATIVE TRANSPORTATION NETWORK
A. Summary Description

Following is a general description of the roadway, bicycle and pedestrian, and transit improvements that would occur under the Streetcar Alternative. The next section provides a description of differences in capital improvements for design options that are under consideration in three of the project’s six segments. See Figure 1-4 for an illustration of the project segments and the design options under consideration.

- **Roadway Capital Improvements.** There would be no roadway improvements under the Streetcar Alternative in the following corridor segments: 1) Downtown Portland; and 2) South Waterfront. The roadway capital improvements that would occur under the other corridor segments are described below for those segments. Changes to traffic controls at signalized and non-signalized intersections would occur throughout the corridor to accommodate the safe and efficient operation of the streetcar and local traffic. The *Detailed Definition of Alternatives Report* and the *Streetcar Plan Set* provide additional details on changes to traffic operations at intersections under the Streetcar Alternative.

- **Bicycle and Pedestrian Improvements.** There would be no change in bicycle and pedestrian improvements under the Streetcar Alternative, compared to the No-Build Alternative, except as noted in the following segment-by-segment description.

  **Bus Capital Improvements.** Under the Streetcar Alternative, all 26 bus stops that would be served by Line 35 on Highway 43 between downtown Lake Oswego and the Sellwood Bridge and on SW Macadam Boulevard north of SW Corbett Street under the No-Build Alternative would be removed, because Line 35 service would be replaced in the corridor by streetcar service. The bus stops served by Line 35 between Lake Oswego and Oregon City would be unchanged under the Streetcar Alternative, compared to the No-Build Alternative. In addition, under the Streetcar Alternative, the Lake Oswego Transit Center would be relocated to be adjacent to the Lake Oswego Terminus Station, from its existing location on 4th Street, between A and B avenues. The changes to the bus capital improvements under the Streetcar Alternative would not vary by any of the design options under consideration.

  **Light Rail Capital Improvements.** There would be no change in light rail capital improvements under the Streetcar Alternative, compared to the No-Build Alternative.

  **Interim Excursion Trolley Capital Improvements.** Under the Streetcar Alternative, there would no longer be an operating and maintenance agreement between the City of Lake Oswego and the Willamette Shore Line Consortium that would allow for the operations of the excursion trolley between SW Bancroft Street and Lake Oswego. Further, the Oregon Electric Railway Historical Society would no longer operate the vintage excursion trolley on the Willamette Shore Line alignment under agreement with the City of Lake Oswego, as they currently do and as they would under the No-Build and Enhanced Bus Alternatives.

- **Streetcar Improvements and Vehicles.** The Streetcar Alternative would extend streetcar tracks and stations south from the existing Portland Streetcar line that operates between NW 23rd Avenue and SW Bancroft Street. Compared to existing conditions and the No-Build Alternative, the Streetcar Alternative would add approximately 5.9 to 6.0 one-way miles of new streetcar tracks and catenary (overhead electrical wiring and support) and ten new streetcar stations.
between SW Bancroft Street and Lake Oswego. Except when crossing over waterways, roadways, or freight rail lines or through an existing tunnel, the new streetcar line would generally be at the same grade as existing surface streets. Of the approximately six miles of new streetcar tracks, 5.3 miles would be double-tracked (i.e., two one-way tracks) and 0.7 miles would be single-tracked (i.e., inbound and outbound streetcars would operate on the same tracks; see Figure 1-4 for an illustration of the location of single and double-track segments). The new streetcar stations would be of a design similar to the existing streetcar stations in downtown Portland and the Pearl District.

- **Park-and-Ride Facilities.** In addition to the park-and-ride facilities included under the No-Build Alternative, the Streetcar Alternative would include: a) a 100-space surface park-and-ride lot served by the proposed streetcar line at the B Avenue Station; and b) a 300-space structured park-and-ride lot that would be served by the proposed streetcar line at the Lake Oswego Terminus Station. The size and location of these park-and-ride lots would not vary by any of the design options under consideration.

- **Operations and Maintenance Facilities.** With the Streetcar Alternative, a new storage facility that would accommodate eight streetcars would be located adjacent to the streetcar alignment under the Marquam Bridge. The size and location of the streetcar operating and maintenance facilities would not vary by any of the design options under consideration.

### B. Segment by Segment Description and Design Option Differences

For the purposes of description and analysis, the Lake Oswego to Portland Corridor has been divided into six segments for the Streetcar Alternative – those segments and design options within four of the segments are illustrated schematically in Figure 1-4. Figure 1-3 illustrates the proposed roadway improvements, streetcar alignment, stations, and park-and-ride lots that would occur in the corridor under the Streetcar Alternative. Figures 1-5 and 1-6 provide more detailed illustrations of the streetcar design options currently under study.

1. **Downtown Portland Segment.** There would be no roadway or bicycle and pedestrian improvements within the Downtown Portland Segment under the Streetcar Alternative, compared to the No-Build Alternative. Under the Streetcar Alternative, a connection would be added between westbound streetcar tracks on SW Market Street to southbound tracks on W 10th Avenue, which would allow inbound streetcars from Lake Oswego to turn back toward Lake Oswego, providing increased operational flexibility. There are no streetcar alignment design options within this segment and there would be no new streetcar stations within this segment.

2. **South Waterfront Segment.** The South Waterfront Segment extends between SW Lowell Street to SW Hamilton Court. Streetcar tracks would be extended south of their existing southern terminus at SW Lowell Street, within the right of way of the planned Moody/Bond Couplet extension, to SW Hamilton Street. There would be two new streetcar stations within this segment (Bancroft and Hamilton stations).

3. **Johns Landing Segment.** The Johns Landing Segment extends between SW Hamilton Court to SW Miles Street. This segment includes three design options: Willamette Shore Line; Macadam In-Street; and Macadam Additional Lane. Under all options, the streetcar alignment would extend south from SW Hamilton to near SW Julia Street, generally within the existing Willamette Shore Line right of way. The three design options would include two new streetcar stations at varying locations,
described below. To the south, all three options would share a common alignment between SW Carolina and SW Miles Street, generally via the existing Willamette Shore Line right of way, and they would share one common station at SW Nevada. Following is a description of how the design options would differ:

a. **The Willamette Shore Line Design Option** would continue the extension of streetcar tracks south within the existing Willamette Shore Line right of way from SW Julia Street to SW Carolina Street (extending to SW Miles Street). There would be three new streetcar stations (Boundary, Nebraska, and Nevada stations).

b. **The Macadam In-Street Design Option** would locate the new streetcar tracks generally within the existing outside lanes of SW Macadam Avenue, approximately between SW Boundary and Carolina streets. Between approximately SW Julia and Boundary streets, the streetcar alignment would be within the right of way of SW Landing Drive, which would be converted from a private to a public street. There would be three new streetcar stations (Boundary, Carolina, and Nevada stations). An optional station at Pendleton Street is also under consideration.

c. **The Macadam Additional Lane Design Option** would be similar to the Macadam In-Street Design Option, except that the new northbound streetcar tracks would be located within a new traffic lane just east of the existing general purpose lanes – streetcars would share the new lane with right-turning vehicles. Between approximately SW Julia and Boundary streets, the streetcar alignment would be within the right of way of SW Landing Drive, which would be converted from a private to a public street. There would be three new streetcar stations (Boundary, Carolina, and Nevada stations). An optional station at Pendleton Street is also under consideration.
<table>
<thead>
<tr>
<th>Segments</th>
<th>Design Options</th>
<th>Single-Track Sections (All others are double-track sections)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - Downtown Portland</td>
<td></td>
<td>Yellow = Short-Term Single Track</td>
</tr>
<tr>
<td>2 - South Waterfront</td>
<td></td>
<td>Red = Long-Term Single Track</td>
</tr>
<tr>
<td>3 - Johns Landing</td>
<td></td>
<td>Willamette Shore Line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Macadam Additional Lane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Macadam In-Street</td>
</tr>
<tr>
<td>4 - Sellwood Bridge</td>
<td>Sellwood Bridge</td>
<td>South End of Park to Short Trestle (1,500')</td>
</tr>
<tr>
<td>5 - Dunthorpe/Riverdale</td>
<td>South End of Park</td>
<td>South End of Park to Short Trestle (1,500')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Willamette Shore Line</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Riverwood</td>
</tr>
<tr>
<td>6 - Lake Oswego</td>
<td></td>
<td>Elk Rock Tunnel (1,400')</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UPRR Right of Way Foothills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>UPRR Right of Way (1,500')</td>
</tr>
</tbody>
</table>

*Streetcar Alternative Design Option Locations*  

*Figure 1-4*  

**FIGURE 1-4 STREETCAR ALTERNATIVE DESIGN OPTION LOCATIONS**
FIGURE 1-5 STREETCAR AND ENHANCED BUS ALTERNATIVES AND DESIGN OPTIONS
FIGURE 1-6 STREETCAR ALTERNATIVE DESIGN OPTION DETAILS

JOHNS LANDING
- Willamette Shore Line Design Option
- Macadam In-Street Design Option
- Macadam Additional Lane Design Option

DUNTHORPE/RIVERDALE
- Willamette Shore Line Design Option
- Riverwood Design Option
- SW Boundary St
- SW Carolina St
- SW Riverwood Rd

LAKE OSWEGO
- Lake Oswego Terminus Park and Ride Lot
- 900 spaces
- Lake Oswego Terminus
- E Avenue
- Union Pacific RR Right of Way Design Option
- E Avenue
- 118th Ave
- Park and ride lot
- 100 spaces

Streetcar Alternative Design Option Details

Johns Landing Design Options
- Willamette Shore Line
- Macadam In-Street
- Macadam Additional Lane

Dunthorpe/Riverdale Design Options
- Willamette Shore Line
- Riverwood

Lake Oswego Design Options
- UPRR Right of Way
- Foothills

Map Index
- Streetcar alignment common for all options
- Streetcar design options
- Streetcar station
- Park and ride
- Optional station
- Transit Center

Oct 22, 2010
4. **Sellwood Bridge Segment.** The Sellwood Bridge Segment extends from Miles Street to the southern end of Powers Marine Park. Generally, the streetcar alignment would be located in the Willamette Shore Line right of way, except for the area between Stephens Creek and approximately 1,200 feet south of the Sellwood Bridge. In this area, the streetcar alignment would be constructed in conjunction with the planned west interchange improvements with the Sellwood Bridge (the streetcar would be located slightly east of the existing Willamette Shore Line right of way). The design and construction of the streetcar alignment under this design option would be coordinated with the design and construction of the new interchange for the Sellwood Bridge. There would be one new streetcar station within this segment (Sellwood Bridge Station).

5. **Dunthorpe/Riverdale Segment.** The Dunthorpe/Riverdale Segment extends between the southern end of Powers Marine Park and SW Briarwood Road. There are two design options in this segment: Willamette Shore Line Design Option and Riverwood In-Street Design Option. Both options would share a common alignment within the Willamette Shore Line right of way, generally north of where SW Riverwood Road intersects with Highway 43 and generally south of the intersection of SW Military Road and SW Riverwood Road. One new streetcar station is proposed within this segment, generally common to both design options (Riverwood Station). Following is a description of how the design options would differ:

   a. **The Willamette Shore Line Design Option** would generally locate the new streetcar alignment in the existing Willamette Shore Line right of way between the intersections of SW Riverwood Road and Highway 43 and SW Riverwood Road and SW Military Road.

   b. **The Riverwood Design Option** would locate the new streetcar alignment generally adjacent to Highway 43, north of SW Riverwood Road, and within the right of way of SW Riverwood Road, generally between where it intersects with Highway 43 (that intersection would be closed) and where it intersects SW Military Road. Except for the closure of the Highway 43 and SW Riverwood Road intersection, SW Riverwood Road would remain open to traffic (with joint operation with streetcars).

6. **Lake Oswego Segment.** The Lake Oswego Segment extends between SW Briarwood Road and the Lake Oswego Terminus Station. There are two design options within this segment: the UPRR ROW design option and the Foothills design option. Both options would generally be the same in two sections: 1) the new streetcar line alignment would extend south from SW Briarwood Road to where the alignment would cross under the existing UPRR tracks; and 2) the new streetcar alignment would be located within a new roadway that would extend south from SW A Avenue to the alignment’s terminus near the intersection of N State Street and Northshore Road. Both options would provide for a new bicycle and pedestrian connection under the existing UPRR tracks. There would be two stations within this segment, one that would be common to the two design options (Lake Oswego Terminus Station). An optional station at E Avenue is also under consideration.

   This segment would include two park-and-ride lots, both of which would be generally common to the two design options. Following is a description of how the design options would differ:

   a. **The UPRR ROW Design Option** would extend the streetcar alignment south, generally in the UPRR right of way, from its under crossing of the existing UPRR tracks to SW A Avenue. The B Avenue Station would be located on the west side of the 100-space surface park-and-ride lot.
b. The Foothills Design Option would extend the streetcar alignment south from its under crossing of the UPRR tracks to SW A Avenue generally within the right of way of a new general purpose roadway (Foothills Road), which would be built as part of the Streetcar Alternative.

1.4.3.2 Transit Operations

This section describes transit operations under the Streetcar Alternative, generally compared to the No-Build Alternative (see Table 1-2). Figure 1-3 provides an illustration of the transit lines in the vicinity of the corridor under the Streetcar Alternative. There would be no difference in transit operations under any of the design options under consideration.

The Streetcar Alternative would extend the existing Portland Streetcar line from its current southern terminus at Lowell Street to the Lake Oswego Terminus Station in downtown Lake Oswego, expanding the streetcar length from 4 miles to 9.9 to 10 miles (depending on design option). The total round trip running time of the streetcar line between 23rd Avenue and downtown Lake Oswego (10 miles) in 2035 would be 105 or 112 minutes, excluding layover (based on the Willamette Shore Line and Macadam design options in the Johns Landing Segment, respectively). In comparison, under the No-Build Alternative the round trip running time for the streetcar line between 23rd Avenue and Lowell Street (4 miles) would be 68 minutes.

With the extension of streetcar service to Lake Oswego, Line 35 service between Lake Oswego and downtown Portland would be eliminated. The remainder of Line 35 between Oregon City and Lake Oswego would be combined with Line 78, in effect to create a new route between Oregon City and Beaverton. The new bus route and other TriMet transit routes serving downtown Lake Oswego would be rerouted to serve the relocated Lake Oswego Transit Center, which would be adjacent to Lake Oswego Terminus Station.

1.4.3.3 Construction Phasing Options

This section summarizes Streetcar Alternative construction phasing options currently under consideration – neither the No-Build Alternative nor the Enhanced Bus Alternative include construction phasing options. Currently, there are two types of construction phasing options or scenarios under consideration: 1) finance-related and 2) external project related. The Streetcar Alternative evaluated in this Technical Report and the DEIS is as Full-Project Construction. Should the Streetcar Alternative with phasing be selected as the Locally Preferred Alternative, during preliminary engineering (PE) additional analysis of environmental impacts resulting from the interim project alignment (as opposed to Full-Project Construction) will be conducted and additional opportunity for public review and comment may be required.

A. Finance-Related Phasing Options

Following is a description of the two finance-related phasing options currently under consideration.

- **Full-Project Construction.** Under the first construction phasing option, the project would be constructed and opened in its entirety as described within Section 2.2.2.

- **Sellwood Bridge Minimum Operable Segment (MOS).** Under the Sellwood Bridge MOS phasing option, the Streetcar Alternative would be initially constructed between SW Lowell Street and the Sellwood Bridge, with a second construction phase between the Sellwood Bridge
and the Lake Oswego Terminus Station occurring prior to 2035. Under this construction phasing option, there would be no additional park-and-ride facilities in the corridor, compared to existing conditions. Under this phasing option, Line 35 would operate between Oregon City and the Nevada Street Station; frequencies would be adjusted to meet demand. Service and bus stops served exclusively by Line 35 would be deleted between the Nevada Station and downtown Portland.

B. External Project Coordination Related Phasing Options

Following is a description of phasing options related to the coordination of the Streetcar Alternative, if it is selected as the LPA, and other external projects. These external project coordination related phasing options represent interim steps in the construction process that would be taken to implement the Streetcar Alternative.

- **South Waterfront Segment Phasing Options.** If the planned and programmed South Portal roadway improvements are not in place or would not be constructed concurrently with the Streetcar Alternative, there would be two options for proceeding with construction of the streetcar alignment in the segment: 1) a different streetcar alignment using the Willamette Shore Line right of way would be initially constructed within the South Waterfront Segment; or 2) the streetcar alignment and its required infrastructure improvements would be constructed consistent with the alignment under the Full-Project Construction phasing option, but other non-project roadway improvements would be constructed at a later date by others. If the Willamette Shore Line right of way were to be used, then, when the South Portal roadway improvements were made, the streetcar alignment would be reconstructed consistent. The transit operating characteristics of the Streetcar Alternative would not be affected by this phasing option.

