



August 1, 2023

Jesse Winterowd Winterbrook Planning 610 SW Alder Street, Suite 810 Portland, OR 97205

Subject: Supplemental Information

Re: Land Use Permitting

Dear Jesse:

Delve Underground was asked to provide additional information in regard to the "expansive soil" and "Fat Clay" layer identified in in response to comments on those issues included in a memorandum prepared by True North Geotechnical dated June 28, 2023 (Exhibit E.21). An extensive geotechnical exploration program was performed on the project site, all relevant soil layers were identified with recommendations for design and construction provided to the Portland Water Bureau and design team.

Expansive soils are clayey soils, generally Fat Clays containing specific clay minerals, that exhibit volume changes due to changes in water content. Fat Clay was not encountered in the explorations near the proposed shaft location. Fat Clay soils were identified in field explorations in eastern half of the raw water pipeline (RWP) alignment, within the upper 20 feet of the ground. Attached are the project site plan showing the exploration locations and logs of the borings completed by Delve Underground. Borings in which fat clay was identified are highlighted in green. The pipeline in this section of the alignment will be embedded in gravelly soils, below fat clay. Gravelly soils are not susceptible to expansion. The foundations of ancillary structures such as manholes or access way structures will also be constructed on gravelly soils. Therefore, presence of fat clay in this section of the alignment is not anticipated to impact the pipeline and associated structures.

The map of expansive soils in the U.S. by Olive, et al. (1989) identifies soils within eastern part of the Portland metro as "Little or no Swelling Clay". Specific testing of the expansive potential of the Fat Clays was not performed because the design of the pipeline is not sensitive to the expansive properties on account of the pipeline being founded on material below the Fat Clay and because steel pipes, which will be utilized in this project, are flexible elements that can accommodate a moderate amount of deformation.



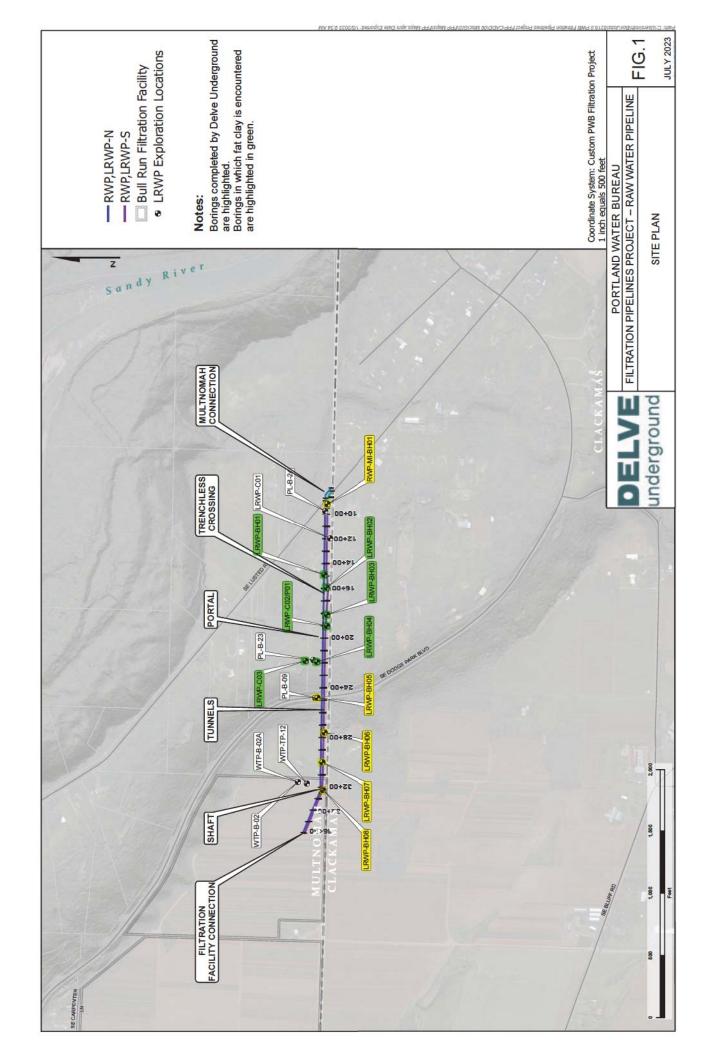
Supplemental Information July 2023 Page 2 of 2

The conclusion provided in Exhibit A.82 that "Based on a review of published geologic and seismic hazard mapping and the explorations and analyses performed for the project as documented in this report, the location of the RWP section of the Pipelines project is suitable for the proposed development", remains valid.

Sincerely,

Farid Sariosseiri, PE Lead Associate

cc: File



MOISTURE CONTENT

DESCRIPTION	CONDITION			
Dry	Absence of moisture, dusty, dry to the touch.			
Moist	Damp, but no visible water.			
Wet	Visible free water, typically below water table.			

ABBREVIATIONS

SYMBOL	DEFINITION
Н	Atterberg Limits
0	Moisture Content
	Blows per foot (N)

FINE-GRAINED SOIL CONSISTENCY

RELATIVE CONSISTENCY	N, SPT Blows/foot
Very Soft	0 to 1
Soft	2 to 4
Medium stiff	5 to 8
Stiff	9 to 15
Very Stiff	16 to 30
Hard	> 30

SOIL CONSTITUENCY DEFINITIONS

Major Less than 50% fines: SAND or GRAVEL Secondary 12%¹ or more fine- grained: Silty or Clayey Sandy or 5 to 12%¹ fine-grained: with Silt or with Clay Minor SILT, ELAS LEAN CLAY, ORGAN 30% or more grain Sandy or 5 to 12%¹ fine-grained: with Sand or	ONSTITUENT	COARSE- GRAINED	FINE-GRAINED
Secondary grained: Silty or Clayey Sandy or 5 to 12%¹ fine-grained: with Silt or with Clay Minor 30% or more	Major		More than 50% fines: SILT, ELASTIC SILT, LEAN CLAY, FAT CLAY, ORGANIC SOIL
with Silt or with Clay with Sand or	Secondary	grained:	30% or more coarse- grained: Sandy or Gravelly
Minor 30% or more			15 to 30% coarse-grained: with Sand or with Gravel
15% or more of a second coarse-grained and coarse constituent: with Sand or with Gravel	Minor	constituent: with Sand	30% or more total coarse- grained and the lesser coarse constituent is 15% or more: with Sand or with Gravel

COARSE-GRAINED SOIL DENSITY

Relative Density	N, SPT Blows/foot
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	> 50

PERCENTAGE RANGE TERMS^{1,2}

DESCRIPTION	RANGE
Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

- Gravel, Sand and fines are estimated by mass. Other constituents such as organics, cobbles, and boulders are estimated by volume.
- 2. Percentages per ASTM D2488.

PARTICLE SIZE DEFINITIONS

IDTON	SIEVE SIZE
IPTON	PER ASTM D2488
ES	<#200 (0.075 mm)
Fine	#200 to #40 (0.075 to 0.4 mm)
Medium	#40 to #10 (0.4 to 2 mm)
Coarse	#10 to #4 (0.4 to 4.75 mm)
Fine	#4 to ¾ in. (4.75 to 19 mm)
Medium	¾ to 3 in. (19 to 76 mm)
BLES	3 to 12 in. (76 to 305 mm)
DERS	> 12 in. (305 mm)
	Fine Medium Coarse Fine Medium BLES



	UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) ¹													
5)	MAJOR DIVISIONS		SYMBOL		TYPICAL DESCRIPTION	ALTERNATE DESCRIPTIONS								
	VE)	:VE)	CLEA	N GRAVELS	GW	***	WELL-GRADED GRAVEL	WELL-GRADED GRAVEL WITH SAND						
). 4 SIEVE)	(≤ 5% FINES)		(≤	5% FINES)	GP	5.5.5	POORLY GRADED GRAVEL	POORLY GRADED GRAVEL WITH SAND				
		ON NO			GW-GM		WELL-GRADED GRAVEL WITH SILT	WELL-GRADED GRAVEL WITH SILT AND SAND						
	VELS	VINED	GI	RAVELS ^{2,4}	GW-GC		WELL-GRADED GRAVEL WITH CLAY	WELL-GRADED GRAVEL WITH CLAY AND SAND						
VE)	GRAVELS	% RET/		- 12 % FINES)	GP-GM		POORLY GRADED GRAVEL WITH SILT	POORLY GRADED GRAVEL WITH SILT AND SAND						
SOILS 0. 200 SIE		AN 50%			GP-GC		POORLY GRADED GRAVEL WITH CLAY	POORLY GRADED GRAVEL WITH CLAY AND SAND						
D SC		(MORE THAN 50% RETAINED ON NO.		VELS WITH	GM		SILTY GRAVEL	SILTY GRAVEL WITH SAND						
COARSE-GRAINED		OW)		FINES ² 12% FINES)	GC		CLAYEY GRAVEL	CLAYEY GRAVEL WITH SAND						
-GR/	į	€ CI		(i)	CLE	AN SANDS	SW		WELL-GRADED SAND	WELL-GRADED SAND WITH GRAVEL				
RSE 1	(1ESS THAN 50% RETAINED ON NO. 4 SIEVE) (S0% OR MORE RETAINED BY NO. 200 SIEVE) (GR (GR (GR (GR (GR (GR (GR (G	(≤5%	≤ 5% FINES)	SP		POORLY GRADED SAND	POORLY GRADED SAND WITH GRAVEL							
COA % OR N		(S RETAINED ON NO			SW-SM		WELL-GRADED SAND WITH SILT	WELL-GRADED SAND WITH SILT AND GRAVEL						
(50)			S	SANDS ^{2,4}	SW-SC		WELL-GRADED SAND WITH CLAY	WELL-GRADED SAND WITH CLAY AND GRAVEL						
			S RETAI	6 RETA	6 RETA	6 RETA	(5 – 12 % FIN	(5 – 12 % F	(5 -	(5 -	12 % FINES)	(5 – 12 % FINES)	SP-SM	
		N 50%			SP-SC		POORLY GRADED SAND WITH CLAY	POORLY GRADED SAND WITH CLAY AND GRAVEL						
		SS THA		NDS WITH	SM		SILTY SAND	SILTY SAND WITH GRAVEL						
		(E)		FINES ³ 12% FINES)	SC		CLAYEY SAND	CLAYEY SAND WITH GRAVEL						
.VE)	SILT	S AN	ND	INORGANIC	ML		SILT	SILT WITH SAND OR GRAVEL; SANDY OR GRAVELLY SILT						
SOILS		CLAYS		INORGANIC	CL	<i>\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\</i>	LEAN CLAY	LEAN CLAY WITH SAND OR GRAVEL; SANDY OR GRAVELLY LEAN CLAY						
ان رم ا	(LL	L < 50)	ORGANIC	OL		ORGANIC SOIL	ORGANIC SOIL WITH SAND OR GRAVEL; SANDY OR GRAVELLY ORGANIC SOIL						
AINED S	SILT	S AN	ND	D INCOCANIC	МН		ELASTIC SILT	ELASTIC SILT WITH SAND OR GRAVEL; SANDY OR GRAVELLY ELASTIC SILT						
FINE-GR	E SILIS A	LAYS	S		INORGANIC	INORGAINIC	СН		FAT CLAY	FAT CLAY WITH SAND OR GRAVEL; SANDY OR GRAVELLY FAT CLAY				
FINE-GR	(LL	L≥50			ОН	3333	ORGANIC SOIL	ORGANIC SOIL WITH SAND OR GRAVEL; SANDY OR GRAVELLY ORGANIC SOIL						
(509)	SILT	/CLA	Y ²	INORGANIC	CL-ML		SILTY CLAY	SILTY CLAY WITH SAND OR GRAVEL; SANDY OR GRAVELLY SILTY CLAY						
HIGH	ILY ORGAI	NIC SC	DILS	ORGANIC	PT	77 77 7 77 7	PEAT							

NOTES:

- 1. The USCS described here is based on ASTM standards D2487 & D2488.
- 2. Dual symbol materials (e.g., SP-SM) are used for soils between 5% and 12% fines or when liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart, (LL: 12 -25, PI: 4-7).
- 3. ASTM D2488 specifies the use of dual symbol coarse-grained soils between 5% and 15% fines.

BACKFILL, WELL, AND SAMPLE SYMBOLS						
Bentonite Chips			Grout		X	2" OD Split Barrel Sampler
Concrete			Observation Well - Solid			Shelby Tube Sample
Sand			Observation Well – Screen		·w.	Grab Sample
Asphalt		14	Vibrating Wire Piezometer			Rock Core Run
Gravel		_	Measured Groundwater Level			





Key to Rock Core Logs

Rock Strength

Grade ¹	Description	Recognition	UCS ² (psi)
R0	Extremely Weak	Indented by thumbnail	30 to 150
R1	Very Weak	Peeled by pocketknife	150 to 700
R2	Weak	Peeled with difficulty by pocketknife	700 to 3,600
R3	Medium Strong	Indented 5 mm with sharp end of pick	3,600 to 7,200
R4	Strong	One hammer blow to fracture	7,200 to 14,500
R5	Very Strong	Many hammer blows to fracture	14,500 to 36,000
R6	Extremely Strong	Only chipped by hammer blows	>36,000

- 1: Rock strength grades from Brown (1981)
- 2: Uniaxial Compressive Strength (pounds per square inch)

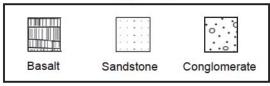
Rock Weathering/Alteration

Residual Soil	Entirely decomposed to secondary minerals; material can be easily broken by hand			
Completely Weathered/Altered	Almost entirely decomposed to secondary minerals; material can be granulated by hand			
Highly Weathered/Altered	More than half of the rock is decomposed			
Moderately Weathered/Altered	Rock is discolored and noticeably weakened, but less than half is decomposed			
Slightly Weathered/Altered	Rock is slightly discolored, but not noticeably lower in strength than fresh rock			
Fresh/Unweathered	Rock shows no discoloration, loss of strength, or other effect of weathering or alteration			

Rock Fracture Spacing

IF	Intensely Fractured	Fractures spaced less than 2 inches apart
HF	Highly Fractured	Fractures spaced 2 inches to 1 foot apart
MF	Moderately Fractured	Fractures spaced 1 foot to 3 feet apart
SF	Slightly Fractured	Fractures spaced 3 feet to 10 feet apart
M	Massive	Fracture spacing greater than 10 feet

Lithology Graphics



Core Recovery Calculation (%)

Σ Length of the recovered core pieces
Total Length of core run x100

RQD Calculation (%)

 $\frac{\Sigma \text{ Length of intact core pieces >4 in.}}{\text{Total Length of core run}} \quad x100$

Discontinuity Type

	, ,,
J	Joint
MB	Mechanical Break
FJ	Joint along foliation
S	Shear
F	Fault
HJ	Healed joint
В	Joint along bedding

Shape



Planar (PL)



Curved (C)



Stepped (ST)



Irregular (IR)

Aperture (Inches)

VW	Wide (<1.0)
W	Moderately Wide (0.2-1.0)
N	Narrow (0.05-0.2)
VN	Very Narrow (0-0.05)
Т	Tight (0)

Surface Roughness

SLK	Slickensided
S	Smooth
SR	Slightly Rough
R	Rough
VR	Very Rough

Bedding Spacing

Very Thin	Laminated (<2 in.)
Thin	2 in to 1 ft
Medium	1 ft to 3 ft
Thick	3 ft to 10 ft
Very Thick	>10 ft

Joint Infill

CL	Clay	Ctg	Coating/ Staining	Fe	Iron Oxide	11	Unknown
Fi	100% Filling	-	None/ Not observed	Si	Silt	U	Olknown

