

APPENDIX C
BOREHOLE SUMMARY LOGS

ROCK DESCRIPTION: **ROCK TYPE**, rock color, grain size, weathered state, rock strength, structure, discontinuity spacing, discontinuity condition. [Formation Name]

Grain Size

Grain Size	Description	Criteria
Less than 0.04 inches	Fine grained	Few crystal boundaries/ grains distinguishable in the field or with a hand lens.
0.04 to 0.2 inches	Medium grained	Most crystal boundaries/ grains distinguishable with the aid of a hand lens.
Greater than 0.2 inches	Coarse grained	Most crystal boundaries/ grains distinguishable with the naked eye.

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength (Approx)
R0	Extremely Weak Rock	Indented by thumbnail	0.04 to 0.15 ksi
R1	Very Weak Rock	Specimen crumbles under sharp blow with point of geological hammer, and can be cut with a pocket knife.	0.15 to 3.6 ksi
R2	Moderately Weak Rock	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3.6 to 7.3 ksi
R3	Moderately Strong Rock	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer point.	7.3 to 15 ksi
R4	Strong Rock	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15 to 29 ksi
R5	Very Strong Rock	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 29 ksi

Degree of Weathering

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

Discontinuity Spacing

Description	Spacing of Discontinuity
Very Widely Spaced	Greater than 10 ft.
Widely Spaced	3 ft to 10 ft.
Moderately Spaced	1 ft to 3 ft.
Closely Spaced	2 inches to 12 inches
Very Closely Spaced	Less than 2 inches

Rock Type

Rock Name	Characteristics
Pyroclastic Breccia	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which <u>angular</u> pyroclasts predominate.
Agglomerate	Pyroclastic rock whose average pyroclast size exceeds 2.5 inches and in which <u>rounded</u> pyroclasts predominate.
Lapilli Tuff	Pyroclastic rock whose average pyroclast size is 0.08 to 2.5 inches.
Ash Tuff	Pyroclastic rock whose average pyroclast size is less than 0.08 inches.

$$\text{Core Recovery (\%)} = \frac{100 \times \text{Length of Core Recovered}}{\text{Length of Core Run}}$$

Discontinuity Condition

Condition	Description
Excellent Condition	Very rough surfaces, no separation, hard discontinuity wall.
Good Condition	Slightly rough surfaces, separation less than 0.05 inches, hard discontinuity wall.
Fair Condition	Slightly rough surface, separation greater than 0.05 inches, soft discontinuity wall.
Poor Condition	Slack-sided surfaces, or soft gouge less than 0.2 inches thick, or open discontinuities 0.05 to 0.2 inches.
Very Poor Condition	Soft gouge greater than 0.2 inches, or open discontinuities greater than 0.2 inches.

$$\text{RQD (\%)} = \frac{100 \times \text{Length of Core in pieces} > 4 \text{ inches}}{\text{Length of Core Barrel}}$$

References:

Washington State Department of Transportation. Geotechnical Design Manual M 46-03. September, 2005.

SOIL DESCRIPTION: SOIL TYPE, color, angularity, density, moisture. [Deposition Type]

Soil Constituent Definition

Soil Constituent	Description
Boulder	Particles of rock that will not pass through a 12 in. opening.
Cobble	Particles of rock that will pass through a 12 in. opening, but will not pass through a 3 in. opening.
Gravel	Particles of rock that will pass through a 3 in. opening, but will not pass a 0.19 in. (4.75 mm) opening.
Sand	Particles of rock that will pass through a 0.19 in. (4.75 mm) opening, but will not pass a 0.003 in. (0.075 mm) opening.
Silt	Soil that will pass through a 0.003 in. (0.075 mm) opening that is <i>non-plastic</i> or very slightly plastic and exhibits <i>little or no strength</i> when air-dried.
Clay	Soil that will pass through a 0.003 in. (0.075 mm) opening that can be made to exhibit <i>plasticity</i> (putty-like properties) within a range of water contents, and exhibits <i>considerable strength</i> when air-dried.
Organic Soil	Soil that contains enough organic particles to influence the soil properties.
Peat	Soil that is composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

Angularity Classification

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

Moisture Conditions

Moisture Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

USCS Soil Classification

Major Divisions		Group Symbol	Typical Names
Course-Grained Soils More than 50% retained on the 0.075 mm (No. 200) sieve	Gravels 50% or more of course fraction retained on the 4.75 mm (No. 4) sieve	Clean Gravels	GW Well-graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GP Poorly graded gravels and gravel-sand mixtures, little or no fines
			GM Silty gravels, gravel-sand-silt mixtures
		Sands 50% or more of course fraction passes the 4.75 (No. 4) sieve	Clean Sands
	Sands with Fines		SP Poorly graded sands and gravelly sands, little or no fines
			SM Silty sands, sand-silt mixtures
			SC Clayey sands, sand-clay mixtures
	Fine-Grained Soils More than 50% passes the 0.075 mm (No. 200) sieve	Silts and Clays Liquid Limit 50% or less	ML Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
CL Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays			
OL Organic silts and organic silty clays of low plasticity			
Silts and Clays Liquid Limit greater than 50%		MH Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
		CH Inorganic clays or high plasticity, fat clays	
		OH Organic clays of medium to high plasticity	
Highly Organic Soils		PT	Peat, muck, and other highly organic soils

Density of Cohesionless Soils

SPT N (Blows/Foot)	Relative Density
0 to 4	Very Loose
5 to 10	Loose
11 to 24	Medium Dense
25 to 50	Dense
Over 50	Very Dense

Consistency of Cohesive Soils

SPT N (Blows/Foot)	Consistency
0 to 1	Very Soft
2 to 4	Soft
5 to 8	Medium Stiff
9 to 15	Stiff
16 to 30	Very Stiff
31 to 60	Hard
Over 60	Very Hard

References:

Washington State Department of Transportation. Geotechnical Design Manual M 46-03. September, 2005.

American Society for Testing and Materials, 1985, D 2487-83, *Classification of Soils for Engineering Purposes: Annual Book of ASTM Standards*. Vol. 04.08, pp 395-408.

Borehole logs were prepared under the direction of Wyllie & Norrish Rock Engineers Inc., Project Number 03-2007. Original field logs contain detailed source information.

All colors designated in conformance with the Rock-Color Chart, Geological Society of America, 1991

Rock strength values provided on the gINT log represent those values obtained by performing field Diametral Point Load Tests (PLT-D) or Axial Point Load Tests (PLT-A) at specific test depths. Only valid failure results (passing through the plane of the platens) are represented on the log.

Standard Penetration Test (SPT) values provided on the gINT log were completed in general accordance with ASTM D 1586. The sampler was advanced into relatively undisturbed soil in three 0.5 foot increments (unless refusal conditions were encountered) using a 140 lb weighted cathead hammer falling a vertical distance of 30 inches. The blowcount, N, is indicated on the log as the number of blows required to advance the sampler through the final 1.0 foot of penetration or another specified distance if refusal conditions were encountered.

The ">>" symbol on the borehole logs located just right of the Rock Quality Designation (RQD) column for select sample intervals represents an RQD value greater than 100%.

References:

Washington State Department of Transportation. Geotechnical Design Manual M 46-03. September, 2005.

American Society for Testing and Materials, 1985, D 2487-83, *Classification of Soils for Engineering Purposes: Annual Book of ASTM Standards*. Vol. 04.08, pp 395-408.

American Society for Testing and Materials, 1987, D 1586-84, *Standard Method for Penetration Test and Split – Barrel Sampling Soils: Annual Book of ASTM Standards*. Vol. 04.08.



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0	0									<p>TOPSOIL/FOREST DUFF [TS], pedogenic soil, moss and root organics with fine to coarse sand and silt, very loose, moist. Advanced borehole using HWT with tri-cone advancer to approximately 5.0 feet bgs.</p> <p>SILTY SAND [SM], silty, fine to coarse SAND, some gravels and cobbles, loose, pale yellowish brown (10YR 6/2), dry. [Colluvium]</p>			
5	1.5							1	SPT N=29	<p>POORLY-GRADED SAND [SP - SC], fine to medium SAND, with gravels and clay, medium dense to dense, dark yellowish orange to moderate yellowish brown (10YR 6/6 - 10YR 6/2), moist. [Colluvium] Blow Counts/0.5' = 5, 17, 12 [N = 29, Recovery = 0.5'/1.5']</p>			
10	3.0					71 0.0	R2 R2	2	PLT - A PLT - D	<p>META-WELDED LAPILLI DACITE TUFF, olive gray to dark greenish gray (5Y 4/1 - 5G 4/1), fine grained groundmass with fine to coarse grained phenocrysts and lapilli-sized clasts (10 to 30%), slightly welded, fresh to slightly weathered (I - II), moderately weak to moderately strong (R2 - R3) rock, discontinuities are moderately to closely spaced and in good condition. [Ohanapecosh Formation] At 10.0 feet, becomes moderately strong (R3) rock</p>			
15	4.5					96 0.6		3		<p>At 15.0 feet, becomes dark greenish gray (5G 4/1), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock</p>			
20	6.0					104 1.2	R3 R3		PLT - A PLT - D				



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								4		META-WELDED LAPILLI DACITE TUFF , greenish gray to dark greenish gray (5G 6/1 - 5GY 4/1), fine grained groundmass with fine to coarse grained phenocrysts and lapilli-sized clasts (10 to 30%), slightly welded, fresh to slightly weathered (I - II), moderately weak to moderately strong (R2 - R3) rock, discontinuities are widely spaced and in good condition. [Ohanapecoh Formation]			
25								5		At 24.4 to 24.7 feet, discontinuity in very poor condition At 25.0 feet, healed discontinuities occur at 0 to 2 per foot			
8								6		At 27.8 to 28.2 feet, discontinuity in poor condition			
30								7	PLT - D	At 30.0 to 32.0 feet, becomes light olive gray to olive gray (5Y 5/2 - 5Y 4/1), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock			
35								8	PLT - D PLT - A	At 34.0 becomes greenish gray to dark greenish gray (5G 6/1 - 5GY 4/1), fresh (I), moderately strong to strong (R3 - R4) rock			
40								9		At 40.0 feet, becomes moderately weak (R2) and discontinuities become moderately to closely spaced and in excellent to good condition			
45													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14		[Dotted pattern]	[Diagonal hatching]				$\frac{100}{1.0}$	R4 R2	10	PLT - A PLT - D	<p>META-WELDED LAPILLI DACITE TUFF, greenish gray to dark greenish gray (5G 6/1 - 5GY 4/1), fine grained groundmass with fine to coarse grained phenocrysts and lapilli-sized clasts (10 to 30%), slightly welded, fresh to slightly weathered (I - II), extremely weak (R0) to very weak (R1) rock, discontinuities are closely spaced and in very poor condition. [Ohanapecosh Formation]</p> <p>At 48.0 feet, becomes fresh (I), moderately strong to strong (R3 - R4) rock, discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 5 to 10% frequency</p>		
15			[Diagonal hatching]				$\frac{100}{3.4}$		11		At 50.6 feet, becomes moderately weak (R2) rock		
16			[Diagonal hatching]								At 52.0 to 52.8 feet, healed discontinuities become closely spaced		
55			[Diagonal hatching]				$\frac{100}{1.2}$	R3	12	PLT - D	At 55.0 feet, healed discontinuities occur at 0 to 1 per foot		
18		[Dotted pattern]	[Diagonal hatching]				$\frac{102}{0.8}$		13				
60			[Diagonal hatching]										
19			[Diagonal hatching]										
65			[Diagonal hatching]				$\frac{102}{>2.7}$	R3	14	PLT - D	At 65.0 feet, becomes moderately strong (R3) rock		
20		[Dotted pattern]	[Diagonal hatching]								At 67.2 to 68 feet bgs - becomes moderately weak (R2) rock		
21			[Diagonal hatching]										
70			[Diagonal hatching]										

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22								15		META-WELDED LAPILLI DACITE TUFF , greenish gray to dark greenish gray (5G 6/1 - 5GY 4/1), fine grained groundmass with fine to coarse grained phenocrysts and lapilli-sized clasts (10 to 30%), slightly welded, fresh to slightly weathered (I - II), moderately strong (R3) rock, discontinuities are closely spaced and in fair condition. [Ohanapecosh Formation]			
							R2		PLT - D				
75	23							16					
							R2		PLT - A				
										At 77.0 feet, discontinuities become moderately to very closely spaced and in good condition			
80								17					
							R3 R3		PLT - D PLT - A				
										At 81.0 feet, becomes moderately weak (R2) rock, discontinuities become very closely			
85	26							18					
										At 83.8 to 84.5 feet, becomes very weak (R1) rock, discontinuities in poor condition			
										At 85.0 feet, discontinuities become moderately to very closely spaced and in fair to good condition			
90								19					
										At 91.0 to 92.0 feet, becomes moderately weathered (III), very weak rock (R1) rock, discontinuities in very poor condition			
95													
							R2		PLT - D				

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29								20		META-WELDED LAPILLI DACITE TUFF , greenish gray to dark greenish gray (5G 6/1 - 5GY 4/1), fine grained groundmass with fine to coarse grained phenocrysts and lapilli-sized clasts (10 to 30%), slightly welded, fresh (I), moderately weak (R2) to moderately strong (R3) rock, discontinuities are moderately to closely spaced and in poor to fair condition. [Ohanapecoh Formation]			
30													
100							R4	21	PLT - A				
31													
105							R3		PLT - D	Borehole completed to 105.0 feet bgs on August 15, 2007. Borehole was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on August 22, 2007. Borehole completed with two vibrating wire piezometers at 53.0 feet and 100.5 feet bgs on September 12, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at 83.4 feet on August 22, 2007 prior to beginning optical borehole survey. VWP #88219 = 51.5 to 53.0 feet bgs VWP #92271 = 99.0 to 100.5 feet bgs #10-20 silica sand filter pack from 88.0 to 105.0 feet bgs Grout mix from 0.0 to 88.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 lbs pure bentonite powder Well Tag # = APC 425			
32													
33													
110													
34													
35													
115													
36													
120													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								5		META-WELDED LAPILLI DACITE TUFF , yellowish gray to pale olive to light olive gray (5Y 7/2 - 10Y 6/2 - 5Y 5/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (10 to 30%), slightly welded, slightly weathered (II), moderately weak (R2) to moderately strong (R3) rock, discontinuities are moderately to closely spaced at widely to moderately spaced intervals and in excellent to good condition. [Ohanapecosh Formation]			
25										At 25.5 feet, discontinuity in very poor condition			
8								6		At 27.5 feet, becomes fresh (I) to slightly weathered (II) and moderately weak (R2) to moderately strong (R3) rock			
9							R2 R3		PLT - D PLT - A				
30								7		At 34.0 feet, becomes pale olive to greenish gray to dark greenish gray (10Y 6/2 - 5GY 6/1 - 5GY 4/1), fresh (I) rock, and discontinuity in fair condition.			
10													
35													
11								8		At 38.0 feet, becomes greenish gray to dark greenish gray (5GY 6/1 - 5GY 4/1) rock			
12							R2 R2		PLT - A PLT - D				
40													
13								9		At 43.5 to 43.9 feet, healed discontinuities become very closely spaced			
13							R3 R2		PLT - A PLT - D				
45													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14										<p>META-WELDED LAPILLI DACITE TUFF, greenish gray to dark greenish gray (5GY 6/1 - 5GY 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (10 to 30%), slightly welded, slightly weathered (II), moderately weak (R2) to moderately strong (R3) rock, discontinuities are moderately to closely spaced at widely to moderately spaced intervals and in good condition. [Ohanapcosh Formation]</p>			
						$\frac{100}{0.6}$		10					
15										<p>At 52.5 feet, becomes pale olive to light olive gray (10Y 6/2 - 5Y 5/2), slightly weathered (II), moderately weak (R2) rock, discontinuities are very closely to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 3 to 8% frequency, discontinuities in fair condition occur at a 20 to 25% frequency</p>			
50						$\frac{100}{>3.2}$		11					
16										<p>At 58.6 feet, becomes greenish gray to dark greenish gray (5GY 6/1 - 5GY 4/1), fresh (I), moderately strong (R3) rock</p> <p>At 60.0 to 61.6 feet, becomes moderately weak (R2) rock, discontinuities become very closely spaced and in good to very poor condition, discontinuities in very poor condition occur at a 45 to 55% frequency</p>			
55						$\frac{98}{>3.3}$	R3 R2	12	PLT - A PLT - D				
17										<p>At 67.5 feet, healed discontinuities become closely to very closely spaced occurring at 4 to 10 per foot</p> <p>At 68.5 to 69.0 feet bgs - discontinuity in very poor condition</p>			
						$\frac{100}{>2.4}$	R3 R3	13	PLT - A PLT - D				
18													
60						$\frac{102}{>2.4}$		14					
19													
65													
20													
21													
70													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22								15		<p>META-WELDED LAPILLI DACITE TUFF, greenish gray to dark greenish gray (5GY 6/1 - 5GY 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (10 to 30%), slightly welded, fresh (I), moderately strong (R3) rock, discontinuities are moderately to closely spaced and in fair to good condition. [Ohanapecosh Formation]</p> <p>At 81.0 feet, healed discontinuities occur at 3 to 6 per foot</p> <p>At 83.6 feet, discontinuities become moderately to closely spaced and in good condition, healed discontinuities occur at 0 to 3 per foot</p>			
								$\frac{100}{0.6}$					
75								16					
23								$\frac{94}{0.0}$					
24								$\frac{104}{0.4}$					
80													
25								$\frac{104}{1.5}$	R2 R3				
									PLT - D PLT - A				
85								$\frac{104}{0.7}$					
26								$\frac{108}{0.7}$					
27								$\frac{98}{0.4}$					
90													
28													
95									R4 R3				
									PLT - A PLT - D				