- **Sellwood Bridge Segment Phasing Options.** The Sellwood Bridge Segment includes two phasing options for the Streetcar Alternative that reflect two potential phasing options or scenarios for construction of the project in relationship to construction of a proposed new interchange that is planned to occur with the Sellwood Bridge replacement project. If the new interchange is constructed prior to or concurrently with the Streetcar Alternative, the initial and long-term streetcar alignment would be based on the new interchange design. The new interchange design is the basis for the analysis in this technical report and the DEIS. If the proposed interchange is constructed after the Streetcar Alternative, then the initial streetcar alignment to be constructed would be in the Willamette Shore Line right of way. Subsequently, when the proposed interchange is constructed, the Sellwood Bridge replacement project would relocate the streetcar alignment with the new interchange design. Therefore, the long-term streetcar alignment would be the new interchange and the Willamette Shore Line phasing option would only be implemented as an interim alignment. Therefore, the two design options in this segment do not constitute a choice of alignments – instead they represent two construction phasing scenarios, dependent upon how external conditions transpire.

- The Foothills Design Option. The Foothills design option of the Streetcar Alternative is based on roadway improvements that would occur under the City of Lake Oswego’s Foothills redevelopment project. If those roadway improvements are not constructed prior to or concurrently with construction of the streetcar alignment, then the Lake Oswego to Portland Transit Project would construct the streetcar alignment and required infrastructure improvements using the same alignment and the roadway improvements would be added at a later date by others.
2. EVALUATION METHODS

2.1 Introduction

The purpose of this section is to describe the methodology and data sources that have been used to investigate the existing geologic, hydrogeologic, soil and seismic conditions for the Lake Oswego to Portland Transit Project (Project). Information obtained in this investigation has been used to identify geologic conditions that may affect project design, schedule and costs for the proposed alternatives. The study has also investigated the affect of the Project on local geologic conditions.

2.2 Related Laws and Regulations

Laws or regulations pertaining specifically to geology that are applicable to the Project area are addressed through industry practices established by the Oregon Department of Transportation (ODOT) Environmental Procedures Manual (2002).

2.3 Contacts, Coordination and Consultation

State and Local agencies and municipalities were contacted to obtain existing soil and geologic reports and maps along the project corridor. The following agencies were contacted:

- Oregon Department of Geology and Mineral Industries (DOGAMI)
- Oregon Department of Transportation (ODOT)
- Multnomah County
- The City of Portland
- The City of Lake Oswego

2.4 Data Collection

The primary data used for the analyses were collected from existing maps, publications and reports. Data sources included the following:

- U.S. Army Corps of Engineers (USACE)
- U.S. Geological Survey (USGS)
- U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS)
- Oregon Department of Transportation (ODOT)
- Oregon Department of Geology and Mineral Industries (DOGAMI)
- Oregon Water Resources Department (OWRD)
- Portland State University
- Metro
- City of Portland
- Previous data developed by URS within the Project area.

In addition to reviewing this data, personnel performed field reconnaissance across the project area to identify potential impacts and adverse geologic conditions. Field reconnaissance was limited to visual observation of the surface conditions along the project alignment. Site-specific subsurface investigation and analyses were not performed for this analysis. Detailed subsurface investigation is typically performed during preliminary and final design phases of the project.

2.5 Affected Environment Profile
The data collected ranged from regional geologic maps to site specific geotechnical investigations and water well data providing detailed soil and groundwater information in localized areas. Over 200 Geotechnical and water well records from the Oregon Water Resourced Department were reviewed for geologic and hydrogeologic data with in the study area. Selected geotechnical and water well reports are presented in Appendix A. This data was reviewed and integrated with field observations to develop an understanding of the existing geologic conditions for the project area. The data provided information such as predominant soil types, depths to rock, regional groundwater conditions and geologic hazards.

2.6 Impact Assessment Analysis Methods

The soil and geologic conditions of the project area have been evaluated with regard to their affect on the project alternatives. Soil and geologic conditions may affect the cost and feasibility of alternatives. Aspects of the project may also adversely affect the existing geologic conditions. Certain geologic conditions may require mitigation to maintain the safety and integrity of the project.

Existing groundwater conditions were assessed through hydrogeologic resource studies and review of Willamette River data. The impacts of groundwater on the alternatives (for example, special construction methods may be required where groundwater is near-surface) as well as the affect of the project on groundwater resources (for example, cutting and filling may alter regional groundwater flow patterns) were investigated.

Seismic hazards were assessed by review of USGS and DOGAMI publications for the project area. Site ground motions based on USGS probabilistic methods were determined. Using ground motion data and the geologic model developed for the site, potential seismic hazards such as liquefaction and slope instability have been identified. The impacts of these hazards with respect to the project have been assessed. Peak ground acceleration (PGA) calculations and Probabilistic Seismic Hazard (PSH) analyses are presented in Appendix B.

The direct, indirect, and cumulative effects of the project were evaluated with regard to the site geologic and hydrogeologic conditions, as well as the seismic and geologic hazards.

2.7 Mitigation Measures

A range of potential project impacts have been identified during the completion of this assessment. General mitigation measures have been developed to address these impacts. These measures range from avoidance of the impact to engineered modifications to the existing conditions. Mitigation measures will be coordinated with state and local government requirements and with other technical disciplines.

2.8 Documentation

The geology, soils and seismic analyses have documented the existing conditions within the project area, impacts of the study alternatives, potential mitigation measures and information sources used in the assessment. A summary of the analyses is included in Chapter 3 of the Draft Environmental Impact Statement.

3. CONTACTS, COORDINATION AND CONSULTATION
Data used in support of this Technical Report were primarily obtained through published information and record searches on Federal, State, and Local web-based data depositories. State and Local agencies were contacted to obtain detailed information relating to geotechnical investigations for specific projects within the Lake Oswego to Portland Transit study area.

3.1 State Agency Coordination

Various Oregon State agencies and divisions were contacted via telephone and email during development of this Report. Geologic, geotechnical, seismic hazard and hydrogeologic information was obtained through ODOT Rail Division, ODOT Region 1, OWRD, and DOGAMI.

3.3 Local Agency Coordination

The City of Portland, Bureau of Environmental Services was contacted to request information related the West Side Combined Sewer Overflow project. Multnomah County was contacted to obtain information related to the Sellwood Bridge replacement project.

4. AFFECTED ENVIRONMENT

This section provides a description of the primary geologic and groundwater conditions and geologic hazards within the project’s study area.

4.1 Geologic, Soil and Groundwater Conditions

The Lake Oswego to Portland Transit project is located in the northern Willamette Valley physiographic province, an elongated north-south trending alluvial valley that lies between the Oregon Coastal Mountain Range and the Cascade Mountain Range to the west and east, respectively (Orr and Orr, 2000). Specifically, the site is positioned along the western side of the Portland Basin, a northwest trending structural basin bounded by the Portland Hills to the west and the foothills of the Cascade Mountains to the east.

Much of the Portland basin is mantled with late Pleistocene-aged silt, sand, gravel, cobbles, and boulders deposited during repeated catastrophic glacial outburst flood events that originated from Pleistocene Lake Missoula, which was located in eastern Idaho and western Montana. Locally, particularly near the Willamette River and its tributary drainages, alluvial deposits consisting primarily of silt and sand, are present. Historically placed fill deposits are present in areas of human development; primarily within the lowland areas near the Willamette River and its tributaries. The fill is commonly composed of sand, silt and clay with varying amounts of gravel, debris and wood waste (Beeson et al., 1989, 1991).

Throughout the study area, the near surface flood deposits, alluvium and artificial fill are generally underlain by completely weathered to fresh, basaltic volcanic rocks of the Eocene Waverly Heights Volcanics and the Miocene Columbia River Basalt Group. The basaltic rocks are generally deeply weathered to depths of 30 feet or greater, except where streams, rivers, Pleistocene glacial outburst flooding, and human activity have removed the weathered rock.

The Northern Willamette Valley has undergone substantial structural deformation, resulting in the Portland fold belt as defined by Unruh et al. (1994). The tectonic underpinnings of the Portland Fold Belt are not well understood and are further complicated by the fact that this area lies in a transition zone between the rotating Coast Range forearc block and the continental interior (Wells et al, 1998). The most prominent structural feature associated with the western edge of the Portland Basin is the Portland Hills Fault (PHF), which includes a series of northwest-trending subsurface faults that
extend for a distance of about 40-km along the eastern margin of the Portland Hills (Geomatrix, 1995; Madin, 1990). The trace of the PHF is inferred to cross the Willamette River from northwest to southeast between the west end of the Ross Island Bridge and the Oaks Bottom area (Beeson et al., 1989).

The Oatfield Fault has been mapped through the western Tualatin Mountains and the northern Willamette Valley. The Oatfield Fault has been located based on northeast-facing escarpments in volcanic rocks of the Miocene Columbia River Basalt Group, gravity studies, aeromagnetic data (Blakely et al., 1995), and mapped traces within light rail tunnels west of downtown Portland (Blakely et al., 2000). The mapped trace of the Oatfield Fault crosses the Lake Oswego to Portland Transit corridor near SW Briarwood Road (Wong et al., 200). The geology of the study area, as excerpted from Beeson et al., (1989) is shown on Figure 4-1.

The United States Department of Agriculture Natural Resources Conservation Service (NRCS) has mapped and described 10 soil map units within the project study area. A large percentage of the corridor is mapped by the NRCS as Urban Land, indicating considerable human modification of the near-surface soils. The soils identified on the NRCS maps consist predominantly of loams with varying sand, silt, clay and gravel contents. Predominant soils in the project area are within hydrologic class C or D and, therefore, have low rates of infiltration.
FIGURE 4-1 GEOLOGIC MAP
Groundwater levels within the LAKE OSWEGO TO PORTLAND study area are influenced by the Willamette River stage as well as groundwater flow from upland sources to the west of the proposed alignment. Groundwater data from existing wells in the project vicinity indicate depths to groundwater vary seasonally and spatially from within a few inches of the surface (near the Willamette River – especially north of the Sellwood Bridge) to tens of feet below the surface. A search of Oregon Water Resources Department (OWRD) water well records did not return any active potable water wells within the immediate vicinity of any of the Lake Oswego to Portland Transit alignment options.

Locally, the highly to completely weathered bedrock underlying the surficial sediments can create perched conditions due to the relatively low permeability of the clayey residual soils associated with the weathered basalt. Groundwater flow within the basalt bedrock underlying the Lake Oswego to Portland Transit corridor is controlled mainly by fractures and volcanic flow boundaries within the rock mass. Perched groundwater conditions are also possible within the basalt units where low-permeability, soil-like volcanic flow boundaries are present.

Excavations associated with construction of the Lake Oswego to Portland Transit project in areas of shallow groundwater may require temporary groundwater control (dewatering), especially during wetter fall through spring periods.

4.2 Geologic Hazards
A. Seismic Hazards
Seismic hazards can include the primary effects of an earthquake such as surface rupture or ground shaking, as well as secondary responses such as liquefaction or seismically induced landslides. In preparation of this Technical Report, URS has conducted limited peak ground acceleration and probabilistic seismic hazard analyses for the South Waterfront and Lake Oswego segments of the Lake Oswego to Portland Transit. These analyses are presented in Appendix B of this report.

Liquefaction is the drastic loss of soil strength that can accompany ground shaking during a moderate to strong seismic event. During ground shaking, cyclic earthquake loading on the soil increases pore water pressure to a point where the effective stress on the soil is zero or even negative, resulting in suspension of soil particles in the water. Loose, granular soils located below the water table are generally susceptible to liquefaction. Liquefaction itself does not pose a risk to soil deposits. But, phenomena accompanying liquefaction, such as settlement and lateral spreading can severely damage structures situated in or on the soil.

The Pacific Northwest has four principle types of seismic sources. These sources include (1) the Cascadia Subduction Zone megathrust, which represents the boundary (interface) between the downgoing Juan de Fuca plate and the overriding North American plate; (2) faults located within the Juan de Fuca plate (referred to as the intraplate or intraslab region); (3) crustal faults located principally within the North American plate; and (4) volcanic sources associated with Cascade Range volcanic centers (Wong and Silva, 1998). Of these four sources, intraplate and crustal faults have produced damaging earthquakes in the Pacific Northwest during the relatively short history following European settlement of the area. The 1993 Scotts Mills Mw 5.6 earthquake is an example of a crustal source earthquake event, while the 2001 Mw 6.8 Nisqually earthquake is an example of an intraplate event. Megathrust earthquakes, while capable of producing earthquakes of moment magnitude (Mw) 8.0 to 9.0, occur at greater distance and with less frequency than intraplate and crustal source quakes. Based on geologic evidence along the Pacific Northwest coast, and historic tsunami records from
Japan, the most recent megathrust earthquake along the Cascadia Subduction Zone occurred in 1700 (Atwater et al., 1995; Satake et al., 1996).

Because of their proximity, crustal faults are typically the most significant seismic sources to inland sites. Studies by Pezzopane (1993) and Geomatrix Consultants (1995) show that at least 70 crustal faults with earthquake potential exist in Oregon. Many of these faults were unknown or not recognized as being seismogenic until recently. Although the largest known crustal earthquake in western Oregon is only about Mw 6.0 (Wong and Bott, 1995), potential exists for events of Mw 6½ or greater along several recognized faults including the Portland Hills and the East Bank faults in Portland and the Gales Creek - Mt. Angel fault zone (Wong et al., 2000). The Mt. Angel fault is considered a possible source of the 1993 Scotts Mills Mw 5.6 earthquake.

Crustal faults occur in the vicinity of the Lake Oswego to Portland Transit corridor that are either active or potentially active. These faults are possible sources of strong motion that may affect the performance of the Lake Oswego to Portland Transit project. Due to the proximity to the project, the length, and the newly discovered evidence of a potential higher degree of activity along the Portland Hills Fault system, this fault is the most critical source for seismic hazard analyses for the Lake Oswego to Portland Transit project. The Portland Hills Fault zone includes a series of northwest-trending subsurface faults that extend for a distance of about 25 miles along the eastern margin of the Portland Hills (Geomatrix Consultants, 1995; Madin, 1990). Extension of the fault toward the southeast, beyond the Portland Hills, based on aeromagnetic gravity (Blakely et al., 1995) and high-resolution seismic reflection imaging (Pratt et al., 2001), provides a total estimated fault length of about 38 miles. The closest approach of the Portland Hills fault to the site is approximately 0.5 miles. Based on a maximum estimated length of 38 miles (Wong et al., 2000), which includes projection of the fault to the south of the Portland Hills through and beyond the Rowe Middle School area, an estimated Maximum Credible Earthquake (MCE) with Mw 6.8 is calculated for the Portland Hills fault.

The Oatfield Fault, which crosses the Lake Oswego to Portland Transit corridor approximately 1 mile north of the Lake Oswego Terminus, has been incorporated into the probabilistic ground motion data. Other crustal faults such as the East Bank Fault do exist within a few miles of the project site. These faults have also been incorporated into the probabilistic ground motion data available from the USGS (Appendix B).

The Oregon Department of Geology and Mineral Industries (DOGAMI) Relative Earthquake Hazard Maps (Mabey et al, 1995, 1997) for the Portland Metropolitan area show the relative hazards throughout the area based on a combination of liquefaction potential, earthquake-induced slope instability, and amplification of ground motion during an earthquake. The rating system is divided into four categories or zones ranging from the greatest relative hazard (Zone A) to the least relative hazard (Zone D). The Lake Oswego to Portland Transit project alignment options are located primarily within Zone A to the north of the Sellwood Bridge and Zone B to the south of the bridge. The primary contributing factors to the relatively high seismic hazards are elevated liquefaction and amplification potential to the north of the bridge and a combination of steep slopes and amplification to the south. The relative earthquake hazards of the study area as excerpted from Mabey, et al, (1995) are shown on Figure 4-2.
FIGURE 4-2 RELATIVE EARTHQUAKE HAZARD
B. Volcanic Hazards

The primary volcanic hazards posed to the project by active Cascade volcanoes are ash fall and flooding of the Willamette River. Ash fall exceeding 1 to 5 centimeters (0.4 to 2 inches) can disrupt transportation, including operation of bus and streetcar facilities. Flooding due to rapid melting of snow and generation of large debris flows as a result of eruptions in Willamette tributary headwaters could cause shoreline inundation of the Willamette River and its tributary streams within the Lake Oswego to Portland Transit project area.

According to the United States Geological Survey (USGS, 1999) the annual probability of ash fall exceeding 1 centimeter (0.4 inches) within the Lake Oswego to Portland Transit project corridor is between 0.02 and 0.1 percent (1 in 5,000 to 1 in 1,000). The annual probability of ash fall exceeding 10 centimeters (4 inches) is between 0.01 and 0.02 percent (1 in 10,000 to 1 in 5,000). The low annual probabilities are due to the relative rarity of moderate to large volcanic eruptions coupled with the project location up-gradient of the Cascade Range axis relative to prevailing winds.