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

RWP-MI-BH01

Date(: Drilled	s) i	0	3/09/	2021			Client	Jac	cobs	Engineering Group	Final Depth 70.2 ft bgs		
	linates	7	7456	89.4 E, 65	9465.	5 N	Geotechnical Consultant	Мс	Miller	n Jacobs Associates	Method/ Rig Type Mud Ro	otary/CME 850 Track Mounted	
Surfa Eleva		4	99.5	ft.			Drilling Contractor	Wes	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 4.00 i	n	
Locat	on	L	RWP	North Sta	ation 9	9+18	Logged by/ Checked by	D.	Roth	/ K. Elliott	Hammer Type 140 lk	o / 30 in / Automatic	
ELEV. (FT)	WATER LEVEL DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	ETRATION ISTANCE WS/FT 30 40 TRANCE R CONTENT BERG LL/PL 60 80	USCS GRAPHIC	nscs	MATERIAL DES	e Maria da meneral de la companya de Promonio (n	REMARKS DIA DONA TESTS STEEL/INSTALL.	
			73	2-1-2 (N=3)	S-01		O		ML	Moist, brown, SILT with Sa Topsoil Soft, moist, orange-brown (ML); trace subangular to medium to coarse sand, lo Gresham Formation	n SILT with Sand angular fine gravel,	S-01: 73.0% Fines.	
495 - - -	5	X	80	4-6-10 (N=16)	S-02	•	0			Medium dense to dense, mottled gray, light brown, SAND with Gravel (SC); fir highly to completely weat coarse angular gravel, hig	and black, Clayey ne to medium sand, thered fine to	S-02: 32.6% Fines.	
- 490 -	10	X	0	27-22-10 (N=32) 4-4-8	S-03 S-04a	0	0						
- - -		X	83	(N=12) 8-9-32 (N=41)	MC-4 b S-05		0 •					S-03, S-04, and S-05	
485	15	X	60	3-12-21 (N=33)	S-06				sc			composite sample: 22.0% Gravel, 47.1% Sand, 30.9% Fines.	
- 4 80 -	20	X	53	9-12-20 (N=32)	S-07		•						
- 475 - -	25	X	77	9-12-16 (N=28)	S-08a MC-8 b	g i o	-6					MC-8b; 13.1% Gravel, 59.6% Sand, 27.3% Fines.	
- 470		-											



NOTES:

Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring RWP-MI-BH01**

Sheet 1 of 3

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

RWP-MI-BH01

Date(s Drilled)	0	3/09/	2021			Jacobs Engineering Group			Engineering Group	Final Depth 70.2 ft bgs		
Coordi	nates	7	7456	89.4 E, 65	9465.5	5 N	Geotechnical Consultant	Мс	Miller	Jacobs Associates	Method/ Rig Type Mud R	otary/CME 850 Track Mounted	
Surfac Elevati		4	99.5	ft.			Drilling Contractor	Wes	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 4.00	in	
Locatio	n	L	RWP	North Sta	ation 9	N - N - N	Logged by/ Checked by	D. I	Roth	/ K. Elliott	Hammer Type 140 I	b / 30 in / Automatic	
ELEV. (FT)	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO' 10 20 10 WATE (MC) ATTERI	ETRATION ISTANCE WS/FT 30 40	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION	REMARKS AND TESTS STEATH	
		-	100	50/6" (Refusal)	S-09					Very dense, moist black, F GRAVEL with Silt and Sand angular highly weathered coarse sand, low plasticity sand lenses.	l (GP-GM); fine gravel, fine to		
465 - - -	35	X	100	50/6" (Refusal)	S-10		•		GP- GM				
460 - - -	40	X	100	12-10-10 (N=20)	S-11a MC-1 1b					Medium dense to dense, SAND with Gravel (SM); fi fine to coarse, angular to low plasticity fines.	ne to coarse sand,		
±455 - - -	45	X	80	14-22-25 (N=47)	S-12	0	•		SM			S-12 and S-13 composite sample; 27.9% Gravel, 49.8% Sand, 22.3% Fines.	
450 - - - - 445	50		100	8-5-9 (N=14)	S-13	0 🔳						Borehole caved in from 50 to 55 feet; redrilled.	
- - - - 440	55	X	80	27-34-39 (N=73)	S-14				SP	Very dense, wet, dark gramottled, Poorly-Graded S/(SP); fine to coarse sand.			



NOTES:

Location and Elevation Source: 90% Drawings
Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring RWP-MI-BH01

Sheet 2 of 3

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

RWP-MI-BH01

Date(s) Drilled		03/09/	2021			Client	Jac	obs	Engineering Group	Final Depth 70.2 ft bgs		
Coordinat	es	77456	89.4 E, 65	9465.	5 N	Geotechnical Consultant	Мс	Mille	n Jacobs Associates	Method/ Rig Type Mud R	otary/CME 850 Track Mounted	
Surface Elevation		499.5	ft.			Drilling Contractor	West	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 4.00 i	in	
Location		LRWF	North Sta	ation 9	9+18	Logged by/ Checked by	D. I	Roth	/ K. Elliott	Hammer	b / 30 in / Automatic	
ELEV. (FT) WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 WATE (MC)	ETRATION ISTANCE WS/FT	USCS GRAPHIC	USCS	MATERIAL DESC		REMARKS AND TESTS	
- - - 430		0 = 100	50/0" (Refusal) 50/1" (Refusal)	S-15 S-16				SP	Very dense, wet, dark gramottled, Poorly-Graded S. (SP); fine to coarse sand.		Driller reported easier drilling from 61 to 64 feet. Poor recovery, broken black rock fragment in sampler at 70 feet.	
	0	0	50/3"	S-17								
- - 425 - - -	75-		(Refusal)								Borehole completed at 70.25 feet below ground surface (bgs).	
420 8 - -	30 -											
- - -	35-											
410	1		NOTE			1 1						



Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH01

Date(s) Drilled	03/23/	2021			Client	Jac	obs	Engineering Group	Final Depth 70.5 ft bgs		
Coordinates	77451	50.0 E, 65	9473.2	2 N	Geotechnical Consultant	Mc	Mille	n Jacobs Associates	Method/ Rig Type M	Mud Rotary/CME 850 Track Mounted	
Surface Elevation	493.5	ft.			Drilling Contractor	West	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 4	4.00 in	
Location	LRWP	North Sta	ation 1		Logged by/ Checked by	K. E	lliot	t / J. Fissel	Hammer Type 1	140 lb / 30 in / Automatic	
ELEV. (FT) WATER LEVEL DEPTH (FT)	SAMPLE TYPE RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 10 WATE (MC)	ETRATION ISTANCE WS/FT 30 40 R CONTENT BERG LL/PL 60 80	USCS GRAPHIC	USCS	MATERIAL DESC		REMARKS SARAMAN TESTS BACKFILL/INSTALL.	
489 -	100	2-3-7 (N=10)	S-01	•]			ML CH MH	Moist, dark brown, SILT (North grass sod. Topsoil Soft, wet, brown, Fat CLAN plasticity. Gresham Formation Medium stiff, moist, gray, high plasticity.	(CH); high	above 5 feet; 6-inch diameter steel casing installed from 0 to 5 feet.	
484 - 10-	100	8-10-15 (N=25)	S-02	0	•			Medium dense to very de grading to dark gray, Poor with Clay and Sand (GP-G angular, fresh gravel, fine low plasticity fines.	ly Graded GRA\ C); fine to coars	AVEL rse,	
	100	18-50/4" (Refusal)	S-03	O	•			Becomes very dense at 1	15 feet.	Switched from spade to 4 7/8-inch tri-cone bit at 15 feet.	
474 - 20-	100	50/1" (Refusal)	S-04		•		GP- GC				
469 25-	100	5-12-18 (N=30)	S-05	O				Becomes medium dense	at 25 feet.		
464 -	1										



NOTES:

Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH01**

Sheet 1 of 3

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

Date(s Drilled)	0	3/23/	2021			Client	Jac	obs	Engineering Group	Final Depth	70.5 ft	t bgs	
Coordi	inate	s 7	7451	50.0 E, 65	9473.2	2 N	Geotechnical Consultant	Мс	Miller	Jacobs Associates	Method/ Rig Type	Mud Ro	otary/CME 850 Track Mount	ted
Surfac Elevati		4	93.5	ft.			Drilling Contractor	West	tern Sta	ates Soil Conservation, Inc.	Hole Diameter	4.00 ii	n	
Locatio	on	L	RWP	North Sta	ation 1	14+90	Logged by/ Checked by	checked by K. Elliott / J. Fissel			Hammer Type	140 lb	/ 30 in / Automatic	
ELEV. (FT)	WAIER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 10 WATE (MC)	ETRATION ISTANCE WS/FT 30 40 R CONTENT BERG LL/PL 60 80	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION		REMARKS AND TESTS	BACKFILL/INSTALL.
- - - 459 -	35	X	7	28-50/5" (Refusal) 7-10-8 (N=18)	S-06					Medium dense to very de grading to dark gray, Poor with Clay and Sand (GP-G angular, fresh gravel, fine low plasticity fines. Becomes very dense at 3 Becomes medium dense	ly Graded GI C); fine to co to medium s	RAVEL arse,	Periodic rod chatter from 35 to 40 feet.	
- 454 - -	40		40	16-12-16 (N=28)	S-08					Coarse gravel at 40 feet.				
449 -	45	5 X	73	8-10-13 (N=23)	S-09	O. I		000000000000000000000000000000000000000	GP- GC				Rod chatter at 48 feet.	
- 1 444 -	50		100	8-13-27 (N=40)	S-10	0	•			Becomes dense at 48 fee	rt.		nou chatter at 40 leet.	
- 439 - -	55	X	84	18-50/4" (Refusal)	S-11	G				Becomes very dense at 5	55 feet.		Rod chatter at 53 feet.	
434		-												



Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

Date(s Drilled)	0	3/23/	2021			Client	Jac	obs	Engineering Group	Final 70.5 f	t bgs
Coordi	nate	s 7	7451	50.0 E, 65	9473.2	2 N	Geotechnica Consultant	Mc	Mille	n Jacobs Associates	Method/ Rig Type Mud Ro	otary/CME 850 Track Mounted
Surfac Elevati		4	193.5	ft.			Drilling Contractor	West	ern Sta	ates Soil Conservation, Inc.	Hole Diameter 4.00 i	n
Locatio	on	L	RWP	North Sta	ation 1		Logged by/ Checked by	K. I	lliot	t / J. Fissel	Hammer Type 140 lk	/ 30 in / Automatic
ELEV. (FT)	WAIEN LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLC 10 20 WATE (MC)	NETRATION SISTANCE DWS/FT 0 30 40 ER CONTENT BBERG LL/PL 0 60 80	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION	REMARKS AND TESTS STEAT
429	65	X	100	16-10-15 (N=25) 9-18-17 (N=35)	S-12 S-13				GP- GC	Medium dense to very de grading to dark gray, Poor with Clay and Sand (GP-Gangular, fresh gravel, fine low plasticity fines. Becomes medium dense Becomes dense at 65 fee	ly Graded GRAVEL C); fine to coarse, to medium sand, at 60 feet.	
- 424	70		40	50/6"	S-14					Becomes very dense at 6	58 feet.	
419	75	5-		(Refusal)								Borehole completed at 70.5 feet below ground surface (bgs).
- -414 -	80) - - - - -										
- 409 -	85	5-										
- 404		-	411.15	'N NOTE	-c.							L DWD BLIGA



Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH02

Date(s) Drilled		03/25	/2021 - 03/	26/202	21	Client	Jac	obs	Engineering Group	Final Depth 70.9 ft bgs		
Coordina	ates	77450	02.0 E, 65	9483.1	I N	Geotechnica Consultant	Mc	Miller	n Jacobs Associates	Method/ Sonic Dri Rig Type LS	illing/Track Mounted Geoprobe 8150	
Surface Elevation	n	494.2	ft.			Drilling Contractor	West	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00 i	n	
Location		LRWF	North Sta	ation 1	5+91	Logged by/ Checked by	Α	Judy	/ K. Elliott	Hammer Type 140 lb	/ 30 in / Automatic	
ELEV. (FT) WATER LEVEL	DEPTH (FT)	SAMPLE TYPE RECOVERY (%)	BLOW	SAMPLE NUMBER	RESI BLOV 10 20 O WATEI (MC)	ETRATION ISTANCE WS/FT 30 40 R CONTENT	USCS GRAPHIC	USCS	MATERIAL DES	CRIPTION	REMARKS AND TESTS STATE	
- - - 490 -	5	100	2-2-2 (N=4)	SC-01 Grab 1 S-01	[0]			CL	Moist, dark brown, SILT (Notes) Topsoil Moist, light brown, Lean College (Plasticity, micaceous, trace) above 2.5 feet. Gresham Formation Grades to Sandy Lean College (CH); high plasticity.	CLAY (CL); low e rootlets present LAY below 4 feet.		
- 485 -	10	100	12-35-44	SC-02 S-02				СН	Color becomes orange-between mottles and grade CLAY (CH) at 8 feet.	es to Sandy Fat rown and gray,		
- - -480 -	15	100	(N=79) 50/6" (Refusal)	SC-03 Grab 2 S-03	0			SC	Clayey Sand with Gravel (sand, fine to coarse, subrosubangular moderately whigh plasticity fines. Cobbles below 12.5 feet	ounded to eathered gravel,	Grab 2: 30.8% Gravel, 36.2% Sand, 33.0% Fines.	
- 475 -	20	78	30-16-8 (N=24)	SC-04 S-04		•		GP- GC	Medium dense, dry, brow Graded GRAVEL with Clay fine to coarse subrounded slightly to moderately we to coarse sand, scattered plasticity fines. Becomes moist at 19.5 f	and Sand (GP-GC); I to subangular, athered gravel, fine cobbles, high		
470 	25	4 5	30-19-24 (N=43)	S-05 Grab 3 SC-06	-0-			SC	Dense, moist, dark gray, C Gravel (SC), fine to coarse to subangular, fresh fine t high plasticity fines.	sand, subrounded	Water level at 23.6 bgs on 5/18/2021. Grab 3: 26.8% Gravel, 47.7% Sand, 25.5% Fines.	