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29										<p>META-WELDED LAPILLI DACITE TUFF, greenish gray to dark greenish gray (5GY 6/1 - 5GY 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (10 to 30%), slightly welded, fresh (I), moderately strong (R3) rock, discontinuities are moderately to closely spaced and in good condition. [Ohanapecosh Formation]</p> <p>At 98.6 to 99.0 feet, discontinuities in fair condition</p>			
						$\frac{102}{0.6}$		21					
30													
						$\frac{100}{0.4}$	R3	22	PLT - D				
31													
100													
						$\frac{102}{1.2}$		23					
32													
105													
						$\frac{100}{1.4}$		24					
33													
110													
							R3						
34													
115							R2		PLT - A PLT - D				
						$\frac{100}{0.0}$		25					
35													
120													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



LOG OF TEST BORING

Start Card RE02067

Job No. 03-2007

SR 90

Elevation 2620.3 ft (798.7 m)

HOLE No. RKS-09-07

Sheet 6 of 6

Project 2007 I-90 Geotechnical New Alignment Feasibility Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
37											<p>Borehole completed to 120.0 feet bgs on August 22, 2007. Borehole was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on September 4, 2007. Borehole completed with one vibrating wire piezometer at 69.5 feet bgs on September 13, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at 87.8 feet on September 4, 2007 prior to beginning optical borehole survey.</p> <p>VWP #88131 = 68.0 to 69.5 feet bgs #10-20 silica sand filter pack was not used Grout mix from 0.0 to 120.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 to 30 lbs pure bentonite powder Well Tag # = APC 423</p>			
125	38													
39														
130	40													
41														
135	41													
42														
140	42													
43														
44														
145	43													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0										<p>TOPSOIL/FOREST DUFF [TS], pedogenic soil, moss and root organics with fine to coarse sand and silt, very loose, moist. Advanced borehole using HWT with tri-cone advancer to approximately 7.0 feet bgs.</p> <p>SILTY SAND [SM], silty fine to coarse SAND, some gravels and cobbles, loose, pale yellowish brown (10YR 6/2), moist. [Colluvium]</p>			
1													
5										<p>META-WELDED LAPILLI DACITE TUFF, yellowish gray to light olive gray (5Y 7/2 - 5Y 6/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, slightly to moderately weathered (II - III), very weak (R1) rock, discontinuities are moderately to closely spaced and in good condition. [Ohanapecoh Formation]</p>			
2									1				
10									2				
3													
4													
15									3				
5													
6													
20													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								4	PLT - D	META-WELDED LAPILLI DACITE TUFF , yellowish gray to light olive gray (5Y 7/2 - 5Y 6/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, slightly weathered (II), moderately weak (R2) rock, discontinuities are moderately to closely spaced and in good condition. [Ohanapecosh Formation]			
25								5		At 25.7 feet, becomes greenish gray to pale olive (5GY 6/1 - 10Y 6/2) rock			
30								6		At 30.7 feet, becomes greenish gray (5GY 6/1), slightly to moderately weathered (II - III) rock			
35								7	PLT - D				
40								8					
41								9		At 40.7 feet, becomes greenish gray (5GY 6/1 - 5G 6/1), fresh (I) rock At 41.4 to 41.6 feet, discontinuity in poor condition			
45													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14								10		<p>META-WELDED LAPILLI DACITE TUFF, greenish gray to light olive gray (5GY 6/1 - 5Y 6/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), moderately weak (R2) rock, discontinuities are moderately to closely spaced and in good condition. [Ohanapecosh Formation]</p> <p>At 52.0 feet, discontinuities become moderately to closely spaced at widely spaced intervals and in good to fair condition</p>			
15							R1	11					
50								12					
16								13					
55								14					
17								15					
18													
60													
19													
65													
20													
21													
70													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22								16		META-WELDED LAPILLI DACITE TUFF , greenish gray to light olive gray (5GY 6/1 - 5Y 6/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), moderately weak (R2) rock, discontinuities are moderately to closely spaced and in good condition. [Ohanapecosh Formation]			
75							R2		PLT - A				
23							R2	17	PLT - D				
24													
80								18					
25													
85													
26													
27													
90													
28													
95													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument	
			20	40	60	80								
29							$\frac{102}{0.8}$	R2 R1	21	PLT - A PLT - D	META-WELDED LAPILLI DACITE TUFF , greenish gray to light olive gray (5GY 6/1 - 5Y 6/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), moderately weak (R2) rock, discontinuities are moderately to closely spaced and in good condition. [Ohanapecosh Formation]			
30														
100														
31							$\frac{102}{0.4}$		22					At 100.7 feet, becomes moderately weak to moderately strong (R2 - R3) rock and discontinuity in very poor condition
105							$\frac{100}{0.4}$	R2 R2		PLT - D PLT - A				
32							$\frac{100}{0.4}$		23					
33														
110														
34							$\frac{98}{0.6}$		24					
35								R2 R1		PLT - A PLT - D				
115							$\frac{100}{1.4}$		25					
36											At 117.0 feet, discontinuities become moderately to closely spaced and in poor to fair condition			
120							R3		PLT - A					

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
37							R3	26	PLT - D	META-WELDED LAPILLI DACITE TUFF , greenish gray to light olive gray (5GY 6/1 - 5Y 6/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), moderately weak (R2) to moderately strong (R3) rock, discontinuities are moderately to closely spaced and in poor to fair condition. [Ohanapecoh Formation]			
125	38							27		At 125.2 feet, discontinuity in very poor condition			
								28					
39								29					
130	40							30		At 130.7 feet, becomes slightly to moderately weathered (II - III) rock, very weak (R1), and discontinuities are closely spaced and in good to poor condition, discontinuities in good condition occur at 10 to 20 % frequency			
								31		At 131.2 feet, becomes fresh (I), moderately weak to moderately strong (R2 - R3) rock			
41								32		At 134.0 to 134.5 feet, becomes highly weathered (IV), extremely weak (R0) rock, 0.2 feet core loss, discontinuities in very poor condition			
135	42									At 136.0 feet, healed discontinuities occurring at 2 to 8 per foot			
42													
140	43						R3		PLT - D	Borehole completed to 140.7 feet bgs on July 29, 2007. Borehole was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on August 11, 2007. Borehole completed with one vibrating wire piezometer at 138.5 feet bgs on September 19, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at 122.1 feet on August 11, 2007 prior to beginning optical borehole survey.			
43													
145	44												

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



LOG OF TEST BORING

Start Card RE02067

Job No. 03-2007

SR 90

Elevation 2653.3 ft (808.7 m)

HOLE No. RKS-10-07

Sheet 7 of 7

Project 2007 I-90 Geotechnical New Alignment Feasibility Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
45											VWP #92272 = 137.0 to 138.5 feet bgs #10-20 silica sand filter pack from 125.0 to 140.7 feet bgs Grout mix from 0.0 to 125.0 feet bgs: 1.94 lb bag Type I-II Portland Cement 30 gallons water 25 lbs pure bentonite powder Well Tag # = APC 424			
150														
155														
160														
165														
170														



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0										TOPSOIL/FOREST DUFF [TS] , pedogenic soil, moss and root organics with fine to coarse sand and silt, very loose, moist. Advanced borehole using HWT with tri-cone advancer to approximately 1.4 feet bgs.			
1						100		1		SILTY SAND [SM] , silty fine to coarse SAND, some gravels and cobbles, loose, pale yellowish brown (10YR 6/2), moist. [Colluvium]			
5						1.1		2					
2						96		3		META-WELDED LAPILLI DACITE TUFF , olive gray (5Y 4/1 - 5Y 3/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, fresh to slightly weathered (I - II), moderately strong (R3) rock, discontinuities are moderately to closely spaced and in fair to good condition, discontinuities in fair condition occur at 10 to 50% frequency, healed discontinuities occur at 4 to 8 per foot. [Ohanapecosh Formation]			
10						2.7		4					
15						98		5					
4						102				At 9.3 feet, discontinuity in very poor condition and discontinuities occur at 1 to 3 per foot			
5						0.8				At 15.4 feet, becomes slightly weathered (II) rock			
6						102							
20						0.6							

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								6		<p>META-WELDED LAPILLI DACITE TUFF, olive gray (5Y 4/1 - 5Y 3/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, slightly weathered (II), moderately strong (R3) rock, discontinuities are moderately to closely spaced and in poor to fair condition, discontinuities in fair condition occur at 10 to 50% frequency. [Ohanapecoh Formation]</p> <p>At 28.6 to 28.8 feet, discontinuity in poor to very poor condition</p> <p>At 40.4 feet becomes light olive gray to greenish gray (5Y 5/2 - 5GY 6/1) rock</p>			
25								7					
8								102 2.0					
9								8					
30								100 0.6					
10													
35								R2	PLT - D				
11								104 1.5					
12													
40								96 0.2					
13													
45													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14		[Profile with triangles]	[Hatched area]				96 / 0.8	R2	11	PLT - D	<p>META-WELDED LAPILLI DACITE TUFF, light olive gray to greenish gray (5Y 5/2 - 5GY 6/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, slightly weathered (II), moderately strong (R3) rock, discontinuities are moderately to closely spaced and in poor to fair condition, discontinuities in fair condition occur at 10 to 50% frequency. [Ohanapecoh Formation]</p>		
15													
50				[Hatched area]				98 / 0.0	R2	12	<p>At 50.4 feet, becomes fresh to slightly weathered (I - II), moderately strong to strong (R3 - R4) rock, discontinuities are moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at 5 to 10% frequency, discontinuities in fair condition occur at 10 to 50% frequency</p>		
16													
55				[Hatched area]				102 / 1.6	R2	13	PLT - A		
17													
18			[Hatched area]				100 / 0.6	R2	14		<p>At 60.4 feet, becomes dark greenish gray (5GY 4/1), fresh (I), strong (R4) rock</p>		
60													
19			[Hatched area]				98 / 1.0	R3	15	PLT - D	<p>At 65.4 feet, becomes dark greenish gray to medium dark gray (5GY 4/1 - N4) rock</p>		
65													
20			[Hatched area]										
21			[Hatched area]										
70			[Hatched area]										

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22								16		META-WELDED LAPILLI DACITE TUFF , dark greenish gray to medium dark gray (5GY 4/1 - N4), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, slightly weathered (II), fresh (I), strong (R4) rock, discontinuities are moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at 30 to 35% frequency, discontinuities in fair condition occur at 10 to 50% frequency. [Ohanapecosh Formation]			
75							R5	17	PLT - A	At 75.4 feet, becomes olive gray (5Y 4/1), strong to very strong (R4 - R5) rock			
24							R4	18	PLT - D	At 80.4 feet, becomes medium dark gray to dark gray (N4 - N3), discontinuities become moderately to closely spaced in fair condition			
80							R4	19	PLT - D	At 85.4 to 86.0 feet, healed discontinuities are very closely spaced			
25								20					
85													
26													
27													
90													
28													
95							R5		PLT - D				

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29			[Hatched pattern]				$\frac{96}{2.3}$		21		<p>META-WELDED LAPILLI DACITE TUFF, medium dark gray to dark gray (N4 - N3), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, slightly weathered (II), fresh (I), strong (R4) to very strong (R5) rock, discontinuities become moderately to closely spaced and in fair to very poor condition, discontinuities in poor to very poor condition occur at 30 to 35%. [Ohanapecossh Formation]</p> <p>At 98.0 feet, becomes dark gray (N3), slightly weathered (II), moderately strong (R3) rock</p> <p>At 99.4 feet, becomes fresh to slightly weathered (I - II), strong (R4) rock</p> <p>At 102.2 feet, becomes fresh (I), strong to very strong (R4 - R5) rock</p> <p>At 105.4 feet, becomes dark gray to olive gray (N3 - 5Y 5/2) rock and healed discontinuities occur very closely spaced</p>		
30			[Hatched pattern]										
100			[Hatched pattern]				$\frac{98}{1.4}$		22				
31			[Hatched pattern]										
105			[Hatched pattern]				$\frac{100}{1.6}$		23				
32			[Hatched pattern]										
33			[Hatched pattern]										
110			[Hatched pattern]				$\frac{102}{1.4}$		24				
34			[Hatched pattern]										
115			[Hatched pattern]				$\frac{98}{0.8}$		25				
35			[Hatched pattern]										
36			[Hatched pattern]										
120			[Hatched pattern]										

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
37			[Hatched pattern]				100 1.0	R5 R5		26	PLT - D PLT - A	<p>META-WELDED LAPILLI DACITE TUFF, dark gray to olive gray (N3 - 5Y 5/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, slightly weathered (II), fresh (I), strong (R4) to very strong (R5) rock, discontinuities become moderately to closely spaced and in fair to very poor condition, discontinuities in poor to very poor condition occur at 30 to 35%. [Ohanapecosh Formation]</p> <p>At 126.2 feet, becomes olive gray to medium dark gray (5Y 4/1 - N4) rock</p> <p>At 132.0 feet, discontinuities become moderately to closely spaced and in fair to good condition</p> <p>At 135.4 feet, becomes very strong (R5) rock</p>		
38	125		[Hatched pattern]				38 0.0			27				
39			[Hatched pattern]				114 0.8			28				
40	130		[Hatched pattern]				94 0.6			29				
41	135		[Hatched pattern]				104 1.2	R4 R5		30	PLT - A PLT - D			
42			[Hatched pattern]											
43	140		[Hatched pattern]				98 0.6	R4 R4		31	PLT - D PLT - A			
44			[Hatched pattern]											
145			[Hatched pattern]											

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
		△ · △ ·	[Hatched Area]					[Hatched Area]					
											<p>Borehole completed to 145.4 feet bgs on July 29, 2007. Borehole was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on August 9, 2007. Groundwater was measured at approximately 11.2 feet bgs during drilling activities and at 82.5 feet on August 9, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on September 21, 2007.</p>		
45													
150													
46													
47													
155													
48													
160													
49													
50													
165													
51													
170													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0													
1							R3	1	PLT - D	META-WELDED LAPILLI DACITE TUFF , olive gray (5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, slightly weathered (II), moderately strong (R3) rock, discontinuities are moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 5 to 10% frequency. [Ohanapcosh Formation]			
5							R1	2	PLT - A				
2													
3													
8							R4	3	PLT - D	At 8.0 feet, becomes medium dark gray to olive gray (N4 - 5Y 4/1), fresh to slightly weathered (I - II), strong (R4) rock, discontinuities become moderately to closely spaced and in good to very poor condition, discontinuities in poor to very poor condition occur at a 18 to 23% frequency			
10													
15							R4	4	PLT - A				
4													
5							R5	5	PLT - A				
18										At 18.0 feet, becomes fresh (I) rock			
20													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7										<p>META-WELDED LAPILLI DACITE TUFF, medium dark gray to olive gray (N4 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, fresh (I), very strong (R5) rock, discontinuities become moderately to closely spaced and in good to very poor condition, discontinuities in poor to very poor condition occur at a 18 to 23% frequency. [Ohanapecosh Formation]</p> <p>At 33.0 feet, becomes fresh to slightly weathered (I - II), moderately strong (R3) rock, healed discontinuities occur greater than 10 per foot</p> <p>At 38.0 feet, becomes slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become closely spaced and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency</p>			
								6					
								7	PLT - D PLT - A				
25							R5 R5						
8								8					
9								8					
30													
							R5		PLT - A				
10								9					
35													
11													
12								10	PLT - D				
40							R4						
13								11					
45													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14										META-WELDED LAPILLI DACITE TUFF , medium dark gray to olive gray (N4 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become closely spaced and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency. [Ohanapecosh Formation]			
						$\frac{90}{0.0}$		12					
15							R3	13	PLT - D				
50													
16													
55						$\frac{96}{1.0}$		14		At 54.0 feet, discontinuities become moderately to closely spaced and in very poor to fair condition, discontinuities in poor to good condition occur at a 35 to 40% frequency			
17													
18							R2	15	PLT - D	At 59.0 feet, becomes moderately strong (R3) rock			
60						$\frac{100}{1.2}$							
19													
65						$\frac{100}{2.4}$		16					
20													
21										At 67.0 feet, healed discontinuities decrease in occurrence			
70						$\frac{102}{1.4}$	R4	17	PLT - D				

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22										<p>META-WELDED LAPILLI DACITE TUFF, medium dark gray (N4), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, fresh (I), very strong (R5) rock, discontinuities become moderately to closely spaced and in very poor to fair condition, discontinuities in poor to very poor condition occur at a 35 to 40% frequency. [Ohanapecoh Formation]</p>			
75						$\frac{98}{0.8}$		18					
23													
24						$\frac{102}{0.8}$		19					
80							R5		PLT - A				
25										<p>At 84.0 feet, discontinuities become moderately to closely spaced and in fair to good condition, discontinuities in fair condition occur at a 15 to 45% frequency</p>			
85						$\frac{96}{1.3}$		20					
26										<p>At 89.0 feet, becomes slightly weathered (II), strong (R4) rock</p>			
27													
90						$\frac{98}{>1.6}$		21					
28										<p>At 94.0 feet, becomes fresh to slightly weathered (I - II) rock</p>			
95						$\frac{98}{>1.6}$		22					