C. Landslides

The most common types of landslides in the Pacific Northwest include rock falls, topples, rotational-translational slides, earthflows, debris slides, and debris flows. Most slope failures are complex combinations of these distinct types, but the generalized groupings enable the investigator to communicate the types of hazards anticipated and observed.

Landslides can be initiated in marginally stable slopes by a number of natural and human disturbances. Processes and conditions that can trigger slope failure include earthquake shaking, volcanic eruption, deforestation, intense rainfall, and rapid snowmelt. Two of the most common triggering events in northwest Oregon are intense rainfall and human alterations to the topography. The Pacific Northwest is subject to severe rainfall storm events, particularly in the wet winter and spring months of November through April. These relatively high-precipitation storm events can trigger slope failures through a number of mechanisms. Water infiltration into zones of weakness can trigger failures by reducing the frictional resistance to sliding, increasing pore pressures within slope masses and adding weight acting downslope. Typically, all three mechanisms combine during longer duration, heavy precipitation or rain on snow events to trigger slope stability problems.

Landslide hazards were assessed as part of the public document review, aerial photograph investigation, field reconnaissance, and Light Distance and Ranging (LiDAR) image analysis. All of these studies indicate that the primary areas of concern with regards to slope instability are located adjacent to, and south of the Sellwood Bridge. The elevated slope stability hazard at the bridge is due to an existing ancient landslide, referred to as the Sellwood Landslide (CH2M-Hill, 2009). South of the Sellwood Landslide, the Lake Oswego to Portland Transit corridor traverses relatively steep terrain, which is more susceptible to slope instability.

As part of the ongoing Sellwood Bridge Project, Multnomah County has conducted a geotechnical investigation of the Sellwood Landslide (CH2M-Hill, 2009). Movement of the Sellwood Landslide has historically damaged the western abutment of the bridge as a portion of the landslide reactivated following construction of the bridge. Construction of the new Sellwood Bridge will require mitigation of the Sellwood Landslide to prevent future movement of the landslide and resultant damage to the new bridge structure. Mitigation performed for the Sellwood Bridge project will stabilize the western approaches to the bridge, including the area to be occupied by the proposed Lake Oswego to Portland Transit project.
LiDAR imagery reveals a large, arcuate-shaped topographic low located west (upslope) of the alignment between SW Riverwood Rd and SW Radcliffe Rd (approximate Lake Oswego to Portland Transit project stations 2047+00 and 2075+00). The northern boundary of this topographic feature is very well defined as a steep, linear escarpment oriented approximately perpendicular to the Willamette River. The western boundary is also sharply defined and is oriented roughly parallel to the river. The southern boundary of the feature is poorly-defined. This feature may represent a large, dormant, ancient landslide or may be an erosional feature related to differential erosion of weaker rock. There is no evidence of recent damage to structures that cross the feature (existing rail, roads, utilities, buildings) so, if the feature is an ancient landslide, it is assumed to be historically stable. This feature has been identified as a landslide on DOGAMI’s Statewide Landslide Information Database for Oregon (SLIDO).

Steep slopes are defined as having an inclination greater than 20 degrees (37 percent). The proposed alignment of the Streetcar Alternative would traverse several steep slopes, some in excess of 30 degrees (60 percent). Hazards associated with steep slopes include higher susceptibility to landslides, rock fall and erosion.
5. ENVIRONMENTAL CONSEQUENCES

This section summarizes the long-term direct, indirect and cumulative affects on geology and soils that would occur due to the No-Build, Enhanced Bus and Streetcar alternatives, focusing on estimates of required cut and fill material and length of new retaining wall and on the potential of the alternatives to increase the risk of geologic and soils hazards. In geologic and soil science terms, the design options are not substantially different and are not individually assessed. Rather, the geologic and soil characteristics of the alternatives – No-Build, Enhanced Bus and Streetcar are analyzed in this document.

There would be no additional cumulative impacts due to the project alternatives beyond the described direct and indirect impacts, because the project’s analysis is based on adopted state, regional and local land use plans and transportation project lists, which are the reasonably-foreseeable activities within the project vicinity that could also affect geology and soils. There are no prime or unique farmlands and soils within the project corridor as defined under the Farmlands Protection Policy Act.

A. No-Build Alternative

There would be no direct effects related to geology, hydrogeology and seismic hazards associated with the No-Build Alternative. Indirectly, without any planned construction activities within the existing Willamette Shore Line right of way, the No-Build Alternative would generally allow the continuing degradation of soils and stability within existing right of way. On-going regional development would use existing groundwater and rock resources.

B. Enhanced Bus Alternative

Long term direct and indirect effects of the Enhanced Bus Alternative would be similar to those resulting from the No-Build Alternative. Design of the 300-space structured park-and-ride lot at the Lake Oswego Village Shopping Center under the Enhanced Bus Alternative would comply with applicable earthquake design standards for the site. There would be no cut and fill of soil under the Enhanced Bus Alternative.

C. Streetcar Alternative

The proposed Streetcar Alternative would require the construction of cut slopes and placement of engineered fill to accommodate the track and associated structures. Table 5-1 shows total estimated cut and fill volumes and estimated volume of export (excess cut material) for the various Streetcar Alternative options. In summary, the Streetcar Alternative would result in the excavation of approximately 76,350 to 95,100 cubic yards of material (depending on the design options). Approximately 11,820 to 45,850 cubic yards of the excavated material would be used as fill within the project’s alignment, while approximately 37,580 to 76,200 cubic yards of excavated material would be removed from the project site, which would require locating and filling an off-site disposal area and/or identifying and contracting with other projects that could use the excess excavated material.

The majority of the engineered cuts and fills under the Streetcar Alternative would be supported by retaining walls. The Streetcar Alternative would result in approximately 22,050 to 27,450 linear feet of new retaining wall, generally along the proposed streetcar alignment, depending on the design options. Through the use of appropriate design standards, the Streetcar Alternative would avoid increasing geologic hazards, which would include the following: areas of undocumented fill and/or shrink-swell soils may be encountered, which could require additional excavation and replacement with suitable fill material; and potential rehabilitation of the Elk Rock Tunnel and associated portal.
structures, which would provide improved stability of the rock within the tunnel and the rock slopes in the vicinity of the portals.

Engineered bridges and structures included in the Streetcar Alternative would be designed to withstand a major seismic event by using current applicable design standards based on site specific geologic and seismic criteria. The Streetcar Alternative would not increase the likelihood or severity of geologic or soils hazards in the project vicinity. However, through the addition of improvements along the existing Willamette Shore Line right of way, the Streetcar Alternative would lead to increased soil stability and reduced soil erosion due to the introduction of new improvements, such as new retaining walls, the mitigation of unstable soils and improved drainage.

Compared to the No-Build Alternative, the Streetcar Alternative could use additional rock resources for fill if the project’s cut material does not provide acceptable fill for the project. In contrast, the excess excavated material could be used for fill for other projects, which could reduce the demand for rock generally equivalent to the amount of excess cut from the project that could be used.

Table 5-1 Estimated Cubic Feet of Cut and Fill and Linear Feet of Retaining Wall for the Streetcar Alternative By Segment and Design Option

<table>
<thead>
<tr>
<th>Segment/Design Option</th>
<th>Cubic Yards of Cut</th>
<th>Cubic Yards of Fill</th>
<th>Cubic Yards of Excess Cut¹</th>
<th>Linear Feet of Retaining Wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Downtown Portland</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2 – South Waterfront</td>
<td>4,000</td>
<td>8,000</td>
<td>(4,000)</td>
<td>1,200</td>
</tr>
<tr>
<td>3 – Johns Landing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willamette Shore Line</td>
<td>16,350</td>
<td>90</td>
<td>16,260</td>
<td>5,150</td>
</tr>
<tr>
<td>Macadam In-Street</td>
<td>6,400</td>
<td>30</td>
<td>6,370</td>
<td>3,250</td>
</tr>
<tr>
<td>Macadam Additional Lane</td>
<td>4,600</td>
<td>10</td>
<td>4,590</td>
<td>2,000</td>
</tr>
<tr>
<td>4 – Sellwood Bridge</td>
<td>24,000</td>
<td>110</td>
<td>23,890</td>
<td>6,450</td>
</tr>
<tr>
<td>5 – Dunthorpe/Riverdale</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willamette Shore Line</td>
<td>24,400</td>
<td>250</td>
<td>24,150</td>
<td>8,100</td>
</tr>
<tr>
<td>Riverwood</td>
<td>27,750</td>
<td>3,950</td>
<td>23,800</td>
<td>8,850</td>
</tr>
<tr>
<td>6 – Lake Oswego</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UPRR</td>
<td>19,350</td>
<td>3,450</td>
<td>15,900</td>
<td>4,300</td>
</tr>
<tr>
<td>Foothills Realignment</td>
<td>23,000</td>
<td>33,700</td>
<td>(10,700)</td>
<td>5,800</td>
</tr>
<tr>
<td>Total (range)</td>
<td>76,350 – 95,100</td>
<td>11,820 – 45,850</td>
<td>37,580 – 76,200</td>
<td>22,050 – 27,450</td>
</tr>
</tbody>
</table>

¹ Excess cut material would be exported from the project site.
Source: Lake Oswego to Portland Transit Project Streetcar Plan Set, November 9, 2009.

Following is a summary of how the approximate volume of cut and fill material and approximate length of new retaining wall would differ by Streetcar design option, by segment.

- **Segment 3, Johns Landing.** In Segment 3, Johns Landing, the Willamette Shore Line Design Option would result in the greatest volume of cut and excess cut material (16,350 and 16,260 cubic yards, respectively) and the greatest length of new retaining wall (5,150 linear feet). There would be 6,370 and 4,590 yards of excess cut material under the Macadam In-Street and Macadam Additional Lane design options, respectively. The Macadam In-Street and Macadam Additional Lane design options would also result in 3,250 and 2,000 feet of new retaining wall, respectively.
- **Segment 5, Dunthorpe/Riverdale.** In Segment 5, Dunthorpe/Riverdale, the Riverwood Design Option would result in the greater volume of cut material (27,750 cubic yards), but the lower volume of excess cut material (23,800 cubic yards), because it would require the greater volume of fill (3,950 cubic yards), which could be supplied from the cut material. In comparison, the Willamette Shore Line Design Option would result in 24,400 and 24,150 cubic yards of cut and excess cut material, respectively. The Riverwood Design Option would result in the greater length of new retaining wall (8,850 linear feet).

- **Segment 6, Lake Oswego.** In Segment 6, Lake Oswego, the Foothills Realignment Design Option would result in the greater volume of cut material (23,000 cubic yards), but the lower volume of excess cut material (a deficit of 10,700 cubic yards), because it would require the greater volume of fill (33,700 cubic yards), which could be supplied from the cut material in this and one or more segments. In comparison, the UPRR Design Option would result in 19,350 and 15,900 cubic yards of cut and excess cut material, respectively. The Foothills Design Option would result in the greater length of new retaining wall (5,800 linear feet).
6. POTENTIAL MITIGATION MEASURES

A. Seismic Hazards
The primary seismic hazards that could affect the Lake Oswego to Portland Transit project include: liquefaction-related phenomena such as lateral spread and settlement; seismically-induced slope instability; strong ground motion; and surface fault rupture. Mitigation of these potential hazards could be achieved with one or more of the following techniques, depending upon the situation:

- Avoidance of the susceptible area(s);
- Densification of the subsurface soils through in-situ treatment including compaction or cement/chemical grout treatment;
- Removal of the liquefiable material and replacement with select backfill;
- Placement of retaining walls and/or rock-fall catchment zones or structures; and
- Improvement of rock slopes using mechanical reinforcement.

B. Landslides
Should landslides be identified through site-specific geotechnical investigations during subsequent phases of the project, stability analyses would be performed. Mitigation of landslide hazards could be accomplished using one or more of the following techniques:

- Mechanical retaining structures such as cantilevered walls, tied back walls, soil nail walls;
- Construction of shear keys and / or placement of earth buttresses at the landslide toe;
- Removal of driving forces in the upper portion of the landslide; and
- Installation of enhanced drainage facilities to redirect surface water and / or remove groundwater

C. Steep Slopes
Mitigation options for steep slope areas could include:

- Construction of retaining walls in areas of cuts (below ascending slopes) or fills (above descending slopes);
- Improvement of rock slopes using mechanical reinforcement such as rock bolts, steel mesh, shotcrete and drainage;
- If blasting is necessary to excavate rock slopes, controlled, pre-split blasting techniques should be employed to minimize damage to the finished rock cut face

D. Shrink/Swell and Hydric Soils
Hydric soils in areas of shallow groundwater may be encountered. Mitigation techniques for these soil types generally involve removal and replacement with engineered fill having properties that will provide a stable foundation for the Lake Oswego to Portland Transit facilities. Additional mitigation related to wetlands impacts may be necessary in areas where soft soils are encountered and treated (see Section 3.9 for additional information on wetlands and hydrology). If zones are encountered that involve very large volumes of unsuitable soils, it may not be economical to remove and replace all of the unsuitable base material. Other mitigation options include:

- Partial removal and replacement with a combination of geogrid or geofabric and specified rock to bridge soft and/or wet zones;
- Soil treatment using amendments to improve the soil structure; and
- Permanent drainage facilities to lower the groundwater.
REFERENCES


CH2M Hill, 2009; 2009 Geotechnical Data Report, Sellwood Bridge Project, Prepared for Multnomah County, Oregon

Geomatrix Consultants, 1995; Seismic Design Mapping, State of Oregon


Orr, W.N. and Orr, E.L., 2000; Geology of Oregon

Pezzopane, S.K., 1993; Active Faults and Earthquake Ground Motions in Oregon, University of Oregon, Unpublished Ph.D. Dissertation


The United States Department of Agriculture Natural Resources Conservation Service


November 2010
Lake Oswego to Portland Transit Project
Geology, Soils and Seismic Hazards Technical Report


**LIST OF PREPARERS**

Dan Meier, CEG. Geologist, URS Corporation.
    Bachelor of Science in Geology, San Deigo State University.

Bryan Duevel, PE, GE. Geotechnical Engineer, URS Corporation.
    Bachelor of Science in Geotechnical Engineering, University of Minnesota.

Debashis Sikdar, PE, PhD. Geotechnical Engineer, URS Corporation.
    Doctorate in Civil Engineering, North Dakota State University.
    Bachelor of Science in Civil Engineering, University of North Bengal, India.
APPENDIX A: SELECT OREGON WATER RESOURCES DEPARTMENT GEOTECHNICAL HOLE REPORTS WITH LOCATIONS
# Geotechnical Hole Report

## Owner/Project:
- **Name:** AT&T Wireless Services
- **Address:** 1600 SW 4th Ave.
- **City:** Portland
- **State:** OR
- **Zip:** 97201

## Location of Hole by Legal Description:
- **County:** Multnomah
- **Tipt:** N
- **Range:** 17 E
- **Sec:** 15
- **Lot:** 20D
- **Street Address:** 5100 SW Macadam
- **Subdivision:** Portland

## Static Water Level:
- **Depth:** 7 ft. below land surface
- **Date:** 10/26/96
- **Artesian Pressure:** 10 lb. per square inch
- **Date:**

## Subsurface Log:
- **Ground Elevation:**
- **Material Description:**
  - Acqually Aggregate Rock 0' 8''
  - Native Dk. Grey-Brown 8'' to 12''
  - Deeply weathered, moist, silty 6'' to 12''
  - Same, silty sand 0' 12''
  - Dk. Grey-Brown Silty 12'' to 20''
  - Fine to medium sand, dark brown 12'' to slightly siltier, fine to medium sand, dark brown 12''
- **Date Started:** 10/26/96
- **Date Completed:** 10/26/96

## Abandonment Log:
- **Material Description:**
  - Bentonite Chips 0' 20.3 sacks
  - Native
- **Date Started:** 10/24/96
- **Date Completed:** 10/26/96

## Professional Certification:
- **License or Registration Number:** 10013
- **Signed:** Randy L. Crismen
- **Date:** 11/24/96
- **Affiliation:** Crismen Drilling Co.

---

**Remarks:**

- Depth of strata analyzed, from ft. to ft.