NOTES:

Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH02**

Sheet 1 of 3

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH02

Date(s) Drilled	0	3/25/	2021 - 03/	26/202	21	Client	Jac	obs l	Engineering Group	Final Depth	70.9 ft	bgs	
Coordinates	s 7	7450	02.0 E, 65	9483.1	l N	Geotechnica Consultant	McI	Miller	Jacobs Associates		Sonic Dri LS	lling/Track Mounted Geoprobe 8	8150
Surface Elevation	4	94.2	ft.			Drilling Contractor	West	ern Sta	ites Soil Conservation, Inc.	Hole Diameter	5.00 ir	า	
Location	L	RWP	North Sta	ation 1	5+91	Logged by/ Checked by	Α	Judy	/ K. Elliott	Hammer Type	140 lb	/ 30 in / Automatic	
ELEV. (FT) WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	R CONTENT	USCS GRAPHIC	NSCS	MATERIAL DESC	CRIPTION		REMARKS AND TESTS	BACKFILL/INSTALL.
- ▼ 460 	5	100	1-2-3 (N=5)	S-06 SC-07		1		SC	Loose to dense, wet, dark with Gravel (SC); fine to co coarse fresh gravel and coplasticity fines. Encountered red-brown	parse sand, fi obbles, high	ne to	S-06: 24.0% Fines. Water level at 31.2 bgs on 10/24/2021.	
455 . 40		100	8-11-29 (N=40)	S-07 Grab 4 SC-08	0			GC	from 35 to 36 feet bgs. Dense, moist, gray, Clayey and Cobbles (GC); fine to to medium sand, high platencountered fresh, hard >4 inches or boulders frobgs.	coarse gravel sticity fines. basalt cobblo om 37.5 to 39	, fine es) feet	Grab 4: 15.7% Cobbles, 35.6% Gravel, 28.5% Sand, 20.2% Fines. S-08: 17.2% Fines.	
- - - 450		55	5-5-8 (N=13)	S-08 SC-09	0.				Medium dense, wet, gray, Gravel (SC); fine to mediu coarse, subrounded to sul high plasticity fines.	m sand, fine	to		
_ 45 _ _ _ _		100	7-9-11 (N=20)	S-09 Grab 5 SC-10	•							Grab 5: 26.8% Gravel, 51.6% Sand, 21.6% Fines.	
_ 50 _ -		100	11-13-11 (N=24)	S-10 SC-11		•		SC	Coarse gravel layer from	n 52 to 53 fee	t.		
-440 _ 55 -	5 - X	100	11-21-23 (N=44)	S-11 SC-12									
- 435	-		N NOTE						Coarse gravel and cobbl to 59 feet.	e layer from :	57.5		



NOTES:

Location and Elevation Source: 90% Drawings
Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH02

Sheet 2 of 3

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

Date(s Drilled)	0	3/25/	2021 - 03/	26/202	21	Client		Jac	obs	Engineering Group		ft bgs	
Coordi	nates	7	7450	02.0 E, 65	9483.	1 N	Geotec Consult	tant	Mc	Miller	Jacobs Associates	Method/ Sonic D Rig Type LS	rilling/Track Mounted Geoprobe 8	3150
Surfac Elevat		4	94.2	ft.			Drilling Contract	ctor	West	tern Sta	tes Soil Conservation, Inc.	Hole Diameter 5.00	in	
Location	on	L	RWP	North Sta	ation 1	15+91	Logged Checke	by/ ed by	Α	Judy	/ K. Elliott	Hammer Type 140 I	b / 30 in / Automatic	
ELEV. (FT)	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 WATE (MC)	ETRATION SISTANC WS/FT OF 30 A SISTANC	40 HOTENT	USCS GRAPHIC	nscs	MATERIAL DES		REMARKS AND TESTS	BACKFILL/INSTALL.
- - - -430			100	6-23-29 (N=52)	S-12 Grab 6 SC-13	0					Medium dense, wet, gray, Gravel (SC); fine to mediu coarse, subrounded to sul high plasticity fines.	m sand, fine to	Grab 6: 30.2% Gravel, 47.8% Sand, 22.0% Fines.	
- - -	65		83	12-18-19 (N=37)	S-13 SC-14		•	I		SC	Boulder or cobble > 4-in	ches at 66 feet.		
- 425 -	70		90	22-50/5" (Refusal)	S-14									
- - 420 - -	75			(Netusal)									Borehole completed at 70.92 feet below ground surface (bgs).	
- 415 - -	80)-												
- -410 - - -	85	-												
405		-		NOTE										



Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH03

Date(s		0	3/24/	2021			Client	Jac	obs	Engineering Group	Final 50.0) ft bgs
Coord		vc.		61.0 E, 65	9399.1	l N	Geotechnica Consultant				Method/	Rotary/CME 850 Track Mounted
Surfac			03.7				Drilling Contractor	10111		ates Soil Conservation, Inc.	Hole Diameter 5.00	
Locati		104		North St	ation 1	8+12	Logged by/ Checked by	180 CH	A STATE OF THE STA	kost / K. Elliott	Llammer	lb / 30 in / Automatic
ELEV. (FT)	WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	ETRATION ISTANCE WS/FT 30 40 HR CONTENT BERG LL/PL	USCS GRAPHIC	USCS	MATERIAL DESC		REMARKS AND DIVISION OF STREET
- - 499 -		X	100	2-2-3 (N=5) 2-2-4 (N=6)	S-01 S-02	■ C			ML CL	Soft, wet, dark brown, SIL organics and grass. Topsoil Medium stiff grading to st Lean CLAY with Sand (CL); plasticity, trace red-brown Gresham Formation Color becomes gray with brown mottling at 5 feet	iff, moist, brown, fine sand, low and gray mottles on brown and red	casing installed from 0 to 5 feet.
494	1		100	3-4-5 (N=9) 3-4-7 (N=11)	S-03 S-04	■ 0	-1			Stiff, moist, gray with red- CLAY with Sand (CH); fine high plasticity. Below 12 feet, becomes	to medium sand,	
- -489 - -	1	5-	100	4-7-10 (N=17)	SH-01 S-05	I O	1		СН	fine, subangular highly v present in concentrated	weathered gravel	SH-1: Dry Unit Weight = 84.4 pcf.
- 484 - -	2		100	3-5-6 (N=11)	S-06	•	0			Becomes stiff at 20 feet. Volcanic ash present at 2		
- 479 - -	2	5	100	50/5" (Refusal)	S-07a S-07b				GP- GC	Very dense, wet, gray and mottles, Poorly Graded Gi and Sand (GP-GC); fine to fresh gravel, fine to coarse	RAVEL with Clay coarse, angular,	Rod chatter followed by slow and hard drilling at 23 feet. Switched from spade to 4 7/8-inch tricone bit at 25 feet. Slow and hard drilling from 25 to 30 feet.
474		-										
		Mal	ALL L E	NOTE	FÇ.			- N/		<u> </u>		- I DWD DUO2



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH03**

Sheet 1 of 2

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH03

Date(s) Drilled	03/24	2021			Client	Jac	obs	Engineering Group	Final Depth 50.0 f	t bgs	
Coordinates	77440	61.0 E, 65	9399.1	1 N	Geotechnical Consultant	Мс	Miller	Jacobs Associates	Method/ Rig Type Mud Ro	otary/CME 850 Track Mour	nted
Surface Elevation	503.7	ft.			Drilling Contractor	West	tern Sta	tes Soil Conservation, Inc.	Hole Diameter 5.00 i	n	
Location	LRWF	North Sta	ation 1	18+12	Logged by/ Checked by	A. I	Have	kost / K. Elliott	Hammer Type 140 lk	/ 30 in / Automatic	
ELEV. (FT) WATER LEVEL DEPTH (FT)	SAMPLE TYPE RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	ETRATION ISTANCE WS/FT 30 40 R CONTENT BERG LL/PL 60 80	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
469 35	24	50/5" (Refusal)	S-08					Very dense, wet, gray and mottles, Poorly Graded Gi and Sand (GP-GC); fine to fresh gravel, fine to coarse Becomes medium dense	RAVEL with Clay coarse, angular, e sand.	Intermittent rod chatter from 30 to 35 feet. Driller notes "more gravelly" from 35 to 40	
464 40-	100	(N=23) 10-10-41 (N=51)	S-10				GP- GC	Becomes very dense at 4	10 feet.	feet.	
459 45-	78	14-26-24 (N=50)	S-11							Intermittent rod chatter from 45 to 50 feet.	
449 55-		50/0" (Refusal)	5-12							Borehole completed at 50 feet below ground surface (bgs).	
444	1	No.	C.		<u> </u>						Щ
	lcMII I I	NOTE	:5:						Doring	I DIVID DITUS	



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH03**

Sheet 2 of 2

Project Location: Multnomah County, OR LRWP-P01 Project Number: 6218.0 11/16/2021 Jacobs Engineering Group 12.0 ft bgs Drilled Depth Geotechnical Method/ Coordinates 7744030.8 E, 659399.3 N McMillen Jacobs Associates Geoprobe/Track-Mounted GeoProbe 6622 CPT Rig Type Consultant Surface Drilling Hole 505.3 ft. 4.00 in Oregon Geotechnical Explorations, Inc. Diameter ocation Logged by/ Hammer LRWP North Station 18+42 N/A F. Sariosseiri / J. Fissel SAMPLE NUMBER BACKFILL/INSTALL. RESISTANCE **USCS GRAPHIC** RECOVERY (%) SAMPLE TYPE WATER LEVE BLOWS/FT DEPTH (FT) BLOW REMARKS 10 20 30 40 USCS MATERIAL DESCRIPTION AND WATER CONTENT 0 **TESTS** ATTERBERG LL/PL 40 60 80 Wet, dark brown SILT (ML), with rootlets. Medium stiff, wet, brown Fat CLAY (CH); high plasticity. **Gresham Formation** СН Groundwater at 3.7 feet bgs after drilling. 501 Medium stiff, wet, brown, Lean CLAY (CL), low plasticity. 100 SH-01 SH-01: Pocket torvane = 0.55 tsf. CL SH-02 Unconfined 496 Compressive Strength = 32 psi, 10 Becomes very stiff below 10 feet Dry Unit Weight = 83.7 100 SH-02 ----Pocket torvane = 0.5 tsf. Borehole completed at 12 feet below ground surface (bgs). 491 15 486 **Boring LRWP-P01** Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Log of Boring

Sheet 1 of 1

Project: Filtration Pipelines Project – Raw Water Pipeline

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH04

Date(0	3/23/	2021 - 03/	24/202	21	Client	Jac	cohs	Engineering Group	Final	70.0 ft	has
Drilled Coord	linates	2	-720	69.2 E, 65	She Gotton H	100	Geotechnical			- II A:-4	Depth Method/	SITE SHOW HIS LAND A	lling/Track Mounted Geoprobe 8150
Surfac			24.4		19330.2	+ 14	Consultant Drilling			A CONTRACTOR OF STREET	Rig Type Hole	5.00 ir	
Eleva: Locati		240		North St	ation '	04±02	Contractor Logged by/	(100 × 100		/ K. Elliott	Diameter Hammer	PROFESSION CONTRACTOR	/ 30 in / Automatic
			KVVF	NOITH ST	-	PEN	Checked by ETRATION	0000	Judy	7 K. Elliott	Туре	140 ID	
ELEV. (FT)	WATER LEVEL DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	BLO 10 20 O WATE (MC)	ISTANCE WS/FT 30 40 R CONTENT BERG LL/PL 60 80	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION		REMARKS AND TESTS BACKFILL/INSTALL
-									ML	Moist, dark brown, SILT (N Topsoil	/IL); low pla	sticity.	
520 - -	5		100	3-3-4 (N=7)	SC-01 Grab 1 S-01	₽	1		МН	Medium stiff, moist, red-b (MH); high plasticity, occa mottles, trace fine subrou gravel, medium plasticity. Gresham Formation	sional orang	ge	
- 515 - -	10		100	1-3-3 (N=6)	S-02					Medium stiff, moist, orang brown mottles, Fat CLAY (trace fine sand.			
- 510 -	15		100	2-3-4	Grab 2 S-03	I O	-1		СН				
505			100	2-3-4 (N=7)	Grab 3 SC-04		⊢0			Very loose to loose, moist GRAVEL with Sand (GM); f rounded to subangular gra sand, moderately to highly high plasticity fines. Becomes wet at 18 feet.	ine to coars avel, fine to	se coarse	Grab 3: 46.5% Fines.
	20	X	100	1-1-2 (N=3)	S-04 SC-05			20000	GM				
	25	-	100	1-2-3 (N=5)	Grab 4 S-05 SC-06	•	 ⊕ 						Grab 4: 28.4% Fines. Water level at 26.5 feet bgs on 6/13/2022.
- 495		-							sc	Loose, to very dense, wet, SAND; fine to coarse sand gravel, high plasticity fines	, 13% fine r		Water level at 27.5 feet bgs on 10/24/2021.
	- A	A - B	ALLE	NOT	EC.								



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH04**

Sheet 1 of 3

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH04

Date(s	s)		02/02/	2024 22	041000	14	Client		-1-	F	Final 70.0	41	_
Drilled Coord	1	20	K-72, 10-10	2021 - 03/		200	Geotechnica	1				ft bgs rilling/Track Mounted Geoprobe 8	3150
	VICE. 10 V	13		69.2 E, 65	9550.4	1 N	Consultant	Mc	Mille	n Jacobs Associates	Rig Type LS		, 130
Surface Elevat	tion		524.4	ft.			Drilling Contractor	West	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00	n	
Locati	on		LRWP	North Sta	ation 2		Logged by/ Checked by	Α	Judy	/ K. Elliott	Hammer Type 140 II	o / 30 in / Automatic	
ELEV. (FT)	WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 10 WATE (MC)	ETRATION ISTANCE WS/FT 30 40	USCS GRAPHIC	USCS	MATERIAL DES	CRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
		-	100	18-31-35	S-06				SC	Loose, to very dense, wet		Grab 5: 13.0% Gravel,	
- -490 -	3	5	- 100	(N=66) 50/0" (Refusal)	Grab 5 SC-07	О			GC	SAND; fine to coarse sand gravel, high plasticity fine: Very dense, moist, brown, Clayey GRAVEL with Cobb (GC); fine to coarse, subro subangular, moderately to gravel, some fine to coars plasticity fines. Color becomes brown and	s. , gray and red, les and Boulders ounded to o highly weathered e sand, low	48.9% Sand, 38.1% Fines. Driller noted material becomes much harder at 31 feet. Driller noted 1-2 foot diameter boulders below 33 feet.	
485	4	0	32	50/3" (Refusal)	SC-08 Grab 6 S-08	0				Very dense, moist, dark b GRAVEL with Sand (GC); fi subangular to rounded gr	ne to coarse	Grab 6: 46.8% Gravel, 30.7% Sand, 22.5% Fines. Driller noted cored rock/boulder at 40 feet.	
- 480 - -	4	5	100	7-50/5" (Refusal)	SC-09 S-09 Grab 7 SC-10	0	1			cobbles, high plasticity fin	es.	Grab 7: 54.2% Gravel, 31.3% Sand, 14.5% Fines.	
475 - -	5	0	100	50/6" (Refusal)	S-10 SC-11		1		GC	Encountered hard, fresh weathered cobbles from			
- 470 - -	5	5	84	50/6" (Refusal)	S-11 Grab 8 SC-12	0				,	.,	Grab 8: 54.4% Gravel, 24.4% Sand, 21.2% Fines.	
465								0%					
		Ma	MILLE	NOTE	FS.			/				L DWD DUG4	



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH04**

Sheet 2 of 3

Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH04

Date(s Drilled)	0	3/23/	2021 - 03/	24/202	21	Client		Jac	obs	Engineering Group	Final 70.0 f	t bgs
Coordi		7	7444	69.2 E, 65	9550.4	4 N	Geotech Consulta	nnical ant	Мс	Miller	Jacobs Associates	Method/ Sonic Dri Rig Type LS	illing/Track Mounted Geoprobe 8150
Surfaci Elevati		5	24.4	ft.			Drilling Contract	tor	West	tern Sta	ites Soil Conservation, Inc.	Hole Diameter 5.00 i	n
Locatio	n	L	RWP	North Sta	ation 2	21+92	Logged Checked	by/ d by	Α	Judy	/ K. Elliott	Hammer Type 140 lb	/ 30 in / Automatic
ELEV. (FT)	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	IETRATIC SISTANCE WS/FT) 30 4 	0 HH ENT	USCS GRAPHIC	nscs	MATERIAL DES	3500000 12.500000000	REMARKS AND TESTS
		-	75	14-50/6" (Refusal)	S-12 SC-13					GC	Very dense, moist, dark be GRAVEL with Sand (GC); fi subangular to rounded gra cobbles, high plasticity fin	ne to coarse avel, occasional	
- - -	65		100	50/6" (Refusal)	S-13					SC	Very dense, moist, dark br multicolored clasts, Clayer (SC); fine to coarse sand, t subrounded gravel., low p	y SAND with Gravel fine to coarse	
455	70	X	100	45-50/2"	S-14								47
- - - 450 - -	75			(Refusal)									Borehole completed at 70 feet below ground surface (bgs).
445	80	-											
440 - - -	85												
435				'M NOTE									