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29										META-WELDED LAPILLI DACITE TUFF , medium dark gray (N4), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, fresh to slightly weathered (I - II), strong (R4) rock, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 18 to 23% frequency. [Ohanapecosh Formation]			
30								23					
100													
31													
105													
32													
33													
110													
34													
115													
35													
36													
120													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
37											<p>META-WELDED LAPILLI DACITE TUFF, medium dark gray (N4), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 50%), slightly welded, fresh (I), strong to very strong (R4 - R5) rock, discontinuities become moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 18 to 23% frequency. [Ohanapecosh Formation]</p>		
125	38					$\frac{114}{0.6}$	28						
39													
130							$\frac{115}{0.0}$	29	PLT - A	At 128.4 feet, becomes very strong (R5) rock			
40											<p>Borehole completed to 130.4 feet bgs on September 4, 2007. Borehole was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on September 6, 2007. Borehole completed with one vibrating wire piezometer at 127.4 feet bgs on September 8, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 54.3 feet bgs during drilling activities and at 103.4 feet on September 6, 2007 prior to beginning optical borehole survey.</p> <p>VWP #92273 = 125.9 to 127.4 feet bgs #10-20 silica sand filter pack from 108.0 to 130.4 feet bgs Grout mix from 0.0 to 108.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 to 30 lbs pure bentonite powder Well Tag # = APC 420</p>		
41													
135													
42													
140													
43													
44													
145													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0										<p>TOPSOIL/FOREST DUFF [TS], pedogenic soil, moss and root organics with fine to coarse sand and silt, very loose, moist. Advanced borehole using HWT with tri-cone advancer to approximately 6.0 feet bgs.</p> <p>SILTY SAND [SM], silty, fine to coarse SAND, some gravels, trace organics, medium dense to dense, grayish orange to dark yellowish orange (10YR 7/4 - 10YR 6/6), dry. [Colluvium] Blow Counts/0.5' = 10, 25/0.1' [N = 25/0.1', Recovery = 0.6'/0.7']</p> <p>META-WELDED LAPILLI DACITE TUFF, pale olive to light olive gray (10Y 62 - 5y 5/2) with moderate yellowish brown to dark yellowish orange (10YR 5/4 - 10YR 6/6) staining, fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, moderately to highly weathered (III - IV), very weak (R1) rock, discontinuities are moderately to closely spaced and in fair to poor condition. [Ohanapecos Formation] At 6.5 feet, becomes moderately weathered (III), moderately weak (R2) rock At 8.0 feet, becomes highly weathered (IV), very weak (R1) rock At 8.5 feet becomes moderately weathered (III), very weak to moderately weak (R1 - R2) rock</p>			
1									SPT N=25/0.2				
5													
2								1					
10								2					
15								3					
4								4					
5								5					
6								6					
20													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14							R4 R1		PLT - A PLT - D	META-WELDED LAPILLI DACITE TUFF , light bluish gray to medium gray (5B 7/1 - N5) with moderate yellowish brown to dark yellowish orange (10YR 5/4 - 10YR 6/6) staining, fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh to slightly weathered (I - II), moderately weak to moderately strong (R2 - R3) rock enveloping discontinuities, discontinuities become moderately to closely spaced and in good to poor condition, discontinuities in poor condition occur at a 35 to 40% frequency. [Ohanapecoh Formation]			
15						$\frac{136}{0.6}$		13					
50										At 50.3 feet becomes moderately weathered (III) rock			
16						$\frac{68}{1.2}$	R3	14	PLT - A	At 52.3 feet, becomes grayish blue (5PB 5/2) when fresh (I) rock			
55						$\frac{100}{0.8}$		15		At 53.9 to 56.0 feet, becomes moderately weathered to highly weathered (III - IV), extremely weak to very weak (R0 - R1) rock			
17													
18						$\frac{100}{0.6}$	R3 R4	16	PLT - D PLT - A	At 59.0 feet, becomes grayish blue green (5BG 5/2) when fresh (I) rock, and moderate yellowish brown (10YR 5/4) when slightly weathered (II) rock			
60													
19													
65						$\frac{100}{2.2}$		17		At 63.7 to 63.9 feet, becomes highly weathered (IV), extremely weak (R0) rock, discontinuities become closely spaced and in very poor condition At 64.2 feet, becomes moderately weathered (III), very weak (R1) rock, discontinuity in very poor condition At 65.6 feet, becomes highly weathered (IV), extremely weak (R0) rock, discontinuities become very closely spaced and in poor to very poor condition			
20													
21						$\frac{98}{2.0}$		18					
70													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22													
75	23					$\frac{108}{0.9}$	R3 R3	19	PLT - A PLT - D	META-WELDED LAPILLI DACITE TUFF , grayish blue green (5BG 5/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh to slightly weathered (I - II), moderately strong (R3) rock, discontinuities become moderately to closely spaced and in fair to very poor condition, discontinuities in poor to very poor condition occur at a 15 to 20% frequency. [Ohanapecosch Formation]			
24						$\frac{96}{1.0}$		20		At 77.9 feet becomes slightly weathered (II), very weak (R1) rock			
80							R4		PLT - D	At 79.9 to 80.0 feet, discontinuity in good condition At 80.6 feet, becomes fresh (I), moderately strong (R3) rock			
25						$\frac{98}{1.0}$		21					
85	26												
27						$\frac{102}{1.0}$		22					
90							R4 R3		PLT - D PLT - A				
28						$\frac{69}{0.3}$		23		At 93.5 feet, becomes moderately strong to strong (R3 - R4) rock			
95													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29		[Pattern: Small triangles]	[Pattern: Diagonal lines]					R3			<p>META-WELDED LAPILLI DACITE TUFF, grayish green (5G 5/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, moderately to highly weathered (III - IV), extremely weak to very weak (R0 - R1) rock, discontinuities become closely spaced and in good to very poor condition, discontinuities in poor to very poor condition occur at a 75 to 80% frequency. [Ohanapecosh Formation]</p>	[Pattern: Dotted]	[Pattern: Vertical lines]
30						$\frac{76}{4.2}$	24						
31							$\frac{100}{1.2}$		25				
32							$\frac{96}{1.0}$		26	PLT - D			
100										At 102.2 feet, becomes moderately weathered (III), very weak (R1) rock			
105										At 103.5 feet, becomes fresh (I), moderately weak to moderately strong (R2 - R3) rock			
33							R3		PLT - A PLT - D	At 105.6 to 106.3 feet, becomes highly weathered (III), extremely weak (R0) rock, discontinuity in very poor condition	▼		
110										<p>Borehole completed to 108.5 feet bgs on September 9, 2007. Borehole was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on September 26, 2007. Borehole completed with two vibrating wire piezometers at 70.5 feet and 106.5 feet bgs on October 4, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 28.6 feet bgs during drilling activities and at 105.9 feet on September 26, 2007 prior to beginning optical borehole survey.</p> <p>VWP #92058 = 69.0 to 70.5 feet bgs VWP #92079 = 105.0 to 106.5 feet bgs #10-20 silica sand filter pack from 94.8 to 108.5 feet bgs Grout mix from 0.0 to 94.8 feet bgs: 1.94 lb bag Type I-II Portland Cement 30 gallons water 25 to 30 lbs pure bentonite powder Well Tag # = APC 418</p>			
34													
115													
35													
36													
120													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								4		META-WELDED LAPILLI DACITE TUFF , greenish gray to medium bluish gray (5G 6/1 - 5B 5/1) with dusky yellow (5GY 5/2) weathering envelopes, fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), strong to very strong (R4 - R5) rock, discontinuities are moderately to closely spaced and in fair to good condition. [Ohanapecosh Formation]			
25										At 24.0 feet, discontinuities become very widely to moderately spaced and in fair to good condition			
8								5	PLT - D	At 25.8 feet, becomes very strong (R5) rock			
30													
9								6	PLT - A				
10													
35													
11								7					
40													
12								8	PLT - D				
45													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14								9		<p>META-WELDED LAPILLI DACITE TUFF, greenish gray to medium bluish gray (5G 6/1 - 5B 5/1) with dusky yellow (5GY 5/2) weathering envelopes, fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), strong (R4) rock, discontinuities are moderately to closely spaced and in fair to good condition. [Ohanapecoh Formation]</p> <p>At 60.0 feet, discontinuities become moderately to closely spaced at moderately spaced intervals and in very poor to good condition, discontinuities in poor to very poor condition occur at a 25 to 30% frequency</p> <p>At 65.8 feet, becomes light bluish to medium bluish gray to medium light gray (5B 7/1 - 5B 5/1 - N6), fresh (I), moderately weak to moderately strong (R2 - R3) rock, with dusky yellow (5GY 5/2), slightly weathered (II), moderately weak to moderately strong (R2- R3) rock enveloping discontinuities</p>			
						$\frac{98}{0.2}$	R4		PLT - D PLT - A				
15								10					
50						$\frac{98}{0.2}$							
16													
55							R4		PLT - D				
17						$\frac{102}{0.4}$		11					
							R4		PLT - D PLT - A				
18													
60						$\frac{100}{1.0}$		12					
19													
						$\frac{100}{0.0}$		13					
						$\frac{100}{1.1}$		14					
65													
20						$\frac{96}{>1.5}$		15					
21													
70													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22								16	PLT - D	<p>META-WELDED LAPILLI DACITE TUFF, light bluish to medium bluish gray to medium light gray (5B 7/1 - 5B 5/1 - N6) with dusky yellow (5GY 5/2) weathering envelopes, fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), moderately weak to moderately strong (R2 - R3) rock, discontinuities are moderately to closely spaced at moderately spaced intervals and in very poor to good condition, discontinuities in poor to very poor condition occur at a 25 to 30% frequency. [Ohanapecosh Formation]</p>			
75							17						
23							104 1.2						
24													
80								18		At 79.6 to 80.0 feet, becomes yellowish gray to light olive gray to olive gray (5GY 5/1 - 5GY 6/1 - 5Y 4/1), moderately weathered (III), very weak (R1) rock			
25							96 1.2			At 80.5 feet, becomes slightly to moderately weathered (II - III), very weak to moderately weak (R1 - R2) rock			
85								19		At 84.6 feet, becomes fresh (I), moderately strong (R3) rock			
26							100 0.0						
27								20	PLT - D PLT - A				
90													
28							100 0.6						
95										At 94.0 to 97.0 feet, healed discontinuities occur greater than 10 per foot			

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument				
			20	40	60	80											
29		[Hatched pattern]					$\frac{102}{1.2}$	R3	21	PLT - D	<p>META-WELDED LAPILLI DACITE TUFF, light bluish to medium bluish gray to medium light gray (5B 7/1 - 5B 5/1 - N6) with dusky yellow (5GY 5/2) weathering envelopes, fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, slightly to moderately weathered (II - III), very weak to moderately weak (R1 - R2) rock, discontinuities are moderately to closely spaced at moderately spaced intervals and in very poor to good condition, discontinuities in poor to very poor condition occur at a 25 to 30% frequency. [Ohanapecosh Formation]</p> <p>At 97.3 feet, becomes medium bluish gray to medium light gray (5B 5/1 - N6), fresh (I), moderately strong (R3 - R4) rock, with dusky yellow (5GY 5/2), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock enveloping discontinuities, discontinuities become moderately to closely spaced at moderately spaced intervals and in very poor to good condition, discontinuities in poor to very poor condition occur at a 25 to 30% frequency</p>						
30																	
100																	
31							$\frac{98}{1.4}$					22					
105																	
32		[Hatched pattern]					$\frac{102}{1.0}$	R3	23	PLT - D							
33																	
110																	
34		[Hatched pattern]					$\frac{100}{1.2}$	R3	24								
35																	
115																	
36		[Hatched pattern]					$\frac{104}{1.2}$	R5	25	PLT - D							
120																	

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
37						$\frac{98}{0.4}$	R5	26		<p>META-WELDED LAPILLI DACITE TUFF, light bluish to medium bluish gray to medium light gray (5B 7/1 - 5B 5/1 - N6) with dusky yellow (5GY 5/2) weathering envelopes, fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), very strong (R5) rock, with slightly weathered (II), moderately strong (R3) rock enveloping discontinuities, discontinuities are moderately to closely spaced and in good to poor condition, discontinuities in poor condition occur at a 38 to 43% frequency. [Ohanapecoh Formation]</p>			
125	38												$\frac{95}{0.8}$
130	39												
135	40									<p>Borehole completed to 130.0 feet bgs on September 5, 2007. Borehole was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on September 7, 2007. Groundwater was measured at approximately 25.6 feet bgs during drilling activities and at 92.4 feet on September 7, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 5, 2007.</p>			
140	41												
145	42												
	43												
	44												



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0	0							1		<p>TOPSOIL/FOREST DUFF [TS], pedogenic soil, moss and root organics with fine to coarse sand and silt, very loose, moist.</p> <p>POORLY-GRADED GRAVEL [GP - GM], fine to coarse GRAVEL, with fine to coarse sand and silt, with organics, medium dense to dense, grayish orange to dark yellowish orange (10YR 7/4 - 10YR 6/6), moist. [Colluvium]</p>			
5	5					138	R1	2	PLT - D	<p>META-WELDED LAPILLI DACITE TUFF, dark yellowish orange to pale yellowish brown (10YR 6/6 - 10YR 6/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 50%), slightly welded, moderately weathered (III), very weak (R1) rock, discontinuities are moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at 45 to 50% frequency. [Ohanapecoh Formation]</p>			
10	10				94	3							
15	15				>0.6	4							
20	20					98		5		At 13.0 feet, becomes moderately to highly weathered (III - IV) rock			

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7													
25													
8													
9													
30													
10													
35													
11													
40													
12													
45													
13													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09

META-WELDED LAPILLI DACITE TUFF, dark yellowish orange to pale yellowish brown (10YR 6/6 - 10YR 6/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 50%), slightly welded, slightly to moderately weathered (II - III), very weak to moderately weak (R1 - R2) rock, discontinuities are moderately to closely spaced and in very poor to good condition, discontinuities in poor to very poor condition occur at a 13 to 18% frequency. [Ohanapecoh Formation]

At 24.2 feet, becomes moderately to highly weathered (III - IV), very weak (R1) rock

At 27.6 feet, becomes highly weathered (IV) rock, discontinuity in very poor condition
At 28.2 feet, becomes slightly weathered (II), moderately weak (R2) rock

At 32.2 feet, becomes grayish blue green (5BG 5/2), fresh (I), moderately strong to strong (R3 - R4) rock

At 33.2 feet, becomes light brown to light olive gray (5YR 5/6 - 5Y 6/1), slightly weathered (II), moderately strong (R3) rock

At 39.6 feet, becomes grayish blue green (5BG 5/2), fresh (I), strong (R4) rock

PLT - A
PLT - D
PLT - A

PLT - A

R4
R4
R4

R4

$\frac{100}{>0.6}$

$\frac{104}{0.6}$

$\frac{98}{>1.2}$

$\frac{102}{0.2}$

$\frac{90}{0.9}$



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14													
15								11					
50													
16								12					
55							R3		PLT - D				
17													
18								13					
60							R4		PLT - D				
19								14					
65								15					
20													
21							R4		PLT - A				
70								16					

ROCK NAF BOREHOLES_2007.GPJ 2/13/09

META-WELDED LAPILLI DACITE TUFF, pale olive to dark yellowish orange (10Y 6/2 - 10YR 6/6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 50%), slightly welded, fresh to slightly weathered (I - II), moderately strong to strong (R3 - R4) rock, discontinuities become closely to very closely spaced at moderately spaced intervals and in poor to good condition, discontinuities in fair condition occur at a 5 to 20% frequency, discontinuities in poor condition occur at 5 to 10% frequency. [Ohanapeosh Formation]

At 51.7 feet, becomes moderately weathered (III), moderately weak (R2) rock

At 66.8 feet, becomes greenish gray (5G 6/1), fresh (I), strong (R4) rock, with pale olive to dark yellowish orange (10Y 6/2 - 10YR 6/6), fresh to slightly weathered (I - II), moderately strong to strong (R3 - R4) rock enveloping discontinuities



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29													
30							R2	22	PLT - A	<p>META-WELDED LAPILLI DACITE TUFF, pale blue to pale green to medium light gray (5B 6/2 - 10G 6/2 - N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 50%), slightly welded, fresh (I), strong (R4) rock, with pale olive to dark yellowish orange (10Y 6/2 - 10YR 6/6), fresh (I), strong (R4) rock, with light brown to pale yellowish brown (10YR 6/2 - 5YR 5/6), slightly weathered (II), moderately strong to strong (R3 - R4) rock enveloping discontinuities, discontinuities become closely to very closely spaced at widely to moderately spaced intervals and in good to very poor condition, discontinuities in good condition occur at a 5 to 20% frequency, discontinuities in poor to very poor condition occur at a 20 to 25% frequency. [Ohanapecoh Formation]</p> <p>At 101.7 feet, becomes medium gray to greenish gray (N5 - 5GY 6/1) when fresh (I) rock</p> <p>At 108.2 feet, becomes medium gray (N5), strong to very strong (R4 - R5) when fresh (I) rock</p> <p>At 118.2 feet, becomes light brown to dark yellowish orange (5YR 5/6 - 10YR 6/6), slightly weathered (II), moderately strong (R3) rock, discontinuities become moderately to closely spaced and in poor to good</p>			
100													
31							R4	23	PLT - D				
105													
32							R5	24	PLT - D				
110													
33													
115													
34													
120													
35													
36							R4 R4	25 26	PLT - A PLT - D				
120													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
45										<p>META-WELDED LAPILLI DACITE TUFF, medium gray to medium bluish gray (N5 - 5B 5/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 50%), fresh (I), strong (R4) rock, discontinuities become moderately to closely spaced and in good to poor condition, discontinuities in poor condition occur at a 10 to 30% frequency. [Ohanapecoh Formation]</p> <p>At 149.2 feet, discontinuities becomes moderately spaced with slickensides observed</p>			
150							102 0.0	32					
46													
155									100 0.0				33
47										<p>At 158.2 feet, becomes pale blue (5B 6/2) rock</p>			
160									100 0.0				34
48													
165													
49										<p>Borehole completed to 163.2 feet bgs on September 13, 2007. Borehole was advanced at an angle 80 degrees from horizontal with a direction of 029 degrees. Borehole was overcased with HWT casing to 6.9 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on September 18, 2007. Borehole completed with two vibrating wire piezometers at 84.5 and 158.5 feet bgs on September 20, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 39.7 feet bgs during drilling activities and at 81.1 feet on September 18, 2007 prior to beginning optical borehole survey.</p> <p>VWP #88130 = 83.0 to 84.5 feet bgs VWP #92269 = 157.0 to 158.5 feet bgs #10-20 silica sand filter pack from 138.0 to 163.2 feet</p>			
50													
170													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