---

This report must be submitted to the Water Resources Department within 30 days of completion of work.
Legend

B-1 Indicates approximate location of exploratory drilled boring

SITE EXPLORATION MAP

Project No. 110.069.G
PROPOSED JOHNS LANDING VAULT SITE
Figure No. 2

T15, R1E, S15

RECEIVED
DEC 30 1996
WATER RESOURCES DEPT.
SALEM, OREGON
APR 15 1997

GEOTECHNICAL HOLE REPORT
WATER RESOURCES DEPT.
SALEM, OREGON

(1) OWNER/PROJECT: VFT Realstate Court c/o Douglas Cornelius Nult.
Hole Number D-1

(2) TYPE OF WORK: Withdrawal

(3) CONSTRUCTION:
- Rotary Air
- Rotary Mud
- Hollow Stem Auger
- Deepening
- Alteration (repair/recondition)
- Abandonment

(4) TYPE OF HOLE:
- Uncased Temporary
- Cased Permanent
- Uncased Permanent
- Slope Stability
- Other

(5) USE OF HOLE:
Geotechnical-soil formation

(6) BORE HOLE CONSTRUCTION:
Special Construction approval
Yes ☐ No ☐ Depth of Completed Hole ___ ft.

HOLE Diameter From To Material From To Sacks or pounds

N/A

(7) CASING/SCREEN:
Casing:

Screen:

Slot size

(8) WELL TEST:
- Pump ☐ Bailer ☐ Air ☐ flowing Artesian
Permeability Yield GPM
Conductivity PH
Temperature of water N/A °F
Depth artesian flow found ___ ft.
Was water analysis done? Yes ☐ No ☐
By whom?

Depth of strata analyzed. From ___ ft. to ___ ft.

Remarks:

(9) LOCATION OF HOLE by legal description:

Township 15 N or S Range 1B E or W WM.
Section 20 S 1/4 NE 1/4
Lot 2000 Block Subdivision
Street Address of Well (or nearest address):
5100 SW Macadam Ave.

Portland, OR

(10) STATIC WATER LEVEL:
17.0 ft. below land surface.
Artesian pressure lb. per square inch.
Date ___ 02/05/97 ___

(11) SUBSURFACE LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard rock</td>
<td>0'</td>
<td>5'</td>
<td></td>
</tr>
<tr>
<td>Brown silts.</td>
<td>5'</td>
<td>20'</td>
<td></td>
</tr>
<tr>
<td>Brown silty sand.</td>
<td>20'</td>
<td>31.5'</td>
<td></td>
</tr>
</tbody>
</table>

Date Started 02/05/97 Date Completed 02/05/97

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentonite chips &amp;</td>
<td>0'</td>
<td>31.5'</td>
<td>4 sacks native.</td>
</tr>
</tbody>
</table>

Date started 02/05/97 Date completed 02/05/97

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10374

Signed _______________ Date _______________

Affiliation Crisman Drilling, Inc.

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER
STATE OF OREGON

GEOTECHNICAL HOLE REPORT

(as required by OAR 690-240-035)

(1) OWNER/PROJECT

Hole No. 1
Co. Job No. 624

Name
AND LARRY'S WHO SONG
WHO SON AND LARRY'S

Street
4850 SW MACADAM

City
PORTLAND

State OR Zip
State OR Zip 97201

(2) TYPE OF WORK

☐ New
☐ Alter (Recondition)
☐ Alter (Repair)
☐ Deepening
☐ Abandonment

(3) CONSTRUCTION

☐ Rotary Air
☐ Hand Auger
☐ Hollow Stem Auger
☐ Rotary Mud
☐ Cable Tool
☐ Push Probe
☐ Other

(4) TYPE OF HOLE

☐ Uncased Temporary
☐ Cased Permanent
☐ Uncased Permanent
☐ Slope Stabil
☐ Other

(5) USE OF HOLE

(6) BORE HOLE CONSTRUCTION

Special Standards
 Depth of completed well
30 ft.

HOLE

Diameter

9.00

From

To

0

30

SEAL

From

To

Material

Amount

Grout Weight

Units

0

30

BE

600

6

Backfill placed from

ft. TO ft.

Material

Filler pack placed from

ft. TO ft.

Size

in.

(7) CASING/SCREEN

Screen

(8) WELL TEST

Permeability

Yield

GPM

Conductivity

PH

Temperature of water

58 °F/°C

Depth artesian flow found

ft.

Was water analysis done?

☐

By Whom?

WEST COAST

Depth of strata to be analyzed. From

ft. TO ft.

Remarks

Name of supervising Geologist/Engineer

(9) LOCATION OF HOLE

By legal description

County

Multnomah

Latitude

Longitude

Township

1.00 S

Range

1.00 E

Section

15

NE 1/4 NW 1/4

Tax lot

Lot

Block

Subdivision

Legal desc:

Street Address of Well (or nearest address)
SAME

MAP with location identified must be attached

(10) STATIC WATER LEVEL

20.0 ft. below land surface.

Date 8/24/1997

Artesian Pressure

lb/sq. in.

Date

(11) SUBSURFACE LOG

Ground Elevation

ft.

Material

From

To

SWL

SILTS & CLAY

0

20

SATURATED SAND

20

30

Date started

8/24/1997

Completed

8/24/1997

(12) ABANDONMENT LOG

Professional Certification

(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number

10408

Signed By

PETE LARSEN

Date

Affiliation

GEO-TECH EXPLORATIONS

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK.
(1) OWNER/PROJECT
Hole No. 4
AND LARRY’S WHO SONG
WHO SONG AND LARRY’S
Street 4850 SW MACADAM
City PORTLAND
(2) TYPE OF WORK
☑ New
☐ Alter (Recondition)
☐ Alter (Repair)
☐ Deepening
☐ Abandonment
(3) CONSTRUCTION
☐ Rotary Air
☐ Hand Auger
☒ Hollow Stem Auger
☐ Rotary Mud
☐ Cable Tool
☐ Push Probe
☐ Other
(4) TYPE OF HOLE
☒ Uncased Temporary
☐ Cased Permanent
☐ Uncased Permanent
☐ Slope Stabilitat
☐ Other
(5) USE OF HOLE
(6) BORE HOLE CONSTRUCTION
Special Standards
Depth of completed well 30 ft.
HOLE
Diameter
From
To
8.00
0
30
SEAL
From
To
Material
Amount
Grnd Weight
Units
0
30 BE
608
p
Backfill placed from ft.
TO ft.
Material
Filter pack placed from ft.
TO ft.
Size in.
(7) CASING/SCREEN
Screen
(8) WELL TEST
Permeability Yield GPM
Conductivity PH
Temperature of water 57 °F
Temperature of water Depth artesian flow found ft.
Was water analysis done? ☐
By Whom? WEST COAST
Depth of strata to be analyzed. From ft. to ft.
Remarks
(9) LOCATION OF HOLE By legal description
County Multnomah
Latitude
Longitude
 Township 1.00 S
 Range 1.00 E
Section 15 NE 1/4 NW 1/4
Tax lot
Lot
Block
Subdivision
Legal desc:
Street Address of Well (or nearest address) SAME
(10) STATIC WATER LEVEL
20.0 Ft below land surface. Date 8/24/1997
Artesian Pressure Ib/eq. in. Date
(11) SUBSURFACE LOG
Ground Elevation ft.
Material From To SWL
SILTS & GRAVELS 0 20
SATURATED SAND 20 30
Date started 8/24/1997 Completed 8/24/1997
(12) ABANDONMENT
Date started Completed
Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.
License or Registration Number 10408
Signed By PETE LARSEN Date
Affiliation GEO-TECH EXPLORATIONS

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK
# Geotechnical Hole Report

**Date:** FEB - 2 1998  
**MUT:** SS006  
**Author:** Barry R. Smith, Architect  
**Address:** 621 SW Morrison St., #1237  
**City:** Portland  
**County:** Multnomah  
**State:** OR  
**Zip Code:** 97205

## Owner/Project
- **Hole Number:** R-1

## Location of Hole
- **County:** Multnomah  
- **Latitude:**  
- **Longitude:**  
- **Twp.:**  
- **Range:**  
- **Sec.:**  
- **Lot:**  
- **Block:**  
- **Subdivision:**  
- **St.:** Macadam Ave., Portland, OR

## General Information
- **Type of Work:** New  
- **Construction:** Rotary Air
- **Type of Hole:** Uncased Temporary
- **Use of Hole:** Geotechnical - SPT Sampling

## Bore Hole Construction
- **Special Construction Approval:** Yes  
- **Depth of Completed Hole:** 21.5 ft

### Hole Details
<table>
<thead>
<tr>
<th>Diameter From</th>
<th>To</th>
<th>Material</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in</td>
<td>0</td>
<td></td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 in</td>
<td>20</td>
<td></td>
<td>21.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Backfill placed from:** ft. to ft.  
- **Filter Pack placed from:** ft. to ft.  

## Casings/Screen
- **N/A**

## Well Test
- **Pump:** N/A  
- **Bailer:** N/A  
- **Air:** N/A  
- **Flowing Artesian:** N/A

## Subsurface Log
- **Material:** Fill - Brdy Silt w/Gravel  
- **Depth:** From 0 to 3 ft
- **SWL:** 20 ft below land surface

## Abandonment Log
- **Material:** Bentonite Chips  
- **Depth:** From 0 to 21.5 ft  
- **Sacks or Pounds:** 6 sacks

---

**Signature:** C. E. Ehler  
**Date:** 1-29-98

## Professional Certification
- **License or Registration Number:** L9410  
- **Affiliation:** Brown Interests, Inc.

---

**Reminders:**
- This report must be submitted to the Water Resources Department within 30 days of completion of work.
- Original & first copy - Water Resources Department  
- Second copy - Contractor  
- Third copy - Customer

---
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

(7) OWNER/PROJECT
Name: PAUL BRENNERKE
Co. No.: B-1

(2) TYPE OF WORK
☐ New
☐ Alter (Recondition)
☐ Alter (Repair)
☐ Deepening
☐ Abandonment

(3) CONSTRUCTION
☐ Rotary Air
☐ Hand Auger
☐ Hollow Stem Auger
☐ Rotary Mud
☐ Cable Tool
☐ Push Probe
☐ Other

(4) TYPE OF HOLE
☐ Uncased Temporary
☐ Cased Permanent
☐ Uncased Permanent
☐ Slope Stability
☐ Other

(5) USE OF HOLE
GEOTECHNICAL STUDY

(6) BORE HOLE CONSTRUCTION
Special Standards
Depth of completed well: 24 ft.

HOLE
Diameter 8.00
From 0.00
To 24

SEAL
From 0.00
To 24.00
Material Bentonite
Volume 3.00
Units 5

Backfill placed from ft. TO ft.
Filler pack placed from ft. TO ft.

(7) CASING/SCREEN
Screen

(8) WELL TEST
Permeability
Conductivity
Temperature of water 54 °F/C
Was water analysis done? [ ]
By Whom? GRI
Depth of strata to be analyzed from ft. TO ft.

Remarks

(9) LOCATION OF HOLE
County: Multnomah
Latitude 45° 14' 0" N
Longitude 122° 31' 0" W
Township 1.00 S
Range 1.00 E
Section 15
Lot 1/4
Block 1/4
Subdivision

Legal desc:
Street Address of Well (or nearest address): 4630 SW MACADAM AVE

(10) STATIC WATER LEVEL
Ft. below land surface
Date
Artesian Pressure
Date

(11) SUBSURFACE LOG
Ground Elevation
Material
From To SWL
GRAVELS 0 2
SILT 2 22
BEDROCK 22 24

Date started: 02/04/1999
Completed: 02/04/1999

(12) ABANDONMENT LOG

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed By LARRY INSELMAN
License or Registration Number 10452
Date

Affiliation GEO TECH EXPLORATIONS
STATE OF OREGON

GEOTECHNICAL HOLE REPORT

(1) OWNER/PROJECT

Name: PAUL BRENNENKE
Co. Job No: B-2

(2) TYPE OF WORK

☐ New ☐ Alter (Recondition) ☐ Alter (Repair)
☐ Deepening ☒ Abandonment

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☐ Hollow Stem Auger
☐ Rotary Mud ☐ Cable Tool ☐ Push Probe ☐ Other

(4) TYPE OF HOLE

☒ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☐ Slope Stability ☐ Other

(5) USE OF HOLE

GEOTECHNICAL STUDY

(6) BORE HOLE CONSTRUCTION

Special Standards ☐ Depth of completed well: 16 ft.

<table>
<thead>
<tr>
<th>HOLE</th>
<th>Diameter</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.00</td>
<td>0.00</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEAL</th>
<th>From</th>
<th>To</th>
<th>Material</th>
<th>Amount Seal</th>
<th>Grout Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>16.00</td>
<td>Bentonite</td>
<td>2.00</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

Backfill placed from ft. TO ft. Material
Filter pack placed from ft. TO ft. Size in.

(7) CASING/SCREEN

Screen ☐

(8) WELL TEST

Permeability: Yield GPM
Conductivity: PH
Temperature of water: *F/C Depth artesian flow found ft.
Was water analysis done? ☐
By Whom?
Depth of strata to be analyzed: From ft. to ft.
Remarks

Name of supervising Geologist/Engineer

(9) LOCATION OF HOLE By legal description

County: Multnomah Latitude: Longitudes
Township: 1.00 S Range: 1.00 E
Section: 15 SW 1/4 NE 1/4
Tax lot: Lot Block: Subdivision
Legal desc:

Street Address of Well (or nearest address): 4630 SW MACADAM

MAP with location indentified must be attached

(10) STATIC WATER LEVEL

Ft. below land surface: Date
Artesian Pressure lbs/sq. in: Date

(11) SUBSURFACE LOG

<table>
<thead>
<tr>
<th>Ground Elevation</th>
<th>ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAVELS</td>
<td>0</td>
</tr>
<tr>
<td>SILT</td>
<td>2</td>
</tr>
<tr>
<td>BEDROCK</td>
<td>16</td>
</tr>
</tbody>
</table>

Date started: 02/04/1999 Completed: 02/04/1999

(12) ABANDONMENT LOG

Date started: Completed:

Professional Certification

(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed By: LARRY INSCHMAN
License or Registration Number: 10452
Date

Affiliation: GEO TECH EXPLORATIONS

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK.
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
MULT 57559
(Received date 03/04/1999)

(1) OWNER/PROJECT
Hole No.
Co-Job No. B-3
Name: PAUL BRENNEKE

(2) TYPE OF WORK
☒ New ☐ Alter (Recondition) ☐ Alter (Repair)
☐ Deepening ☒ Abandonment

(3) CONSTRUCTION
☐ Rotary Air ☐ Hand Auger ☐ Hollow Stem Auger
☒ Rotary Mud ☐ Cable Tool ☐ Push Probe ☐ Other

(4) TYPE OF HOLE
☒ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☐ Slope Stability ☐ Other

(5) USE OF HOLE
GEOTECHNICAL STUDY

(6) BORE HOLE CONSTRUCTION
Special Standards ☐ Depth of completed well 19 ft.

<table>
<thead>
<tr>
<th>HOLE</th>
<th>Diameter From</th>
<th>To</th>
<th>Depth of completed well</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.00</td>
<td>0.00</td>
<td>19</td>
<td>19 ft</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEAL</th>
<th>From</th>
<th>To</th>
<th>Material</th>
<th>Amount</th>
<th>Seal Grout Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>19.00</td>
<td>Bentonite</td>
<td>3.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Backfill placed from ft. TO ft., Material
Filter pack placed from ft. TO ft., Size in.

(7) CASING/SCREEN

Screen ☐

(8) WELL TEST
Permeability Yield GPM
Conductivity PH
Temperature of water °F/C Depth artesian flow found ft.
Was water analysis done? ☐
By Whom? 
Depth of strata to be analyzed. From ft. TO ft.
Remarks

(9) LOCATION OF HOLE by legal description
County Multnomah Latitude
Township 1.00 S Range 1.00 E
Section 15 SW1/4 NE1/4
Tax lot Lot Block Subdivision

(10) STATIC WATER LEVEL
Artesian Pressure lbs. sq. in.

(11) SUBSURFACE LOG

<table>
<thead>
<tr>
<th>Ground Elevation</th>
<th>ft.</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Silts</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>Bedrock</td>
<td>18</td>
<td>19</td>
</tr>
</tbody>
</table>

Date started 02/04/1999 Completed 02/04/1999

(12) ABANDONMENT LOG

Date started 02/04/1999 Completed 02/04/1999

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed By LARRY INSPELMAN
Affiliation GEO TECH EXPLORATIONS

License or Registration Number 10452

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 36 DAYS OF COMPLETION OF WORK
STATE OF OREGON

GEOTECHNICAL HOLE REPORT

(as required by OAR 880-240-038)

(1) OWNER/PROJECT

Hole No. Co. Job No. BH-12

(2) TYPE OF WORK

☒ New ☑ Alter (Recondition) ☐ Alter (Repair)
☐ Deepening ☐ Abandonment

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☒ Hollow Stem Auger
☐ Rotary Mud ☐ Cable Tool ☐ Push Probe ☐ Other

(4) TYPE OF HOLE

☐ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☐ Slope Stability ☐ Other VIBRATING PIEZOMETER

(5) USE OF HOLE

VIBRATING PIEZOMETER

(6) BORE HOLE CONSTRUCTION

Special Standards ☐ Depth of completed well ☒ 35 ft.