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH04**

Sheet 3 of 3

Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring LRWP-P02

Date(:	s)		11/16/	2021			Client	Jac	obs	Engineering Group	Final Depth	17.0 ft	t bgs	╗
Coord		es	77436	81.6 E, 65	9492.2	2 N	Geotechnical Consultant	Mc	Miller	n Jacobs Associates	Method/ Rig Type	Geoprobe	e/Track-Mounted GeoProbe 6622	СРТ
Surfac			524.4				Drilling Contractor	A 800 1 80 C	11 (11 (11 (11 (11 (11 (11 (11 (11 (11	otechnical Explorations, Inc.	Hole Diameter	4.00 ir	n	
Locati			LRWP	North St	ation 2	22+93	Logged by/ Checked by	11.0	- 11	sseiri / J. Fissel	Hammer Type	N/A		
ELEV. (FT)	WATER LEVEL	SAMDI E TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	ETRATION ISTANCE WS/FT 30 40 R CONTENT BERG LL/PL	USCS GRAPHIC	USCS	MATERIAL DESC			REMARKS AND TESTS	BACKFILL/INSTALL.
520	•	5-							CL	Wet, dark brown SILT (ML Topsoil Soft, wet, brown, Lean CL plasticity. Gresham Formation		tlets.	Groundwater at 2.7 feet bgs after drilling.	
515	1	0	100		SH-01		-1		мн	Medium stiff, wet, brown, high plasticity.	Elastic SILT	(MH);	SH-01 Unconfined Compressive Strength = 22 psi, Dry Unit Weight = 87.5 pcf. Pocket torvane = 0.55 tsf. SH-02 (15.5-16 feet) Unconfined Compressive Strength = 7 psi, Dry Unit Weight = 73.4	
510 -	1	5-	100		SH-02	I •	-1		СН	Medium stiff, moist, red-b (CH); high plasticity. Becomes very stiff below		LAY	pcf. SH-02 (16.2-16.7 feet) Unconfined Compressive Strength = 23 psi, Dry Unit Weight = 77.0 pcf. Pocket torvane = 0.55 tsf.	
505		-											Borehole completed at 17 feet below ground surface (bgs).	
505		Mc	MILLE	N NOTE	ES:						D.	orina	I DWD D02	



Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH05

Date(: Drilled		0	4/13/	2021 - 04/	15/202	21	Client	Jac	obs	Engineering Group	Final Depth 207.0) ft bgs
Coord	linates	7	7433	93.3 E, 65	9476.3	3 N	Geotechnical Consultant	Mc	Miller	Jacobs Associates	Method/ Sonic E Rig Type LS	Prilling/Track Mounted Geoprobe 8150
Surfa Eleva		6	14.4	ft.			Drilling Contractor	West	ern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00	in
Locat	ion	L	RWP	North Sta	-	W. W. D.	Logged by/ Checked by	K. I	lliot	t, J. Fissel / J. Quinn	Hammer Type N/A	
ELEV. (FT)	WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	IETRATION ISTANCE INSIGNATION ISTANCE INSIGNATION INSI	USCS GRAPHIC	nscs	MATERIAL DESC	CRIPTION	REMARKS AND TESTS BACKFILL/INSTALL
- - - 610	5								GP	ASPHALT PAVEMENT - 6 in Pavement Section Loose to medium dense, r Poorly Graded GRAVEL wi subrounded and subangul gravel, fine to medium sar Base Aggregate/Fill	moist, brown, th Sand (GP); lar fine to coarse	
	J				Grab 1	0			CL	Wet, brown, Sandy Lean C (CL); low plasticity, fine to subrounded gravel, fine to Residual Soil of the Sp Formation	coarse coarse sand.	
- - - -	10		75		SC-01					Moist, brown, Poorly Grad Sand, Clay, and Cobbles (G coarse rounded gravel, fin low plasticity fines. Less Weathered Sprin	GP-GC); fine to e to coarse sand,	
- - - 595	15				Grab 2	0			GP- GC			Grab 2: 9.5% Cobbles, 39.1% Gravel, 25.1% Sand, 26.3% Fines.
- - - 590 -	20								GP- GC	Moist, brown with slight of Poorly Graded GRAVEL wi Cobbles (GP-GC); fine to of coarse subangular to roun cobble, low plasticity fines	th Clay, Sand, and oarse sand, fine to ided gravel and	
- - - 585		- My		N NOTE	Grab 3	- O		00.00				



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH05**

Sheet 1 of 7

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH05

Date(s) Drilled	04/13	3/2021 - 04/	15/202	21	Client	Jac	obs	Engineering Group		207.0	
Coordinates	s 7743	393.3 E, 65	9476.3	3 N	Geotechnical Consultant	Мс	Mille	n Jacobs Associates		Sonic Dri	lling/Track Mounted Geoprobe 815
Surface Elevation	614.4	l ft.			Drilling Contractor	Wes	tern Sta	nt - material and control of the control	11-1-	5.00 ir	i
Location	LRW	P North Sta	ation 2		Logged by/ Checked by	K. I	Elliot	t, J. Fissel / J. Quinn	Hammer Type	N/A	
ELEV. (FT) WATER LEVEL	SAMPLE TYPE RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	R CONTENT	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION		REMARKS AND TESTS
580 . 35 . 35 			SC-02 Grab 4 SC-03 Grab 5	O		00.00.00.00.00.00.00.00.00.00.00.00.00.	GP- GC	Moist, brown with slight of Poorly Graded GRAVEL with Cobbles (GP-GC); fine to coarse subangular to roun cobble, low plasticity fines at 40 feet.	th Clay, Sand, oarse sand, f ided gravel ands.	, and ine to nd	Grab 5: 30% Fines.
565 - 50 -			6				CL	Moist, red-brown, Lean Cl plasticity, saprolitic. Residual Soil of Borin			
- -560 - 55	5- 100		SC-04					Dark brown to slightly red			



NOTES:

Location and Elevation Source: 90% Drawings
Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
Coordinate System: Water Bureau Filtration Project Custom Coordinate System

GC

Boring LRWP-BH05

(CL); low plasticity, scattered, moderately to highly weathered vesicular basalt cobbles. Light gray-brown, Clayey GRAVEL (GC); fine to coarse gravel, low plasticity fines.

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH05

Date(s Drilled		0	4/13/2	2021 - 04/ ⁻	15/202	21	Client	Jac	obs	Engineering Group	Final Depth	207.0	ft bgs	
Coordi	inates	7	7433	93.3 E, 65	9476.3	B N	Geotechnical Consultant	Mc	Miller	n Jacobs Associates	Method/ Rig Type	Sonic Dri	illing/Track Mounted Geoprobe	8150
Surfac Elevat		6	14.41	ft.			Drilling Contractor	West	tern Sta	ates Soil Conservation, Inc.	Hole Diameter	5.00 ii	n	
Locatio	on	L	RWP	North Sta	ation 2	4+80	Logged by/ Checked by	K. E	Elliot	t, J. Fissel / J. Quinn	Hammer Type	N/A		
ELEV. (FT)	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	R CONTENT BERG LL/PL	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION		REMARKS AND TESTS	BACKFILL/INSTALL.
- 550 -	65		100		SC-05	0			GC	Light gray-brown, Clayey (to coarse gravel, low plast Encountered 9-inch cobb with angular basaltic gra Occasional 3-inch cobble clay matrix from 65 to 76	icity fines. ole in brown avel at 60 fe es in red-bro	ı clay eet.		
545 - - - - 540	70	-	Grab O 7							BASALT; moderately weath moderately spaced clay-fil Boring Lava		,	Unconfined Compressive Strength of sample from 70.1 to 70.8 feet = 13,542 psi.	
535	75 80	-	100		SC-06					Basalt rock broken in fin and cobble sizes, angula moderately weathered f	r, vesicular,			
530 - -	85									Moderately to closely sp joints; bright orange oxid feet. Fragmented, clay-filled 2 between 85 and 86 feet slightly to moderately w vesicular basalt.	dized zone d cone presen followed by	at 83 t		
525														36



NOTES:

Location and Elevation Source: 90% Drawings
Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH05

Sheet 3 of 7

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH05

Date(s)		11421	2024 044	451202	14	Client	Les	oh-	Engineering Crave	Final	207.0	ft has
Drilled Coordi				2021 - 04/	Marie Processor - All	38"11	Geotechnical				Depth Method/		ft bgs Illing/Track Mounted Geoprobe 8150
Surfac	CTA WARRIES			93.3 E, 65	9476.3	3 N	Consultant Drilling	Мс	Miller	Jacobs Associates	Rig Type Hole	LS	The state of the s
Elevati Locatio	on		14.4		1831 I I I I I I I	V. 00. P. 4. Aug 12 (1971)	Contractor Logged by/	1,200		tes Soil Conservation, Inc.	Diameter	5.00 ii	n
LUCAUC	л	L	RWP	North Sta	_		Checked by	K.	Elliot	, J. Fissel / J. Quinn	Hammer Type	N/A	
ELEV. (FT)	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 WATE (MC)	ETRATION ISTANCE WS/FT 30 40	USCS GRAPHIC	USCS	Material desc			REMARKS AND TESTS BACKFILL/INSTALL.
	95-		100		SC-08					BASALT; moderately weath moderately spaced clay-fil Boring Lava Slightly to moderately w extremely close to closel from 90 to 101 feet.	lled joints.		
515	100 - - - - - - -	-								Becomes dark gray, sligh weathering, closely-spac joints from 100 to 104 fe	ed clay-fille		
510 - -	105 - - - - - -		100		SC-09				GP-	Moist, orange-brown, Poo with Silt, Sand, and Cobble medium sand, fine to coar subrounded to rounded co plasticity fines, weakly cer Troutdale Formation	es (GP-GM) rse gravel; obbles, low	; fine to	
505 - - -	110-				Grab 8	0			GM				Grab 8: 46.5% Gravel, 30.3% Sand, 23.2% Fines.
500 - - -	115-		100		Grab 9 SC-10	•••			SC	Moist, orange-brown, Clay to medium sand, low plast cemented.			Grab 9: 28.5% Fines.
495	-	1											
	I N/	Lall	ALL L	NOTE	ς.			191	1				



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH05**

Sheet 4 of 7

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH05

Date	s)		4/13/	2021 - 04/	15/202	21	Client	Jac	obs	Engineering Group	Final Depth	207.0	ft bas
Drille Coor	dinates			93.3 E, 65	A STATE OF THE STA	100	Geotechnica	-1			Method/		lling/Track Mounted Geoprobe 8150
Surfa			14.4		3470.0) IV	Consultant Drilling			u compressionare de la compressione de la compressi	Rig Type Hole	5.00 ii	•
Eleva Local					-4: <i>c</i>	14.00	Contractor Logged by/	100000000		ates Soil Conservation, Inc.	Diameter Hammer	100000000000000000000000000000000000000	1
450.500			RWP	North Sta	-		Checked by ETRATION	K. I	EIIIOT	t, J. Fissel / J. Quinn	Туре	N/A	
ELEV. (FT)	WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	BLO 10 20 WATE (MC)	ISTANCE WS/FT 30 40 H H R CONTENT BERG LL/PL 60 80	Ü	USCS	MATERIAL DESC	SACRANA N. SANTANANA		REMARKS AND TESTS BACKFILL/INSTALL.
					Grab 10				SC	Moist, orange-brown, Clay to medium sand, low plast cemented.			
490	125		100		SC-11				GP- GC	Moist, brown-gray, Poorly with Clay and Cobbles (GP subangular and subround to coarse sand, low plastic	P-GC); fine ed gravel, to city fines.	race fine	
- - - 4 85		- 1			Grab 11	0				Moist, orange-brown grad then back to orange-brow (SC); fine to medium sand fines. Encountered some fine r and scattered cobbles up	n, Clayey Sa , low plastic counded gro o to 4-inch	AND	Grab 11: 34.1% Fines.
	130				Grab 12 Grab	0			SC	particle size below 128 f	eet.		Grab 13: 30.8% Fines.
480	135	- V	100		13 SC-12								
475	140				Grab 14	0							Grab 14: 66.1% Sand, 33.9% Fines.
	140	-								Moist, gray-brown, Poorly fine to medium sand, low			Core loss 140 to 145
4 70	145		75		Grab 15 SC-13	0			SP				feet.
	140		/3		JC-13) JF	Becomes orange-brown weakly cemented with fi gravel below 147 feet.			
		A - B	411 I F	NOTE	· ·	1 : :	; ;			L			NNA



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH05**

Sheet 5 of 7

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH05

Date(s) Drilled	0	4/13/2	2021 - 04/	15/202	21	Client	Jac	obs	Engineering Group	Method/ Sonia Drilling/Treak Mounted Coopraha 9150		
Coordinates	⁵ 7	7433	93.3 E, 65	9476.3	3 N	Geotechnical Consultant	Mc	Miller	Jacobs Associates	Method/ Sonic D Rig Type LS	rilling/Track Mounted Geoprobe 8150	
Surface Elevation	6	14.41	ft.			Drilling Contractor	West	tern Sta	tes Soil Conservation, Inc.	Hole Diameter 5.00	in	
Location	L	RWP	North Sta	ation 2		Logged by/ Checked by	K. E	Elliot	t, J. Fissel / J. Quinn	Hammer Type N/A		
ELEV. (FT) WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE	IETRATION SISTANCE WS/FT 0 30 40	USCS GRAPHIC	nscs	MATERIAL DESC	gardeles A - 12 de algunes A - 1	SAND CONTRACT STREET ST	
460 . 155		100		Grab 16 SC-14	Ο			SC	Wet, gray, Clayey SAND wito medium sand, fine subsubrounded gravel, low placettered cobbles. Encountered two 4-inch feet. Becomes orange-brown coarse, rounded, weakly at 153.5 feet.	angular and lasticity fines with cobbles at 152 with trace fine to	Grab 16: 16.3% Cobbles/Boulders, 22.8% Gravel, 39.3% Sand, 21.6% Fines.	
- 455 160 -				Grab 17	•				Moist, red-brown and gra (SC); fine to medium sand cemented regions. Becomes red-brown and cemented at 160 feet.	" scattered weakly	·· Grab 17: 24.7% Fines.	
450 165	5-	100		SC-15								
445 170) - 1			Grab 18 Grab 19	0			SC	Becomes gray-brown an cemented at 170 feet.	d weakly	Grab 19: 18.9% Fines.	
440 175	5 - 99	100		SC-16 Grab 20	0							
435	1											
			M NOTE	•	<u> </u>		14/	1			. AND	



NOTES

Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH05**

Sheet 6 of 7

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH05

Date(s) Drilled	0	4/13/	2021 - 04/·	15/202	21	Client	Jac	obs	Engineering Group	Final Depth 207.0	ft bgs	
Coordinate	s 7	7433	93.3 E, 65	9476.3	3 N	Geotechnical Consultant	Mc	Mille	n Jacobs Associates	Method/ Sonic Dri Rig Type LS	lling/Track Mounted Geoprobe 8	150
Surface Elevation	6	14.4	ft.			Drilling Contractor	West	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00 i	n	
Location	L	RWP	North Sta	tion 2	24+80	Logged by/ Checked by	K. E	Iliot	t, J. Fissel / J. Quinn	Hammer Type N/A		
ELEV. (FT) WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	IETRATION SISTANCE IWS/FT 0 30 40	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.
- - 430 185	5-	100		SC-17				SC	Moist, red-brown and gra (SC); fine to medium sand cemented regions.	,, scattered weakly		
- 425 _ 190				Grab 21	0			SC	Moist, red-brown and grader (SC); fine to coarse coarse subrounded gravel Encountered 8-inch base feet bgs. Moist, red-brown and grader SAND with Gravel (SP); me sand, coarse subrounded	sand, fine to , weakly cemented. alt cobble at 189 y, Poorly Graded edium to coarse	Grab 21: 27.9% Fines.	
420 195	5-								cemented regions.	,		
+ 415 200		100		Grab 22 SC-18	0			SP				
410 205	5-											
- - 1 405	-										Borehole completed at 207 feet below ground surface (bgs).	
	McN	/III I F	NOTE	S:						Boring	I RWP-BH05	