LOG OF TEST BORING

Start Card RE02069

Job No. 03-2007

SR 90

Elevation 2624.6 ft (800.0 m)

HOLE No. RKS-15-07

Sheet 8 of 8

Project 2007 I-90 Geotechnical New Alignment Feasibility Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
52											bgs Grout mix from 0.0 to 138.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 to 30 lbs pure bentonite powder Well Tag # = APC 422			
53														
175														
54														
180														
55														
56														
185														
57														
190														
58														
59														
195														



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0										<p>TOPSOIL/FOREST DUFF [TS], pedogenic soil, moss and root organics with fine to coarse sand and silt, very loose, moist. Advanced borehole using HWT with tri-cone advancer to approximately 8.4 feet bgs.</p> <p>SANDY SILT [ML], fine to coarse sandy SILT, some organics, trace gravels, medium stiff, dark yellowish orange to moderate yellowish brown (10YR 6/6 - 10Y 5/4), moist. [Colluvium]</p> <p>SPT N=5 Blow Counts/0.5' = 2, 2, 3 [N = 5, Recovery = 0.4'/1.5']</p>			
10						78 2.1		1		<p>META-WELDED LAPILLI DACITE TUFF, yellowish gray to pale olive (5Y 7/2 - 10Y 6/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, slightly to moderately weathered (II - III), very weak (R1) rock, discontinuities are moderately to closely spaced and in good to fair condition, discontinuities in good condition occur at a 10 to 30% frequency. [Ohanapecosh Formation]</p>			
15						102 >3.0		2		<p>At 13.2 feet, discontinuity in poor condition</p>			
20						100 >1.6	R1	3	PLT - D	<p>At 16.0 feet, becomes slightly weathered (II), very weak to moderately weak (R1 - R2) rock</p> <p>At 18.9 feet, becomes moderately weathered (III), extremely weak to very weak (R0 - R1) rock, discontinuities in very poor to poor condition</p>			



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								4		<p>META-WELDED LAPILLI DACITE TUFF, dark yellowish orange to moderate yellowish brown (10YR 6/6 - 10Y 5/4), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, slightly to moderately weathered (II - III), very weak (R1) rock, discontinuities in very poor to poor condition. [Ohanapecosh Formation]</p> <p>At 23.0 feet, becomes slightly weathered (II) and very weak (R1) rock</p>			
25							R3	5	PLT - D				
8										<p>At 27.0 feet, becomes light bluish gray to medium light gray (5B 7/1 - N6), fresh (I), moderately weak to moderately strong (R2 - R3) rock, with moderate brown (5YR 4/4 - 5YR 3/4), slightly weathered (II), very weak to moderately weak (R1 - R2) rock enveloping discontinuities</p>			
30								6					
10							R4		PLT - D				
35										<p>At 34.0 feet, becomes slightly weathered (II), moderately weak (R2) rock</p>			
11								7					
40										<p>At 37.4 feet, becomes slightly to moderately weathered (II - III), very weak (R1) rock, discontinuities in poor condition</p> <p>At 39.0 feet, discontinuities become moderately spaced and in poor condition</p>			
12								8		<p>At 40.2 feet, becomes slightly to moderately weathered (II - III), moderately weak (R2) rock, discontinuities in poor condition</p>			
13													
45													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14							R3 R3	9	PLT - D PLT - A	<p>META-WELDED LAPILLI DACITE TUFF, light bluish gray to medium gray (5B 7/1 - N5), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), moderately strong (R3) rock, with moderate brown to light brown (5YR 4/4 - 5YR 5/6), slightly weathered (II), moderately strong (R3) rock enveloping discontinuities, discontinuities become moderately to closely spaced at widely spaced intervals and in very poor to good condition, discontinuities in poor to very poor condition occur at a 10 to 15% frequency, discontinuities in fair condition occur at a 5 to 20% frequency. [Ohanapecoh Formation]</p>			
15								10					
50							R4 R4		PLT - A PLT - D				
16													
55								11					
17													
18													
60								12					
19							R4		PLT - D				
65													
20								13					
21							R5		PLT - A				
70													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22								14		<p>META-WELDED LAPILLI DACITE TUFF, medium bluish gray to greenish gray to dark greenish gray (5B 5/1 - 5G 6/1 - 5G 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), strong (R4) rock, discontinuities become moderately to closely spaced at widely spaced intervals and in very poor to good condition, discontinuities in poor to very poor condition occur at a 10 to 15% frequency, discontinuities in fair condition occur at a 5 to 20% frequency. [Ohanapecosh Formation]</p>			
75								15	R5 R5		PLT - D PLT - A		
24								16					
80								17					
25								18					
85									R4		PLT - A		
27													
90													
28													
95													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09

At 93.4 feet, becomes greenish gray to olive gray (5GY 6/1 - 5Y 4/1), slightly weathered (II), moderately strong (R3) rock



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29		[Hatched pattern]					100 / 0.4	R4	19	PLT - D	<p>META-WELDED LAPILLI DACITE TUFF, light gray to medium gray to yellowish gray (N7 - N5 - 5Y 8/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), strong (R4) rock, discontinuities become moderately to closely spaced at widely spaced intervals and in very poor to good condition, discontinuities in poor to very poor condition occur at a 10 to 15% frequency, discontinuities in fair condition occur at a 5 to 20% frequency. [Ohanapecoh Formation]</p> <p>At 104.4 feet, becomes greenish gray to olive gray (5GY 6/1 - 5Y 4/1), slightly weathered (II), moderately strong (R3) rock</p>		
30													
100							100 / 0.2		20				
31													
105		[Hatched pattern]					100 / 0.0		21				
32													
110		[Hatched pattern]					98 / 0.4	R4	22	PLT - D			
33													
115		[Hatched pattern]					104 / 0.0	R5	23	PLT - A			
34													
120		[Hatched pattern]											

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
37		[Hatched pattern]					$\frac{98}{0.2}$	R5 R4	24	PLT - A PLT - D	<p>META-WELDED LAPILLI DACITE TUFF, greenish gray to olive gray (5GY 6/1 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, slightly weathered (II), moderately strong to strong (R3 - R4) rock. Discontinuities become moderately to closely spaced at widely spaced intervals and in very poor to good condition, discontinuities in poor to very poor condition occur at a 10 to 15% frequency, discontinuities in fair condition occur at a 5 to 20% frequency. [Ohanapecosh Formation]</p> <p>At 128.2 feet, becomes light gray to medium gray to yellowish gray (N7 - N5 - 5Y 8/1), fresh (I), moderately strong to strong (R3 - R4) rock, with olive gray to dark greenish gray (5Y 4/1 - 5GY 4/1), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock enveloping discontinuities</p> <p>At 133.3 feet, becomes moderately strong (R3) when fresh (I) rock</p>		
125	38						$\frac{102}{0.4}$		25				
130	39						$\frac{100}{0.4}$	R4 R4	26	PLT - A PLT - D			
135	41						$\frac{98}{0.6}$	R3	27	PLT - D			
140	42						R5 R3		PLT - A PLT - D				
143	43									<p>Borehole completed to 140.2 feet bgs on August 29, 2007. Borehole was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on September 7, 2007. Groundwater was measured at approximately 59.9 feet bgs during drilling activities and at 58.5 feet on September 7, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 5, 2007.</p>			
145	44												

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Start Card SE01782

Job No. 03-2007 SR 90 Elevation 2650.7 ft (807.9 m)

HOLE No. RKS-17-07

Sheet 1 of 5

Project 2007 I-90 Geotechnical New Alignment Feasibility Investigation

Driller R. Gregory/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector M. Hommeyer

Start August 23, 2007 Completion August 25, 2007 Well ID# Not Applicable Equipment Skid-Mounted Burley 5500-1

Station 1394+81 Offset 105 Feet Left Casing Not Applicable Method HQ3 Triple Tube Wireline

Northing 734999.95 Easting 1426313.65 Latitude 47°20'44.075"N Longitude 121°21'49.083"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0	0									<p>TOPSOIL/FOREST DUFF [TS], pedogenic soil, moss and root organics with fine to coarse sand and silt, very loose, moist. Advanced borehole using HWT with tri-cone advancer to approximately 2.7 feet bgs.</p> <p>SANDY SILT [ML], fine to coarse sandy SILT, with gravels and boulders, some organics, trace gravels, medium stiff, dark yellowish orange to moderate yellowish brown (10YR 6/6 - 10Y 5/4), moist. [Colluvium]</p>			
1	0.3					$\frac{38}{N/A}$		1					
5	1.5					$\frac{50}{2.4}$		2					
10	3.0					$\frac{98}{2.0}$		3		<p>META-WELDED LAPILLI DACITE TUFF, light olive gray to light greenish gray (5Y 6/1 - 5GY 8/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, slightly weathered (II), very weak to moderately weak (R1 - R2) rock, discontinuities are very closely to closely spaced and in poor to fair condition. [Ohanapecosh Formation]</p>			
15	4.5					$\frac{100}{2.2}$	R1	4	PLT - D	At 12.0 feet, becomes moderately weak (R2) rock			
20	6.0					$\frac{100}{0.2}$		5					

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7							R4	6	PLT - A	<p>META-WELDED LAPILLI DACITE TUFF, light gray to medium light gray (N7 - N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), moderately strong (R3) rock, with yellowish gray to light olive gray (5Y 8/1 - 5Y 6/1), slightly weathered (II), moderately weak (R2) rock enveloping discontinuities, discontinuities become widely spaced and in good to very poor condition, discontinuities in poor to very poor condition occur at a 55 to 65% frequency. [Ohanapechosh Formation]</p> <p>At 26.6 feet, discontinuities become very closely to closely spaced and in very poor condition</p>			
25						$\frac{98}{0.6}$							
8							R3	7	PLT - D				
9						$\frac{102}{0.2}$							
30													
10													
35						$\frac{96}{0.2}$							
11													
40						$\frac{100}{0.0}$	R3 R4	9	PLT - D PLT - A				
12													
13													
45						$\frac{104}{0.0}$		10					

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14										META-WELDED LAPILLI DACITE TUFF , light gray to medium light gray (N7 - N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), moderately strong to strong (R3 - R4) rock, with yellowish gray to light olive gray (5Y 8/1 - 5Y 6/1), slightly weathered (II), moderately weak (R2) rock enveloping discontinuities, discontinuities become widely spaced and in good to very poor condition, discontinuities in poor to very poor condition occur at a 55 to 65% frequency. [Ohanapecosh Formation]			
15						$\frac{100}{0.2}$	R4	11	PLT - D				
50							R4		PLT - A				
16							R2		PLT - D				
55						$\frac{98}{0.2}$		12					
17													
18						$\frac{102}{0.0}$	R4	13	PLT - D	PLT - A			
60							R3						
19													
65						$\frac{102}{0.0}$		14					
20													
21						$\frac{98}{0.4}$	R4	15	PLT - D				
70													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22							R4		PLT - A	META-WELDED LAPILLI DACITE TUFF , light gray to medium light gray (N7 - N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), strong (R4) rock, with yellowish gray to light olive gray (5Y 8/1 - 5Y 6/1), slightly weathered (II), moderately weak (R2) rock enveloping discontinuities, discontinuities become moderately to closely spaced at widely spaced intervals and in poor to good condition, discontinuities in poor condition occur at 12 to 17% frequency. [Ohanapecoh Formation]			
							R3	16	PLT - D				
75													
23													
24													
80													
25													
85													
26													
27													
90													
28													
95													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
29		[Hatched pattern]					100	R4		21	PLT - D PLT - A	<p>META-WELDED LAPILLI DACITE TUFF, light gray to medium light gray (N7 - N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 45%), slightly welded, fresh (I), strong to very strong (R4 - R5) rock, with yellowish gray to light olive gray (5Y 8/1 - 5Y 6/1), slightly weathered (II), moderately strong (R3) rock, discontinuities become moderately to closely spaced at widely spaced intervals and in poor to good condition, discontinuities in poor condition occur at 12 to 17% frequency. [Ohanapecoh Formation]</p>		
30				98		0.4			22					
31							102	R5		23	PLT - A PLT - D			
105	32						2.0	R4						
33		[Hatched pattern]					94			24		<p>At 106.2 feet, becomes yellowish gray to olive gray (5Y 8/1 - 5Y 4/1), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock and discontinuities are very closely to closely spaced and in poor condition At 107.6 feet, becomes very weak to moderately weak (R1 - R2) rock</p>		
110	34						0.0	R4			PLT - D	<p>At 108.9 feet, becomes light gray to medium light gray (N7 - N6), fresh (I), strong to very strong (R4 - R5) rock</p>		
35								R5			PLT - D PLT - A	<p>Borehole completed to 114.0 feet bgs on August 25, 2007. Borehole was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on September 5, 2007. Groundwater was measured at approximately 21.3 feet bgs during drilling activities and at 65.9 feet on September 5, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 6, 2007.</p>		
115	36													
120														

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Start Card RE02072

Job No. 03-2007 SR 90 Elevation 2745.5 ft (836.8 m)

HOLE No. RKS-18-07

Sheet 1 of 8

Project 2007 I-90 Geotechnical New Alignment Feasibility Investigation

Driller S. Wilson/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector A. Shriver

Start September 5, 2007 Completion September 8, 2007 Well ID# RKS-18-07 Equipment Skid-Mounted Burley 5500-2

Station 1372+11 Offset 170 Feet Left Casing Stick-up Monument Method HQ3 Triple Tube Wireline

Northing 737296.78 Easting 1426299.7 Latitude 47°21'06.741"N Longitude 121°21'49.651"W

County Kittitas Subsection NE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
1								1		META-WELDED LAPILLI DACITE TUFF , olive gray (5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 55%), slightly welded, slightly weathered (II), moderately strong (R3) rock, discontinuities are moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 3 to 8% frequency, discontinuities in fair condition occur at a 5 to 30% frequency. [Ohanapecoh Formation]			
5						94 2.4		2					
10						98 1.6		3					
15						98 1.0		4					
20						106 1.1							



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								5		<p>META-WELDED LAPILLI DACITE TUFF, olive gray (5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 55%), slightly welded, slightly weathered (II), moderately strong (R3) rock, discontinuities are moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 3 to 8% frequency, discontinuities in fair condition occur at a 5 to 30% frequency. [Ohanapecosh Formation]</p>			
25						100	R2	6	PLT - D				
30						102		7			At 29.9 feet, becomes moderately weak to moderately strong (R2 - R3) rock		
10										At 33.0 feet, healed discontinuities occur from 4 to greater than 10 per foot			
35						100	R2	8	PLT - A	At 34.9 feet, becomes medium dark gray to olive gray (N4 - 5Y 4/1), fresh (I), moderately weak to moderately strong (R2 - R3) rock			
40						100	R1	9	PLT - A				
45													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14								10		META-WELDED LAPILLI DACITE TUFF , medium dark gray to olive gray (N4 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 55%), slightly welded, slightly weathered (II), moderately strong (R3) rock, discontinuities are moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 3 to 8% frequency, discontinuities in fair condition occur at a 5 to 30% frequency. [Ohanapecosh Formation]			
15								11	PLT - D				
16								12	PLT - A				
55								13	PLT - A PLT - D				
17								14	PLT - D PLT - A				
18													
60													
19													
65													
20										At 64.9 feet, becomes slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock At 65.5 feet, becomes moderately weathered (III) rock			
21													
70													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22								15		META-WELDED LAPILLI DACITE TUFF , medium dark gray to olive gray (N4 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 55%), slightly welded, slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities are moderately to closely spaced and in poor to good condition, discontinuities in poor condition occur at a 3 to 8% frequency, discontinuities in fair condition occur at a 5 to 30% frequency. [Ohanapecosh Formation]			
						117 0.0		16					
75	23						R2 R3	17	PLT - D PLT - A	At 75.9 feet, becomes slightly to moderately weathered (II - III), moderately weak to moderately strong (R2 - R3) rock			
						103 0.3		18					
80	24							19					
						105 1.2		20					
85	25						R3 R3	21	PLT - A PLT - D				
						100 0.4		22					
90	26							23					
						100 0.6		24					
95	27							25					
						87 0.0		26					
	28							27					
						100 0.5		28					

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29							100 0.6	R3	22	PLT - D	META-WELDED LAPILLI DACITE TUFF , medium dark gray to olive gray (N4 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 55%), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become moderately to closely spaced at widely spaced interval and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency. [Ohanapecosh Formation]		
30													
100							102 0.4		23				
31													
105							98 0.6		24				
33							100 0.6	R3 R4	25	PLT - D PLT - A			
110													
34													
115							100 0.0		26				
35													
36													
120													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
37								27					
38								28					
39								29					
40								30					
41								31					
42													
43								32					
44													
145													

ROCK NAF BOREHOLES_2007.GPJ 2/13/09

META-WELDED LAPILLI DACITE TUFF, medium dark gray to olive gray (N4 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 55%), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become moderately to closely spaced at widely spaced interval and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency. [Ohanapecosh Formation]