HOLE

<table>
<thead>
<tr>
<th>Diameter</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.00</td>
<td>0.00</td>
<td>35</td>
</tr>
</tbody>
</table>

SEAL

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Material</th>
<th>Amount</th>
<th>Seal Grout Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>1.00</td>
<td>Concrete</td>
<td>2.00</td>
<td>S</td>
</tr>
<tr>
<td>1.00</td>
<td>30.00</td>
<td>Bentonite</td>
<td>19.00</td>
<td>S</td>
</tr>
</tbody>
</table>

Backfill placed from 30.00 to 35.00 ft. Material S

Filter pack placed from ft. TO ft. Size in.

(7) CASINGS/CORES

Screen ☐

(8) WELL TEST

Permeability Yield GPM
Conductivity PH
Temperature of water °F Depth artesian flow found ft.
Was water analysis done? ☐
By Whom? 
Depth of strata to be analyzed. From ft. TO ft.
Remarks

(9) LOCATION OF HOLE By legal description

County Multnomah Latitude 
Township 1.00 S Longitude 
Range 1.00 E
Section 22 SE 1/4 SW 1/4
Tax lot Lot Block Subdivision
Legal desc:

Street Address of Well (or nearest address)
SW VIRGINIA & SW NEVADA

MAP with location identified must be attached

(10) STATIC WATER LEVEL

Fl. below land surface. Date

Artesian Pressure ib/sq. in. Date

(11) SUBSURFACE LOG

Ground Elevation ft.

<table>
<thead>
<tr>
<th>Material</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silty Sands</td>
<td>0</td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

Date started 02/23/2000 Completed 02/23/2000

(12) ABANDONMENT LOG

Date started Completed

Professional Certification

(to be signed by a licensed water supply or monitoring well contractor, or registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10076

Signed By BRADLEY WIEBERDINK Date

Affiliation GEO TECH EXPLORATIONS

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK
(1) OWNER/PROJECT: 
Name: City of Portland 
Address: 1120 S.W. Fifth Ave 
City: Portland 
State: OR 
Zip: 97204 

(2) TYPE OF WORK: 
[ ] New 
[ ] Deepening 
[ ] Alteration (repair/recondition) 
[ ] Abandonment 

(5) CONSTRUCTION: 
[ ] Rotary Air 
[ ] Hand Auger 
[ ] Hollow Stem Auger 
[ ] Rotary Mud 
[ ] Cable Tool 
[ ] Push Probe 
[ ] Other 

(6) BORE HOLE CONSTRUCTION: 
Special Construction approval: [ ] Yes 
[ ] No 
Depth of Completed Hole: 23 ft. 

(7) CASINGS/SCREEN: 
Casing: 
Diameter: 
From: 
To: 
Gauge: 
Steel: 
Plastic: 
Welded: 
Threaded: 

Screen: 
Slot size: 

(8) WELL TEST: 
[ ] Pump 
[ ] Bailer 
[ ] Air 
[ ] Flowing Artesian 
Permeability: 
Yield: 
GPM: 

Conductivity: 
Temperature of water: 51°F 
[ ] Depth artesian flow found: 12 ft. 

Was water analysis done? [ ] Yes 
[ ] No 
By whom? 
Remarks: 

(9) LOCATION OF HOLE by legal description: 
County: Mult 
Latitude: 
Longitude: 
Township: N of S Range: 
West of E R.W. WM. 
Section: 15 
Lot: 1/4 
Block: Subdivision 
Street Address of Well (or nearest address): 

Map with location identified must be attached 

(10) STATIC WATER LEVEL: 
ft. below land surface. 
Date: 4/3/01 
Artesian pressure: lb. per square inch. 
Date: 

(11) SUBSURFACE LOG: 

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand/Silt</td>
<td>0</td>
<td>9</td>
<td>23</td>
</tr>
</tbody>
</table>

Date Started: 4/3/01 
Date Completed: 4/3/01 

(12) ABANDONMENT LOG: 

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentonite</td>
<td>0</td>
<td>23</td>
<td>1164.5</td>
</tr>
</tbody>
</table>

Date started: 4/3/01 
Date Completed: 4/3/01 

Professional Certification: 
I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief. 

Signed: [Signature] 
License or Registration Number: 16025 
Affiliation: Geo-Tech Exploration, Inc. 

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK 

ORIGINAL – WATER RESOURCES DEPARTMENT 
FIRST COPY – CONSTRUCTOR 
SECOND COPY – CUSTOMER
**STATE OF OREGON**

**GEOTECHNICAL HOLE REPORT**

**(as required by OAR 690-240-055)**

**WATER RESOURCES DEPT.**

**SALEM, OREGON**

---

(1) **OWNER/PROJECT:**
- **Name:** Jim Oil
- **Address:** 1337 W. Commodore Way
- **City:** Seattle
- **State:** WA
- **Zip:** 98199

(2) **TYPE OF WORK:**
- [ ] Deepening
- [ ] Alteration (repair/recondition)
- [ ] Abandonment

(3) **CONSTRUCTION:**
- [ ] Rotary Air
- [ ] Hand Auger
- [ ] Hollow Stem Auger
- [ ] Rotary Mud
- [ ] Cable Tool
- [ ] Push Probe
- [x] Other

(4) **TYPE OF HOLE:**
- [ ] Uncased Temporary
- [ ] Cased Permanent
- [ ] Uncased Permanent
- [ ] Slope Stability
- [ ] Other

(5) **USE OF HOLE:**
- [ ] Check Soil Quality

---

(6) **BORE HOLE CONSTRUCTION:**
- **Special Construction approval:** [ ] Yes [ ] No
- **Depth of Completed Hole:** 70 ft.

<table>
<thead>
<tr>
<th>ホール</th>
<th>Diameter</th>
<th>From</th>
<th>To</th>
<th>Material</th>
<th>From</th>
<th>To</th>
<th>Sacks or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 in.</td>
<td>0</td>
<td>70</td>
<td>Asphalt</td>
<td>0</td>
<td>8 in.</td>
<td>20</td>
<td>40 #5</td>
</tr>
<tr>
<td>Hackfill placed from 8 in. to 70 ft.</td>
<td>Material: Bast Chips</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter Pack placed from 70 ft. to 8 in.</td>
<td>Size of pack: n/a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

(7) **CASING/SCREEN:**
- **Casing:** N/A
- **Screen:**
- **Not size:**

---

(8) **WELL TEST:**
- [ ] Pump
- [ ] Daiser
- [ ] Air
- [ ] Flowing Artesian
- **Permeability:** Yield: GPM
- **Conductivity:** PH
- **Temperature of water:** N/A
- **Flow rate:** Artesian flow found 20 ft.
- **Water analysis done:** [ ] Yes [ ] No
- **Illy from:**
- **Depth of strata analyzed:** From 70 ft. to 8 in. ft.

---

(9) **LOCATION OF HOLE by legal description:**
- **County:** Multnomah
- **Latitude:**
- **Longitude:**
- **TOWNSHIP:** 15
- **S or R Range:** E
- **W or W. WM.:**
- **SECTION:** 15
- **NE 1/4 NE 1/4
- **TAX LOT:**
- **LOT:**
- **BLOCK:**
- **SUBDIVISION:**
- **Street Address of Well (or nearest address):** 7955 Sw Macadam Ave Portland, OR

---

(10) **STATIC WATER LEVEL:**
- **Artesian pressure:** N/A ft. below land surface
- **Date:** July 27, 2001

---

(11) **SUBSURFACE LOG:**
- **Ground Elevation:**

---

(12) **ABANDONMENT LOG:**

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Patch</td>
<td>0</td>
<td>8 in.</td>
<td>N/A</td>
</tr>
<tr>
<td>Bast Chips</td>
<td>8 in.</td>
<td>20</td>
<td>40 #5</td>
</tr>
</tbody>
</table>

---

**Date Started:** July 27, 2001  
**Date Completed:** July 27, 2001

---

**Professional Certification**

(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

**License or Registration Number:** 10,448

**Signed:** B. R. Garrett  
**Date:** July 27, 2001

**Affiliation:** CASCADE DRILLING, INC. - OREGON

---

**THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK**

**ORILLIO**

**ORIGINAL:** WATER RESOURCES DEPARTMENT  
**FIRST COPY:** CONSTRUCTOR  
**SECOND COPY:** CUSTOMER
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(Water Resources Dept., Salem, Oregon)

(1) OWNER/PROJECT:
Name: Jim OIl
Address: 3377 W. Commodore Way
City: Seattle, State: WA, Zip: 98199

(2) TYPE OF WORK:
□ New □ Depletion □ Alteration (repair/recondition) □ Abandonment

(3) CONSTRUCTION:
□ Rotary Air □ Hand Auger □ Hollow Stem Auger
□ Rotary Mud □ Cable Tool □ Push Probe □ Other

(4) TYPE OF HOLE:
□ Uncased Temporary □ Cased Permanent
□ Uncased Permanent □ Slope Stability □ Other
□ Other

(5) USE OF HOLE: Check Soil Quality

(6) BORE HOLE CONSTRUCTION:
Special Construction approval □ Yes □ No
Depth of Completed Hole: 75 ft.

<table>
<thead>
<tr>
<th>Hole Seal</th>
<th>Diameter</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7&quot;</td>
<td>0&quot;</td>
<td>25&quot;</td>
</tr>
</tbody>
</table>

Backfill placed from 7" ft to 25" ft. Material: Beat Cheps
Filter Pack placed from 25" to ___ ft. Size of pack: N/A

(7) CASING/SCREEN:
Diameter | From | To | Gauge Steel | Plastic | Welded | Threaded |
Casing: N/A

Screen: N/A

(8) WELL TEST:
□ Pump □ Bailer □ Air □ Flowing Artesian
Permeability: ___________ Yield: ___________ GPM: ___________
Conductivity: ___________ pH: ___________
Temperature of water: ___ °F, Depth artesian flow found: ___ ft.
Was water analysis done? □ Yes □ No
By whom? ____________________________
Depth of strata analyzed: From ___ ft to ___ ft.
Remarks: ____________________________

(9) LOCATION OF HOLE by legal description:
County: Multnomah
Latitude: ___________ Longitude: ___________
Township: 15 N or S Range: 16 E or W, WM.
Section: 15 NW 1/4 NE 1/4
Tax Lot: Lot __ Block: __ Subdivision: __
Street Address (Well or nearest address): 5855 SW Macadam Ave, Portland, OR
Map with location identified must be attached

(10) STATIC WATER LEVEL:
76.5 ft. below land surface. Date: July 27, 2001
Artesian pressure: ___________ lb. per square inch. Date: ___________

(11) SUBSURFACE LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASPHALT PATCH</td>
<td>0&quot;</td>
<td>8&quot;</td>
<td>25&quot;</td>
</tr>
<tr>
<td>ASPHALT BIT</td>
<td>0&quot;</td>
<td>8&quot;</td>
<td>25&quot;</td>
</tr>
</tbody>
</table>

Date Started: July 27, 2001 Date Completed: July 27, 2001

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASPHALT PATCH</td>
<td>0&quot;</td>
<td>8&quot;</td>
<td>50 #3</td>
</tr>
</tbody>
</table>

Date Started: July 27, 2001 Date Completed: July 27, 2001

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed: ____________________________ Date: July 27, 2001

License or Registration Number: 10413
Affiliation: CASCADE DRILLING, INC. OREGON
STATE OF OREGON
GEOTECHNICAL HOLE REPORT.
(as required by OAR 690-240-035)

(1) OWNER/PROJECT: 
Name: Roger Pollock
Address: 12532 S.W. Hasselmann Ave.
City: Portland
State: OR
Zip: 97219

(2) TYPE OF WORK
□ New □ Deepening □ Alteration (repair/recondition) X □ Abandonment

(3) CONSTRUCTION:
□ Rotary Air □ Hand Auger □ Hollow Stem Auger
□ Rotary Mud □ Cable Tool □ Push Probe □ Other

(4) TYPE OF HOLE:
□ Uncased Temporary □ Cased Permanent
□ Uncased Permanent □ Slope Stability □ Other

(5) USE OF HOLE:
X Soil Samples

(6) BORE HOLE CONSTRUCTION:
Special Construction approval □ Yes □ No. Depth of Completed Hole __________ ft.

HOLE
Diameter From To Material From To Sacks or pounds
__ 0 _ __ _ _ _

SEAL

Backfill placed from _______ ft. to _______ ft. Material
Filter Pack placed from _______ ft. to _______ ft. Size of pack

(7) CASING/SCREEN:
Casing: _______ ft. Material
Screen: _______ ft. Material
Slot size:

(8) WELL TEST:
□ Pump □ Bailer □ Air □ Flowing Artesian Permeability Yield GPM
Conductivity__________ Temperature of water _______°F Depth artesian flow found _______ ft.
Was water analysis done? □ Yes □ No
By whom?
Depth of strata analyzed. From _______ ft. to _______ ft.
Remarks:

(9) LOCATION OF HOLE by legal description:
County Multnomah
Latitude ________________
Longitude ________________
 Township _______ N _______ S Range _______ E or W WM.
 Section _______ NE _______ SW _______ SE _______ NW _______
 Tax Lot _______ Lot _______ Block _______ Subdivision _______
Address of Well (or nearest address) _______

Map with location identified must be attached

(10) STATIC WATER LEVEL:
14 ft. below land surface. Date 8/28/01
Artesian pressure _______ lb. per square inch. Date

(11) SUBSURFACE LOG:
Ground Elevation

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravels &amp; Sands</td>
<td>0</td>
<td>20</td>
<td>19</td>
</tr>
</tbody>
</table>

Date Started 8/28/01 Date Completed 8/28/01

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bricklin</td>
<td>0</td>
<td>20</td>
<td>3165</td>
</tr>
</tbody>
</table>

(Date of Gross Receipt), Date 9/25/2001

WATER RESOURCES DEPT.
SALEM, OREGON

Date started 8/28/01 Date Completed 8/28/01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon’s geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10357

Signed _______ Date 8/28/01

Affiliation Geo-Tech

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINA L - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER
RECEIVED
SEP 25 2001
WATER RESOURCES DEPT.
SALEM, OREGON
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

(1) OWNER/PROJECT:
Hole Number P-4
Name: Roger Polack
Address: 6328 S.W. Macadam Ave
City: Portland
State: OR
Zip: 97219

(2) TYPE OF WORK
[X] Abandonment
[ ] Deepening
[ ] Alteration (repair/recondition)
[ ] Rotary Air
[ ] Rotary Mud
[ ] Hand Auger
[ ] Cable Tool
[ ] Hollow Stem Auger
[ ] Push Probe
[ ] Other

(3) CONSTRUCTION:

(4) TYPE OF HOLE:
[X] Uncased Temporary
[ ] Cased Permanent
[ ] Uncased Permanent
[ ] Slope Stability
[ ] Other

(5) USE OF HOLE:
Soil Samples

(6) BORE HOLE CONSTRUCTION:
Special Construction approval: [X] Yes
No
Depth of Completed Hole: 20 ft.

HOLE
Diameter From To Material From To Sacks or pounds

SEAL

Backfill placed from _____ ft. to _____ ft. Material
Filter Pack placed from _____ ft. to _____ ft. Size of pack

(7) CASING/SCREEN:
Casing:

Screen:

Slot size

(8) WELL TEST:

Pump
Bailer
Air
Flowing Artesian

Permeability

Yield

GPM

Conductivity

Temperature of water

°F/C

Depth artesian flow found

ft.

Was water analysis done? [X] Yes
[ ] No

By whom?

Depth of strata analyzed. From _____ ft. to _____ ft.

Remarks:

(9) LOCATION OF HOLE by legal description:
County: Multnomah
Latitude

Longitude

Township: N of Range: E or W WM.
Section: 30

NE

1/4

1/4

Tax Lot: 520

Lot

Block

Subdivision

Street Address of Well (or nearest address)

Map with location identified must be attached

(10) STATIC WATER LEVEL:
19 ft. below land surface. Date 8/28/01

Artesian pressure
lb. per square inch. Date

(11) SUBSURFACE LOG:

Material Description
Gravels + Sands 0 20 19

Ground Elevation

Date Started 8/28/01 Date Completed 8/28/01

(12) ABANDONMENT LOG:

Material Description
Bentonite 0 20 31 165

RECEIVED
SEP 25 2001

WATER RESOURCES DEPT.
SALEM, OREGON

Date started 8/28/01 Date Completed 8/28/01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number: 10357

Signed

Date: 9/28/01

Affiliation: Geo-Tec Explorations

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAl - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER
RECEIVED
SEP 25 2001
WATER RESOURCES DEPT.
SALEM, OREGON
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-340-035)

(1) OWNER/PROJECT: B 18
Name: DOT Och 2
Address: 5442 S.W. Westgat Dr. Sk835
City: Portland State: OR Zip: 97221

(2) TYPE OF WORK
☐ New ○ Deepening ☐ Alteration (repair/condition) ☑ Abandonment

(3) CONSTRUCTION:
☐ Rotary Air ☐ Hand Auger ☑ Hollow Stem Auger
☐ Rotary Mud ☐ Cable Tool ☐ Push Probe ☐ Other

(4) TYPE OF HOLE:
☐ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☐ Slope Stability ☐ Other

(5) USE OF HOLE:
Geotechnical Study

(6) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☐ No
Depth of Completed Hole: 20 ft.