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH05**

Sheet 7 of 7

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

Date(s)			0004 044	40/000		Client				Final 050 4	7(1
Drilled Coordina	toc	28-701-20-90	2021 - 04/	STOR MERCEN CO.	3.00	Geotechnica	ı			— -р-и	ft bgs illing/Track Mounted Geoprobe 8150
	10000		45.7 E, 65	9520.6	6 N	Consultant	Mc	Miller	n Jacobs Associates	Rig Type LS	
Surface Elevation		685.1	ft.			Drilling Contractor	West	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00 i	n
Location		LRWP	North Sta	ation 2		Logged by/ Checked by	J. F	isse	I / K. Elliott	Hammer Type 140 lk	o / 30 in / Automatic
ELEV. (FT) WATER LEVEL	DEPTH (FT)	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLOV 10 20 10 WATEI (MC)	ETRATION ISTANCE WS/FT 30 40	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION	REMARKS AND TESTS STEEL/INSTALL.
- - - 681	5	100		SC-01 Grab	0			CL	Moist, brown, SILT with Sa Topsoil Moist, brown, Lean CLAY of Gravel (CL); medium to co subrounded gravel, low pl Residual Soil of the Sa Formation	with Sand and arse sand, fine asticity. pringwater ble at 5 feet.	
- 676 -	10	100	8-16-27 (N=43)	S-01 Grab 2	a -l				Medium dense to dense, Clayey SAND with Gravel (coarse sand, fine subangu gravel, low plasticity fines Less Weathered Sprin	SC-SM); fine to lar to subrounded	Grab 2: 28.5% Fines.
- 671 -	15-	100		SC-02				SC- SM			
- 666 - 2	20	100	10-13-15 (N=28)	S-02 Grab 3	0	•			Occasional small cobble feet.	s from 20 to 25	
661	25	100		SC-03 Grab 4			86 86 96 96 96	GC	Very dense, moist, gray, C Sand (GC); occasional cob subangular to subrounded coarse sand, weakly ceme Less Weathered Sprin	bles, fine to coarse d gravel, fine to ented.	Grab 4: 48.5% Gravel, 33.8% Sand, 17.7% Fines.
	N/Io	NAILLE	'N NOTE	· ·	<u> </u>	<u> </u>	(J) (A)	1			



Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

Date(s) Drilled		0	3/31/	2021 - 04/	12/202	21	Client Jacobs Engineering Group				According to the control of the cont	
Coordin		7	7438	45.7 E, 65	9520.6	S N	Geotechnical Consultant	McI	Miller	n Jacobs Associates	Method/ Sonic D Rig Type LS	rilling/Track Mounted Geoprobe 8150
Surface Elevatio		6	85.1	ft.			Drilling Contractor	West	ern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00	in
Location	1	L	RWP	North Sta	ation 2	7+59	Logged by/ Checked by	J. F	isse	I / K. Elliott	Hammer Type 140 I	b / 30 in / Automatic
ELEV. (FT) WATER LEVEL	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO' 10 20 O WATE (MC)	R CONTENT BERG LL/PL	USCS GRAPHIC	nscs	MATERIAL DESC	3000460 100000000000000000000000000000000	REMARKS DANA TESTS STEATH
651	35-		100	31-50/3" (Refusal)	S-03 Grab 5 SC-04	Ο				Very dense, moist, gray, C Sand (GC); occasional cob subangular to subrounded coarse sand, weakly ceme Less Weathered Sprin	bles, fine to coarse d gravel, fine to ented.	
646 - -	40-	- - - - - - - - -								Occasional cobbles up to 50 feet.	o 4-inches from 40	
- 641 - -	45-	-	133		SC-05				GC			
636 - -	50-	- (4)	100	20-50/3" (Refusal)	Grab 6 SC-06 S-04 Grab 7	0	•					Grab 7: 43.6% Gravel, 40.8% Sand, 15.6% Fines.
631 - -	55- -	-	100		SC-07					5-inch cobble at 55 feet. Very dense, moist, gray ar GRAVEL with Sand (GC); fi	nd brown, Clayey ne to coarse	
626	-	-	IIIIE	N NOTE					GC	angular to rounded gravel low plasticity fines. Less Weathered Sprin		



Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

Date(s Drilled)	0	3/31/	2021 - 04/	12/202	21	Client	Jac	obs	Engineering Group	Final Depth 250	.4 ft bgs
Coord	inates	7	7438	45.7 E, 65	9520.6	6 N	Geotechnical Consultant	Мс	Miller	n Jacobs Associates	Method/ Sonic Rig Type LS	Drilling/Track Mounted Geoprobe 8150
Surfac Elevat		6	85.1	ft.			Drilling Contractor	Wes	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00) in
Location	on	L	RWP	North Sta	ation 2		Logged by/ Checked by	J. F	isse	I / K. Elliott	Hammer Type 140	lb / 30 in / Automatic
ELEV. (FT)	DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO' 10 20 O WATE (MC)	ETRATION STANCE WS/FT 30 40	USCS GRAPHIC	USCS	MATERIAL DES	CRIPTION	REMARKS AND TESTS STEEL/INSTALL.
621	65-		100		Grab 8 SC-08	0			GC	Very dense, moist, gray ar GRAVEL with Sand (GC); fi angular to rounded gravel low plasticity fines. Less Weathered Sprin Encountered 6-inch cobb 68.5 feet.	ne to coarse , medium sand, gwater Formatio	n
	70-	- 1	100	50/3" (Refusal)	S-05 Grab 9		•			Very dense, moist, gray, P GRAVEL with Clay, Sand, a GC); fine to coarse angula gravel, fine to coarse sand Less Weathered Sprin Encountered 5-inch nest	nd Cobbles (GP- r to rounded l,. gwater Formatio	Grab 9: 34.7% Cobbles, 26.6% Gravel, 27.2% Sand, 11.5% Fines.
	75-	- <u> V </u> -	100		SC-09			000000000000000000000000000000000000000	GP- GC	72 to 75 feet.		
-	80 -	-								Very dense, moist, gray, C Sand (GC); fine to coarse coarse sand, high plasticit Less Weathered Sprin Encountered 4-inch cobb brown moderately ceme	gravel, medium to y fines. I gwater Formatio Oles in an olive-	0
601 - - - - 596	85	-	100		SC-10				GC	matrix from 81 to 88 fee		



Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH06

Date(Drille	s)	(3/31/	2021 - 04/	12/202	21	Client	Jac	cobs	Engineering Group	Final 250.4	ft bgs
Coord	dinate	es -	77438	45.7 E, 65	9520.6	6 N	Geotechnical Consultant	Mc	Mille	n Jacobs Associates		illing/Track Mounted Geoprobe 8150
Surfa Eleva		(85.1	ft.			Drilling Contractor	Wes	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00 i	n
Locat	ion	ı	RWP	North Sta	ation 2	7+59	Logged by/ Checked by	J. F	isse	I / K. Elliott	Hammer Type 140 lk	o / 30 in / Automatic
ELEV. (FT)	WATER LEVEL	SAMPLE TYPE		BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	ETRATION ISTANCE WS/FT 30 40	USCS GRAPHIC	USCS	MATERIAL DESC	2004 2011 - 100 2010 100000 2	REMARKS CANAMAN TESTS STREET
	9	5 -	100	50/5" (Refusal)	S-06 Grab 10 SC-11	0				Very dense, moist, brown GRAVEL with Sand and Co coarse subrounded gravel sand, high plasticity fines, inch particle size. Less Weathered Sprin	bbles (GC); fine to , fine to coarse cobbles up to 5-	
586	10	0			Grab 11				***************************************			Grab 11: 40.5% Gravel, 27.7% Sand, 31.8% Fines.
581 576	10	5-	85		SC-12				GC			
-	11	0	100	50/4" (Refusal)	S-07		•			Becomes weakly cement 135 feet.	ted from 110 to	
571 - - - 566	11:	5 -	100		SC-13					Occasional cobbles up to size below 114 feet.	5-inch particle	
		-						QX)	1			



NOTES:

Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH06**

Sheet 4 of 9

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

Date(0	3/31/	2021 - 04/	12/202	21	Client	Jac	obs	Engineering Group	Final Depth 250.4 ft bgs		
Coord	dinate	es 7	7438	45.7 E, 65	9520.6	6 N	Geotechnica Consultant	Мс	Miller	n Jacobs Associates	Method/ Sonic Dri Rig Type LS	illing/Track Mounted Geoprobe 8150	
Surfa Eleva		6	85.1	ft.			Drilling Contractor	Wes	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00 is	n	
Locat	ion	L	RWP	North Sta	ation 2	N N N	Logged by/ Checked by	J. F	isse	I / K. Elliott	Hammer Type 140 lb	/ 30 in / Automatic	
ELEV. (FT)	WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	R CONTENT BERG LL/PL	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION	REMARKS AND TESTS SACKFILL/INSTALL.	
	129	5-	90		SC-14 Grab 12				GC	Very dense, moist, brown GRAVEL with Sand and Co coarse subrounded gravel sand, high plasticity fines, inch particle size. Less Weathered Sprin Large nested cobbles fro feet.	bbles (GC); fine to , fine to coarse cobbles up to 5-	Grab 12: 17.7% Cobbles, 23.8% Gravel,	
- - - 551 -	13		100	50/4" (Refusal)	S-08					Very dense, moist, orange brown, Silty GRAVEL (GM)		32.7% Sand, 25.8% Fines.	
- 546	14	-							GM	gravel, completely weather vesicular lava. Residual Soil of Borin	ered angular g Lava		
541 - - - - -	14:		100		SC-16					BASALT: gray, highly weath closely-spaced joints. Boring Lava	nered, vesicular,		



Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH06

Date(Drille	s) d	0	3/31/	2021 - 04/	12/202	21	Client	Jac	obs	Engineering Group	Final 250.4	ft bgs
	dinates	7	7438	45.7 E, 65	9520.6	6 N	Geotechnical Consultant	Mc	Miller	Jacobs Associates	Method/ Sonic Dr Rig Type LS	illing/Track Mounted Geoprobe 8150
Surfa Eleva	tion	6	85.1	ft.			Drilling Contractor	West	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00 i	n
Locat	ion	L	RWP	North Sta	(A)		Logged by/ Checked by	J. F	issel	/ K. Elliott	Hammer Type 140 lk	/ 30 in / Automatic
ELEV. (FT)	WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 WATE (MC)	ETRATION ISTANCE WS/FT 30 40 R CONTENT BERG LL/PL 60 80	USCS GRAPHIC	USCS	MATERIAL DESC	3503600 - 5003948395500	REMARKS AND TESTS TESTS
531	155		100	50/1" (Refusal)	S-09					BASALT: gray, highly weath closely-spaced joints. Boring Lava	nered, vesicular,	Unconfined Compressive Strength on sample from 154 to 155 feet = 7,579 psi.
526	160											
521	165		100		SC-18					Voru donce maist graven	nd brown Clavov	
516 - -	170	-							GC	Very dense, moist, gray ar GRAVEL with Sand (GC); fi high plasticity fines, grave weathered vesicular basal Weathered Boring Lav Very dense, moist, gray, b brown, Silty GRAVEL with subrounded gravel, mediu	ne to coarse gravel, I consists of highly It. va rown and yellow- Sand (GM); coarse	Grab 13: 14.1%
511 - - - 506	175		100		Grab 13 SC-19				GM	low plasticity fines, gray vecobbles up to 5-inches in Troutdale Formation	esicular basalt	Cobbles, 37.9% Gravel, 23.1% Sand, 24.9% Fines.
		111	/III I E	M NOTE		<u> </u>	: :	Y N	1	<u> </u>		



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH06**

Sheet 6 of 9

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH06

Date(s) Drilled	03/3	31/2021 - 04	/12/202	1	Geotechnical					Final Depth 250.4 ft bgs Method/ Sonic Drilling/Track Mounted Geoprobe 8150		
Coordinates	774	3845.7 E, 65	9520.6	N	Geotechnical Consultant	Мс	Miller	Jacobs Associates	Method/ Rig Type	Sonic Dri LS	Illing/Track Mounted Geoprobe 8	3150
Surface Elevation	685	.1 ft.			Drilling Contractor	West	tern Sta	tes Soil Conservation, Inc.	Hole Diameter	5.00 ii	n	
Location	LRV	VP North St	ation 27	7+59	Logged by/ Checked by	J. F	issel	/ K. Elliott	Hammer Type	140 lb	/ 30 in / Automatic	
ELEV. (FT) WATER LEVEL DEPTH (FT)	SAMPLE TYPE		SAMP	RES BLO 10 20 O WATE (MC)	R CONTENT BERG LL/PL	USCS GRAPHIC	USCS	MATERIAL DESC	98-376-5 12/20/00/20/20/20 B		REMARKS AND TESTS	BACKFILL/INSTALL.
501 -	10	(Refusal)	S-10 Grab 14		Ic		SM	Very dense, moist, gray, Si some medium sand, high cobbles of vesicular lava u	plasticity fin p to 4-inche rown and gra m sand., we	es, es. ey, Silty	Grab 14: 28.6% Fines. Liquid Limit = 113.	
496 -	10	0 50/6" (Refusal)	Grab 15 S-11	0	•		SM	Very dense, moist, gray, Si Gravel (SM); fine to coarse coarse subrounded gravel fines, weakly cemented re Troutdale Formation	e sand, fine t , high plastic	to	Grab 15: 19.2% Fines. Grab 16: 33.4% Gravel,	
491 - . 195- 	90	0	Grab 16 SC-21					Very dense, moist, red-bro SAND (SM); trace fine and subrounded gravel, fine to high plasticity fines, weakl Troutdale Formation	l coarse o medium sa	nd,	36.8% Sand, 30.1% Fines.	
486 - - 200 - 	10	00 16-30-50/ 6" (Refusal)	Grab 17 S-12	Φ	-1 ,		SM	Encountered a 4 inch col	bble at 202 j	feet.	Grab 17: 32.5% Fines.	
481 - - 205 - 	9:	5	SC-22					Large cobble at 207 feet				
476 -	OMII	IEM NOT	ES:							•	I DWD DU06	



Location and Elevation Source: 90% Drawings
Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH06

Sheet 7 of 9

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH06

Date(s Drilled	5)	0	3/31/	2021 - 04/	12/202	21	Client	cobs	Engineering Group	Final Depth 250.4 ft bgs				
Coord	inates	7	7438	45.7 E, 65	9520.6	S N	Geotechnical Consultant	Mo	Mille	Jacobs Associates	Method/ Sonic Drilling/Track Mounted Geoprobe 8150 Rig Type LS			
Surfac Elevat		6	85.1	ft.			Drilling Contractor	Wes	stern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00 in			
Location	on	L	RWP	North Sta	ation 2		Logged by/ Checked by	J.	Fisse	I / K. Elliott	Hammer Type 1	40 lb	/ 30 in / Automatic	
ELEV. (FT)	VALIER LEVEL DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	RES BLO' 10 20 O WATE (MC)	ETRATION STANCE WS/FT 30 40 R CONTENT BERG LL/PL 60 80	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION		REMARKS AND TESTS	BACKFILL/INSTALL.
471	215		100	50/5" (Refusal)	S-13					Very dense, moist, red-bro SAND (SM); trace fine and subrounded gravel, fine to high plasticity fines, weak Troutdale Formation	l coarse o medium sand ly cemented.			
- -461 -	225	-							SM					
- -456 - -	230	X	100	15-29-50/ 5" (Refusal)	Grab 18 S-14								Grab 18: 1% Gravel, 70.2% Sand, 28.7% Fines.	
- 451 - -	235	-	75		SC-24									
446		-												
	III N	/Icl	HILE	NOTE	S:						Davi		I DIMD DHUE	



Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR Project Number: 6218.0

Log of Boring

LRWP-BH06

Date(s	5) 1	0	3/31/	2021 - 04/	12/202	21	Client	Jac	obs	Engineering Group	Final Depth 250.4 ft bgs			
Coord	linates	7	7438	45.7 E, 65	9520.6	6 N	Geotechnica Consultant	Mc	Mille	n Jacobs Associates	Method/ Sonic Drilling/Track Mounted Geoprobe 8150 Rig Type LS			
Surface Elevat		6	85.1	ft.			Drilling Contractor	Wes	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 5.00 in			
Locati	LRWP North Station 27+59						Logged by/ Checked by	J. F	isse	I / K. Elliott	Hammer Type 140 lb / 30 in / Automatic			
ELEV. (FT)	WAIEK LEVEL DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO' 10 20 O WATE (MC)	R CONTENT	USCS GRAPHIC	USCS	MATERIAL DES		REMARKS AND TESTS	BACKFILL/INSTALL.	
- - - 441 -	245								SM	Very dense, moist, red-br SAND (SM); trace fine and subrounded gravel, fine to high plasticity fines, weak Troutdale Formation Encountered >7-inch col 245 feet.	d coarse o medium sand, dy cemented.			
- 436 -	250	-	100	50/5"	SC-25 S-15							9 Ki		
- -431	255			(Refusal)								Borehole completed at 250.42 feet below ground surface (bgs).		
- 426 - -	260							-						
421	265							-						
- 416		- - -		'M NOTE				-						



NOTES

Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH06**

Sheet 9 of 9

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH07

Date(s) Drilled	11/16/2021 - 11/30/2021	Client Jac	cobs	Engineering Group	Final Depth 232.0 ft bgs			
Coordinates	7742874.8 E, 659436.9 N	Geotechnical Consultant Mc	Miller	Jacobs Associates	Method/ Mud Rotary and HQ Wireline/CME 850 Track Rig Type Mounted			
Surface Elevation	707.5 ft.	Drilling Contractor Wes	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 4.00 in			
Location	LRWP North Station 29+98	Logged by/ Checked by K. I	Elliot	t, A. Judy / K. Elliott	Hammer Type 140 lb	/ 30 in / Automatic		
ELEV. (FT) WATER LEVEL DEPTH (FT)	BLOW COUNTS IN THE NUMBE IN THE	R CONTENT SS	USCS	MATERIAL DESC		REMARKS AND TESTS SACKFILL/INSTALL.		
			CL	Moist, dark brown, Lean C Topsoil Moist CLAY (CL); low plast Residual Soil of the S Formation	icity.	Material description from 0.5 to 90.0 feet is inferred from drilling action.		
698 - - 10-				Medium dense to very de graded GRAVEL with Clay low plasticity fines, fine to to coarse gravel with occa scattered boulders. Less Weathered Sprin	and Sand (GP-GC); coarse sand, fine sional cobbles and	Drill rod chatter from 7 to 7.5 feet. Drill rod chatter from 10 to 10.5 feet.		
693 - - - - - - -								
688 - - - - - -			GP- GC					
683 - 25-			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \					
678 -	NOTE:	0/5						
	CMILIFN NOTES:				Darina			



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH07**

Sheet 1 of 15

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH07

Date(s	5)		441401	2024 44"	20/202	4	Client	1-	! !	Fu min a a min m C	Final 000 0	ft b are	- 8	
Drilled Coord	1		AND THE PARTY	2021 - 11/3			Geotechnical				Final Depth 232.0 ft bgs Method/ Mud Rotary and HQ Wireline/CME 850 Track			
Control Section Control	ACCUS NO			74.8 E, 65	9436.9	9 N	Consultant	Мс	Miller	Jacobs Associates	Rig Type Mounted			
Surface Elevat	tion		707.5	ft.			Drilling Contractor	Wes	tern Sta	tes Soil Conservation, Inc.	Hole Diameter 4.00 in			
Locati	on		LRWP	North Sta	ation 2		Logged by/ Checked by	K. I	Elliot	t, A. Judy / K. Elliott	Hammer Type 140 lk	/ 30 in / Automatic		
ELEV. (FT)	WAIER LEVEL	SAMPI F TYPE	RECOVERY (%)	BLOW COUNTS	SAMPLE NUMBER	RESI BLOV 10 20 O WATEI (MC)	ETRATION STANCE WS/FT 30 40	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.	
	35									Medium dense to very de graded GRAVEL with Clay low plasticity fines, fine to to coarse gravel with occa scattered boulders. Less Weathered Sprin	and Sand (GP-GC); coarse sand, fine sional cobbles and	Strong drill rod chatter at 34 feet.		
668	4()-												
663	45	5-							GP- GC			Strong drill rod chatter at 45 feet.		
- 658 -	50)-										Strong drill rod chatter		
- 653 -	55							000000000000000000000000000000000000000				from 52 to 63 feet.		
		-						000						
648		1	MILLE	'N NOTE	· ·				1			L DWD DU07		



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH07**

Sheet 2 of 15

Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH07

Date(s) Drilled	11/16/2021 - 11/30/2021	Client Jacobs	Engineering Group	Final Depth 232.0			
Coordinates	7742874.8 E, 659436.9 N	Geotechnical Consultant McMille	n Jacobs Associates	Method/ Mud Rota Rig Type Mounted	Method/ Mud Rotary and HQ Wireline/CME 850 Track Rig Type Mounted		
Surface Elevation	707.5 ft.	Drilling Contractor Western S	tates Soil Conservation, Inc.	Hole Diameter 4.00 in			
Location	LRWP North Station 29+98	Logged by/ Checked by K. Ellio	tt, A. Judy / K. Elliott	Hammer	/ 30 in / Automatic		
ELEV. (FT) WATER LEVEL DEPTH (FT)	BLOW COUNTS BLOW COUNTS	R CONTENT SS	MATERIAL DESC	CRIPTION	REMARKS CANADAS TESTS STEEL/INSTALL.		
643 -			Medium dense to very de graded GRAVEL with Clay low plasticity fines, fine to to coarse gravel with occascattered boulders. Less Weathered Sprin	and Sand (GP-GC); coarse sand, fine sional cobbles and			
638 - 70-							
633 75-		GP- GC					
628 - 80		000000000000000000000000000000000000000			Very strong drill rod chatter from 80 to 85 feet.		
623 - 85- 							
- 10	oMILLEN NOTES:						



NOTES:

Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH07**

Sheet 3 of 15

Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR Project Number: 6218.0 Date(s) Project 11/16/2021 - 11/30/2021 Client Jacobs Engineering Group

Log of Boring

LRWP-BH07

232 0 ft has

Drilled	A	/16/2	2021 - 11/3	30/202	21	Cilcii	Jac	obs	Engineering Group	Depth 232.0 ft bgs			
Coordinates	77	4287	74.8 E, 65	9436.9	N	Geotechnical Consultant	Мс	Miller	Jacobs Associates	Method/ Mud Rotary and HQ Wireline/CME 850 Track Rig Type Mounted			
Surface Elevation	70	7.5 f	t.			Drilling Contractor	Wes	tern Sta	ates Soil Conservation, Inc.	Hole Diameter 4.00 in			
Location	LRWP North Station 29+98					Logged by/ Checked by	K. I	Elliot	t, A. Judy / K. Elliott	Hammer Type 140 lk	/ 30 in / Automatic		
ELEV. (FT) WATER LEVEL DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RESI BLOV 10 20 O WATEI (MC)	ETRATION STANCE WS/FT 30 40 R CONTENT BERG LL/PL	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION	REMARKS AND TESTS	BACKFILL/INSTALL.	
613 95	-	100	50/2" (Refusal)	S-01					Very dense, moist, dark gr GRAVEL with Clay and San plasticity fines, fine to coa coarse angular to subroun occasional cobbles and bo bound by low plasticity fir Less Weathered Sprin	nd (GP-GC); low arse sand, fine to aded gravel with oulders; weakly nes.	Moderate drill rod chatter from 90 to 95 feet.		
608 100 - -		100	50/3" (Refusal)	S-02		•							
603 105	-						900000000000000000000000000000000000000	GP- GC					
598 110 - -	1	132	50/3" (Refusal)	S-03									
593 115 - - - 588													



Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH07

Date Drille	(s)	1	1/16/	2021 - 11/3	30/202	1	Client	Jac	obs	Engineering Group	Final Depth 232.0 ft bgs			
Coor	7742874.8 E, 659436.9 N					N	Geotechnical Consultant McMillen Jacobs Associates				Method/ Mud Rotary and HQ Wireline/CME 850 Track Rig Type Mounted			
Surfa Eleva	ace ation	7	07.5	ft.			Drilling Contractor Western States Soil Conservation, Inc.				Hole Diameter 4.00 i	n		
Loca	tion	L	RWP	North Sta	ation 2	29+98	Logged by/ Checked by	K. I	Elliot	t, A. Judy / K. Elliott	Hammer Type 140 lk	o / 30 in / Automatic		
ELEV. (FT)	WATER LEVEL	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RES BLO 10 20 O WATE (MC)	ETRATION SISTANCE WS/FT	USCS GRAPHIC	USCS	MATERIAL DESC	CRIPTION	REMARKS AND TESTS		
583 - - 578 -	125		26	50/15" (Refusal) 50/2" (Refusal)	S-04					Very dense, moist, dark gr GRAVEL with Clay and Sar plasticity fines, fine to coa coarse angular to subrour occasional cobbles and be bound by low plasticity fir Less Weathered Sprin	nd (GP-GC); low burse sand, fine to nded gravel with bulders; weakly nes. ngwater Formation			
573	135	5-							GP- GC					
568 - - - 563 -	140		32	50/3" (Refusal)	S-06					Becomes yellow-brown.				
		-												



NOTES:

Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH07**

Sheet 5 of 15

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Drilled Geotechnical Mud Rotary and HQ Wireline/CME 850 Track Mounted Method/ Coordinates 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Rig Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Diameter ocation Logged by/ Hammer LRWP North Station 29+98 K. Elliott, A. Judy / K. Elliott 140 lb / 30 in / Automatic Checked by PENETRATION SAMPLE NUMBER BACKFILL/INSTALL. RESISTANCE **USCS GRAPHIC** RECOVERY (%) SAMPLE TYPE WATER LEVE BLOWS/FT DEPTH (FT) BLOW REMARKS 20 30 40 USCS MATERIAL DESCRIPTION AND WATER CONTENT 0 **TESTS** ATTERBERG LL/PL 20 40 60 80 68 50/3" S-07 Very dense, moist, dark gray, poorly graded (Refusal) GRAVEL with Clay and Sand (GP-GC); low 151.6 ft.: switched to GC plasticity fines, fine to coarse sand, fine to HQ coring - 2-3/8" ID coarse angular to subrounded gravel with occasional cobbles and boulders; weakly bound by low plasticity fines. **Less Weathered Springwater Formation** 553 155 Log continued on next page.



NOTES:

Location and Elevation Source: 90% Drawings
Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH07

Sheet 6 of 15

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 Date(s) 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Depth Drilled Geotechnical Coordinates Method/ Mud Rotary and HQ Wireline/CME 850 Track 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Riq Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Hammer ocation Logged by/ LRWP North Station 29+98 K. Elliott, A. Judy / K. Elliott 140 lb / 30 in / Automatic DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE WATER LVL DEPTH (FT) Roughness ROD nclination MATERIAL DESCRIPTION AND Aperture SRAPHIC Amount **TESTS** Shape nfill 150 Log continued from previous page. Lost approx. 1,800 gal. BASALT; moderately strong to strong, slightly 46 32 R-1 R PL Fe Ctg 0 J Ν of drilling fluid between weathered to fresh, highly fractured, dark R U Ctg M Fe/ 151.6 and 180 feet. gray. Joint surfaces are planar to undulating, MB Si W rough, and iron oxide stained. Common joint sets occur between 0 and 15 degrees and at +/- 60 degrees with apertures between 2 and MB ЩЩ3mm. Fe R C Ctg 30 J Ν Except as noted below, basalt is 5% to 20% Grab 1: Unconfined Grab 1 Compressive Strength = vesicular throughout. 2,045 psi; [Boring Lava] Dry Density= 150.8 pcf. Core Loss: 153.8 to 157.5 feet. -553 155 80 58 R-2 156.6 ft.:Becomes residual soil from 156.6 to 157.2 feet. PL Ctg 60 R Ν Fe MB MB Grab 2 MB -548 **Boring LRWP-BH07** Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Sheet 7 of 15 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 Date(s) 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Depth Drilled Geotechnical Coordinates Method/ Mud Rotary and HQ Wireline/CME 850 Track 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Riq Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter ocation Logged by/ Hammer LRWP North Station 29+98 K. Elliott, A. Judy / K. Elliott 140 lb / 30 in / Automatic DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE **WATER LVL** DEPTH (FT) Roughness nclination MATERIAL DESCRIPTION AND ROD Aperture Amount **TESTS** Shape nfill nfill 160 BASALT; moderately strong to strong, slightly weathered to fresh, highly fractured, dark gray. Joint surfaces are planar to undulating, rough, and iron oxide stained. Common joint PL VN U Ctg 20 R sets occur between 0 and 15 degrees and at R PL Ν Fe Ctg 40 +/- 60 degrees with apertures between 2 and Ctg J R PL Ν Fe 0 13mm. PL R N. .Fe Ctg Ω. Except as noted below, basalt is 5% to 20% 98 58 R-3 R C J N vesicular throughout. [Boring Lava] VR IR Ν Fe Ctg 0 R U W Fe Ctg 10 Grab 3 VR IR F W Ctg VR IR W CL Fi MB MB -543 Grab 4 Grab 4: Unconfined MB Compressive Strength = 4,924 psi; 165 Dry Density= 139.7 pcf. Ctg 60 R C Ν Fe VR ST VN Fe Ctg 10 VR ST Ν Ctg 0 Fe 84 76 R-4 VR IR F Ctg 0 J VR ST Fe Ctg 0 MB J R U Ν Fe Ctg 60 J R U Fe Ctg 20 М W Grab 5 MB MB PL VN 55 VR U Ctg Ctg R PL M Fe J W -538 MB Boring LRWP-BH07 Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Sheet 8 of 15

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 Date(s) 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Depth Drilled Geotechnical Coordinates Method/ Mud Rotary and HQ Wireline/CME 850 Track 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Riq Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Logged by/ ocation Hammer LRWP North Station 29+98 K. Elliott, A. Judy / K. Elliott 140 lb / 30 in / Automatic DISCONTINUITIES SAMPLE TYPE 8 REMARKS RECOVERY SAMPLE **WATER LVL** DEPTH (FT) Roughness nclination MATERIAL DESCRIPTION AND Aperture Amount **TESTS** Shape nfill nfill BASALT; moderately strong to strong, slightly 170 weathered to fresh, highly fractured, dark gray. Joint surfaces are planar to undulating, Grab 6 rough, and iron oxide stained. Common joint MB sets occur between 0 and 15 degrees and at +/- 60 degrees with apertures between 2 and MB Except as noted below, basalt is 5% to 20% 100 48 R-5 vesicular throughout. ST Ν Ctg 0 ı Ν Fe [Boring Lava] Grab 7: Unconfined MB Grab 7 Compressive Strength = 6,182 psi; Dry Density = 158.6 pcf. R C VN Fe Ctg 10 Grab 8 -533 MB R PL VN Fe Ctg 10 175 C VN U Ctg 10 R IR Ν Ctg 35 VR ST VN Ctg 15 VR PL VN Fe Ctg 15 Ctg Fe R PL VN 15 PL R VN Fe Ctg 10 MB 100 70 R-6 VR PL HF Fe Fi 80 Ctg VR IR Fe 10 Ctg VR IR Fe 10 VR IR Fe Ctg 10 Grab 9 VR PL 35 W J Fe Ctg 178.5 - 181.0 ft.:Slightly vesicular, moderately weathered. VR PL 10 W Fe Ctg -528 179.8 ft.:Irregular vertical joint, heavily iron VR Fe Ctg 90 U Ν stained, vesicular, aperture 1-2 mm, trace clay. **Boring LRWP-BH07** Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Sheet 9 of 15