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
45								33		META-WELDED LAPILLI DACITE TUFF , medium dark gray to olive gray (N4 - 5Y 4/1), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 55%), slightly weathered (II), moderately weak to moderately strong (R2 - R3) rock, discontinuities become moderately to closely spaced at widely spaced interval and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency. [Ohanapecosh Formation]			
150	46						R2	34	PLT - D	At 150.9 feet, discontinuities become very closely spaced and in poor condition			
155	47							35					
160	48							36					
165	49						R3	37	PLT - D	At 163.0 feet, becomes medium bluish gray to medium dark gray (5B 5/1 - N4), fresh (I), strong (R4) rock			
170	50						R4	38	PLT - D				
175	51						R5	39	PLT - D PLT - A	At 167.0 feet, becomes very strong (R5) rock			

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument	
			20	40	60	80								
52							97 0.0	R4	40	PLT - A	<p>META-WELDED LAPILLI DACITE TUFF, medium bluish gray to medium dark gray (5B 5/1 - N4), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (15 to 55%), fresh (I), very strong (R5) rock, discontinuities become moderately to closely spaced at widely spaced interval and in poor to good condition, discontinuities in poor condition occur at a 10 to 15% frequency. [Ohanapecoh Formation]</p>			
53						107 0.0	41							PLT - A
175														
54							R5	43	PLT - D					
180													96 1.0	55
56														
185														
57														
190														
58														
195														
59														
195														

ROCK NAF BOREHOLES_2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0 - 1	0 - 0.3						38 N/A	1		GRAVEL [GP] , fine to coarse, angular to subangular GRAVEL, cobbles and boulders, with fine to coarse sand, loose, dry. [Anthropogenic Fill]			
1 - 2	0.3 - 0.6						63 N/A	2	SPT N=27	Blow Counts/0.5' = 4, 2, 25 [N = 27, Recovery = 0.5'/1.5']			
2 - 3	0.6 - 0.9						100 1.2	3	SPT N=50/0.4	GRAVEL [GP - GM] , fine to coarse subangular to subrounded GRAVEL, with fine to coarse sand, trace silt, medium dense, pale yellowish brown to dark yellowish brown (10YR 6/2 - 10YR 4/2), moist. [Colluvium] Blow Counts/0.5' = 9, 50/0.4' [N = 50/0.4', Recovery = 0.6'/0.9']			
3 - 4	0.9 - 1.2						94 1.6	4		META-WELDED LAPILLI DACITE TUFF , pale yellowish brown to dark yellowish brown (10YR 6/2 - 10YR 4/2), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 45%), moderately weathered (III), very weak to moderately weak (R1 - R2) rock, discontinuities are closely spaced and in fair to very poor condition. [Ohanapecosh Formation] At 12.0 to 12.5 feet, becomes highly weathered (IV), extremely weak (R0) rock			
4 - 5	1.2 - 1.5									At 15.3 feet, becomes slightly to moderately weathered (II - III), moderately weak to moderately strong (R2 - R3) rock, discontinuities become moderately to closely spaced and in poor and good condition, discontinuities in poor condition occur at a 10 to 30% frequency			
5 - 6	1.5 - 1.8									At 17.6 to 17.9 feet, becomes highly weathered (IV), extremely weak (R0) rock			



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								5		<p>META-WELDED LAPILLI DACITE TUFF, medium light gray (N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 45%), fresh (I), moderately weak to moderately strong (R2 - R3) rock, with dark yellowish orange to pale yellowish brown (10YR 6/6 - 10YR 6/2) enveloping discontinuities, discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor and fair condition occur at a 5 to 15% frequency. [Ohanapecosh Formation]</p>			
25						$\frac{104}{1.8}$	R2		PLT - D				
8						$\frac{98}{1.0}$		6					
9						$\frac{102}{1.4}$	R2	7	PLT - D				
10						$\frac{100}{3.0}$		8					
35						$\frac{100}{2.7}$		9					
11							R2		PLT - D				
12						$\frac{102}{1.4}$		9A		At 40.8 to 41.8 feet, becomes slightly to moderately weathered (II - III) rock, discontinuity in poor to very poor condition			
13													
45													

ROCK SCD BOREHOLES 2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14							$\frac{98}{1.0}$	R3	10	PLT - D	<p>META-WELDED LAPILLI DACITE TUFF, medium light gray (N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 45%), slightly weathered (I) to moderately weathered (II), moderately weak to moderately strong (R2 - R3) rock, with dark yellowish orange to pale yellowish brown (10YR 6/6 - 10YR 6/2) enveloping discontinuities, discontinuities become moderately to closely spaced and in poor to good condition, discontinuities in poor and fair condition occur at a 5 to 15% frequency. [Ohanapecosh Formation]</p> <p>At 51.3 feet, discontinuities become closely to very closely spaced at very widely spaced intervals and in good condition</p>		
15							R3		PLT - A				
50							$\frac{100}{0.6}$	R3	11	PLT - D			
16							R3 R4		PLT - D PLT - A				
55							$\frac{100}{0.0}$		12				
17								R4		PLT - D			
18									13				
60							$\frac{102}{0.0}$	R3 R4		PLT - D PLT - A			
19													
65							$\frac{96}{1.6}$		14				
20													
21													
70													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22							$\frac{102}{0.0}$	15	PLT - A	<p>META-WELDED LAPILLI DACITE TUFF, medium light gray (N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 45%), slightly weathered (I) to moderately weathered (II), moderately weak to moderately strong (R2 - R3) rock, with dark yellowish orange to pale yellowish brown (10YR 6/6 - 10YR 6/2) enveloping discontinuities, discontinuities become closely to very closely spaced at very widely spaced intervals and in good condition. [Ohanapecoh Formation]</p>			
							R3						
75	23						$\frac{98}{>2.4}$	16					
										At 76.9 to 77.9 feet, becomes slightly weathered (II), very weak to moderately weak (R1 - R2), discontinuities become very closely spaced and in good condition			
80	24						$\frac{98}{0.0}$	17					
										At 80.0 feet, becomes fresh (I), moderately strong (R3) rock, discontinuities become closely to very closely spaced at very widely spaced intervals and in good condition			
85	25						$\frac{102}{0.8}$	18	PLT - D				
										At 85.9 feet, discontinuities become moderately to closely spaced and in fair to good condition			
90	26						$\frac{102}{>1.6}$	19					
										At 90.2 to 90.6 feet, discontinuity in poor condition			
95	28								PLT - D PLT - A				

ROCK SCD BOREHOLES 2007.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29								20		<p>META-WELDED LAPILLI DACITE TUFF, medium light gray (N6), fine grained groundmass with fine to medium grained phenocrysts and lapilli-sized clasts (20 to 45%), fresh (I), moderately strong (R3) rock, with dark yellowish orange to pale yellowish brown (10YR 6/6 - 10YR 6/2), slightly weathered (II), moderately weak (R2) rock enveloping discontinuities, discontinuities become very closely spaced at moderately spaced intervals and in good condition. [Ohanapecosh Formation]</p>			
30													
100													
31							R4 R3						
105													
32										<p>Borehole completed to 105.1 feet bgs on September 20, 2007. Borehole was overcased with HWT casing to 11.5 feet bgs and was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on September 20, 2007. Borehole completed with one vibrating wire piezometer at 103.1 feet bgs on September 21, 2007. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at approximately 5.4 feet bgs during drilling activities and at 65.0 feet on September 20, 2007 prior to beginning optical borehole survey.</p> <p>VWP #92270 = 101.6 to 103.1 feet bgs #10-20 silica sand filter pack from 90.0 to 105.1 feet bgs Grout mix from 0.0 to 90.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 30 gallons water 25 to 35 lbs pure bentonite powder Well Tag # = APC 419</p>			
33													
110													
34													
35													
115													
36													
120													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
							31		1		The borehole collar elevation is approximately 1.2 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.			
1											SILTY SAND, GRAVEL, COBBLE, AND BOULDERS [SM/GM] , sub-angular to sub-rounded, loose to very dense, medium gray (N4), moist, homogeneous. [Colluvium]			
5							98 3.4		2					
2								R5		PLT-D	META WELDED LAPILLI TUFF , medium gray (N5), massive aphanitic groundmass with fine to medium phenocrysts(10-20%), lapilli sized rock fragments (10-20%), lapilli sized pumice fragments (10-15%), slightly weathered (II), moderately strong (R3). Discontinuities are closely spaced and in fair condition. [Ohanapecosh Formation]			
10							108 7.6		3		At 7.8 feet, core becomes fresh (I) and moderately strong (R3) to strong (R4). At 9.5 feet, core becomes strong (R4).			
4							104 5.6		4					
15							108 2.8		5		PLT-D	At 14.5 feet, core becomes medium dark gray (N4).		
5														
							76 2.0		6					
20								R5		PLT-D				
							133		7					



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14							9.8						
15							0		17				
50							102		18				
16							1.0						
55							98	R1	19	PLT-D			
17							0.8						
18													
60							104	R2	20	PLT-D			
18							0.4						
19													
65							98		21				
20							0.6						
21													
70							104		22				

ROCK PHASE C.G.F.J. 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22							R2		PLT-D	META WELDED LAPILLI TUFF , greenish gray (5G 6/1), massive aphanitic groundmass with fine to medium phenocrysts (5-12%), lapilli sized rock fragments (10-12%), lapilli sized pumice fragments (5-10%), fresh (I), strong (R4) to very strong (R5). Discontinuities are closely to moderately spaced and in fair condition. [Ohanapecoh Formation]			
75	23						R2	23	PLT-A	At 74.5 feet, core becomes strong (R4) and discontinuities become moderately spaced and in fair condition.			
80	24						R1	24	PLT-D	At 79.5 feet, core becomes greenish gray (5B 6/1) and moderately strong (R3).			
85	26						R3	25	PLT-D				
90	28						R2	26	PLT-A				
95								27		At 92.0 feet, discontinuities become closely spaced and in fair condition.			

ROCK PHASE C.GPJ 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29							R2		PLT-D	META WELDED LAPILLI TUFF , greenish gray (5G 6/1), massive aphanitic groundmass with fine to medium phenocrysts (5-15%), lapilli sized rock fragments (7-15%), lapilli pumice fragments (3-5%), fresh (I), moderately strong (R3). Discontinuities are moderately to widely spaced and in fair to good condition. [Ohanapecoh Formation]			
30													
100								28		At 99.5 feet, core becomes medium gray (N5) to greenish gray (5G 6/1).			
31													
105							R2	29	PLT-D	At 104.5 feet, core becomes greenish gray (5G 6/1) and moderately strong (R3) to strong (R4).			
32													
33							R3		PLT-A				
110								30		At 109.5 feet, core becomes strong (R4).			
34													
115							R4	31					
35									PLT-D				
36													
120								32					



LOG OF TEST BORING

Start Card SE03294

Job No. 103-WA

SR 90

Elevation 2636.3 ft (803.5 m)

HOLE No. RKS-38-08

Sheet 6 of 6

Project Interstate 90 Hyak Re-Alignment - 2008 Geotechnical Investigation

Driller M. Starling/ S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
37											<p>Borehole completed to 119.5 feet below ground surface (bgs) on October 15, 2008. Borehole was overcased with HWT casing to 7.1 feet bgs and was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on October 12, 2008. Borehole completed with time domain reflectometry cable from ground surface to 119.5 feet bgs. Groundwater was measured at 46.5 ft. bgs on October 15, 2008 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 30, 2008.</p> <p>Grout mix from 0.0 to 119.5 feet bgs: One 94 pound bag of Type I-II Portland Cement 6 gallons of water</p> <p>Well Tag # = APA 653</p>			
125														
39														
130														
40														
41														
135														
42														
140														
43														
44														
145														



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
								1		The borehole collar elevation is approximately 3 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.			
								2		SILTY SAND WITH GRAVEL, COBBLES, AND BOULDERS [SM/GM] , sub-angular to sub-rounded, loose to very dense, medium gray (N4), moist, homogeneous. [Colluvium]			
5								3		META WELDED LAPILLI TUFF , greenish gray (5G 6/1), massive aphanitic groundmass with fine to medium phenocrysts (10-20%), lapilli sized rock fragments (10-20%), lapilli sized pumice fragments (10-15%), fresh (I) to slightly weathered (II), moderately weak (R2). Discontinuities are closely spaced and in poor to fair condition. [Ohanapecosh Formation]			
10								4					
								5					
15									R2 R3	PLT-D PLT-D			
20													
										At 16.0 feet, core becomes moderately strong (R3).			
										At 18.6 feet, discontinuities become very closely spaced and in poor to fair condition.			



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7													
25							R4	6	PLT-D	META WELDED LAPILLI TUFF , greenish gray (5G 6/1), massive aphanitic groundmass with fine to medium phenocrysts, lapilli sized rock fragments, lapilli sized pumice fragments, fresh (I) to slightly weathered (II), moderately strong (R3) to strong (R4). Discontinuities are closely to moderately spaced and in poor to fair condition. [Ohanapecosh Formation]			
8								7		At 26.0 feet, core becomes moderately strong (R3).			
30							R4	8	PLT-D	At 30.2 feet, core becomes moderately strong (R3) to strong (R4) and discontinuities become moderately spaced and in fair condition.			
35								9		At 36.0 feet, discontinuities become widely spaced and in good condition.			
40							R4	10	PLT-D				
45													

ROCK PHASE C.G.F.J. 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14								11		META WELDED LAPILLI TUFF , greenish gray (5G 6/1), massive aphanitic groundmass with fine to medium phenocrysts (10-20%), lapilli sized rock fragments (10-20%), lapilli sized pumice fragments (10-15%), fresh (I), moderately strong (R3) to strong (R4). Discontinuities are widely spaced and in good condition. [Ohanapecosh Formation]			
15								12	PLT-D				
50								13		At 53.6 feet, core becomes moderately weathered (III) to highly weathered (IV), extremely weak (R1), and discontinuities become closely spaced and in poor condition. Observed crushed rock with clay infilling.			
16								14		At 55.3 feet, core becomes fresh (I) and moderately strong (R3).			
55								15					
17								16					
18								17					
60								18	PLT-D	At 61.0 feet, discontinuities become closely to very closely spaced and in poor condition.			
19								19					
65								20					
20								21	PLT-D	At 66.0 feet, core becomes moderately strong (R3) to strong (R4) and discontinuities become closely to moderately spaced and in fair condition.			
21								22					
70								23					



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
							R1		PLT-D	META WELDED LAPILLI TUFF , greenish gray (5G 6/1), massive aphanitic groundmass with fine to medium phenocrysts (10-20%), lapilli sized rock fragments (10-20%), lapilli sized pumice fragments (10-15%), fresh (I) to slightly weathered (II), moderately strong (R3) to strong (R4). Discontinuities are closely spaced and in poor to fair condition. [Ohanapecosh Formation]			
	22					100		17					
						4.8							
	75					100		18		At 73.8 feet, core becomes highly weathered (IV) and extremely weak (R0). Observed possible shear zone with sandy gouge and slicken-sides.			
						0				At 74.4 feet, core becomes fresh (I) to slightly weathered (II) and very weak (R1) to moderately weak (R2). Observed 4 to 8 healed fractures per foot.			
	23					40		19					
						10.0							
	24					90		20		At 77.5 to 81.0 feet core becomes highly weathered (IV) and extremely weak (R0) to moderately weak (R2), and discontinuities become close to very close and in poor to fair condition. Area of poor core recovery.			
						10.0							
	80					66		21					
						6.6							
	25					100		22		At 81.0 to 82.6 feet, core becomes fresh (I) to slightly weathered (II), moderately weak (R2) to moderately strong (R3), and discontinuities become closely spaced and in poor to fair condition.			
						100							
						5.0		23					
						57							
						2.5		24					
	85					10		25		At 83.0 to 92.0 feet, core becomes highly weathered (IV) and extremely weak (R0) to moderately weak (R2), and discontinuities become close to very close and in poor to fair condition. Area of poor core recovery.			
						0							
	26					0		26					
						0							
						100		27					
						10.0							
						70		28					
						10.0							
	27					100		29					
						10.0							
	90					100		30					
						10.0							
						100		31					
						100							
						8.3		32					
						100							
	28					2.0		33					
						100							
						10.0		34		At 92.0 feet, core becomes fresh (I), moderately strong (R3), and discontinuities are closely spaced and in fair condition.			
						100							
						1.5		35					
	95												



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
29		[Profile with triangles]	[Hatched area from 20% to 80%]				100/4.0	[Rock Strength bar]	[Sample Type bar]	36		<p>META WELDED LAPILLI TUFF, greenish gray (5G 6/1), massive aphanitic groundmass with fine to medium phenocrysts (10-20%), lapilli sized rock fragments (10-20%), lapilli sized pumice fragments (15-20%), fresh (I), moderately strong (R3). Discontinuities are very closely to closely spaced and in poor to fair condition. [Ohanapecosh Formation]</p>		
30			[Hatched area from 20% to 40%]				100/4.0			37				
100														
31											<p>Borehole completed to 101.0 feet below ground surface (bgs) on October 21, 2008. Borehole was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 07, 2008. Groundwater was measured at approximately 10.0 feet bgs during drilling activities and at 54.5 feet on November 7, 2007 prior to beginning optical borehole survey. Borehole backfilled with cement grout on November 7, 2007.</p>			
105														
33														
110														
34														
115														
35														
36														
120														



LOG OF TEST BORING

Start Card RE02930

Job No. 103-WA SR 90 Elevation 2660.6 ft (811.0 m)

HOLE No. RKS-40-08

Sheet 1 of 7

Project Interstate 90 Hyak Re-Alignment - 2008 Geotechnical Investigation

Driller B. Kotzian/ S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector D. Meier

Start October 9, 2008 Completion October 11, 2008 Well ID# RKS-40-08 Equipment Burley 5500

Station 1385+23 Offset -128 Left Casing Stick-Up Monument Method HQ3 Triple Tube Wireline

Northing 735963.62 Easting 1426476.86 Latitude 47°20'53.604"N Longitude 121°21'46.867"W

County Kittitas Subsection SE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
								1		The borehole collar elevation is approximately 1.5 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.			
								2		SILTY SAND WITH GRAVEL, COBBLES, AND BOULDERS [SM/GM] , sub-angular to sub-rounded, loose to dense, medium gray (N4) to light bluish gray (5B 7/1) to grayish orange (10YR 7/4), dry to moist. [Colluvium]			
1								3		META WELDED LAPILLI TUFF , light bluish gray (5B 7/1) with pale yellowish orange (10YR 7/6) staining on discontinuity surfaces and pumice fragments, massive aphanitic groundmass with fine to medium phenocrysts (10-15%), lapilli sized rock and pumice fragments (10-20%), moderately weathered (III), very weak (R1) to moderately weak (R2). Discontinuities are closely spaced and in poor to fair condition. [Ohanapecosh Formation]			
5								4		At 6.0 feet, core becomes slightly weathered (II) to moderately weathered (III) and moderately weak (R2).			
								5					
								6		At 9.0 feet, core becomes pale blue (5PB 7/2), fresh (I) to moderately weathered (II) and discontinuities become closely spaced and in poor to fair condition.			
10								7	PLT-D	At 11.8 feet, core becomes extremely weak (R0) and highly weathered (IV).			
								8	PLT-D	At 13.6 feet, core becomes slightly (II) to moderately weathered (III) and moderately weak (R2) to moderately strong (R3).			
15													
5													
20										At 18.8 feet, core becomes completely weathered (V) and extremely weak (R0).			