(7) CASING/SCREEN:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 1/4</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

Seal

Material: Sand

SWL: 0

Date Started: 10/1/01 Date Completed: 10/1/01

(8) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability: Yield: GPM
Conductivity: PH
Temperature of water: °F Depth artesian flow found ft.
Was water analysis done? ☐ Yes ☐ No

By whom?

Depth of strata analyzed: From ft. to ft.

Remarks:

(9) LOCATION OF HOLE by legal description:
County: Multnomah
Township: N of S Range: 15 W 1/4 N 1/4
Tax Lot: 400 Lot: 0 Block: 5 Subdivision: SW Portlan

Map with location identified must be attached

(10) STATIC WATER LEVEL:
Artesian pressure: lb. per square inch. Date:

(11) SUBSURFACE LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>0</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Date Started: 10/1/01 Date Completed: 10/1/01

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotechnite</td>
<td>0</td>
<td>20</td>
<td>0</td>
</tr>
</tbody>
</table>

Date started: 10/1/01 Date Completed: 10/1/01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon’s geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed: License or Registration Number: 04462
Affiliation: Date: 10/1/01

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

(1) OWNER/PROJECT: ODOT Dist. 2
Hole Number: B-20

(2) TYPE OF WORK:
X New [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) CONSTRUCTION:
[ ] Rotary Air [ ] Hand Auger [ ] Hollow Stem Auger
[ ] Rotary Mud [ ] Cable Tool [ ] Push Probe [ ] Other

(4) TYPE OF HOLE:
[ ] Uncased Temporary [ ] Cased Permanent
[ ] Uncased Permanent [ ] Slope Stability [ ] Other

(5) USE OF HOLE:
Geotechnical Shaly

(6) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [ ] No
Depth of Completed Hole 20 ft.

<table>
<thead>
<tr>
<th>HOLE Diameter</th>
<th>From</th>
<th>To</th>
<th>Material From</th>
<th>To</th>
<th>Sacks or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 1/2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Backfill placed from ft. to ft. Material
Filter Pack placed from ft. to ft. Size of pack

(7) CASINGS/SCREEN:

<table>
<thead>
<tr>
<th>Casing Diameter</th>
<th>From</th>
<th>To</th>
<th>Gauge Steel</th>
<th>Plastic</th>
<th>Welded</th>
<th>Threaded</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Screen Diameter</th>
<th>From</th>
<th>To</th>
<th>Slot size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(8) WELL TEST:

<table>
<thead>
<tr>
<th>Pump</th>
<th>Bailer</th>
<th>Air</th>
<th>Flowing Artesian</th>
</tr>
</thead>
</table>

Permeability: [ ]
Yield: [ ] GPM
Conductivity: [ ]
Temperature of water: [ ]
F/C Depth artesian flow found ft.
Was water analysis done? [ ] Yes [ ] No
By whom?
Depth of strata analyzed: From ft. to ft.
Remarks:

(9) LOCATION OF HOLE by legal description:
County: [ ] Township [ ] Section [ ] Lot [ ] Block [ ] Subdivision
Towrap: [ ] Range: [ ] 1/4 [ ] 1/4
Tax Lot: [ ] 1/4 [ ] 1/4
Street Address of Well (or nearest address): [ ]

Map with location identified must be attached

(10) STATIC WATER LEVEL:
Below land surface: Date
Artesian pressure: [ ] lb. per square inch. Date

(11) SUBSURFACE LOG:

Ground Elevation

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos Felt</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date Started 10/1/01 Date Completed 10/1/01

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rebarite</td>
<td>0</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Date started 10/1/01 Date Completed 10/1/01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed: [ ]
License or Registration Number: 10442
Date: 10/1/01
Affiliation:

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 659-240-003)

(1) OWNER/PROJECT: Hole Number B-2
Name William H. Lundering Associates
Address 1220 NE Flanders St.
City Portland State OR Zip 97232

(2) TYPE OF WORK
☑ New ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) CONSTRUCTION:
☐ Rotary Air ☐ Hand Auger ☐ Hollow Stem Auger
☑ Rotary Mud ☐ Cable Tool ☐ Push Probe ☐ Other

(4) TYPE OF HOLE:
☑ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☐ Slope Stability ☐ Other

(5) USE OF HOLE:
Geotechnical Study

(6) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☑ No Depth of Completed Hole 20 ft.

HOLE SEAL
Diameter From To Material From To Sacks or pounds
5 0 20

Backfill placed from _____ ft. to _____ ft. Material ___________
Filter Pack placed from _____ ft. to _____ ft. Size of pack ___________

(7) CASING/SCREEN:
Casing: ___________
Screen: ___________
Slot size: ___________

(8) WELL TEST:
☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian
Permeability: ___________ Yield: ___________ GPM ___________
Conductivity: ___________ PH ___________
Temperature of water: ___________ °F/°C Depth artesian flow found ___________ ft.
Was water analysis done? ☐ Yes ☐ No
By whom? ___________
Depth of strata analyzed: From _____ ft. to _____ ft.
Remarks: ___________

(9) LOCATION OF HOLE by legal description:
County ___________ Latitude ___________
Township ___________ N or S Range ___________ E or W WM.
Section ___________ Sec 1/4 N 1/4 W 1/4
Tax Lot ___________ Lot ___________ Block ___________ Subdivision ___________
Street Address of Well (or nearest address): ___________

Map with location identified must be attached

(10) STATIC WATER LEVEL:
21 ft. below land surface. Date 11/28/01
Artesian pressure ___________ lb. per square inch. Date ___________

(11) SUBSURFACE LOG:
Ground Elevation

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>0</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Basalt</td>
<td>0.4</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Sandstone/cobblestone</td>
<td>1.5</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Sandstone/cobblestone</td>
<td>4</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Sandstone/cobblestone</td>
<td>18</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Date Started 11/28/01 Date Completed 11/28/01

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentonite</td>
<td>0</td>
<td>30</td>
<td>950 lbs</td>
</tr>
</tbody>
</table>

Date started 11/28/01 Date Completed 11/28/01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed ___________________________ Date ___________
License or Registration Number ___________
Affiliation ___________________________
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

(1) OWNER/PROJECT: Hole Number: B-1
Name: Williamette Landfill Associates, Inc.
Address: 1325 NW Flocene St.
City: Portland
State: OR
Zip: 97209

(2) TYPE OF WORK
[ ] New [ ] Alteration (repair/recondition) [X] Abandonment

(3) CONSTRUCTION:
[ ] Rotary Air [ ] Hand Auger [ ] Hollow Stem Auger
[ ] Rotary Mud [ ] Cable Tool [ ] Push Probe [ ] Other

(4) TYPE OF HOLE:
[ ] Uncased Permanent [X] Cased Permanent
[ ] Uncased Permanent [ ] Slope Stability [ ] Other

(5) USE OF HOLE:
Geotechnical Study

(6) BORE HOLE CONSTRUCTION:
Special Construction approval: [ ] Yes [X] No
Depth of Completed Hole: 35 ft.

<table>
<thead>
<tr>
<th>HOELE</th>
<th>SEAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter: From</td>
<td>To</td>
</tr>
<tr>
<td>Material: From</td>
<td>To</td>
</tr>
<tr>
<td>Sacks or pounds</td>
<td></td>
</tr>
</tbody>
</table>

Backfill placed from ft. to ft. Material ___________ Filter Pack placed from ft. to ft. Size of pack ___________

(7) CASING/SCREEN:

<table>
<thead>
<tr>
<th>Casing:</th>
<th>Diameter</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welded</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threaded</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Screen:</th>
<th>Diameter</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Welded</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Threaded</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Slot size ___________

(9) LOCATION OF HOLE by legal description:
County: Multnomah
Towship: 1N
Range: 1E or W WM.
Section: 15S
1/4 N 1/4
Tax Lot: 100
Lot: 1
Block: 1
Subdivision: ___________

Street Address of Well (or nearest address):
5310 SW Macadam

Map with location identified must be attached

(10) STATIC WATER LEVEL:
5 ft. below land surface.
Date: 11/28/01
Artesian pressure ___________ lb. per square inch.
Date ___________

(11) SUBSURFACE LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silty Gravel, Cobble</td>
<td>0</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>gravel</td>
<td>8</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Sand, Silty Gravel</td>
<td>12</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Sand, Gravel, Cobble</td>
<td>16</td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

Date Started: 11/28/01
Date Completed: 11/28/01

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>35</td>
<td></td>
</tr>
</tbody>
</table>

Date started: 11/28/01
Date Completed: 11/28/01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number: 10033
Signed: Steven Lowery
Date: 12/28/01
Affiliation: ___________

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL: WATER RESOURCES DEPARTMENT
FIRST COPY - CONSTRUCTOR
SECOND COPY - CUSTOMER
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 650-340-035)

(1) OWNER/PROJECT:  Hole Number 341
Name  Sweet Food Company
Address  8944 S C Powell Boulevard
City  Portland  State  OR  Zip 97224

(2) TYPE OF WORK:
☐ New  ☐ Deepening  ☐ Alteration (repair/condition)  ☐ Abandonment

(3) CONSTRUCTION:
☐ Rotary Air  ☐ Hand Auger  ☐ Hollow Stem Auger
☐ Rotary Mud  ☐ Cable Tool  ☐ Push Probe  ☐ Other

(4) TYPE OF HOLE:
☐ Uncased Temporary  ☐ Cased Permanent
☐ Uncased Permanent  ☐ Slope Stability  ☐ Other

(5) USE OF HOLE:
Geotechnical Study

(6) BORE HOLE CONSTRUCTION:
Special Construction approval  ☐ Yes  ☐ No  Depth of Completed Hole 30 ft.

HOLE Diameter  From  To  Material  From  To  Sacks or pounds
[Table with rows for material and measurements]

Backfill placed from ______ ft. to ______ ft. Material ______
Filter Pack placed from ______ ft. to ______ ft. Size of pack ______

(7) CASING/SCREEN:
Casing:
[Table with columns for diameter, from, to, gauge steel, plastic, welded, threaded]
Screen:
[Table with columns for diameter, from, to, gauge steel, plastic, welded, threaded]
Slot size ______

(8) WELL TEST:
☐ Pump  ☐ Bailer  ☐ Air  ☐ Flowing Artesian
Permeability ______ Yield ______ GPM ______
Conductivity ______ pH ______
Temperature of water ______ °F  Depth artesian flow found ______ ft.
Was water analysis done?  ☐ Yes  ☐ No
By whom? ______
Depth of strata analyzed. From ______ ft. to ______ ft.
Remarks: ______

(9) LOCATION OF HOLE by legal description:
County Multnomah  Latitude ______  Longitude ______
Township ______  N of S  Range ______  E or W WM.
Section ______  S/NE  1/4  SE  1/4
Tax Lot ______  Lot ______  Block ______ Subdivision ______
Street Address of Well (or nearest address) ______
Map with location identified must be attached

(10) STATIC WATER LEVEL:
Artesian pressure ______  Date ______
Below land surface ______  Date ______

(11) SUBSURFACE LOG:
[Table with columns for material description, from, to, SWL, and ground elevation]

Material Description  From  To  SWL
Oregon Clay Silt+  0  3
Sand & Gravels  3  20

Date Started 12-17-01  Date Completed 12-19-01

(12) ABANDONMENT LOG:
[Table with columns for material description, from, to, and sacks or pounds]

Material Description  From  To  Sacks or Pounds
Gravel  0  30  $3,456

RECEIVED
JAN 1-6-2002
WATER RESOURCES DEPT.
SALEM, OREGON
Date started 12-17-01  Date Completed 12-19-01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).
I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10453
Signed ______  Date 01-11-02
Affiliation ______

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL - WATER RESOURCES DEPARTMENT  FIRST COPY - CONSTRUCTOR  SECOND COPY - CUSTOMER
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-035)

(1) OWNER/PROJECT:  Hole Number 8H-S
Name: Portland Fuel Company
Address: 11934 S.E. Powell Boulevard
City: Portland
State: OR
ZIP: 97262

(2) TYPE OF WORK:
☐ New  ☐ Deepening  ☐ Alteration (repair/recondition)  ☑ Abandonment

(3) CONSTRUCTION:
☐ Rotary Air  ☐ Hand Auger  ☐ Hollow Stem Auger
☐ Rotary Mud  ☐ Cable Tool  ☐ Push Probe  ☐ Other

(4) TYPE OF HOLE:
☑ Uncased Temporary  ☐ Cased Permanent
☐ Uncased Permanent  ☐ Slope Stability  ☐ Other

(5) USE OF HOLE:
Geostechnical Study

(6) BORE HOLE CONSTRUCTION:
Special Construction approval: ☐ Yes  ☐ No  Depth of Completed Hole: 30 ft.

HOE

<table>
<thead>
<tr>
<th>Diameter</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0</td>
<td>30</td>
</tr>
</tbody>
</table>

SEAL

Material: From | To | Sacks or pounds

Backfill placed from —ft. to —ft. Material:
Filter Pack placed from —ft. to —ft. Size of pack:

(7) CASINGS/SCREEN:

Casing:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>From</th>
<th>To</th>
<th>Gauge Steel</th>
<th>Plastic</th>
<th>Welded</th>
<th>Threaded</th>
</tr>
</thead>
<tbody>
<tr>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Screen:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>From</th>
<th>To</th>
<th>Gauge Steel</th>
<th>Plastic</th>
<th>Welded</th>
<th>Threaded</th>
</tr>
</thead>
<tbody>
<tr>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Slot size:

(8) WELL TEST:

☑ Pump  ☐ Bailer  ☐ Air  ☐ Flowing Artesian

Permeability: Yield GPM

Conductivity PH

Temperature of Water: °F  Depth artesian flow found: —ft.

Was water analysis done?  ☐ Yes  ☐ No  By whom: —

Depth of strata analyzed: From —ft. to —ft.

Remarks:

(9) LOCATION OF HOLE by legal description:
County: Multnomah  Latitude: Longitude:
Township: N of S Range: E or W WM.
Section: 15  6W  1/2  1/4  1/4
Tax Lot: 100  Lot: 1/4  Block: Subdivision:
Street Address of Well (or nearest address): 1920 SW Macadam

Map with location identified must be attached

(10) STATIC WATER LEVEL:
ft. below land surface. Date: —
Artesian pressure: lb. per square inch. Date: —

(11) SUBSURFACE LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown-Grey Silt</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>Sandy Gravel</td>
<td>8</td>
<td>30</td>
</tr>
</tbody>
</table>

Date Started: 12-17-01  Date Completed: 12-19-01

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>0</td>
<td>30</td>
<td>8 bags</td>
</tr>
</tbody>
</table>

Date started: 12-17-01  Date Completed: 12-19-01

RECEIVED
JAN 16 2002
WATER RESOURCES DEPT.
SALEM, OREGON

Date started: 12-17-01  Date Completed: 12-19-01

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number: 10453

Signed:  Date: 01-11-02

Affiliation:

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL - WATER RESOURCES DEPARTMENT  FIRST COPY - CONSTRUCTOR  SECOND COPY - CUSTOMER
STATE OF OREGON
GEOTECHNICAL HOLE REPORT

(received by OAR 690-260-015)

WATER RESOURCES DEPT.
SALEM, OREGON

RECEIVED
MULT 65751

FEB 07 2002

(1) OWNER/PROJECT: Hole Number
Name: William He. Handley Assoc., LLC
Address: 1355 W. W. Flanders St
City: Portland
State: OR
Zip: 97224

(2) TYPE OF WORK
□ New □ Deepening □ Alteration (repair/recondition) □ Abandonment

(3) CONSTRUCTION:
□ Rotary Air □ Hand Auger □ Hollow Stem Auger
□ Rotary Mud □ Cable Tool □ Push Probe □ Other

(4) TYPE OF HOLE:
□ Uncased Temporary □ Cased Permanent
□ Uncased Permanent □ Slope Stability □ Other

(5) USE OF HOLE:
□ Soil Samples

(6) BORE HOLE CONSTRUCTION:
Special Construction approval □ Yes □ No Depth of Completed Hole 30 ft.