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 Date(s) 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Depth Drilled Geotechnical Coordinates Method/ Mud Rotary and HQ Wireline/CME 850 Track 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Ria Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Logged by/ ocation Hammer LRWP North Station 29+98 K. Elliott, A. Judy / K. Elliott 140 lb / 30 in / Automatic DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE WATER LVL DEPTH (FT) Roughness nclination MATERIAL DESCRIPTION AND ROD Aperture **TESTS** Shape nfill nfill BASALT; moderately strong to strong, slightly Lost approx. 1,500 gal. 180 weathered to fresh, highly fractured, dark of drilling fluid at 180 gray. Joint surfaces are planar to undulating, rough, and iron oxide stained. Common joint VR PLVN Ctg 60 Fe sets occur between 0 and 15 degrees and at +/- 60 degrees with apertures between 2 and Except as noted below, basalt is 5% to 20% Run R-7: HQ coring bit MB W PL Fe Ctg 45 100 100 R-7 W blocked off in clay. vesicular throughout. [Boring Lava] 180.0 ft.:Common joint sets occur between 5 Run R-8: HQ coring bit MB 100 50 R-8 and 35 degrees and between 60 and 70 blocked off in clay and degrees below 180 feet. Fe J VR C W Ctg 0 sand. 182.0 - 190.0 ft.:Fresh. J R C T 5 Grab MB 100 0 10 MB R-9 183.5 - 189.0 ft.: No vesicles. MB Grab 94 91 Run R-10: Drilling fluid 11 partially returns. R-10 -523 VN Ctg 20 Grab 12: Unconfined J Fe Grab Compressive Strength = 12 185 11,570 psi; Dry Density= 163.9 pcf. MB R PL Ctg 40 Fe **Drilling fluid fully** MB 100 70 R-11 returns below 187.0 feet. MB PL W Ctg 70 R Fe PL -518 R Ν Fe Ctg 20 VR IR 15 VN Fe Ctg

Location and Elevation Source: 90% Drawings

Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH07

Sheet 10 of 15

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 Date(s) 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Depth Drilled Geotechnical Coordinates Method/ Mud Rotary and HQ Wireline/CME 850 Track 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Riq Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Logged by/ ocation Hammer LRWP North Station 29+98 K. Elliott, A. Judy / K. Elliott 140 lb / 30 in / Automatic DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE **WATER LVL** DEPTH (FT) Roughness nclination MATERIAL DESCRIPTION AND ROD Aperture Amount **TESTS** Shape nfill Grab MB BASALT; moderately strong to strong, slightly Grab 13: Unconfined 190 13 weathered to fresh, highly fractured, dark Compressive Strength = gray. Joint surfaces are planar to undulating, 3,018 psi; rough, and iron oxide stained. Common joint Dry Density = 120.4 pcf. MB sets occur between 0 and 15 degrees and at VR IR Ν Fe Ctg 30 +/- 60 degrees with apertures between 2 and Except as noted below, basalt is 5% to 20% MB vesicular throughout. MB [Boring Lava] 100 78 R-12 190.0 ft.: Vesicular, moderately weathered. 192.5 - 195.0 ft.: No vesicles. PL Ctg 15 Fe R VN Grab 14 PL SR Ctg 25 SR PL Fe Ctg -513 MB 195 PL J R 25 VR C Fe Ctg 25 W 195.5 - 197.2 ft.:Open 25 mm wide horizontal joint with heavy iron stain. Grab 15: Unconfined Grab Compressive Strength = 15 2,446 psi; MB Dry Density = 123.5 pcf. MB 100 42 R-13 MB PL Fe R Ν Ctg 0 PL 80 R Ν Fe Ctg Grab Ctg R PL Ν Fe 0 16 PL R Ν Fe Ctg 0 R PL Ctg 5 Fe Ν Grab Ctg R PL Fe 0 Ν 17 PL Ctg R Fe 0 J Ν 508 PL R 1 Fe Ctg 0 **Boring LRWP-BH07** Location and Elevation Source: 90% Drawings

Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 Date(s) 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Depth Drilled Geotechnical Coordinates Method/ Mud Rotary and HQ Wireline/CME 850 Track 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Riq Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter ocation Logged by/ Hammer LRWP North Station 29+98 140 lb / 30 in / Automatic K. Elliott, A. Judy / K. Elliott DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE **WATER LVL** DEPTH (FT) Roughness ROD nclination MATERIAL DESCRIPTION AND Aperture Amount **TESTS** Shape Infill PL R J Fe Ctg BASALT; moderately strong to strong, slightly 200 MB weathered to fresh, highly fractured, dark MB gray. Joint surfaces are planar to undulating, MB rough, and iron oxide stained. Common joint sets occur between 0 and 15 degrees and at +/- 60 degrees with apertures between 2 and VR ST VN Ctg 10 J Fe Grab C VN Ctg 20 R Fe 18 Except as noted below, basalt is 5% to 20% esicular throughout. RQD calculations were Boring Lava 91 R-14 omitted for this CONGLOMERATE; weak, moderately to highly intermediate weathered, massive; fresh, hard gravel and geotechnical material cobbles in an orange-brown silty sand matrix; (IGM). largest clasts tend to be vesicular, subangular, The conglomerate and occur near the basalt contact and grade matrix material is finer and rounder with depth. Grab largely washed out [Troutdale Formation] 19 above about 213.0 feet. -503 Grab 205 20 Grab 21 67 R-15 Grab 22 498 **Boring LRWP-BH07** Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Sheet 12 of 15

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 Date(s) 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Depth Drilled Geotechnical Coordinates Method/ Mud Rotary and HQ Wireline/CME 850 Track 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Riq Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Hammer ocation Logged by/ LRWP North Station 29+98 140 lb / 30 in / Automatic K. Elliott, A. Judy / K. Elliott DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE WATER LVL DEPTH (FT) Roughness nclination ROD MATERIAL DESCRIPTION AND Aperture GRAPHIC Amount **TESTS** Shape Infill III Grab CONGLOMERATE; weak, moderately to highly 210 23 weathered, massive; fresh, hard gravel and cobbles in an orange-brown silty sand matrix; largest clasts tend to be vesicular, subangular, and occur near the basalt contact and grade finer and rounder with depth. [Troutdale Formation] 76 R-16 493 215 Grab 24: Unconfined 100 SANDSTONE; weak, moderately to highly Grab Compressive Strength = weathered, massive, orange-brown, with 24 731 psi; R-17 occasional fine to coarse gravel, few cobbles; Dry Density = 89.0 pcf. gravel clasts are fresh, hard, fine to coarse, subrounded to rounded of basaltic composition. [Troutdale Formation] 488 **Boring LRWP-BH07** Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Sheet 13 of 15

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Log of Boring

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 Date(s) 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Depth Drilled Geotechnical Coordinates Method/ Mud Rotary and HQ Wireline/CME 850 Track 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Riq Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Hammer ocation Logged by/ LRWP North Station 29+98 140 lb / 30 in / Automatic K. Elliott, A. Judy / K. Elliott DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE WATER LVL DEPTH (FT) Roughness nclination ROD MATERIAL DESCRIPTION AND GRAPHIC Aperture Amount **TESTS** Shape Infill ufill SANDSTONE; weak, moderately to highly 220 weathered, massive, orange-brown, with occasional fine to coarse gravel, few cobbles; gravel clasts are fresh, hard, fine to coarse, Grab 25: Unconfined Grab subrounded to rounded of basaltic Compressive Strength = 25 composition. 253 psi; [Troutdale Formation] Dry Density = 101.4 pcf. 74 R-18 483 Grab 26: 0.4% Gravel, 225 Grab 94.6% Sand, 5.0% Fines. 26 100 R-19 -478 Grab 27: 0.1% Gravel. Grab 99.4% Sand, 0.5% Fines. **Boring LRWP-BH07** Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Sheet 14 of 15 Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH07 Project Number: 6218.0 Date(s) 11/16/2021 - 11/30/2021 Jacobs Engineering Group 232.0 ft bgs Depth Drilled Geotechnical Coordinates Method/ Mud Rotary and HQ Wireline/CME 850 Track 7742874.8 E, 659436.9 N McMillen Jacobs Associates Consultant Riq Type Surface Drilling Hole 707.5 ft. 4.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Hammer ocation Logged by/ LRWP North Station 29+98 140 lb / 30 in / Automatic K. Elliott, A. Judy / K. Elliott DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE WATER LVL DEPTH (FT) Roughness nclination MATERIAL DESCRIPTION AND ROD GRAPHIC Aperture Amount **TESTS** Shape Infill Infil 27 SANDSTONE; weak, moderately to highly 230 weathered, massive, orange-brown, with occasional fine to coarse gravel, few cobbles; gravel clasts are fresh, hard, fine to coarse, subrounded to rounded of basaltic composition. [Troutdale Formation] Borehole completed at 232 feet below ground surface (bgs). -473 235 -468 **Boring LRWP-BH07** Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

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Project Location: Multnomah County, OR

Project Number: 6218.0

Log of Boring

LRWP-BH08

Date(s) Drilled	12	2/02/2	021 - 12/	16/202	21	Geotechnical Management Group					Final Depth 251.6 ft bgs		
Coordinates	7742647.7 E, 659429.9 N						M	lcN	liller	Jacobs Associates	Method/ Rig Type Mud Rotary/CME 850 Track Mounted		
Surface Elevation	7	15.2 f			Drilling Contractor Western States Soil Conservation, Inc.					Hole Diameter 5.00 in			
Location	L	RWP	North Sta	ation 3		Logged by/ Checked by	A.	Ju	dy, K.	Elliott / K. Elliott, J. Fissel	Hammer Type 1	40 lb	/ 30 in / Automatic
ELEV. (FT) WATER LEVEL DEPTH (FT)	SAMPLE TYPE	RECOVERY (%)	BLOW	SAMPLE NUMBER	RESI BLOV 10 20 O WATEI (MC)	R CONTENT BERG LL/PL	USCS GRAPHIC		USCS	MATERIAL DES			REMARKS AND TESTS BACKFILL/INSTALL.
- - - -711 - 5	X	87	2-4-4 (N=8)	S-01	a 0				ML	Medium stiff to stiff, mois (ML); low plasticity, trace black mottles. Residual Soil of the S Formation	fine sand, trace		
- - -706 - 10 -		100	3-5-6 (N=11)	S-02	■.Φ	1							
-701 . 15		100	2-3-2 (N=5)	S-03		0				Medium stiff, moist, orang and black mottles, Sandy high plasticity, fine to med Sensitive Saprolite of Formation Becomes wet at 16.0 fee	Elastic SILT (MIdium sand.	1);	S-03: 58.5% Fines. SH-01: 300 psi from
696 . 20	X	118	2-1-2 (N=3)	SH-01 S-04a /b		- 4				Becomes soft at 18.5 fee	et.		16.5-17.5 ft, 450 psi from 17.5-18.5 feet.
- 691 _ 25 - - -		100	1-2-3 (N=5)	S-05		O			МН	Becomes medium stiff a	t 25.0 feet.		



Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Drilled Geotechnical Method/ Coordinates 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Rig Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Diameter Elevation ocation Logged by/ Hammer LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel Type PENETRATION SAMPLE NUMBER BACKFILL/INSTALL. RESISTANCE **USCS GRAPHIC** RECOVERY (%) SAMPLE TYPE WATER LEVEL BLOWS/FT DEPTH (FT) BLOW REMARKS 20 30 40 USCS MATERIAL DESCRIPTION AND WATER CONTENT 0 **TESTS** ATTERBERG LL/PL 40 60 80 Medium stiff, moist, orange with red, brown, A portion of Sample 100 2-3-2 S-06 4 and black mottles, Sandy Elastic SILT (MH); S-06 is light gray with a (N=5)high plasticity, fine to medium sand. speckled texture; 213 SH-02 Sensitive Saprolite of the Springwater appears to be volcanic Formation ash. Very dense, wet, light brown and green-gray, SH-02: 450 psi from Ø, 60 681 poorly graded GRAVEL with Clay and Sand 31.5 to 32.25 feet, (GP-GC); fine to coarse, subangular to unable to push beyond 35 O. angular gravel, fine to coarse sand, medium 32.25 feet. 47 46-37-26 S-07 plasticity fines. (N=63)**Less Weathered Springwater Formation** Fines may be senstive in sample S-07 at 0 35.0 feet. 676 0 60 40 GP-00 GC O. 45 🗶 100 50/4" S-08 00) (Refusal) þ 666 ď. 50 (d) Very dense, wet, light brown and gray, poorly graded GRAVEL with Silt and Sand (GP-GM); 000 661 fine to coarse subrounded gravel, fine to 55 ୍ଦ ଓ coarse sand, non-plastic fines. 157 39-50/4" S-09 **Less Weathered Springwater Formation** (Refusal) GP-GM



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Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH08

Log of Boring Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Drilled Depth Geotechnical Method/ Coordinates 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Rig Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Diameter ocation Logged by/ Hammer LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel Type Checked by PENETRATION SAMPLE NUMBER BACKFILL/INSTALL. RESISTANCE **USCS GRAPHIC** RECOVERY (%) SAMPLE TYPE WATER LEVE BLOWS/FT DEPTH (FT) BLOW REMARKS 20 30 40 USCS MATERIAL DESCRIPTION AND WATER CONTENT 0 **TESTS** (MC) ATTERBERG LL/PL 40 60 80 Very dense, wet, light brown and gray, poorly 2000 graded GRAVEL with Silt and Sand (GP-GM); fine to coarse subrounded gravel, fine to O. coarse sand, non-plastic fines. **Less Weathered Springwater Formation** 651 0 65 62 50/1" S-10 Ğ, (Refusal) O 646 0 70 00 ୃ 🗘 641 GP-75 🗶 91 Pressure-meter test 50/4" S-11 GM performed between 75 0 (Refusal) and 80 feet. D. 00 636 D, 80 0 ď 631 000 85 🗶 143 50/5" S-12 ď (Refusal) 0



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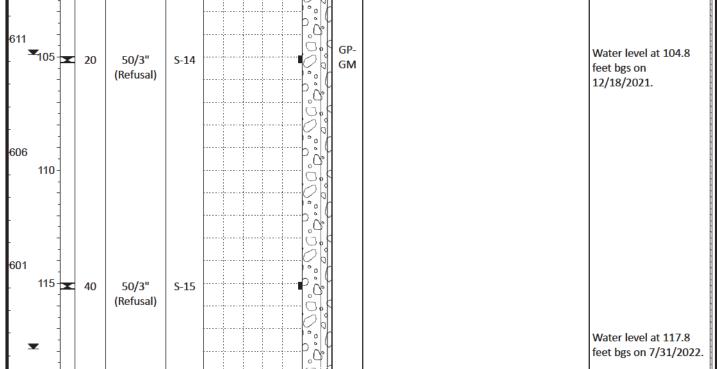
Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System