ROCK PHASE C.GPJ - 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7													
25													
8													
9													
30													
10													
35													
11													
12													
40													
13													
45													

ROCK PHASE C.GPJ 2/13/09

META WELDED LAPILLI TUFF, pale blue (5PB 7/2) with pale yellowish orange (10YR 8/6) staining on discontinuity surfaces and pumice fragments, massive aphanitic groundmass with fine to medium phenocrysts (10-15%), lapilli sized rock and pumice fragments (10-20%), slightly weathered (II) to moderately weathered (III), very weak (R1) to moderately weak (R2). Discontinuities are closely spaced and in fair condition. [Ohanapecoh Formation]
At 23.4 feet, core becomes extremely weak (R0) and highly weathered (IV).

At 25.8 feet, core becomes light blue gray (5B 7/1), slightly weathered (II), moderately weak (R2) and discontinuities become moderately spaced and in fair condition.

At 28.5 feet, core becomes fresh (I) to slightly weathered (II).

At 32.4 feet, core becomes pale blue (5PB 7/2), fresh (I) to slightly weathered (II), and discontinuities become moderately to widely spaced and in fair to good condition.

At 42.0 feet, core becomes moderately weak (R2) to moderately strong (R3).



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14										<p>META WELDED LAPILLI TUFF, pale blue (5PB 7/2) with pale yellow orange (10YR 8/6) staining on discontinuity surfaces and pumice fragments, massive aphanitic groundmass with fine to medium phenocrysts (10-15%), lapilli sized rock and pumice fragments (10-20%), fresh (I) to slightly weathered (II), moderately weak (R2) to moderately strong (R3). Discontinuities are moderately spaced and in fair to good condition. [Ohanapecosh Formation]</p> <p>At 46.9 feet, core becomes fresh (I) to slightly weathering (II) and discontinuities become widely spaced and in fair condition.</p>			
15						1.0	R3	14	PLT-D				
50													
16													
55													
17													
18													
60													
19													
65													
20													
21													
70													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22							1.0	R3		PLT-D	META WELDED LAPILLI TUFF , pale blue (5PB 7/2) to light blue gray (5B 7/1) with pale yellow orange (10YR 6/6) staining on discontinuity surfaces and pumice fragments, massive aphanitic groundmass with fine to medium phenocrysts (10-15%), lapilli sized rock and pumice fragments (10-15%), fresh (I) to slightly (II) weathered, moderately weak (R2) to moderately strong (R3). Discontinuities are moderately to widely spaced and in fair to good condition. [Ohanapocosh Formation]		
75	23						$\frac{100}{0.8}$		19		At 74.5 feet, core becomes fresh (I), moderately strong (R3), and discontinuities become moderately spaced and in fair condition. At 75.4 feet, core becomes fresh (I) to slightly weathered (II) and moderately weak (R2) to moderately strong (R3).		
80	24						$\frac{100}{0.8}$	R3	20	PLT-D	At 79.5 feet, core becomes light blue gray (5B 7/1), fresh (I), moderately strong (R3) to strong (R4), and discontinuities become moderately to widely spaced and in fair condition.		
25								R3		PLT-D			
85	26						$\frac{100}{0.7}$		21 22		At 84.5 feet, core becomes slightly weathered (II), moderately weak (R2) to moderately strong (R3), and discontinuities become closely spaced and in poor to fair condition.		
27								R4		PLT-D	At 87.2 feet, core becomes fresh (I), moderately strong (R3) to strong (R4), and discontinuities become moderately to widely spaced and in fair condition.		
90	28						$\frac{82}{0.4}$		23				
95							96	R4	24	PLT-D	At 92.5 feet, core becomes strong (R4).		



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29										<p>META WELDED LAPILLI TUFF, pale blue (5PB 7/2) to light blue gray (5B 7/1), massive aphanitic groundmass with fine to medium phenocrysts (10-15%), lapilli sized rock and pumice fragments (10-20%), fresh (I), strong (R4). Discontinuities are moderately spaced and in fair condition. [Ohanapecosh Formation]</p>			
30						1.4	R4		PLT-D				
100								25		<p>At 98.5 feet, core becomes moderately strong (R3) to strong (R4) and discontinuities become closely spaced and in poor to fair condition.</p>			
31						$\frac{92}{4.4}$							
105								26		<p>At 106.9 feet, core becomes greenish gray (5G 6/1) and discontinuities become moderately spaced and in fair condition.</p>			
32						$\frac{96}{2.4}$							
33								27		<p>At 112.9 feet, discontinuities become closely spaced and in poor to fair condition.</p>			
110						$\frac{100}{3.4}$	R3		PLT-D				
34								28		<p>At 116.5 feet, discontinuities become closely to moderately spaced and in poor to fair condition.</p>			
35						$\frac{96}{3.4}$	R4		PLT-D				
115								29					
36													
120						100							



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
37						2.6				META WELDED LAPILLI TUFF , pale blue (5PB 7/2) to light blue gray (5B 7/1), massive aphanitic groundmass with fine to medium phenocrysts (10-15%), lapilli sized rock and pumice fragments (10-20%), fresh (I), moderately strong (R3) to strong (R4). Discontinuities are closely spaced and in fair condition. [Ohanapechosh Formation]			
125	38					$\frac{100}{4.4}$		30		At 126.5 feet, discontinuities become closely spaced and in poor to fair condition.			
130	39					$\frac{100}{3.4}$		31		At 130.0 feet, core becomes greenish gray (5G 6/1), fresh (I), moderately strong (R3) to strong (R4), and discontinuities become closely to moderately spaced and in fair condition.			
135	40					$\frac{100}{1.4}$		32		At 134.5 feet, discontinuities become moderately to widely spaced and in fair condition.			
140	41									Borehole completed to 139.5 feet below ground surface (bgs) on October 15, 2008. Borehole was overcased with HWT casing and was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on October 17, 2008. Borehole completed with two vibrating wire piezometers at 100.0 feet and 138.0 feet bgs. Borehole completed with time domain reflectometry cable from ground surface to 75.0 feet bgs. Borehole installation completed on November 07, 2008.			
145	42									VWP# 92732 (98.5 - 100.0 feet bgs) VWP# 92734 (136.5 - 138.0 feet bgs)			
	43												
	44												



LOG OF TEST BORING

Start Card RE02930

Job No. 103-WA

SR 90

Elevation 2660.6 ft (811.0 m)

HOLE No. RKS-40-08

Sheet 7 of 7

Project Interstate 90 Hyak Re-Alignment - 2008 Geotechnical Investigation

Driller B. Kotzian/ S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
45											#10-20 silica sand filter pack from 124.0 feet to 139.5 feet bgs. Grout mix from 0.0 to 124.0 feet bgs: One 94 pound bag of Type I-II Portland Cement 30 gallons of water 25 pounds of bentonite powder Well Tag # = APA 654			
150														
155														
160														
165														
170														



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
1								1		The borehole collar elevation is approximately 1.5 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.			
5								2		SILTY SAND WITH GRAVEL, COBBLES, AND BOULDERS [SM/GM] , sub-angular to sub-rounded, loose to dense, pale yellowish orange (10YR 8/6) to medium reddish brown (10R 4/6), dry to moist. [Colluvium]			
2								3		META WELDED LAPILLI TUFF , pale blue (5PB 7/2) to pale yellowish orange (10YR 8/6), massive, aphanitic groundmass with fine to medium phenocrysts, lapilli sized rock and pumice fragments, slightly weathered (II) to moderately weathered (III), moderately weak (R2) to moderately strong (R3). Discontinuities are closely spaced and in fair condition. [Ohanapecos Formation]			
10								4		At 9.5 feet, core becomes slightly weathered (II) and moderately weak (R2).			
4								5		At 11.3 feet, core becomes grayish orange (10YR 7/4), moderately weathered (III) to completely weathered (V), very weak (R0) to moderately weak (R2), and discontinuities become closely spaced and in poor condition. Observed clay zones.			
15								6		At 14.0 feet, core becomes light bluish gray (5B 7/1) to pale yellow orange (10YR 8/6), slightly weathered (II) to moderately weathered (III), and moderately weak (R2).			
5										At 17.3 feet, discontinuities become closely to moderately spaced and in fair condition.			
20													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7							R3		PLT-D	<p>META WELDED LAPILLI TUFF, light bluish gray (5B 7/1) to pale yellowish orange (10YR 8/6), massive, aphanitic groundmass with fine to medium phenocrysts, lapilli sized rock and pumice fragments, slightly weathered (II) to moderately weathered (III), moderately weak (R2). Discontinuities are closely to moderately spaced and in fair condition. [Ohanapecosh Formation]</p> <p>At 24.5 feet, core becomes moderately weak (R2) to moderately strong (R3).</p> <p>At 29.5 feet, core becomes slightly weathered (II), moderately weak (R2), and discontinuities become moderately spaced and in fair condition.</p> <p>At 32.9 feet, discontinuities become closely spaced and in poor to fair condition.</p> <p>At 40.0 feet, core becomes bluish gray (5B 7/1) to dark gray (N4), fresh (I) to slightly weathered (II), and moderately weak (R2) to moderately strong (R3). Observed pale yellowish orange (10YR 8/6) weathering envelopes around discontinuities.</p>			
25						$\frac{100}{2.8}$	R3	7	PLT-D				
8													
30						$\frac{100}{1.8}$		8					
9													
35						$\frac{100}{1.2}$		9					
11													
40						$\frac{100}{1.2}$		10					
12							R3		PLT-D				
13													
45						100		11					



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14										<p>META WELDED LAPILLI TUFF, bluish gray (5B 7/1) to medium bluish gray (5B 5/1), pale yellowish orange (10YR 8/6) staining on slightly weathered surfaces, massive, aphanitic groundmass with lapilli sized rock and pumice fragments, fresh (I) to slightly (II) weathered, moderately weak (R2) to moderately strong (R3). Discontinuities are closely to moderately spaced and in poor to fair condition. [Ohanapecoh Formation]</p>			
15													
50													
16													
55													
17													
18													
60													
19													
65													
20													
21													
70													

ROCK PHASE C.GPJ - 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)	% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
22				$\frac{100}{4.3}$ 2.8		19		META WELDED LAPILLI TUFF , bluish gray (5B 7/1) to medium bluish gray (5B 5/1), pale yellowish orange (10YR 8/6) staining on slightly weathered surfaces, massive, aphanitic groundmass with lapilli sized rock and pumice fragments, fresh (I) to slightly (II) weathered, moderately weak (R2) to moderately strong (R3). Discontinuities are closely spaced and in poor to fair condition. [Ohanapecosh Formation]		
75				$\frac{100}{8.8}$		20		At 73.8 feet, core becomes grayish orange (10YR 7/4) to pale yellow (10YR 8/6), moderately weathered (III), and extremely weak (R0) to very weak (R1). At 75.5 feet, core becomes completely weathered (V) and extremely weak (R0). Clay filled fault zone with mylonite present. At 76.5 feet, core becomes pale purple (5P 6/2) to light bluish gray (5B 7/1), fresh (I), and moderately strong (R3). Observed no weathering envelopes around discontinuities. Numerous mylonite filled faults with gouge up to 5 millimeters thick and slicken-sides along shears.		
80				$\frac{100}{2.8}$		21		At 79.5 feet, core becomes light bluish gray (5B 7/1), fresh (I) to slightly weathered (II), and moderately weak (R2) to moderately strong (R3).		
85				$\frac{98}{1.4}$		22				
90								Borehole completed to 89.5 feet below ground surface (bgs) on October 14, 2008. Borehole was overcased with HWT casing and flushed in preparation of optical and acoustical televiewer survey. Optical and televiewer surveys were completed on October 17, 2008. Borehole completed with time domain reflectometry cable from ground surface to 89.5 feet bgs. Borehole backfilled with cement grout on November 06, 2008. Grout mix from 0.0 to 89.5 feet bgs: One 94 pound bag of Type I-II Portland Cement 6 gallons of water Well Tag# = APA 655		
95										



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
1													
5													
2													
10													
4													
15													
5													
20													

ROCK PHASE C.G.F.J. 2/13/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7			[Hatched Pattern]				$\frac{100}{0.2}$	R3	5	PLT-D	<p>SANDSTONE, salt and pepper, medium light gray (N6) to light gray (N7) and grayish black (N2), massive, fine to medium grained with 15-25% rock fragments, fresh (I), and moderately strong (R3). Discontinuities are widely spaced and in fair condition. [Naches Formation]</p> <p>At 26.9 to 27.1 feet, observed clay filled discontinuity.</p>		
25	8		[Hatched Pattern]				$\frac{98}{0.4}$		6				
30	9		[Hatched Pattern]				$\frac{98}{0.2}$	R3	7	PLT-D			
35	10		[Hatched Pattern]				$\frac{98}{0.2}$	R3		PLT-D			
11			[Dashed Lines]								<p>Borehole completed to 35.5 feet below ground surface (bgs) on October 25, 2008. Borehole was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on November 07, 2008. Borehole backfilled with cement grout on November 9, 2008.</p>		
12	40		[Dashed Lines]										
13			[Dashed Lines]										
45			[Dashed Lines]										



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7													
25													
8													
25													
30													
9													
30													
35													
10													
35													
11													
35													
40													
12													
40													
45													
13													
45													

ROCK PHASE C.G.F.J. 2/13/09



LOG OF TEST BORING

Start Card RE02737

Job No. 103-WA SR 90 Elevation 2574.3 ft (784.6 m)

HOLE No. RKS-44-08

Sheet 1 of 3

Project Interstate 90 Hyak Re-Alignment - 2008 Geotechnical Investigation

Driller B. Kotzian/ S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector D. Meier

Start October 27, 2008 Completion October 29, 2008 Well ID# RKS-44-08 Equipment Burley 5500

Station 1462+00 Offset -108 Left Casing Stick-Up Monument Method HQ3 Triple Tube Wireline

Northing 730919.68 Easting 1430721 Latitude 47°20'04.278"N Longitude 121°20'44.452"W

County Kittitas Subsection SE Quarter Section 1 Range 11E Township 21N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0	0									The borehole collar elevation is approximately 1.5 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.			
1	0.3									POORLY GRADED GRAVEL AND SILTY SAND [GM/SM] , sub-angular to sub-rounded, dense, dark gray (N4) to medium dark gray (N5) to yellowish orange (10YR 8/6), dry to moist. [Alpine Till]			
5	1.5							33	1	SPT	At 4.5 feet, Standard Penetration Test using 30" drop and 140 pound hammer using a cathead mechanism. Values = 50; N = 50 for 3 inches.		
2	0.6							0	2				
3	0.9							100	3				
10	3.0							80	4				
								70	5				
								0	6	SPT	At 11.5 feet, Standard Penetration Test using 30" drop and 140 pound hammer using a cathead mechanism. Values = 50; N = 50 for 6 inches.		
								79					
4	1.2							60	7				
15	4.5								8				
								14					
5	1.5								9				
								40					
20	6.1												



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
14											<p>Borehole completed to 45.0 feet below ground surface (bgs) on October 28, 2008. Borehole was overcased with HWT casing and flushed for optical and acoustical televiewer survey. Borehole completed with two vibrating wire piezometers at 25.0 feet and 40.5 feet bgs. Borehole installation completed on November 07, 2008.</p> <p>VWP# 94879 (23.5' - 25.0') VWP# 92939 (39.0' - 40.5')</p> <p>#10 -20 silica sand filter pack was used from 33.0 feet to 45.0 feet bgs. Grout mix from 0.0 feet to 33.0 feet bgs One 94 pound bag of Type I-II Portland Cement 30 gallons of water 25 to 30 pounds of pure bentonite powder</p> <p>Well Tag# = APA 656</p>			
15														
50														
16														
55														
17														
18														
60														
19														
65														
20														
21														
70														