<table>
<thead>
<tr>
<th>HOLE</th>
<th>Diameter</th>
<th>From</th>
<th>To</th>
<th>Material</th>
<th>From</th>
<th>To</th>
<th>Sacks or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8</td>
<td>0</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Backfill placed from ft. to ft. Material
Filter Pack placed from ft. to ft. Size of pack

(7) CASINGS/SCREEN:
Casing:
Screen:
Slot size

(8) WELL TEST:
□ Pump □ Bailer □ Air □ Flushing Artesian
Permeability __________ Yield __ GPM
Conductivity PH
Temperature of water °F □ Depth Artesian flow found ft.
Was water analysis done? □ Yes □ No
By whom?
Depth of strata analyzed. From ft. to ft.
Remarks:

(9) LOCATION OF HOLE by legal description:
County _______ Township _______ Range _______ Section _______ SW______
E or W W______

(10) STATIC WATER LEVEL:
Artisan pressure __ lb. per square inch Date
Date

(11) SUBSURFACE LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bruntan Gravel</td>
<td>0</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Rocks With Sand</td>
<td>15</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Date Started 1/4/02 Date Completed 1/4/02

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentonite</td>
<td>0</td>
<td>30</td>
<td>91165</td>
</tr>
</tbody>
</table>

Date started 1/4/02 Date Completed 1/4/02

Professional Certification
(I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed __________________________ Date 2/5/04

License or Registration Number 104162

Affiliation __________________________
STATE OF OREGON
WATER RESOURCES DEPT.
SALEM, OREGON

FEB 07 2002

65752

STATE OF OREGON
WATER RESOURCES DEPT.
SALEM, OREGON

(1) OWNER/PROJECT: Hole Number 2
Name: Williamette Landing Associates, LLC
Address: 1325 N.W. Elton St.
City: Portland
State: OR
ZIP: 97209

(2) TYPE OF WORK:
[ ] New [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) CONSTRUCTION:
[ ] Rotary Air [ ] Hand Auger [ ] Hollow Stem Auger
[ ] Rotary Mud [ ] Cable Tool [ ] Push Probe [ ] Other

(4) TYPE OF HOLE:
[ ] Uncased Temporary [ ] Cased Permanent
[ ] Uncased Permanent [ ] Slope Stability [ ] Other

(5) USE OF HOLE:
Geotechnical Study

(6) BORE HOLE CONSTRUCTION:
Special Construction approval [ ] Yes [ ] No Depth of Completed Hole 30 ft

(7) CASING/SCREEN:
Casing:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brownish Gray Silt</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Gravel with Sand</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>30</td>
<td>1/65</td>
</tr>
</tbody>
</table>

(8) WELL TEST:
[ ] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian
Permeability Yield GPM
Conductivity PH
Temperature of water 48 °F Depth artesian flow found 10 ft.
Was water analysis done? [ ] Yes [ ] No
By whom?
Depth of strata analyzed. From ft. to ft.
Remarks:

(9) LOCATION OF HOLE by legal description:
County: Multnomah
Latitude: N of S
Longitude: E of W
Township: 1
Range: 1
Section: 15
Lot: 10
Lot: 10
Block: 1
Subdivision: S.W. Macaulay

Map with location identified must be attached

(10) STATIC WATER LEVEL:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brownish Gray Silt</td>
<td>0</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Gravel with Sand</td>
<td>15</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Date Started 1/14/02 Date Completed 1/14/02

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>30</td>
<td>1/65</td>
</tr>
</tbody>
</table>

Date started 1/14/02 Date Completed 1/14/02

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed

License or Registration Number: 104142
Date: 1/14/02

Affiliation:

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL – WATER RESOURCES DEPT. FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
NOV 4 2005
WATER RESOURCES DEPT
SALEM, OREGON
Hole Number B-1

(1) OWNER/PROJECT:
Name: Williamette Development Group
Address: 7735 SE Lake Rd
City: Milwaukie
State: Or
Zip: 97227

(2) TYPE OF WORK
☑ New ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) CONSTRUCTION:
☐ Rotary Air ☐ Hand Auger ☐ Hollow Stem Auger
☒ Rotary Mud ☐ Cable Tool ☐ Push Probe ☐ Other

(4) TYPE OF HOLE:
☒ Uncased Temporary ☐ Cased Permanent
☐ Uncased Permanent ☐ Slope Stability ☐ Other

(5) USE OF HOLE: Geo-Technical

(6) BORE HOLE CONSTRUCTION:
Special Construction approval ☐ Yes ☑ No
Depth of Completed Hole: 35 ft

HOLE
Diameter From To
5' 0' 35'

SEAL
Material From To Sacks or pounds

Backfill placed from 0' to 35'. Material: Bottom
Filter Pack placed from to ft. Size of pack

(7) CASING/SCREEN:
Casing:
Screen:
Slot size

(8) WELL TEST:
☐ Pump ☐ Air ☐ Flowing Artesian
Permeability: Yield: GPM
Conductivity: PH
Temperature of water: °F /°C Depth artesian flow found ft
Was water analysis done? ☐ Yes ☑ No
By whom?
Depth of water analyzed: From ft to ft.
Remarks:

(9) LOCATION OF HOLE by legal description:
County: Mult ☑ Latitude:
Township: N or S Range: NE 1/4
Section: 15 Nw 1/4 NE 1/4
Tax Lot: 500 Lot: 1 Block: Macadam Pk
Subdivision: S.50-5W

Map with location identifier must be attached

(10) STATIC WATER LEVEL:
Not Observed ft. below land surface.
Artesian pressure lb. per square inch.

(11) SUBSURFACE LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Gravel</td>
<td>1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Sandy Gravel</td>
<td>15</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Gravel</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Date Started: 10/18/05 Date Completed: 10/18/05

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Blasting Rock</td>
<td>1</td>
<td>35</td>
<td>7</td>
</tr>
</tbody>
</table>

Date started: 10/18/05 Date Completed: 10/18/05

Professional Certification
(to be signed by a licensed water supply consultant, well constructor, or Oregon registered geologist or civil engineer).
I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number: 0559
Signed: Date: 11/10/05
Affiliation: Geo Tech Explorations

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL - WATER RESOURCES DEPARTMENT  FIRST COPY - CONSTRUCTOR  SECOND COPY - CUSTOMER
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(WATER RESOURCES DEPT. SALEM, OREGON)

(1) OWNER/PROJECT: Hole Number B-6
Name: Williams Development Group
Address: 7935 SE Laird Rd
City: Milwaukie State: OR Zip: 97267

(2) TYPE OF WORK
□ New □ Deepening □ Alteration (repair/recondition) □ Abandonment

(3) CONSTRUCTION:
☐ Rotary Air □ Hand Auger □ Hollow Stem Auger
☐ Rotary Mud □ Cable Tool □ Push Probe □ Other

(4) TYPE OF HOLE:
□ Uncased Temporary □ Cased Permanent
□ Uncased Permanent □ Slope Stability □ Other

(5) USE OF HOLE: Geo-Technic

(9) LOCATION OF HOLE by legal description:
County: Mult. □ Latitude: __________
Township N of ___________________________ Range W or W WM.
Section ___________________________ Block __________ Subdivision
Street Address of Well (or nearest address): 4750 SW
Macadam Blvd
Map with location identifier must be attached

(10) STATIC WATER LEVEL:
□ Not observed below land surface. □ Artesian pressure
□ B. per square inch. □ Date ________

(11) SUBSURFACE LOG:

Material Description | From | To | SWL
Artsalt | 0 | 4
Gravel | 1 | 3
Gravel Fill | 3 | 4.5
Sandy Gravel | 4.5 | 50
Debris | 0 | 5

Date Started 10/21/05 Date Completed 10/21/05

(12) ABANDONMENT LOG:

Material Description | From | To | Sacks & Pounds
Artsalt | 0 | 5 | 0
Bentonite Chips | 1 | 50 | 10

Date started 10/21/05 Date completed 10/21/05

Professional Certification
(to be signed by a licensed water supply or m xituring well constructor, or Oregon registered geologist or civil engineer).
I accept responsibility for the construction, artesian, or abandonment work performed during the construction date report above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number: 10599
Signed: ____________________________ Date: 11/10/05
Affiliation: Geo-Tech Explorations

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL - WATER RESOURCES DEPARTMENT FIRST COPY - CONSTRUCTOR SECOND COPY - CUSTOMER
**STATE OF OREGON**
**GEO TECHNICAL HOLE REPORT**
(as required by OAR 590-340-035)

1. **OWNER/PROJECT:**
   - **Owner:** Willamette Development Group
   - **Address:** 7235 SE Laker Rd
   - **City:** Milwaukie
   - **State:** OR
   - **Zip:** 97267

2. **TYPE OF WORK:**
   - X New
   - ® Deepening
   - ® Alteration (repair/condition)
   - ® Abandonment

3. **CONSTRUCTION:**
   - ☐ Rotary Air
   - ☐ Hand Auger
   - ☐ Hollow Stem Auger
   - ☐ Rotary Mud
   - ☐ Cable Tool
   - ® Push Probe
   - ® Other

4. **TYPE OF HOLE:**
   - □ Uncased Temporary
   - □ Cased Permanent
   - □ Uncased Permanent
   - □ Slope Stability
   - □ Other

5. **USE OF HOLE:**
   - Soil sampling

6. **BORE HOLE CONSTRUCTION:**
   - Special Construction approval X Yes ☐ No
   - Depth of Completed Hole: 20 ft

7. **HOLE**
   - Diameter: 2.100" from 0 to 20 ft

8. **SEAL**
   - Material: Gravel
   - Sacks or pounds

9. **LOCATION OF HOLE by legal description:**
   - County: Mult.
   - Township: 15N
   - Range: 25W
   - Section: 14NE
   - Lot: 700
   - Block: 1/4
   - Subdivision: SW 1/4 Macadam
   - Portland
   - Map with location identified must be attached

10. **STATIC WATER LEVEL:**
    - Not Observed ft. below land surface.
    - Date
    - Artesian pressure lb. per square inch.
    - Date

11. **SUBSURFACE LOG:**
    - Ground Elevation

12. **ABANDONMENT LOG:**
    - Date Started: 11/18/05
    - Date Completed: 11/18/05

---

**WELL TEST:**
- Pump ☐ Bailee ☐ Air ☐ Flowing Artesian
- Permeability: Yield: GPM
- Conductivity: PH
- Temperature of water: °F
- Depth artesian flow: ft
- Was water analysis done? X Yes ☐ No
- By whom?
- Depth of strata analyzed: From ft

**RECEIVED**
- Date: DEC 06 2005
- WATER RESOURCES DEPT
- SALEM, OREGON

---

**PROFESSIONAL CERTIFICATION**
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geological hole construction standards. This report is true to the best of my knowledge and belief.

**License or Registration Number:** 10548

Signed: ______________ 
Date: ____________

Affiliation: ______________

---

**THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK**

ORIGINAL - WATER RESOURCES DEPARTMENT
FIRST COPY - CONSTRUCTOR
SECOND COPY - CUSTOMER
(1) OWNER/PROJECT: Willever Development Group
Hole Number: B-14

(2) TYPE OF WORK:
- [ ] New
- [x] Deepening
- [ ] Alteration (repair/condition)
- [x] Abandonment

(3) CONSTRUCTION:
- [ ] Rotary Air
- [ ] Hand Auger
- [ ] Hollow Stem Auger
- [ ] Rotary Mud
- [ ] Cable Tool
- [x] Push Probe
- [ ] Other

(4) TYPE OF HOLE:
- [x] Uncased Temporary
- [ ] Caged Permanent
- [ ] Uncased Permanent
- [ ] Slope Stability
- [ ] Other

(5) USE OF HOLE: Soil Sample

(6) BORE HOLE CONSTRUCTION:
Special Construction approval: [ ] Yes  [ ] No
Depth of Completed Hole: 23 ft.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>From</th>
<th>To</th>
<th>Material</th>
<th>From</th>
<th>To</th>
<th>Sacks or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 1/2&quot;</td>
<td>0 ft.</td>
<td>23 ft.</td>
<td>Gravel</td>
<td>0 ft.</td>
<td>23 ft.</td>
<td>Gravel</td>
</tr>
</tbody>
</table>

Backfill placed from 0 ft. to 23 ft. Material: Gravel
Filter Pack placed from 0 ft. to 20 ft. Material: Gravel

(7) CASING/SCREEN:
Casing:
- [ ] Steel
- [ ] Plastic
- [ ] Welded
- [ ] Threaded

Screen:
- [ ] Steel
- [ ] Plastic
- [ ] Welded
- [ ] Threaded

Slot size:

(8) WELL TEST:
- [ ] Pump
- [ ] Bailor
- [ ] Air
- [ ] Flowing Artesian
Permeability:
Yield: GPM
Conductivity: PH
Temperature of water: N/A
Depth artesian flow found: ft.
Was water analysis done: [x] Yes  [ ] No
By whom?
Depth of strata analyzed: From ft. to ft.
Remarks:

(9) LOCATION OF HOLE by legal description:
- County: Mult
- Latitude: 
- Longitude: 
- Township: 1 N
- Range: 14 E
- Section: 15 NE
- Tax Lot: 508
- Lot: 1
- Block: A
- Subdivision: Portland
- Street Address of Well (or nearest address): 4850 SW Macadam

Map with location identified must be attached

(10) STATIC WATER LEVEL:
- Observed ft. below land surface: Date
- Artesian pressure: lbs. per square inch: Date

(11) SUBSURFACE LOG:
Ground Elevation

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>SWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Sandy Silt with</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fill Material</td>
<td>Cements</td>
<td>0' 23'</td>
<td></td>
</tr>
</tbody>
</table>

Date Started: 11/9/05  Date Completed: 11/18/05

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material Description</th>
<th>From</th>
<th>To</th>
<th>Sacks or pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>0'</td>
<td>1'</td>
<td></td>
</tr>
<tr>
<td>Bentonite Chips</td>
<td>1'</td>
<td>23'</td>
<td>26</td>
</tr>
</tbody>
</table>

Date started: 11/9/05  Date Completed: 11/18/05

Professional Certification
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number: 10548

Signed: Date: 12/14/05
Affiliation: Boett Longyear Company

RECEIVED
DEC 06 2005

WATER RESOURCES DEPT.
Salem, Oregon

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

ORIGINAL – WATER RESOURCES DEPARTMENT  FIRST COPY – CONTRACTOR  SECOND COPY – CUSTOMER
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 650-240-0035)

(1) OWNER/PROJECT
Hole Number: B-1

First Name: Last Name:
Company: Willamette Waterfront Limited Partnership
Address: 2545 SW Terwilliger #1222
City: Portland, State: OR, Zip: 97201

(2) TYPE OF WORK
- New
- Deepening
- Abandonment
- Alteration (repair/recondition)

(3) CONSTRUCTION
- Rotary Air
- Hard Auger
- Hollow stem auger
- Rotary Mud
- Cable
- Push Probe
- Other

(4) TYPE OF HOLE:
- Uncased Temporary
- Cased Permanent
- Uncased Permanent
- Slope Stability
- Other

(5) USE OF HOLE
Soil Samples

(6) BORE HOLE CONSTRUCTION
Depth of Completed Hole: 40.00 ft.

<table>
<thead>
<tr>
<th>BORE HOLE</th>
<th>Special Standard</th>
<th>Attach copy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dia</td>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>Seal</td>
<td>From</td>
<td>To</td>
</tr>
<tr>
<td>sacks/</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Backfill placed from | 0 ft. to | 40 ft. Material: Bentonite |
| Filter pack from | to | ft. Material: Size |

(7) CASING/SCREEN

<table>
<thead>
<tr>
<th>Casing/Screen</th>
<th>Dia</th>
<th>+</th>
<th>From</th>
<th>To</th>
<th>Gauge</th>
<th>Stl</th>
<th>Plate</th>
<th>Wild</th>
<th>Thrld</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(8) WELL TESTS

<table>
<thead>
<tr>
<th>Pump</th>
<th>Baijer</th>
<th>Air</th>
<th>Flowing Artesian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield gal/min</td>
<td>Drawdown</td>
<td>Drill stem/Pump depth</td>
<td>Duration (hr)</td>
</tr>
</tbody>
</table>

| Supervising Geologist/Engineer |

| Water quality concerns? | Yes | No |
| From | To |

(9) LOCATION OF HOLE (legal description)
County: Multnomah
Twp: 1.00 S
Sec: 15 NW
Lat: 0°0'0" or DMS or DD
Long: 0°0'0" or DMS or DD
Nearest address: 5310 SW Macadam Ave, Portland, OR 97239

(10) STATIC WATER LEVEL

<table>
<thead>
<tr>
<th>Date</th>
<th>SWL (psi)</th>
<th>SWL (ft)</th>
</tr>
</thead>
</table>

Existing Well / Predeepening
Completed Well

Flowing Artesian?