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Boring LRWP-BH08

Sheet 3 of 16

Log of Boring Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Drilled Geotechnical Method/ Coordinates 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Rig Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Diameter ocation Logged by/ Hammer LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel Type Checked by PENETRATION SAMPLE NUMBER BACKFILL/INSTALL. RESISTANCE **USCS GRAPHIC** RECOVERY (%) SAMPLE TYPE WATER LEVE BLOWS/FT DEPTH (FT) BLOW REMARKS 20 30 40 USCS MATERIAL DESCRIPTION AND WATER CONTENT 0 **TESTS** ATTERBERG LL/PL 40 60 80 Very dense, wet, light brown and gray, poorly 2000 graded GRAVEL with Silt and Sand (GP-GM); fine to coarse subrounded gravel, fine to O. coarse sand, non-plastic fines. **Less Weathered Springwater Formation** 621 0 ⁹⁵ 🗶 155 50/5" S-13 Ğ, (Refusal) O 616 000 100 00 ୃ 🗘 GP-Water level at 104.8 50/3" S-14





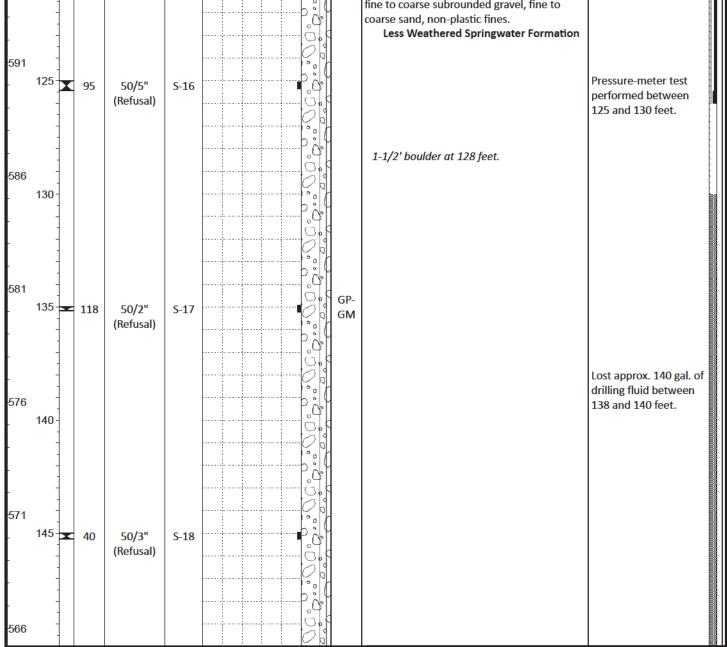
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Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH08**

Sheet 4 of 16

Log of Boring Project: Filtration Pipelines Project – Raw Water Pipeline Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Drilled Geotechnical Method/ Coordinates 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Rig Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Diameter ocation Logged by/ Hammer LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel Type Checked by PENETRATION SAMPLE NUMBER BACKFILL/INSTALL. RESISTANCE **USCS GRAPHIC** RECOVERY (%) SAMPLE TYPE WATER LEVEL BLOWS/FT DEPTH (FT) BLOW REMARKS 20 30 40 USCS MATERIAL DESCRIPTION AND WATER CONTENT 0 **TESTS** (MC) ATTERBERG LL/PL 40 60 80 Very dense, wet, light brown and gray, poorly 2000 graded GRAVEL with Silt and Sand (GP-GM); fine to coarse subrounded gravel, fine to O. coarse sand, non-plastic fines. **Less Weathered Springwater Formation** 591 0 125 Pressure-meter test 50/5" S-16 Ğ, performed between (Refusal) 125 and 130 feet. Ď, 1-1/2' boulder at 128 feet. 586 130





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Location and Elevation Source: 90% Drawings
Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH08

Sheet 5 of 16

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Drilled Depth Geotechnical Method/ Coordinates 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Rig Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Diameter ocation Logged by/ Hammer LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel Type Checked by PENETRATION SAMPLE NUMBER BACKFILL/INSTALL. RESISTANCE **USCS GRAPHIC** RECOVERY (%) SAMPLE TYPE WATER LEVE BLOWS/FT DEPTH (FT) BLOW REMARKS 20 30 40 USCS MATERIAL DESCRIPTION AND WATER CONTENT 0 **TESTS** (MC) ATTERBERG LL/PL 40 60 80 Very dense, wet, light brown and gray, poorly graded GRAVEL with Silt and Sand (GP-GM); 000 fine to coarse subrounded gravel, fine to O. coarse sand, non-plastic fines. **Less Weathered Springwater Formation** 1000 561 155 \star 40 50/3" S-19 Ġ. (Refusal) GP-GM Ď, 556 000 160 🛨 40 50/3" S-20 (Refusal) 163.0 ft.: switched to PQ coring - 3-3/16" ID Log continued on next page.



Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH08**

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Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Riq Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter ocation Hammer Logged by/ LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE WATER LVL DEPTH (FT) Roughness nclination ROD MATERIAL DESCRIPTION AND GRAPHIC Aperture Amount **TESTS** Shape Infill 160 Log continued from previous page. Poor Recovery : weakly cemented, light gray, 18 0 R-1 CLAY (CL); unknown origin. -551 165 20 0 R-2 -546 **Boring LRWP-BH08** Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Riq Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Hammer ocation Logged by/ LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE WATER LVL DEPTH (FT) Roughness nclination MATERIAL DESCRIPTION AND ROD GRAPHIC Aperture Amount **TESTS** Shape Infill ufill 0 R-3 Poor Recovery : weakly cemented, light gray, CLAY (CL); unknown origin. 170.0 - 173.0 ft.:Drilling soft material; drilling fluid return is milky white; clay is inferred. No Recovery; Drilling soft material; drilling 0 0 R-4 fluid is brown; Residual Soil is inferred. -541 Coring Run #5 Poor Recovery; Residual Soil grading to Basalt 0 0 R-5 recovered several "half-IIII rock is inferred based on drilling action.

McMILLEN JACOBS ASSOCIATES

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Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH08**

round" pieces of the basalt plug (see the Appendix B Core Photos).

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Riq Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Logged by/ ocation Hammer LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE **WATER LVL** DEPTH (FT) Roughness nclination MATERIAL DESCRIPTION AND ROD Aperture Amount **TESTS** Shape nfill nfill Poor Recovery; Residual Soil grading to Basalt rock is inferred based on drilling action. MB 83 BASALT; strong, moderately weathered to 83 R-6 fresh, moderately to highly fractured, dark VR IR Ctg 0 gray. Joint surfaces are curved to irregular Grab 1 and rough. Common joint sets occur between Grab 1: Unconfined 0 and 25 degrees. Less common joint Compressive Strength = orientations are noted below. Except as noted 4,590 psi; VR ST 0 Fe Ctg below, basalt is 5% to 25% vesicular Dry Density= 131.9 pcf. throughout. [Boring Lava] Grab 2 PL R Fe Ctg 0 -531 185 Pressure-meter test MB Grab 3 86 52 MB from 186 to 191 feet. 186.2 - 187.1 ft.: No vesicles. R-7 R PL T Fe Ctg 15 J R PL W Fi 30 Fe MB Grab 4 Lost approx. 70 gal. of PL R W Fe Ctg 25 Grab 5 drilling fluid at 188 feet. Grab 5: Unconfined Compressive Strength = PL R W Fe Fi 20 3.023 psi: Dry Density= 124.5 pcf. MB PL -526 R T 80 PL R Fe J W Ctg 0

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Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH08

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Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Rig Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Logged by/ ocation Hammer LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE DEPTH (FT) **WATER LVL** Roughness nclination MATERIAL DESCRIPTION AND ROD Aperture Amount **TESTS** Shape nfill 190 BASALT; strong, moderately weathered to fresh, moderately to highly fractured, dark J R C W Fe Fi 0 gray. Joint surfaces are curved to irregular and rough. Common joint sets occur between 0 and 25 degrees. Less common joint MB 100 100 R-8 orientations are noted below. Except as noted below, basalt is 5% to 25% vesicular Pressure-meter test MB throughout. 92 79 R-9 performed between [Boring Lava] 191.6 and 196.6 feet. MB PL Ctg 30 Т R Fe Ctg R PL VN Fe Grab 6: Unconfined Grab 6 Compressive Strength = 194.0 - 199.0 ft.: No vesicles. 4,601 psi; -521 Dry Density = 157.4 pcf. Ctg PL U 40 R Ν Grab 7 R PL Т 15 195 R PL VN MB SR C W Fe Ctg 20 Grab 8 Grab 9: Unconfined Grab 9 Compressive Strength = 5,916 psi; 92 72 R-10 Dry Density= 161.9 pcf. MB MB C Ctg 55 MB -516 40

McMILLEN JACOBS ASSOCIATES

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Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System

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Boring LRWP-BH08

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Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Riq Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Logged by/ ocation Hammer LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel DISCONTINUITIES SAMPLE TYPE 8 REMARKS RECOVERY SAMPLE DEPTH (FT) WATER LVL Roughness nclination MATERIAL DESCRIPTION AND Aperture Amount **TESTS** Shape Infill BASALT; strong, moderately weathered to R IR J W Fe Ctg 40 fresh, moderately to highly fractured, dark gray. Joint surfaces are curved to irregular and rough. Common joint sets occur between ST T R Fe Ctg 0 and 25 degrees. Less common joint VR IR orientations are noted below. Except as noted Fe Ctg 35 below, basalt is 5% to 25% vesicular MB throughout. 100 82 R-11 [Boring Lava] VR IR VW Fe Ctg 0 200.0 ft.: Vertical latent plane of weakness. Ctg VR ST W 20 Fe 201.9 - 202.3 ft.:Three horizontal open joints in Ctg VR IR VW 0 Fe vesicular zone; rough, irregular, and heavily VR IR VW 0 Fe Ctg iron-stained, 2.5 mm apertures. VR ST W Fe Ctg 30 SR IR W 15 Fe J R C W Fe Ctg 60 203.7 ft.:60 degree open joint, rough, curved SR IR W Fe Fi 20 surface, iron-stained, 3-5 mm apurture. -511R PL Ν Fe Ctg 10 205 Grab 10 PL Ctg | 15 J VR Ν Fe R ST W Fe Ctg 10 206.5 - 208.5 ft.: No vesicles. 100 100 R-12 Ctg 15 R C W Fe MB MB PL VR Ν U Ctg J -506

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Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH08

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Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Riq Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Logged by/ ocation Hammer LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE DEPTH (FT) WATER LVL Roughness nclination MATERIAL DESCRIPTION AND ROD Aperture **TESTS** Shape nfill 210 Grab MB BASALT; strong, moderately weathered to Grab 11: Unconfined fresh, moderately to highly fractured, dark Compressive Strength = 11 gray. Joint surfaces are curved to irregular 6,092 psi; Dry Density= 139.7 pcf. and rough. Common joint sets occur between PL R W Fe Ctg Grab 0 and 25 degrees. Less common joint 12 R PL orientations are noted below. Except as noted W Fe Ctg below, basalt is 5% to 25% vesicular throughout. PŁ Fe Ctg VR: W 85 96 R-13 [Boring Lava] Ctg VR ST W Fe Ctg 1 VR PL W 20 Fe PL VR W Fe Ctg 20 PL Fe VR 25 J W Ctg 213.1 - 216.4 ft.: No vesicles. R PL Ctg 15 N U 501 MB PL Ctg 15 Fe 215 SR PL N U Ctg MB No rock jointing was noted in the Troutdale Formation; numerous MB mechanical breaks 20 R-14 J VR PL W Fe Fi 10 resulted from handling VR C 20 W Fe Ctg the weakly cemented CONGLOMERATE; weak, moderately to highly RQD calculations were weathered, massive; orange-brown, fresh and omitted for this hard gravel and cobbles in an orange-brown intermediate silty sand matrix; dominantly vesicular basalt geotechnical material cobbles near the upper contact grade with (IGM). depth to rounded gravel. [Troutdale Formation] 496

Location and Elevation Source: 90% Drawings
Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)
Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Boring LRWP-BH08

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Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Riq Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Hammer ocation Logged by/ LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE **WATER LVL** DEPTH (FT) Roughness nclination ROD MATERIAL DESCRIPTION AND Aperture GRAPHIC Amount **TESTS** Shape Infill CONGLOMERATE; weak, moderately to highly weathered, massive; orange-brown, fresh and hard gravel and cobbles in an orange-brown silty sand matrix; dominantly vesicular basalt cobbles near the upper contact grade with depth to rounded gravel. [Troutdale Formation] Grab 13: 58.6% Gravel, 60 Grab 39.9% Sand, 1.5% Fines; 13 Unconfined R-15 Compressive Strength = 256 psi; Dry Density = 109.7 pcf. Lost approx. 70 gal. of 491 drilling fluid at 224 feet. 225 90 R-16 SANDSTONE; weak, moderately to highly weathered, massive, orange-brown, occasional gravel, rare cobbles; gravel clasts 486 are fresh, hard, fine to coarse, rounded to well rounded and of basaltic composition. [Troutdale Formation]

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Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH08**

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Riq Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Hammer ocation Logged by/ LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel Checked by DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE DEPTH (FT) **WATER LVL** Roughness nclination MATERIAL DESCRIPTION AND ROD GRAPHIC Aperture Amount **TESTS** Shape Infill Grab SANDSTONE; weak, moderately to highly Grab 14: Unconfined 14 weathered, massive, orange-brown, Compressive Strength = occasional gravel, rare cobbles; gravel clasts 373 psi; are fresh, hard, fine to coarse, rounded to Dry Density = 85.0 pcf. well rounded and of basaltic composition. [Troutdale Formation] 100 R-17 Grab 15: Unconfined Grab Compressive Strength = 15 481 375 psi; Dry Density = 84.9 pcf. Pressure meter test performed between 235 236.5 and 241.5 feet. 100 R-18 Grab 16 Grab 17 Grab 18 Grab 19 476

McMILLEN JACOBS NOTES:

Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH08**

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Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Riq Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Hammer ocation Logged by/ LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel Checked by DISCONTINUITIES SAMPLE TYPE REMARKS 8 RECOVERY SAMPLE WATER LVL DEPTH (FT) Roughness nclination ROD MATERIAL DESCRIPTION AND GRAPHIC Aperture Amount **TESTS** Shape Infill SANDSTONE; weak, moderately to highly weathered, massive, orange-brown, occasional gravel, rare cobbles; gravel clasts are fresh, hard, fine to coarse, rounded to well rounded and of basaltic composition. [Troutdale Formation] 84 R-19 Grab 20 471 245 100 R-20 Grab 17: Unconfined Grab Compressive Strength = 21 213 psi; Dry Density = 98.5 pcf. 466 **Boring LRWP-BH08** Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1)

Coordinate System: Water Bureau Filtration Project Custom Coordinate System

Project: Filtration Pipelines Project – Raw Water Pipeline Log of Boring Project Location: Multnomah County, OR LRWP-BH08 Project Number: 6218.0 Date(s) 12/02/2021 - 12/16/2021 Jacobs Engineering Group 251.6 ft bgs Depth Drilled Geotechnical Coordinates Method/ 7742647.7 E, 659429.9 N McMillen Jacobs Associates Mud Rotary/CME 850 Track Mounted Consultant Riq Type Surface Drilling Hole 715.2 ft. 5.00 in Western States Soil Conservation, Inc. Elevation Contractor Diameter Hammer ocation Logged by/ LRWP North Station 32+26 140 lb / 30 in / Automatic A. Judy, K. Elliott / K. Elliott, J. Fissel DISCONTINUITIES SAMPLE TYPE REMARKS RECOVERY 8 SAMPLE WATER LVL DEPTH (FT) Roughness nclination ROD MATERIAL DESCRIPTION AND GRAPHIC Aperture Amount **TESTS** Shape Infill SANDSTONE; weak, moderately to highly weathered, massive, orange-brown, occasional gravel, rare cobbles; gravel clasts are fresh, hard, fine to coarse, rounded to well rounded and of basaltic composition. [Troutdale Formation] Borehole completed at 251.6 feet below ground surface (bgs). -461 255 456



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Location and Elevation Source: 90% Drawings Vertical Datum: Portland Vertical Datum Feet (NAVD88 - 2.1) Coordinate System: Water Bureau Filtration Project Custom Coordinate System **Boring LRWP-BH08**

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