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
							0				The borehole collar elevation is approximately 1.5 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.		
1											<p>POORLY GRADED SILTY SAND WITH GRAVEL AND COBBLES [SM/GM], sub-angular to sub-rounded, dense, light gray, moist. Gravels and cobbles consist of meta-volcanics and intrusives. [Alpine Till]</p>		
5						100 66		1	SPT	At 4.7 feet, Standard Penetration Test using 30" drop and 140 pound hammer using a cathead mechanism. Values = 50; N = 50 for 3 inches.			
2						35		2					
							53						
10													
							61						
15													
5							50 40						
20													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14								14		<p>META VOLCANICS, light greenish gray (5GY 8/1) to pale olive (10Y 6/2) to very light gray (N8) to medium light gray (N5) with localized dark yellowish orange (10YR 6/8) staining near discontinuities, massive aphanitic groundmass with fine to medium phenocrysts, fresh (I) to slightly (II) weathered, moderately weak (R2) to moderately strong (R3). Discontinuities are moderately spaced and in fair to good condition. [Naches Formation]</p>			
15						100 3.2	R3		PLT-D				
50										<p>Borehole completed to 50.0 feet below ground surface (bgs) on October 27, 2008. Borehole was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 10, 2008. Borehole backfilled with cement grout on November 11, 2008.</p>			
16													
55													
17													
18													
60													
19													
65													
20													
21													
70													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14							$\frac{100}{1.3}$	R5	12	PLT-D	META BASALT , medium dark gray (N4), massive aphanitic groundmass with fine phenocrysts, fresh (I), strong (R4) to very strong (R5). Discontinuities are closely to moderately spaced and in good condition. [Naches Formation]		
15													
50						$\frac{100}{4.4}$		13		At 51.7 feet, core becomes medium dark gray (N4) to medium light gray (N6), fresh (I) to slightly weathered (II), moderately strong (R3) to strong (R4), and discontinuities become closely spaced and in poor to fair condition.			
16										At 54.5 feet, core becomes fresh (I) and strong (R4).			
55						$\frac{100}{1.8}$		14 15		At 56.0 feet, discontinuities become closely to moderately spaced and in fair condition.			
17													
18						$\frac{100}{2.2}$		16		At 61.0 feet, discontinuities become closely spaced and in fair condition.			
60													
19													
65						$\frac{102}{1.2}$		17		At 64.2 feet, core becomes dark greenish gray (5G 4/1) and discontinuities become moderately spaced and in fair condition.			
20													
21													
70													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22							$\frac{100}{2.9}$		18		META BASALT , medium dark gray (N4) to dark dark greenish gray (5G 6/1) to light gray (N7), massive aphanitic groundmass, fresh (I), moderately strong (R3) to strong (R4). Discontinuities are closely spaced and in fair condition. [Naches Formation]		
75	23						$\frac{100}{3.0}$	R3	19 20	PLT-D			
80	24												
25							$\frac{100}{1.75}$		21				
85	26										Borehole completed to 85.0 feet below ground surface (bgs) on November 5, 2008. Borehole was overcased with HWT casing to 4.5 feet bgs and was flushed for optical and acoustical televiewer survey. Borehole completed with two vibrating wire piezometers at 56 feet and 84 feet bgs. Borehole backfilled with cement grout on 11/08/2008.		
27											VWP# 94577 (54.5 - 56.0 feet bgs) VWP# 92938 (82.5 - 84.0 feet bgs)		
90											#10-20 silica sand filter pack from 73.0 feet to 85.0 feet bgs. Grout mix from 0.0 to 85.0 feet bgs: One 94 pound bag Type I-II Portland Cement 30 gallons of water 25 to 30 pounds of pure bentonite powder		
28											Well Tag# = APA 657		
95													



Start Card SE03678

Job No. 103-WA SR 90 Elevation 2588.4 ft (788.9 m)

HOLE No. RKS-47-08

Sheet 1 of 4

Project Interstate 90 Hyak Re-Alignment - 2008 Geotechnical Investigation

Driller B. Kotzian/ S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector D. Meier

Start October 23, 2008 Completion October 24, 2008 Well ID# Not Installed Equipment Burley 5500

Station 1475+70 Offset -99 Left Casing Not Installed Method HQ3 Triple Tube Wireline

Northing 729714.17 Easting 1431275.19 Latitude 47°19'52.440"N Longitude 121°20'36.220"W

County Kittitas Subsection SE Quarter Section 1 Range 11E Township 21N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
								1		The borehole collar elevation is approximately 1.5 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.			
								2		<p>SILTY SAND WITH GRAVEL, COBBLES, AND BOULDERS [SM/GM], sub-angular to sub-rounded, loose to very dense, medium gray (N4), moist. Gravels and cobbles are predominantly meta-volcanic. [Alpine Till]</p>			
								3					
								4					
								5					
								6					
								7					
								8					
								9	PLT-D				
								10					
											<p>SILICIC VOLCANIC, medium bluish gray (5B 6/1) to yellowish gray (5Y 8/1), fine grained, thinly laminated, fresh (I) to slightly weathered (II), moderately strong (R3) to strong (R4). Observed +6 healed discontinuities per foot. Discontinuities are closely to moderately spaced and in fair condition. [Naches Formation]</p>		
										At 17.0 feet, core becomes strong (R4).			



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14							$\frac{102}{0.0}$	-	16		SILICIC VOLCANIC , light gray (N7) to medium light gray (N6) with medium gray (N5) banding, thinly bedded to laminated, fresh (I), strong (R4) to very strong (R5). Discontinuities are moderately to widely spaced and in fair condition. [Naches Formation]		
15													
50													
16													
55													
17							$\frac{100}{0.2}$	-	17				
18													
60													
19													
65							$\frac{100}{1.2}$	-	18		At 58.0 feet, discontinuities become closely spaced and in fair condition.		
18													
61.0													
19							$\frac{100}{0.8}$	-	19		At 61.0 feet, discontinuities become moderately to widely spaced and in fair to good condition.		
19													
20							$\frac{100}{1.3}$	-	20		At 67.5 feet, core becomes fresh (I) and strong (R4) to very strong (R5).		
20													
21							$\frac{100}{1.3}$	-	20				
21													
70													

ROCK PHASE C.G.F.J. 2/13/09



LOG OF TEST BORING

Start Card SE03678

Job No. 103-WA

SR 90

Elevation 2588.4 ft (788.9 m)

HOLE No. RKS-47-08

Sheet 4 of 4

Project Interstate 90 Hyak Re-Alignment - 2008 Geotechnical Investigation

Driller B. Kotzian/ S. Tunison Lic# 2628

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
22											SILICIC VOLCANIC , light gray (N7) to yellowish gray (5Y 8/1) where slightly weathered, thinly bedded to laminated, fresh (I), strong (R4) to very strong (R5). Discontinuities are moderately to widely spaced and in fair condition. [Naches Formation]			
75	23										Borehole completed to 72.0 feet below ground surface (bgs) on October 24, 2008. Borehole was flushed in preparation of optical and acoustical televiwer survey. Optical and acoustical televiwer survey completed on November 07, 2008. Borehole backfilled with cement grout on November 08, 2008.			
80	24													
85	25													
85	26													
90	27													
95	28													



Start Card SE03294

Job No. 103-WA SR 90 Elevation 2620.6 ft (798.8 m)

HOLE No. MRE-05-08

Sheet 1 of 4

Project Interstate 90 Hyak Re-Alignment - 2008 Geotechnical Investigation

Driller T. Washington/S. Tunison # 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector R. Beyer

Start October 24, 2008 Completion October 25, 2008 Well ID# Not Installed Equipment Burley 4500

Station 1361+46 Offset -100 Left Casing Not Installed Method HQ3 Triple Tube Wireline

Northing 738311.67 Easting 1425968.03 Latitude 47°21'16.721"N Longitude 121°21'54.629"W

County Kittitas Subsection NE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
0	0										The borehole collar elevation is approximately 0.5 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.			
1	0.3										POORLY GRADED SAND WITH GRAVEL [SM/GM] , angular to rounded, loose to very dense, medium bluish gray (5B 5/1), dry to moist, occasional cobbles and boulders. [Colluvium]			
5	1.5					$\frac{68}{0.2}$		1						
10	3.0					$\frac{100}{1.2}$		2		META WELDED LAPILLI TUFF , light olive gray (5Y 6/1) to greenish gray (5GY 6/1), massive aphanitic groundmass with fine to medium phenocrysts, lapilli sized rock fragments (5-7%), lapilli sized pumice fragments (5-7%), fresh (I) to slightly weathered (II), moderately weak (R2) to moderately strong (R3). Discontinuities are moderately spaced and in good condition. [Ohanapecosh Formation]				
15	4.5						R3		PLT-D	At 12.8 feet, core becomes slightly weathered (II) and moderately weak (R2) to moderately strong (R3).				
20	6.0					$\frac{98}{0.6}$		3		At 15.5 feet, core becomes light olive gray (5Y 6/1) and moderately strong (R3).				
							R2		PLT-D	At 17.8 feet, discontinuities become widely spaced and in fair condition.				



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								4		META WELDED LAPILLI TUFF , greenish gray (5G 6/1), massive aphanitic groundmass with fine to medium phenocrysts, lapilli sized rock fragments (5-8%), lapilli sized pumice fragments (8-10%), fresh (I), moderately strong (R3). Discontinuities are widely spaced and in fair condition. [Ohanapecoh Formation]			
25							R2		PLT-D				
8								5		At 25.5 feet, core becomes light olive gray (5GY 6/1) to greenish gray (5Y 6/1), slightly weathered (II), moderately weak (R2) to moderately strong (R3), and discontinuities become closely spaced and in poor to fair condition.			
30								6					
9							R2		PLT-D				
10													
35								7		At 35.5 feet, core becomes medium gray (N5) to greenish gray (5GY 6/1), fresh (I) and moderately strong (R3).			
11													
40								8		At 42.0 feet, core becomes medium gray (N5) and discontinuities become closely to moderately spaced and in poor to fair condition.			
12							R3		PLT-D				
13													
45													

ROCK MRE.GPJ 2/6/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14							$\frac{96}{2.8}$	R2	9	PLT-D	<p>META WELDED LAPILLI TUFF, medium light gray (N6) to greenish gray (5G 6/1), massive aphanitic groundmass with fine to medium phenocrysts, lapilli sized rock fragments (10-15%), lapilli sized pumice fragments (10-15%), fresh (I), and moderately strong (R3). Discontinuities are closely to moderately spaced and in poor to fair condition.[Ohanapecoh Formation]</p> <p>At 48.0 feet, discontinuities become widely spaced and in fair condition.</p> <p>At 53.4 feet, core becomes medium bluish gray (5B 5/1) to greenish gray (5G 6/1) and discontinuities become closely to moderately spaced and in poor to fair condition.</p> <p>At 63.0 feet, core becomes greenish gray (5G 6/1) and discontinuities become moderately spaced and in fair condition.</p>		
15													
50							$\frac{96}{1.8}$		10				
16													
55													
17						$\frac{104}{5.4}$	R3	11	PLT-D				
18							R3			PLT-A			
60						$\frac{100}{1.8}$		12					
19							R2			PLT-D			
65						$\frac{98}{0.8}$		13					
20													
21							R2			PLT-D			
70													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22								14		META WELDED LAPILLI TUFF , greenish gray (5G 6/1), massive aphanitic groundmass with medium phenocrysts, lapilli sized rock fragments (8-10%), lapilli sized pumice fragments (5-10%), fresh (I), moderately strong (R3). Discontinuities are widely spaced and in good condition. [Ohanapecosh Formation]			
75	23						R2	15	PLT-D				
24										At 77.5 feet, core becomes slightly weathered (II) and moderately weak (R2) to moderately strong (R3). Observed light olive gray (5Y 6/1) weathering envelopes. At 78.0 feet, core becomes fresh (I) and moderately strong (R3).			
80													
25							R4	16	PLT-D	At 80.5 feet, core becomes light gray to medium light gray (N7-N6). At 82.0 feet, discontinuities become closely to moderately spaced and in fair condition.			
85	26												
27										Borehole completed to 85.5 feet below ground surface (bgs) on October 25, 2008. Borehole was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on October 28, 2008. Groundwater was measured at approximately 34.0 feet bgs during drilling activities on October 24, 2008 prior to beginning optical borehole survey. Borehole backfilled with cement grout on October 29, 2008.			
90													
28													
95													



Job No. 103-WA SR 90 Elevation 2652.9 ft (808.6 m)

HOLE No. MRE-06-08

Sheet 1 of 5

Project Interstate 90 Hyak Re-Alignment - 2008 Geotechnical Investigation

Driller M. Starling/S. Tunison Lic# 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector R. Beyer

Start October 21, 2008 Completion October 23, 2008 Well ID# Not Installed Equipment Burley 4500

Station 1368+74 Offset -92 Left Casing Not Installed Method HQ3 Triple Tube Wireline

Northing 737605.37 Easting 1426140.81 Latitude 47°21'09.770"N Longitude 121°21'52.008"W

County Kittitas Subsection NE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
1													
5													
2													
10													
3													
4													
15													
5													
20													
6													

ROCK MRE.GPJ 2/6/09



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7								6		<p>META WELDED LAPILLI TUFF, medium gray (N5) to medium dark gray (N4), aphanitic groundmass with fine to medium phenocrysts (8-15%), lapilli size rock fragments (3-5%), lapilli size pumice fragments (5-10%), slightly weathered (II), moderately strong (R3) to strong (R4). Discontinuities are closely spaced and in fair condition. [Ohanapecosh Formation]</p> <p>At 29.0 feet, run #9 has a RQD value of 27% and is likely due to drilling induced core breakage.</p> <p>At 40.5 feet, discontinuities become moderately to widely spaced.</p>			
25						$\frac{102}{2.6}$							
8						$\frac{108}{1.2}$	R3	7	PLT-D				
							R5		PLT-D				
9						$\frac{100}{1}$		8					
30						$\frac{100}{7.3}$		9					
						$\frac{98}{3}$		10					
10							R4		PLT-D				
35						$\frac{120}{3.6}$		11					
11													
40						$\frac{75}{1.5}$	R4	12	PLT-D				
12													
13						$\frac{130}{1}$	R4	13	PLT-A				
45						$\frac{60}{1}$	R4	14	PLT-D				



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14								15		META WELDED LAPILLI TUFF , medium gray (N5) to medium dark gray (N4), aphanitic groundmass phenocrysts (8-15%), lapilli size rock fragments (3-5%), lapilli size pumice fragments (5-10%), fresh (I), strong (R4). Discontinuities are moderately spaced and in fair to good condition. [Ohanapecoh Formation]			
50								16	PLT-D	At 50.5 feet, core becomes moderately strong (R3) to strong (R4) and discontinuities become closely spaced and in fair condition.			
55								17		At 55.5 feet, core becomes medium dark gray (N4) and fresh (I) to slightly weathered (II).			
60								18	PLT-D				
65								18					
19								19					
65								20					
20								19	PLT-D	At 65.5 feet, core becomes fresh (I), moderately strong (R3), and discontinuities become moderately spaced and in fair condition.			
21								20					
70								19	PLT-A				



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22								21		META WELDED LAPILLI TUFF , medium dark gray (N4) to medium dark gray (N4), aphanitic groundmass with phenocrysts (10-15%), lapilli size rock fragments (5-8%), lapilli size pumice fragments (10-12%), fresh (I), moderately strong (R3). Discontinuities are moderately spaced and in fair to good condition. [Ohanapecosh Formation]			
75							R4	22	PLT-D	At 75.5 feet, core becomes moderately strong (R3) to strong (R4).			
24							R3	23	PLT-D	At 79.0 feet, discontinuities become closely spaced and in fair to poor condition.			
80								24					
25							R2	24	PLT-D				
85								25					
26								25					
87.8								26		At 87.8 feet, core becomes medium gray (N5) to medium dark gray (N4) with light olive gray (5Y 6/1) weathering envelopes, slightly weathered (II), and moderately strong (R3).			
90							R3	26	PLT-D				
28													
95													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29							$\frac{95}{5}$		27		<p>META WELDED LAPILLI TUFF, grayish olive (10Y 4/2) to medium gray (N5), aphanitic groundmass with fine to medium phenocrysts (10-15%), lapilli size rock fragments (5-8%), lapilli size pumice fragments (2-4%), slightly weathered (II), moderately strong (R3). Discontinuities are closely spaced and in fair condition. [Ohanapecoh Formation]</p> <p>At 104.0 feet, core becomes medium gray (N5) to medium dark gray (N4) and fresh (I).</p>		
							$\frac{100}{3}$	R3	28	PLT-D			
30								R3	29	PLT-A			
31							$\frac{96}{5.4}$						
105							$\frac{100}{1.6}$	R3	30	PLT-D			
33													
110													
34						$\frac{100}{3.7}$							
35						$\frac{113}{1.3}$	R3	32	PLT-D				
36													
120													



Job No. 103-WA SR 90 Elevation 2654.8 ft (809.2 m)

HOLE No. MRE-07-08

Sheet 1 of 5

Project Interstate 90 Hyak Re-Alignment - 2008 Geotechnical Investigation

Driller T. Washington/S. Tunison # 2628

Site Address Interstate 90, Milepost 56.5 to 59.0

Inspector R. Beyer

Start October 26, 2008 Completion October 28, 2008 Well ID# Not Installed Equipment Burley 4500

Station 1370+88 Offset -80 Left Casing Not Installed Method HQ3 Triple Tube Wireline

Northing 737394.89 Easting 1426182.32 Latitude 47°21'07.697"N Longitude 121°21'51.371"W

County Kittitas Subsection NE Quarter Section 35 Range 11E Township 22N

Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
0	0							1		The borehole collar elevation is approximately 0.4 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.			
1	0.3					56				SILTY SAND WITH GRAVEL [SM/GM] , angular to rounded, loose to very dense, medium bluish gray (5B 5/1), dry to moist, occasional cobbles and boulders. [Colluvium]			
5	1.5					100	R5	2	PLT-D	META WELDED LAPILLI TUFF , medium gray (N4) to medium dark gray (N5), massive aphanitic groundmass with medium phenocrysts (12-15%), lapilli sized rock fragments (8-10%), lapilli sized pumice fragments (10-12%), slightly weathered (II), moderately strong (R3) to strong (R4). Discontinuities are moderately spaced and in fair condition. [Ohanapecosh Formation]			
7.4	2.3					100	R5		PLT-D	At 7.4 feet, discontinuities become closely spaced and in fair condition.			
10	3.0					102		3					
13.0	4.0					100				At 13.0 feet, core becomes strong (R4).			
15.9	4.8					100		4		At 15.9 feet, core becomes fresh (I) and discontinuities become closely to moderately spaced and in fair condition. Observed 5 weakly healed joints per foot.			
20	6.1					1.6							



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
7													
25													
8													
30													
9													
10													
35													
11													
40													
12													
13													
45													

ROCK MRE.GPJ 2/6/09

META WELDED LAPILLI TUFF, medium gray (N4) to medium dark gray (N5), massive aphanitic groundmass with medium phenocrysts (5-7%), lapilli sized rock fragments (3-5%), lapilli sized pumice fragments (3-5%), fresh (I), moderately weak (R2) to moderately strong (R3). Discontinuities are closely spaced and in fair condition. [Ohanapecosh Formation]

At 25.9 feet, core becomes slightly weathered (II).