WATER BEARING ZONES

| Depth water was first found |

SWL Date

From | To |

Est Flow

<table>
<thead>
<tr>
<th>SWL Date</th>
<th>From</th>
<th>To</th>
<th>Est Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWL (psi)</td>
<td>+</td>
<td>SWL (ft)</td>
<td></td>
</tr>
</tbody>
</table>

(11) SUBSURFACE LOG

Ground Elevation

| Material |

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt &amp; Clay</td>
<td>0</td>
</tr>
<tr>
<td>Loose Sand &amp; Gravel</td>
<td>14.5</td>
</tr>
<tr>
<td>Cemented Gravel</td>
<td>26</td>
</tr>
</tbody>
</table>

Date Started: 02-09-2006
Completed: 02-09-2006

(12) ABANDONMENT LOG:

| Material |

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Amt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bentonite</td>
<td>0</td>
<td>40</td>
</tr>
</tbody>
</table>

Date Started: 02-08-2006
Completed: 02-08-2006

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number: 10076
Electronically Submitted
First Name: Brad
Last Name: Wieberdink
Affiliation: Boart Longyear Company

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version: 0.35
Map of Hole

N

Boundary

Macadam

Gate

181346

181598

181346

181347
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

MULT 84614
07-14-2006

(1) OWNER/PROJECT
Hole Number B-6

First Name ____________________________ Last Name ____________________________
Company: Oregon Medical Association
Address: 5210 SW CORBETT AVE
City: PORTLAND State: OR Zip: 97239

(2) TYPE OF WORK
☑ New  ☐ Deepening  ☐ Abandonment
☐ Alteration (repair/recondition)

(3) CONSTRUCTION
☐ Rotary Air  ☐ Hand Auger  ☐ Hollow stem auger
☐ Rotary Mud  ☐ Cable  ☑ Push Probe
☐ Other

(4) TYPE OF HOLE:
☑ Uncased Temporary  ☐ Cased Permanet
☑ Uncased Permanent  ☐ Slope Stability
☐ Other

(5) USE OF HOLE

☐ Soil Samples

(6) BORE HOLE CONSTRUCTION
Special Standard [Attach copy]
Depth of Completed Hole: 20.00 ft.

<table>
<thead>
<tr>
<th>BORE HOLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Da</td>
</tr>
<tr>
<td>20</td>
</tr>
</tbody>
</table>

Material: Sand

SEAL

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Amt</th>
<th>lbs</th>
</tr>
</thead>
</table>

Backfill placed from 0 ft. to 20 ft. Material: Bentonite
Filter pack from 0 ft. to 20 ft. Material: Bentonite

(7) CASING/SCREEN

Casing Screen

Dia:

From | To | Gauge | Stl | Plate | Wid | Thrd |
| --- | --- | --- | --- | --- | --- | --- |

(8) WELL TESTS

☐ Pump  ☐ Bailer  ☐ Air  ☐ Flowing Artesian

Yield gal/min: 10
Drawdown: 10
Drill stem/Pump depth: 20
Duration (hr): 10

Temperature: 10°F
Lab analysis: Yes
By ____________________________

Supervising Geologist/Engineer

Water quality concerns? ☐ Yes (describe below)

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Description</th>
<th>Amount</th>
<th>Units</th>
</tr>
</thead>
</table>

(9) LOCATION OF HOLE (legal description)

County: Multnomah  Twp: 15  S N/S  Range: 15  E

<table>
<thead>
<tr>
<th>Lat</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>0°</td>
</tr>
</tbody>
</table>

DMS or DD

Lot 4000

(10) STATIC WATER LEVEL

Existing Well / Predeepening

Completed Well

SWL Date | From | To | Est Flow | SWL (psig) | + SWL (ft) |
| --- | --- | --- | --- | --- | --- |

Flowing Artesian?

Water bearing zones

Depth water was first found

SWL Date | From | To | Est Flow | SWL (psig) | + SWL (ft) |
| --- | --- | --- | --- | --- | --- |

(11) SUBSURFACE LOG

Ground Elevation

Material

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

(12) ABANDONMENT LOG:

| Sacks/ |
| --- | --- |
| Bentonite | 0 | 20 |

Date Started: 06-14-2006  Completed: 06-14-2006

Professional Certification (to be signed by an Oregon licensed water well constructor, or Oregon registered geologist or civil engineer):

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number: 10548  Date: ____________________________

Electronically Submitted

First Name: Marc  Last Name: Chalora

Affiliation Geo-Tech Explorations Div. of Boart Longyear Co.

Form Version: 0.36
Map of Hole

Site Map

Sw Mitchell St

Sw Boundary St

N

Map with location identified must be attached and shall include an approximate scale and north arrow

GEOTECHNICAL HOLE REPORT -
MULT 84614
07-14-2006
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

MULT 85062
08-17-2006

(1) OWNER/PROJECT
Hole Number: B-2

(2) TYPE OF WORK
☐ New
☐ Deepening
☐ Abandonment
☐ Alteration (repair/recondition)

(3) CONSTRUCTION
☐ Rotary Air
☐ Hand Auger
☐ Hollow stem auger
☐ Rotary Mud
☐ Cable
☐ Push Probe
☐ Other:

(4) TYPE OF HOLE:
☐ Uncased Temporary
☐ Cased Permanent
☐ Uncased Permanent
☐ Slope Stability
☐ Other:

(5) USE OF HOLE
SOIL SAMPLES

(6) BORE HOLE CONSTRUCTION
 Depth of Completed Hole: 30.00 ft.

<table>
<thead>
<tr>
<th>Dia</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0</td>
<td>30</td>
</tr>
</tbody>
</table>

Bore Hole Seal:

<table>
<thead>
<tr>
<th>Material</th>
<th>From</th>
<th>To</th>
<th>Amt</th>
</tr>
</thead>
</table>

Backfill placed from 0 ft. to 30 ft. Material: BENTONITE

Filter pack from ft. to ft. Material: Size

(7) CASING/SCREEN
Casing Screen Dia + From To Gauge Stl Plst Wld Thrd

(8) WELL TESTS
☐ Pump
☐ Bailer
☐ Air
☐ Flowing Artesian

Yield gal/min: Drawdown: Drill stem/Pump depth: Duration(hr):

Temperature: °F
Lab analysis: Yes
By

Supervising Geologist/Engineer
Water quality concerns? ☐ Yes (describe below)
Description: Amount: Units

(9) LOCATION OF HOLE (legal description)
County: Multnomah
Twp: 1.00 W
N/S: 1/4 NW
Range: 1.00 E
E/W: 1/4 NW
See: 15 NE
Lot: 501
Tax Map Number: Lot
Lat: 0 ° 0 " or DMS or DD
Long: 0 ° 0 " or DMS or DD
Street address of hole: 6949 SW MACADEM AVE, PORTLAND, OR 97239
Nearest address:

(10) STATIC WATER LEVEL

Existing Well / Predeepening
Completed Well

Flowing Artesian?

WATER BEARING ZONES
Depth water was first found

<table>
<thead>
<tr>
<th>SWL Date</th>
<th>From</th>
<th>To</th>
<th>Flow Rate</th>
<th>SWL (psi)</th>
</tr>
</thead>
</table>

(11) SUBSURFACE LOG
Ground Elevation

<table>
<thead>
<tr>
<th>Material</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
</table>

Date Started: 07-28-2006
Completed: 07-28-2006

(12) ABANDONMENT LOG:

<table>
<thead>
<tr>
<th>Material</th>
<th>From</th>
<th>To</th>
<th>Amt</th>
<th>lbs</th>
</tr>
</thead>
</table>

Date Started: 07-28-2006
Completed: 07-28-2006

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, or Oregon registered geologist or civil engineer).

I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number: 10511
Date: Electronically Submitted
First Name: PAUL
Last Name: SMITH
Affiliation: Geo-Tech Explorations a Div. of Boart Longyear Co.
Map of Hole

Site Map

N

Parking Lot

51 MacAdam Ave

61 MacAdam Ave

41949

Stu MacAdam Ave

61
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

(1) OWNER/PROJECT Hole Number
First Name Last Name
Company: Carlson Geotechnical (Owner's Rep)
Address: 7185 SW Sandburg St STE 110
City: Tigard State: OR Zip: 97223

(2) TYPE OF WORK
- New
- Deepening
- Abandonment
- Alteration (repair/recondition)

(3) CONSTRUCTION
- Rotary Air
- Rotary Mud
- Other:
- Hollow stem auger
- Cable
- Push Probe

(4) TYPE OF HOLE:
- Drilled Temporary
- Uncased Permanent
- Cased Permanent
- Slope Stabilization
- Other:

(5) USE OF HOLE
Geo-Tech

(6) BORE HOLE CONSTRUCTION
Depth of Completed Hole: 30 ft

<table>
<thead>
<tr>
<th>Dia</th>
<th>From</th>
<th>To</th>
<th>Material</th>
<th>SEAL</th>
<th>From</th>
<th>To</th>
<th>Amt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot;</td>
<td>24</td>
<td>30</td>
<td>3½ hole plug</td>
<td>30</td>
<td>0</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Backfill placed from 30 ft to 0 ft Material: 3½ hole plug
Filter pack from 30 ft to 0 ft Material: 3½ hole plug

(7) CASING/SCREEN
Casing: None
Screen Dia: 

From | To | Gauge | Std | Plts | Wld | Thrds |
|-----|----|------|-----|-----|-----|-------|

(8) WELL TESTS
- Pump
- Buiter
- Air
- Flowing Artesian

Yield gal/min | Drawdown | Drill stem/Pump depth | Duration (hr) |
|--------------|----------|----------------------|---------------|

Temperature °F | Lab analysis | Yes

Supervising Geologist/Engineer
Water quality concerns? Yes (describe below)

Date: SEP 1, 2007

(9) LOCATION OF HOLE (legal description)
County: MULTNOM/ Twp: 1.000 S N/S Range: 1.000 E E/W WM Sec: 22 NE 1/4 of the NE 1/4 Tax Lot: Raw Lot DMS or DD Lat: ° °' °" or DMS or DD Long: ° °' °" or DMS or DD

Street address of hole: In front of 0407 SW Nevada St Portland
Nearest address:

(10) STATIC WATER LEVEL
- Date SWL (psi) + SWL (ft)
- Existing Well/Predeepening
- Completed Well
- Flowing Artesian

WATER BEARING ZONES
Depth water was first found

<table>
<thead>
<tr>
<th>SWL Date</th>
<th>From</th>
<th>To</th>
<th>Est Flow</th>
<th>SWL (psi)</th>
<th>+</th>
<th>SWL (ft)</th>
</tr>
</thead>
</table>

(11) SUBSURFACE LOG
Ground Elevation

<table>
<thead>
<tr>
<th>Material</th>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top Fill</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Soil</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Sand</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>Decomposed basalts</td>
<td>24</td>
<td>30</td>
</tr>
</tbody>
</table>

Date Started: 9/12/07 Completed: 9/12/07

(12) ABANDONMENT LOG:

Material: 3½ hole plug

From | To | Amt. |
|-----|----|------|

Date Started: 9/12/07 Completed: 9/12/07

Professional Certification (to be signed by an Oregon licensed water or monitoring well constructor, or Oregon registered geologist or civil engineer).
I accept responsibility for the construction, deepening, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License/Registration Number: 10563 Date: 9/12/07
First Name: Feld Last Name: Stigall
Affiliation: Western States Soil Conservation, Inc.

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK Form Version: 0.36
STATE OF OREGON
GEOTECHNICAL HOLE REPORT
(as required by OAR 690-240-0035)

Instructions for completing this report are on the last page of this form.

(1) OWNER/PROJECT
Name: ODOT
Address: 123 NW FLANDERS 3RD FLOOR
City: PORTLAND
State: OR
Zip: 97209

(2) TYPE OF WORK
☑ New  ☐ Deepening  ☐ Alteration (repair/recondition) ☐ Abandonment

(3) CONSTRUCTION
☐ Rotary Air  ☐ Hand Auger  ☐ Hollow Stem Auger
☐ Rotary Mud  ☐ Cable Tool  ☐ Push Probe  ☐ Other

(4) TYPE OF HOLE
☐ Uncased Temporary  ☐ Cased Permanent
☐ Uncased Permanent  ☐ Slope Stability  ☐ Other

(5) USE OF HOLE
☐ GEOTECHNICAL STUDY

(6) BORE HOLE CONSTRUCTION
Special Construction approval: ☐ Yes  ☐ No
Depth of Completed Well: 50 ft.

HOLE
Diameter
From
To
Material
From
To
SEAL
Sacks or Pounds

3.5"  20  30

Backfill placed from ft. to ft. Material
Filter Pack placed from ft. to ft. Size of pack

(7) CASINGSCREEN
Casing: Diameter From To Gauge Steel Plastic Welded Threaded

Screen: Slot size:

(8) WELL TEST
☐ Pump  ☐ Bailer  ☐ Air  ☐ Flowing Artesian
Permeability: Yield: GPM
Conductivity: PH
Temperature of water: °F/°C Depth artesian flow found ft.
Was a water analysis done? ☐ Yes  ☐ No
By whom

Depth of strata analyzed. From ft. to ft.
Remarks:

(9) LOCATION OF HOLE (legal description)
County: MULTNOMAH
Tax Lot: ROW
Township: 1S N or S Range: 1E E or W WM
Section: 15 SW 1/4 SW 1/4
Lat: ° ° or ° ° (degrees or decimal)
Long: ° ° or ° ° (degrees or decimal)

Street Address of Well (or nearest address): SLAVIN RD
Map with location identified must be attached.

(10) STATIC WATER LEVEL
Artesian pressure: lb. per square inch

N/A ft. below land surface. Date

(11) SUBSURFACE LOG
Material Description
Ground Elevation

S.W.L.

From
To

5/17 gravel
11 11
Weathered Basalt
20 30

Date Started: 2/1/08  Completed: 2/1/08

(12) ABANDONMENT LOG
Material Description

Date Started: 2/1/08  Completed: 2/1/08

PROFESSIONAL CERTIFICATION
(to be signed by a licensed water supply or monitoring well constructor, or Oregon registered geologist or civil engineer)
I accept responsibility for the construction, alteration, or abandonment work performed during the construction dates reported above. All work performed during this time is in compliance with Oregon's geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

Signed

License or Registration Number: 10328
Date: 2/1/08

Affiliation: Cascade Drilling, Inc.

WATER RESOURCES DEPT
SALEM, OREGON

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

PSH Deaggregation on NEHRP BC rock
Lake_Oswego 122.663° W, 45.419 N.
Peak Horiz. Ground Accel. >= 0.1941 g
Ann. Exceedance Rate .214E-02. Mean Return Time 475 years
Mean (R,M,ε₀) = 60.7 km, 7.25, 0.34
Modal (R,M,ε₀) = 91.0 km, 9.00, 0.06 (from peak R,M bin)
Modal (R,M,ε*) = 91.0 km, 9.00, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR 10. km, deltaM=0.2, Deltaε=1.0
PSH Deaggregation on NEHRP BC rock
Lake_Oswego 122.663° W, 45.419 N.

Peak Horiz. Ground Accel.>=0.2825 g
Ann. Exceedance Rate .103E-02. Mean Return Time 975 years
Mean (R,M,ε₀) 56.1 km, 7.30, 0.61
Modal (R,M,ε₀) = 91.0 km, 9.00, 0.54 (from peak R,M bin)
Modal (R,M,ε*) = 91.0 km, 9.00, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR 10. km, deltaM=0.2, Deltaε=1.0

2008 UPDATE
PSH Deaggregation on NEHRP BC rock
SW_Waterfront_P 122.672° W, 45.494 N.
Peak Horiz. Ground Accel. >= 0.1990 g
Ann. Exceedance Rate .210E-02. Mean Return Time 475 years
Mean (R,M,ε₀) 59.3 km, 7.24, 0.34
Modal (R,M,ε₀) = 90.2 km, 9.00, 0.08 (from peak R,M bin)
Modal (R,M,ε*) = 90.2 km, 9.00, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR 10. km, deltaM=0.2, Deltaε=1.0

2008 UPDATE
PSH Deaggregation on NEHRP BC rock

SW_Waterfront_P 122.672° W, 45.494 N.

Peak Horiz. Ground Accl. >= 0.2883 g
Ann. Exceedance Rate .102E-02. Mean Return Time 975 years
Mean (R,M,ε₀) 54.6 km, 7.28, 0.61
Modal (R,M,ε₀) = 90.2 km, 9.00, 0.55 (from peak R,M bin)
Modal (R,M,ε*) = 90.2 km, 9.00, 0 to 1 sigma (from peak R,M,ε bin)
Binning: DeltaR 10. km, deltaM=0.2, Deltaε=1.0

2008 UPDATE