At 34.0 feet, core becomes fresh (I) to slightly weathered (II) and moderately strong (R3).



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14							$\frac{96}{2.0}$	R5	11	PLT-D	META WELDED LAPILLI TUFF , medium gray (N5) to medium dark gray (N4), massive aphanitic groundmass with medium phenocrysts (10-15%), lapilli sized rock fragments (8-10%), lapilli sized pumice fragments (8-10%), fresh (I) to slightly weathered (II), moderately strong (R3). Discontinuities are moderately spaced and in fair to good condition. [Ohanapecoh Formation]		
15											At 49.0 feet, core becomes medium dark gray (N4), fresh (I) and strong (R4) to very strong (R5).		
50							$\frac{96}{1.6}$	R5	12	PLT-D			
16								R5		PLT-A			
55								R5					
17							$\frac{94}{0.6}$		13				▼
18								R5		PLT-D			
60									14		At 59.9 feet, core becomes medium dark gray (N4) to medium bluish gray (5B 5/1).		
19							$\frac{100}{0}$		15				
65								R5		PLT-D	At 63.3 feet, discontinuities become closely spaced and in fair condition.		
20							$\frac{100}{0}$		16	PLT-A	At 66.0 feet, discontinuities become moderately to widely spaced and in fair condition.		
21							$\frac{93}{0.7}$		17				
70													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
							11		1		The borehole collar elevation is approximately 0.5 feet below the existing ground surface due to rig platform preparation. There was approximately 1 foot of topsoil encountered.			
1											SILTY SAND WITH GRAVEL [SM/GM] , angular to rounded, loose to very dense, medium dark gray (N4), dry to moist, occasional cobbles and boulders. [Colluvium]			
5									2		META WELDED LAPILLI TUFF , dark greenish gray (5GY 4/1), massive aphanitic groundmass with medium phenocrysts (10-15%), lapilli sized rock fragments (3-5%), lapilli sized pumice fragments (3-5%), fresh (I), moderately strong (R3) to strong (R4). Discontinuities are moderately spaced and in fair condition. [Ohanapecoh Formation]			
2							100 1.4							
10							93 0.7	R5	3	PLT-D				
							150 98 1.9	R3	4	PLT-D				
									5					
4											At 12.8 feet, discontinuities become closely spaced and in fair condition.			
15								R4 R5		PLT-D PLT-A				
5							94 0.8		6		At 16.0 feet, core becomes medium dark gray (N4), strong (R4) to very strong (R5), and discontinuities become moderately to widely spaced and in fair condition.			
20														



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
							R4		PLT-D	<p>META WELDED LAPILLI TUFF, medium bluish gray (5B 5/1), massive aphanitic groundmass with medium phenocrysts (8-10%), lapilli sized rock fragments (3-5%), lapilli sized pumice fragments (5-7%), fresh (I), strong (R4) to very strong (R5). Discontinuities are widely spaced and in good condition. [Ohanapecosh Formation]</p> <p>At 34.4 feet, core becomes fresh (I) to slightly weathered (II) and discontinuities become moderately to closely spaced and in poor to fair condition.</p> <p>At 37.0 feet, core becomes slightly weathered (II), strong (R4), and discontinuities become closely spaced and in poor to fair condition.</p> <p>At 38.4 feet, core becomes fresh (I), strong (R4) to very strong (R5), and discontinuities become moderately spaced and in fair to good condition.</p> <p>At 41.0 feet, core becomes medium bluish gray (5B 5/1) to medium gray (N5).</p>			
						$\frac{78}{0.2}$		7					
7							R5		PLT-D				
25								8					
8						$\frac{100}{1.6}$	R5		PLT-D				
30							R4		PLT-A				
9						$\frac{100}{1.6}$		9					
35							R5		PLT-D				
10						$\frac{84}{2.8}$		10					
35								11					
11						$\frac{109}{2.6}$		11					
40								12					
12						$\frac{93}{0}$		12					
40							R5		PLT-D				
13						$\frac{102}{1.2}$		13					
45													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14								14		<p>META WELDED LAPILLI TUFF, medium bluish gray (5B 5/1), massive aphanitic groundmass with medium phenocrysts (10-15%), lapilli sized rock fragments (3-5%), lapilli sized pumice fragments (3-5%), fresh (I), strong (R4) to very strong (R5). Discontinuities are moderately to widely spaced and in fair to good condition. [Ohanapecosh Formation]</p>			
15						112 / 0.6		15					
50								15	PLT-D				
16						92 / 0.6	R5	16					
55								16					
17						98 / 1.2		17					
18								17		At 57.3 feet, core becomes fresh (I) to slightly weathered (II), strong (R4) to very strong (R5) and discontinuities become closely spaced and in fair condition. At 58.2 feet, core becomes fresh (I) and discontinuities become moderately to widely spaced and in fair to good condition.			
60								17					
19						123 / 0.8	R4	18	PLT-A	At 61.2 feet, core becomes fresh (I) to slightly weathered (II) and strong (R4).			
65						95 / 0.3		18		At 62.5 feet, core becomes medium bluish gray (5B 5/1) to medium dark gray (N4), fresh (I), strong (R4) to very strong (R5), and discontinuities become moderately to widely spaced and in fair to good condition.			
20							R4	19	PLT-D				
70						98 / 0.8		19		At 66.2 feet, core becomes medium dark gray (N4).			
21													



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
22									20		<p>META WELDED LAPILLI TUFF, medium dark gray (N4), massive aphanitic groundmass with medium phenocrysts (8-10%), lapilli sized rock fragments (4-6%), lapilli sized pumice fragments (6-8%), fresh (I), strong (R4). Discontinuities are moderately spaced and in fair condition. [Ohanapecoh Formation]</p> <p>At 72.8 feet, discontinuities become closely spaced and in poor to fair condition.</p>			
75									21		<p>At 76.8 feet, core becomes strong (R4) to very strong (R5) and discontinuities become moderately spaced and in fair condition.</p>			
24									22					
80									22					
25									23					
85									23					
27											<p>Borehole completed to 86.4 feet below ground surface (bgs) on November 4, 2008. Borehole was flushed in preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on November 5, 2008. Groundwater was measured at approximately 18.3 feet bgs during drilling activities on November 4, 2008 prior to beginning optical borehole survey. Borehole backfilled with cement grout on November 5, 2008.</p>			
90														
28														
95														



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
0 - 1	0 - 0.3						41 N/A		1		SILTY SAND AND GRAVEL [SM/GM] silty fine to coarse SAND and GRAVEL to COBBLE, angular to sub angular, loose, moderate yellowish brown (10YR 5/4), moist [Mixed Colluvium and Fill]			
1 - 5	0.3 - 1.5						96 0.8		2					
5 - 10	1.5 - 3.0						100 1.6		3		META-WELDED LAPILLI DACITE TUFF light brown (5YR 5/6) to dark yellowish orange (10YR 6/6) with medium gray (N5) to medium light gray (N6) groundmass, multi-color lapilli-sized rock fragments (15 - 25%), fine to medium grained phenocrysts of plagioclase (10 - 25%) and quartz (5 - 15%), fresh (I) to slightly weathered (II), strong (R4) to very strong rock (R5), poorly sorted, altered with secondary mineralization, devitrified glass in groundmass, discontinuities are closely to moderately spaced and in very poor to fair condition. [Lake Keechelus member, Ohanapecosh Formation] Circulation is maintained at 0 to 20% and is light gray (N7) At 9.0 feet bgs, becomes moderate olive brown (5Y 4/4) to medium gray (N5) with light brown (5YR 5/6) and dark yellowish orange (10YR 6/6) groundmass			
10 - 15	3.0 - 4.5						100 0.2	R5	4	PLT - D	Becomes medium gray (N5) with slight grayish green (10G 4/2) groundmass, fresh (I) with slight weathering (II) adjacent to discontinuities, discontinuities become moderately spaced and in good to excellent condition			
15 - 20	4.5 - 6.0						100	R5 R4	5	PLT - D PLT - A	Becomes moderate olive brown (5Y 4/4) with medium gray (N5) and light brown (5YR 5/6) groundmass,			

ROCK SLIDE CURVE BOREHOLES.GPJ 1/19/07, 11:09:53 A1



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
										fresh (I) to slightly weathered (II) with slight (II) to moderate weathering (III) between 21.4 and 22.8 feet bgs, discontinuities become closely to moderately spaced and in poor to good condition.			
7						1+				Loose circulation			
						$\frac{100}{2+}$	R4	6	PLT - D				
25						$\frac{98}{0.6}$		7		Becomes medium gray (N5) with slight grayish olive (10Y 4/2) groundmass, fresh (I) with slight weathering (II) adjacent to discontinuities, discontinuities become moderately to closely spaced and in good condition			
8							R5		PLT - D				
						$\frac{106}{1.8}$		8		Becomes moderate olive brown (5Y 4/4) and pale green (10G 6/2) to grayish green (10G 4/2) with medium light gray (N4) groundmass			
30							R5		PLT - D				
						$\frac{76}{1.8}$		9		1-3 per foot healed discontinuities			
10								10		Becomes moderate olive brown (5Y 4/4) to grayish olive (10Y 4/2) groundmass, slightly weathered (II) with zone of slightly (II) to highly weathered (IV) from 38.8 to 40.2 feet bgs, discontinuities become closely spaced and in very poor to fair condition, up to 10 per foot healed discontinuities to 41.5 feet			
35						$\frac{100}{2.5}$		11					
11								12		At 39.2 - 39.6 feet bgs, 0.4 feet of core loss in moderate (III) to highly weathered (IV) zone, approximately 0.6 feet of broken up clasts from 39.6 to 40.2 feet bgs likely caused by drilling action			
40						$\frac{92}{1+}$		11					
12								12		Becomes medium light gray (N6) groundmass, fresh (I) with slight weathering (II) adjacent to discontinuities, discontinuities become moderately spaced and in fair to good condition, up to 4 per foot healed discontinuities			
45						$\frac{102}{1.0}$	R4	12	PLT - A				

ROCK SLIDE CURVE BOREHOLES.GPJ 1/19/07,11:09:54 A1



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
14							R5		PLT - D				
15								13					
50													
16										Becomes medium gray (N5) groundmass, fresh (I), discontinuities become widely spaced and in good condition, 1 to 3 per foot healed discontinuities			
55								14					
17							R5		PLT - D	Becomes medium gray (N5) to pale green (10G 6/2) to grayish green (10G 4/2) groundmass			
18								15					
60								16					
19													
65							R4		PLT - D				
20								17					
21								18					
70													

ROCK SLIDE CURVE BOREHOLES.GPJ 1/19/07,11:09:54 A1



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
22										<p>Becomes moderate olive brown (5Y 4/4) with light brown (5YR 5/6) interbedded with medium gray (N5) with pale green (10G 6/2) and grayish green (10G 4/2) groundmass, fresh (I) with slight weathering (II) adjacent to discontinuities, discontinuities become closely spaced and in poor to good condition</p>			
75								19					
23							R4		PLT - A	<p>Becomes medium gray (N5) with pale green (10G 6/2) to grayish green (10G 4/2) groundmass, fresh (I), discontinuities become widely spaced and in good condition, 1 to 2 per foot healed discontinuities</p>			
24							R4	20	PLT - D				
80													
25							R4	21	PLT - A				
85													
26							R5	22	PLT - D	<p>Becomes pale green (10G 6/2) to grayish green (10G 4/2) with occasional medium gray (N5) groundmass, fresh (I), rock fragments increase to occasional bomb-sized (1 - 10%, increasing downward), discontinuities become widely spaced and in good condition, 1 to 2 per foot healed discontinuities</p>			
27							R4	23	PLT - A				
90													
28							R5	24	PLT - D				
95										<p>At 94.6 - 95.1 feet bgs, 6 - 8 healed discontinuities,</p>			

ROCK SLIDE CURVE BOREHOLES.GPJ 1/19/07, 11:09:54 A1



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
29										calcite filled with spotty iron staining as light brown (5YR 5/6)			
30													
100													
31													
32													
105													
33													
110													
34													
35													
115													
36													
120													

ROCK SLIDE CURVE BOREHOLES.GPJ 1/19/07, 11:09:54 A1

At 102.0 feet bgs, slightly weathered (II) adjacent to discontinuity

Becomes pale green (10G 6/2) to grayish green (10G 4/2) with occasional medium gray (N5) and zones of moderate olive brown (5Y 4/4) groundmass, fresh (I) with slight weathering (II) adjacent to discontinuities, discontinuities become closely to moderately spaced and in fair to good condition, 1 to 5 per foot healed



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength	Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80								
37											<p>Becomes pale green (10G 6/2) to grayish green (10G 4/2) with occasional medium gray (N5) groundmass, fresh (I), discontinuities become widely spaced and in good condition, 1 to 2 per foot healed discontinuities</p>			
38	125					$\frac{100}{0.6}$	R4		33	PLT - A PLT - D				
39											<p>META-WELDED LAPILLI DACITE TUFF light gray (N7) to yellowish gray (5Y 8/1) groundmass, multi-color lapilli-sized rock fragments (15 - 25%), fine to medium grained phenocrysts of plagioclase (10 - 25%) and quartz (5 - 10%), fresh (I) to slightly weathered (II) adjacent to discontinuities, strong rock (R4), gradational upper contact, poorly sorted, altered with secondary mineralization, devitrified glass in groundmass discontinuities are closely to moderately spaced and in fair condition, 1 - 4 per foot healed discontinuities. [Lake Keechelus member, Ohanapecoh Formation]</p>			
40	130					$\frac{98}{0.6}$	R5		34	PLT - D				
41	135					$\frac{102}{0.4}$	R4		35	PLT - D	<p>At 132.4 feet bgs, 0.2' thick discontinuity, light brown (5YR 5/6), highly (IV) to completely weathered (V), extremely weak rock (R0)</p>			
42							R5		36	PLT - D	<p>Discontinuities become widely to very widely spaced, 0 - 3 per foot healed discontinuities</p>			
43	140					$\frac{102}{0}$								
44							R4		37	PLT - D				
45						$\frac{100}{0}$								

ROCK SLIDE CURVE BOREHOLES.GPJ 1/19/07, 11:09:54 A1



Depth (ft)	Meters (m)	Profile	Rock Quality Designation (%)				% Rec. FPF	Rock Strength Sample Type	Sample No.	Lab Tests	Description of Material	Groundwater	Instrument
			20	40	60	80							
45								R4		PLT - D			
150	46									<p>Borehole completed to 149.2 feet bgs on September 28, 2006. Borehole was flushed for preparation of optical and acoustical televiewer survey. Optical and acoustical televiewer survey completed on September 29, 2006. Borehole completed with time domain reflectometer cable from the ground surface to 148.0 feet bgs and two vibrating wire piezometers at 72.2 feet and 147.2 feet bgs on September 29, 2006. Refer to well construction diagram and below for as-built construction details. Groundwater was measured at 67.7 feet bgs during drilling activities.</p> <p>TDR Cable installed from ground surface to 148.0 feet bgs VWP #87189 = 71.5 to 73.0 feet bgs VWP #87177 = 146.5 to 148.0 feet bgs #10-20 silica sand filter pack from 129.0 to 149.2 feet bgs Grout mix from 0.0 to 129.0 feet bgs: 1 94 lb bag Type I-II Portland Cement 5 gallons water Well Tag # = AFS 289</p> <p>Borehole logs were prepared under the direction of Wyllie & Norrish Rock Engineers Inc., Project number 062-2002. Original field logs contain detailed source information.</p> <p>Rock strength values provided on the gINT log represent those values obtained by performing field Diametral Point Load Tests (PLT-D) or Axial Point Load Tests (PLT-A) at specific test depths. Only valid failure results (passing through the plane of the platens) are represented on the log.</p>			
155	47												
160	48												
165	49												
170	50												
	51												

ROCK SLIDE CURVE BOREHOLES.GPJ 1/19/07,11:09:54 A1